Economic Fundamentals, Capital Expenditures and Asset Dispositions

Brent W. Ambrose * Eva Steiner†

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Abstract

Research on the disposition effect in real assets to date ignores the active management component of these investments. Active management notably includes decisions about follow-up investment in the form of capital expenditures, as well as dispositions. Using a real option framework, we develop testable hypotheses and provide empirical evidence for the relationships between economic fundamentals, capital expenditures, property values, and the subsequent likelihood of sale. Our results shed new light on the evidence for the disposition effect in real estate.

*Smeal College of Business, Pennsylvania State University, 381 Business Building, University Park, PA 16802 (e-mail: bwa10@psu.edu).

†Corresponding author: School of Hotel Administration, Cornell SC Johnson College of Business, 465B Statler Hall, Ithaca, NY 14853 (email: ems457@cornell.edu). We are thankful for comments from Robert Connolly, Davi Geltner, David Ling, Crocker Liu, Tim Riddiough, Jacob Sagi, Stijn Van Nieuwerburgh, and Susan Wachter, as well as seminar participants at the RERI Research Conference 2017 and the AREUEA National Meeting 2017. We gratefully acknowledge financial support from the Real Estate Research Institute (RERI). We are also grateful to the National Council of Real Estate Investment Fiduciaries for providing the data used in this study.

The disposition effect denotes a behavioral bias leading investors to hold poorly performing investments to avoid realizing losses.[1] It was first documented in financial assets such as stocks and mutual funds (Coval and Shumway, 2005; Dhar and Zhu, 2006; Frazzini, 2006; Ivković, Poterba, and Weisbenner, 2005; Odean, 1998). More recent evidence also points to a disposition effect in real assets such as real estate (Bokhari and Geltner, 2011; Crane and Hartzell, 2010; Genesove and Mayer, 2001). However, unlike financial securities, real estate investors have a set of active management choices available to them while holding the asset, including the sale of the asset but also the choice to make follow-on investments in the form of capital expenditures to improve the asset. These options co-exist and give rise to a value-add investment strategy, whereby an investor keeps a property until they have made sufficient improvements to realize a profit on the sale. Such a property may well perform poorly in the interim and thus could result in outcomes that are observationally similar to the disposition effect, although the underlying investment strategy is rational. In this study, we model the set of active management choices in real estate, including capital expenditures and their underlying fundamental drivers, and explore their implications for disposition patterns.

We model investment in capital expenditures (CAPEX) as a real option to restore an asset that has suffered physical depreciation and economic obsolescence to its new, undepreciated state. We then consider the investor's real option to sell the asset by incorporating the concept of highest and best use versus second best use from the appraisal literature.[2]

[1]Shefrin and Statman (1985) introduce the concept of loss aversion, which draws upon prospect theory (Kahneman and Tversky, 1979), mental accounting (Shefrin and Thaler, 2004; Thaler, 2004, 2008), aversion to regret (Kahneman and Tversky, 1982; Thaler, 1980), and the ability to exercise self-control (Shefrin and Thaler, 2004). See Ben-David and Hirshleifer (2012) for a concise summary of the literature. DellaVigna (2009) also provides a general survey of the evidence on reference dependence.

[2]See Munneke and Womack (2017) for a discussion of the concept of "highest and best use" in the context of modeling the value of the option to redevelop a property.

By combining the optimal time to invest in CAPEX with the highest and best use assumption, we develop a set of testable hypotheses about the occurrence of CAPEX as a function of the economic environment, the implications for asset value, and the likelihood of sale following CAPEX investments.

We test our empirical predictions in a sample of commercial property investments. Commercial real estate accounts for a substantial fraction of US wealth (Plazzi, Torous, and Valkanov, 2010).[3] We obtain the required data from the National Council of Real Estate Investment Fiduciaries (NCREIF) over the period 2001 to 2014. NCREIF is the leading provider of proprietary investment performance and data on financial as well as physical characteristics for US commercial real estate assets. The data set comprises observations on large, institutional-grade assets owned by pension funds and insurance companies. Unlike any other data source on any other type of real estate we know, NCREIF offers detail on asset-level follow-up investments in the form of CAPEX. At the same time, the data set is rich in asset details, allowing us to control for a wide array of observable property and financial characteristics that aid identification by reducing omitted variable bias. The time-series dimension of the data set, which spans more than one full real estate market cycle, allows us to incorporate lag structures into our estimation to address simultaneity bias. Further, the data set includes unique information about asset-level appreciation returns through time, allowing us to re-examine evidence for the disposition effect, which is based on the relationship between past appreciation returns and disposition choices.

[3] Savill's estimates its value in 2015 to be about $8 trillion, or almost 30% of the US stock market. Moreover, there is a large market for commercial real estate investments in the US, allowing us to observe transaction values or appraisals informed by comparable transactions over time. Real Capital Analytics estimates the total investment volume for US commercial real estate in 2015 to be almost $600 billion.

We first document the cross-sectional and cyclical patterns of different types of CAPEX. Consistent with our hypotheses, we find that investors increase expansion and improvement CAPEX during periods with higher expected market-level income growth, and reduce these CAPEX in periods with higher volatility of those growth expectations. Conversely, investments in tenant incentives and lease commissions (TIs) decline during periods of higher income growth expectations. Our findings suggest that, as leasing market conditions improve, owners are less compelled to offer tenant incentives or lease commissions.

Next, we analyze the effect of CAPEX on asset market value. We find that CAPEX are partially capitalized into asset values. Our results suggest that approximately 28 percent of expansion and improvement CAPEX and 26 percent of TIs are capitalized into subsequent asset market values, respectively. Investors may use these estimates when forming expectations about the return on planned CAPEX projects.

In the final step of our analysis, we re-examine the evidence for the disposition effect. In our baseline model, we find a positive and significant relationship between past appreciation returns and the subsequent likelihood of sale, consistent with the behavioral bias to sell winners and hold losers in an attempt to avoid realizing losses. However, after accounting for the full set of active management choices and their drivers, we show that past capital expenditures reduce the likelihood of sale, all else equal, consistent with a value-add investment strategy. In other words, when we control for market-level rental growth expectations and their volatility, as the underlying exogenous drivers of the real options available to real estate investors, the evidence for the disposition effect vanishes.

As a robustness check, we estimate a multinomial logit model that simultaneously accounts for all active management choices available to investors, including CAPEX and the choice to sell the asset. Again, we find no evidence that past appreciation returns influence the decision to sell, relative to the baseline outcome of doing nothing. Thus, in the context of the debate about the disposition effect in real estate, our findings suggest that the empirical evidence for this effect depends on accounting for the full set of active management choices and their underlying exogenous, fundamental drivers.

Our work relates to the literature addressing seemingly irrational choices by investors and managers. Some assume that managers are subject to behavioral biases (Ben-David and Graham, 2013; Gabaix, 2014). Alternatively, managers may respond rationally to behavioral biases among investors.[4] Our findings suggest that there may be a rational explanation for the disposition effect that does not involve a bias on the part of investors or managers.

We are not the first to offer a rational alternative explanation for the disposition effect, but existing studies focus on stocks. Ben-David and Hirshleifer (2012) argue that the disposition effect is explained by trading based on belief revisions. Dorn and Strobl (2015) show that the effect may result as a rational response to differential access to information. Seru, Shumway, and Stoffman (2010) find that it may be alleviated through trading experience. Dai, Liu, and Xu (2015) argue that active portfolio management can produce the disposition effect. We show that there is also an alternative rational explanation for the disposition effect observed in real estate, related to the active management choices that are typical for the asset class.

[4]Studies in this vein analyze the effects of security mis-pricing on corporate policies (Baker, Greenwood, and Wurgler, 2003; Baker, Stein, and Wurgler, 2003; Baker and Wurgler, 2002, 2004; Graham and Harvey, 2001; Polk and Sapienza, 2009).

Others have studied seemingly irrational choices in real estate. With the exception of Genesove and Mayer's (2001) evidence on the disposition effect, the work in this area often focuses on mortgage choices (see, e.g. Guiso, Sapienza, and Zingales (2013)). Seemingly irrational financing choices in real estate are commonly linked to a lack of financial sophistication (Agarwal, Ben-David, and Yao, 2017; Agarwal and Mazumder, 2013; Agarwal, Rosen, and Yao, 2016). In contrast, we focus on a set of large-scale institutional real estate investors that are arguably more financially sophisticated. Nonetheless, we are able to replicate the disposition effect in our sample. However, our results suggest that the evidence for the disposition effect depends not on the level of sophistication among real estate investors but on whether one accounts for the active management component of real estate.

1 Hypothesis Development

To motivate our analysis and develop testable hypotheses, we adopt the real option analysis for incremental investment problems (e.g., Bertola, 1998; Dixit and Pindyck, 1994; Pindyck, 1988) to the case of commercial real estate to highlight the optionality associated with capital expenditure investment and disposition decisions. Abstracting from the discussion of fixed and variable costs, we assume that an asset generates a simple profit flow (net operating income or NOI) of $\pi_t = H_t M(K_t)$, where $M(K_t)$ is a concave function of capital (K_t) invested in the asset, and H_t is a random shift variable reflecting uncertainty over future NOI. We assume that H_t can be described by the geometric Brownian motion

$$dH_t = \alpha_H H_t dt + \sigma_H H_t dz_H \tag{1}$$

where α_H and σ_H are the expected market rent growth rate and volatility, respectively, and $E\left[dz_H^2\right] = dt$. For analytical convenience, we assume that $M(K_t)$ takes a specialized Cobb-Douglas form $M(K_t) = K_t^{\theta},\ 0 < \theta < 1$ and that κ represents the unit cost of capital. With this set-up, Dixit and Pindyck (1994) demonstrate that if physical depreciation and economic obsolescence occurs exponentially through time following a Poisson process, then over a small time increment of dt, invested capital will depreciate with probability $\lambda K dt$. Assuming no investments in capital expenditures, then the asset will depreciate at the rate $dK = -\lambda K dt$ and the NOI flow at time t is $H_t M(K_t e^{-\lambda t})$. Thus, the expected value of the asset at the date of purchase ($t = 0$) is

$$V(K, H, 0) = \hat{E} \int_0^{\infty} H_t M(K_t e^{-\lambda t}) e^{-\rho t} dt \tag{2}$$

where ρ is the discount rate. Dixit and Pindyck (1994) then show that the optimal value of the income shock (H^*) that triggers investment in capital expenditures in response to the asset's depreciation declines as the growth rate associated with the market rent (α) increases. Thus, higher market rental growth rates reduce the delay between capital expenditure investments.[5] In addition, Dixit and Pindyck (1994) show that an increase in the volatility surrounding market rent (σ) increases the trigger value (H^*) and thus results in a longer time between capital expenditure investments.

Next, we introduce the concept of "highest and best use" from the appraisal literature in order to motivate incentives for trade and thus to uncover potential interactions between

[5] This implicitly assumes that leases are reviewed or renewed so that rents can be reset to the prevailing market level.

capital expenditure investments and asset disposition decisions. We begin by assuming that the asset's current owner is the marginal investor and thus, by definition, must deploy the building at its highest and best use, which is assumed to follow the income process described in equation (1). The concept of highest and best use (HBU) implies that the owner maximizes the property's value, or else there is an incentive to trade.

To capture this incentive, we assume that the building could be redeployed by a new owner at an alternative use (SBU), realizing an income flow that corresponds to a random shift variable (S_t) reflecting uncertainty over future income. We assume that this variable follows a geometric Brownian motion:

$$dS_t = \alpha_S S_t dt + \sigma_S S_t dz_S \tag{3}$$

where α_S and σ_S are the expected growth rate and volatility associated with market rents for the alternative use, respectively, and $E\left[dz_S^2\right] = dt$. Thus, at $t = 0$ we assume that the current owner is the highest-and-best user and the property value to this investor is greater than the value to an alternative user ($H_0 > S_0$ and $V(K, H, 0) > V(K, S, 0)$). Opportunities to trade arise from the evolution of H_t and S_t through time. In other words, if S_t ever exceeds H_t then the current owner no longer values the property at its maximum (or highest-and-best use) and thus would recognize a gain by selling the property. The current owner's opportunity to sell the asset is a perpetual put option with payoff at any time t being $max[0, V(K, S, t) - V(K, H, t)]$. The value of this option is a function of the capital expenditure option that also depends on H and of the stochastic strike price ($V(K, S, t)$). That is, the asset value in its current use at any point t, which determines whether it is optimal to sell to an alternative user, is conditional on investments in capital expenditures prior to t.

Since a higher growth rate in current income (α_H), all else constant, increases the likelihood of capital expenditures and increases the asset value, then the payoff from selling and thus and probability of sale are lower. We also note that a higher growth rate in the alternative use income (S), all else constant, increases the probability of sale. Thus, the probability of sale is a function of the relative difference in the income growth rates. In other words, the probability of sale is an increasing function of the ratio of the alternative income growth rate to the current income growth rate ($\frac{\alpha_S}{\alpha_H}$). Similarly, the probability of selling increases as the ratio of the alternative income volatility (σ_S) to current income volatility (σ_H) increases. Conversely, an increase in σ_H lowers the probability of value-enhancing capital expenditures and thus increases the probability of sale. We also recognize that differences in expectations regarding economic and physical depreciation between the current and alternative user may also alter the probability of sale. For instance, if assets deployed by the current user require higher levels of maintenance or experience greater utilization than the alternative user, then the probability of sale will increase.

To summarize, the option to invest in capital expenditures impacts the decision to sell in two ways. First, past investments in capital expenditures increase the current user's valuation and thus reduce the payoff from selling to an alternative investor, reducing the probability of sale. Second, the option to make future capital expenditures to offset the effects of depreciation increases the asset value to the current owner, again lowers the potential payoff from and probability of disposition.[6] As a result, we formulate a set of testable hypotheses.

[6] Increases in current user physical depreciation relative to an alternative use depreciation will increase the threshold for

H 1: *Higher expected income growth increases subsequent capital expenditures.*

Based on the real option framework, uncertainty increases the value of keeping the option alive, all else equal. Therefore, an increase in the volatility of expected income growth raises the threshold value of income necessary to carry out capital expenditures and thus produces a longer time delay between capital expenditure investments, reducing their likelihood.

H 2: *Higher expected income growth volatility reduces subsequent capital expenditures.*

Next, CAPEX will increase the value of the asset to the current owner. Asset values increase with CAPEX because CAPEX restore the asset to an undepreciated state and enable the owner to capture the full market rent (assuming that leases are up for renewal). As CAPEX are more likely when market rental growth is strong, achievable full market rent after CAPEX is also higher, reinforcing the positive effect on values.

H 3: *An increase in CAPEX increases asset value.*

Further, a lower likelihood of sale follows from higher CAPEX because higher CAPEX implies a higher current asset value and thus the probability that an alternative investor will value the property more than the current owner is reduced, all else being equal. Therefore, the probability of a sale declines following higher CAPEX.

H 4: *Higher capital expenditures reduce the subsequent likelihood of sale.*

capital expenditures and thus lower the asset value.

2 Method

To formally test hypotheses 1 and 2, we estimate an OLS model of the annual capital expenditures per square foot for asset i at time t ($CAPEX_{i,t}$) as a function of income growth expectations and their volatility:

$$CAPEX_{i,t} = \gamma_0 + \gamma_1 GE_{i,t-1} + \gamma_2 VOL_{i,t-1} + \gamma_3 \mathbf{X}_{i,t-1} + u_{it} \tag{4}$$

where γ denotes the coefficients to be estimated, $GE_{i,t-1}$ is the expected rate of asset income growth at time $t-1$, $VOL_{i,t-1}$ is the volatility of income growth expectations during year $t-1$, $\mathbf{X}_{t-1}$ is a matrix of control variables measured at time $t-1$, and u_{it} is the residual.

We distinguish between expansion and improvement projects as well as tenant incentives and lease commissions. Tenant incentives and lease commissions are often part of the negotiation over leasing and thus reflect market leasing conditions, not an effort to restore the asset to an undepreciated state. Our hypotheses refer to value-enhancing improvement and expansion projects that alter the physical structure of the asset to restore its quality. Therefore, we primarily focus on capital improvements and expansion capital expenditures, but use the data on tenant incentives and lease commissions as contrasting evidence.

The control variables include building-level occupancy (percent leased), as CAPEX are unlikely when leasing demand is strong and space is occupied. We control for the age of the asset at acquisition because age influences CAPEX (Bokhari and Geltner, 2016). We also control for asset size (measured as the natural logarithm of square footage), as well as past performance in terms of annual income and appreciation returns.

The right hand side variables are lagged by one year in order to address endogeneity. We include fixed effects for property type, investor type (fund type) and geographic region (division). Standard errors are clustered by asset. Consistent with Hypotheses 1 and 2, we expect a positive value for γ_1 and a negative value for γ_2.

We test hypothesis 3 by estimating an OLS model of the natural logarithm of the market value for asset i at the end of year t as a function of CAPEX (on expansion and improvement as well as tenant incentives and lease commissions) over the previous year $t-1$:

$$\ln(MV_{i,t}) = \gamma_0 + \gamma_1 \ln(CAPEX_{i,t-1}) + \gamma_2 \mathbf{X}_{i,t-1} + u_{it} \tag{5}$$

where notation, control variables, and fixed effects are as in Equation (4). The log-log specification allows us to interpret the coefficients as the marginal effect on market value in percent for a one-percent increase in CAPEX. The lags allow us to address simultaneity and the issue that actual market value effects of CAPEX may enter valuations with a lag. Standard errors are clustered by asset. As per hypothesis 3, we expect a positive value on γ_1.

A relevant practical question for real estate owners is whether any increase in market value is directly proportional to the cost of CAPEX. If that is the case, then $\gamma_1 = 1$. If $\gamma_1 < 1$, then CAPEX may increase market value but may not improve return on investment.

To test hypothesis 4, we estimate a Logit model where the dependent variable takes the value of 1 if the asset was sold by the end of year t:

$$Sale_{i,t} = \gamma_0 + \gamma_1 CAPEX_{i,t-1} + \gamma_2 \mathbf{X}_{i,t-1} + u_{it}. \tag{6}$$

The notation, control variables, and fixed effects are as above. $CAPEX$ refers to expansion and improvement CAPEX and, separately, to tenant incentives and lease commissions over the year $t-1$. Standard errors are clustered by asset. Consistent with hypothesis 4, we expect a negative sign on the coefficient γ_1.

This step allows us to examine the empirical evidence for the disposition effect. We test for the disposition effect by examining the coefficient estimate on the lagged asset-level appreciation return, which is included in our set of control variables. If investors sell strongly performing properties and hold on to poorly performing investments in an attempt to avoid realizing a loss, the coefficient estimate should be positive and significant.

We also estimate an alternative version of this model that accounts for market-level rental growth expectations and the volatility of rental growth. As noted in our hypothesis development, both CAPEX as well as disposition decisions are real options that are driven by the underlying profit flow generated by the property.

In order to recognize the coexistence of the CAPEX and disposition options, we estimate a multinomial logit model with five possible choices. The baseline outcome is continuing to hold the property. The second choice is to invest in expansion and improvement CAPEX. The third choice is to invest in tenant incentives and lease commissions. The fourth choice is to invest in both types of CAPEX simultaneously. The final choice is to sell the property. The exogenous drivers of those real options are market-level rental growth and its volatility.

Identification

In testing Hypotheses 1 and 2, the identifying assumption is that variation in expected income growth and income growth volatility is exogenous to the property investment in question. We believe that this assumption is satisfied because these variables refer to market level expectations of income growth and volatility where the market is defined by property sector, MSA (location) and year, not the asset itself. Given the large number of assets in each market (property sector/ geographic location / year cell), it is unlikely that a given asset would overly influence the growth rate and volatility in the market.

In testing Hypothesis 3, a potential threat to identification is reverse causality from asset values to capital expenditures. The model implies that depreciation and obsolescence reduce the market value of the asset, hence the owner's incentive to invest in CAPEX. In order identify the effect of CAPEX on market values, we rely on two structural issues associated with CAPEX projects in real estate. First, these projects, such as renovations and expansions, take a significant time to plan. Second, once planned and initiated, they take a significant time to complete. These timescales are a result of the planning and construction process. The actual effect on the market value of the asset is thus revealed with a delay; it only becomes apparent once the CAPEX project is completed. We expect that CAPEX completed by the end of year $t-1$ affect market values in year t. Market values in year t may well affect future CAPEX, but not past CAPEX. As a result, the structural idiosyncrasies of the planing and construction process in real estate CAPEX projects allows us to use a lag structure in order to identify the effect of CAPEX on market values.

In testing Hypothesis 4, a potential threat to identification is that CAPEX and the decision to hold or sell the property are simultaneously determined. The choice to invest in CAPEX implies the choice to hold on to the asset, but only until the CAPEX project is completed. Once a given CAPEX project is completed, the owner may well choose to dispose of the asset as shown in the model. Therefore, we are again able to use lag structures in order to identify the effect of CAPEX on the subsequent decision to sell. We expect that CAPEX projects completed by the end of year $t-1$ affect the decision to sell the property in year t, consistent with a value-add strategy whereby investors continue to hold an asset until they have made sufficient improvements to generate a gain on sale.[7]

3 Data

We test our hypotheses in a sample of US direct real estate investments. We collect the required data on property and financial characteristics from $NCREIF$. We begin our analysis in 2000, the first year for which *NCREIF* covers a significant number of properties and offers the full breadth of capital expenditure data required for our analysis; we end in 2014. Our initial sample is the entire $NCREIF$ universe. We then focus on operating properties that form part of $NCREIF's\ NPI$ and where the values for CAPEX are non-negative.[8] Figure 1 shows the evolution of the number of properties in the final sample.

[Figure 1 about here.]

[7] We control for exogenous reasons to sell, such as target fund life, which might impose a timeline on any CAPEX projects carried out on an investment, by including investor/ fund-type indicators.

[8] Those represent accounting anomalies where excess reserves for CAPEX projects were booked and then reversed when the actual cost of the projects was revealed.

NCREIF reports different types of capital expenditures. We focus on capital improvements and property expansions as well as tenant incentives and lease commissions. It is important to note that we do not consider routine repairs and maintenance.[9]

We also obtain property market value data from *NCREIF*. Market values are observed in the transactions of the property. In the absence of a transaction, *NCREIF* shows the appraised value of the property. Appraisals occur once per year. During the course of the year, *NCREIF* incorporates CAPEX by simply adding the cost incurred to the market value. However, the year-end market values we use in our analysis are the transaction values or full appraisal values. Therefore, our results are not biased by any mechanical relationship driven by the way in which *NCREIF* captures CAPEX between appraisals or transactions.

We calculate growth expectations and their volatility by adding up a quarterly time series of yields on the 10-year US Treasury and the quarterly risk premium on a benchmark for BBB-rated corporate bonds over the Treasury rate, as proxy for the typical real estate risk premium. From this, we subtract the current quarterly capitalization rate by property type and MSA to obtain an implied growth expectation by property type and MSA per quarter. We use the non-overlapping series of year-end values as our measure for growth expectations. We calculate the standard deviation of quarterly growth expectations over four quarters. We use the resulting non-overlapping series of annual standard deviations as our measure for the volatility of growth expectations. Interest rate and CPI inflation data is obtained from the Federal Reserve Bank of St Louis's Economic Database (FRED).

[9]CAPEX may also be used to reposition the building to a different use. Investors may also refinance rather than sell. These strategies are beyond the scope of our analysis.

Table 1 presents the descriptive statistics for the 42,894 property-year observations in our final sample, with details on variable definitions and sources. All continuous variables are winsorized at 1st and 99th percentile to mitigate undue influence of outliers. The unconditional probability of sale in any given year is 2.7 percent.[10] CAPEX on expansion an improvement average \$0.91 per square foot (12.0 percent of NOI). In contrast, tenant incentives and lease commissions average \$1.19 per square foot (15.9 percent of NOI).

We note that our data set contains observations where capital expenditures is zero. This is a useful feature of the data set because it rules out sample selection bias. Selection bias occurs when a sample is restricted to observations where a variable of interest, such as capital expenditures, takes a certain value or exceeds a certain threshold, which would be a concern for our study if we only recorded a capital expenditures observation when capital expenditures is non-zero (and positive). However, our capital expenditures variables frequently take the value of zero, meaning that the decision not to invest in capital expenditures is included in the $NCREIF$ data, mitigating this potential selection bias.

Property-type and MSA-level income growth expectations were -1 percent over the sample period, likely due to the negative influence of the Great Recession. However, growth expectations range from approximately -5.3% to +4.8%. The volatility of growth expectations averages 0.4 percent, with a range from 0.1 to 1.2 percent. Building-level occupancy averages 91.4 percent, reflecting the sample focus on properties at a stabilized level of operation. The average building in our sample achieves an annual income return of 6.5 percent, and an

[10] It is possible for a property to be bought and subsequently sold quickly, potentially within the same year. There are no instances of “flipping” properties in our final sample. No asset transacts more often than once in a given year.

annual appreciation return of 0.6 percent, the latter likely again influenced by the decline in asset values during the Great Recession. The average asset size (age at acquisition) in our sample is just under 200,000 square feet (just over 14 years).

[Table 1 about here.]

Table 2 presents average CAPEX values per square foot and scaled by NOI for the different property types in our sample. The highest level of CAPEX on expansion and improvement (per square foot) is spent in the Hotel sector ($4.10), followed by Office ($1.32), Apartment ($1.18), Retail ($1.04), and then Industrial ($0.35). When measured as a percentage of NOI, the ordering of the most CAPEX-intensive sectors is similar, only the Apartment sector ranks just above the Office sector on this measure and Industrial and Retail are approximately equal. This analysis suggests that Hotels are the most CAPEX-intensive property sector as far as expansion and improvement CAPEX are concerned. In terms of tenant incentives and lease commissions (per square foot), the Office sector is the most CAPEX-intensive ($3.03), followed by Retail ($1.17), Industrial ($0.60), Apartment ($0.15), and Hotel ($0.07). The ranking is the same when considering CAPEX scaled by NOI, except the positions of Retail and Industrial are reversed. This analysis reflects the tendency for investors to custom-fit space for tenants and compete for tenants by offering incentives especially in the office sector.

[Table 2 about here.]

Figure 2 shows the evolution of CAPEX over time. The Figure suggests that these two types of CAPEX exhibit some differences in their cyclical patterns. In the early part of our sample, CAPEX on expansion and improvement increased at an increasing rate. This trend reflects that higher income growth expectations, which characterized this period, trigger larger amounts of CAPEX as investors seek to capture the uplift in rent from restoring a building to its undepreciated state. CAPEX on expansion and improvement projects declined during the crisis and bottomed out in 2009, before resuming a cyclical upswing. Tenant incentives and lease commissions also increased during the early part of our sample, but at a decreasing rate, reflecting the strength of the occupier market in this period, which eased the pressure on investors to incentivize tenants during lease negotiations. Again, tenant incentives and lease commissions declined briefly during the crisis before picking up again. Tenant incentives and lease commissions resumed their cyclical upswing at a faster rate than expansion and improvement CAPEX as lease negotiations precede upward revisions of expected income growth, which then triggers expansion and improvement CAPEX.

[Figure 2 about here.]

Table 3 presents pairwise correlation coefficients between the variables in our study. We explore these unconditional results further in our regression analysis. The correlation between CAPEX per square foot and CAPEX scaled by NOI is approximately 70 percent, hence we focus the remainder of our discussions on CAPEX per square foot. We find no excessive correlations between any of the other variables, alleviating concerns around multicollinearity.

[Table 3 about here.]

Table 4 presents an unconditional multivariate analysis that highlights combinations of property characteristics associated with higher CAPEX on expansion and improvement (Panel (a)) as well as tenant incentives and lease commissions (Panel (b)). For this analysis, we sort all property-year observations into quintiles ranked by the amount of CAPEX spent, with quintile 1 containing the lowest CAPEX properties and quintile 5 containing the highest CAPEX properties. We tabulate the mean property characteristics in each quintile, and test the hypothesis that these means differ significantly across the top and bottom quintiles.

Our analysis suggests that properties with the highest expansion and improvement CAPEX are in asset market segments with higher growth expectations and a lower volatility of growth expectations, consistent with our predictions. As expected, higher CAPEX are associated with lower occupancy. In terms of past performance, CAPEX are higher for properties with lower income returns, consistent with the observation that CAPEX mitigate losses in income due to depreciation and obsolescence. Further, CAPEX are higher for larger and older properties with higher LTV ratios. This analysis reinforces our prior observation that the dynamics of tenant incentives and lease commissions are different. Our analysis suggests that, unlike expansion and improvement CAPEX, tenant incentives and lease commissions are associated with lower growth expectations and lower appreciation returns.

[Tables 4 and 5 about here.]

Table 5 presents the same analysis for combinations of property characteristics associated with a higher likelihood of sale (Panel (a)) and a shorter holding period (Panel (b)). Panel (a) suggests that properties are more likely to be sold after tenant incentives and lease commissions, consistent with the strategy of leasing up a property and then disposing of it, and when growth expectations are lower. Lower growth expectations for the current HBU owner increase the chances of the SBU valuation exceeding the HBU valuation, creating an incentive to trade. Lower volatility reduces option value of holding on the property, and are thus associated with a higher likelihood of sale. We find that smaller, older buildings with lower occupancy are also more likely to trade. Our findings also suggest that dispositions are associated with higher appreciation returns, consistent with the disposition effect.

The analysis of the holding period in Panel (b) provides a complementary perspective on those buildings that were sold in our sample, by focusing on the time that passed between acquisition and sale. Longer holding periods are found to be associated with lower expansion and improvement CAPEX, younger properties, higher income returns, and lower appreciation returns. However, this perspective is conditional on a building being sold, whereas our predictions focus on which properties to sell.

4 Results

4.1 Capital expenditures as a function of growth expectations and volatility

Table 6 presents the estimated coefficients for the OLS regression of capital expenditures as a function of growth expectations and volatility as per Equation (4). Capital expenditures are measured as annual CAPEX per sq. ft. of the asset. The Table reports results for the two groups of capital expenditures (improvement and expansion, and tenant incentives and lease commissions) separately.[11]

[11] Note that our hypotheses apply mainly to expansion and improvement CAPEX. Thus, we interpret the results on tenant incentives and lease commissions as contrasting evidence.

[Table 6 about here.]

To restate our hypotheses, we anticipate that expected income growth is positively related to subsequent capital expenditures (hypothesis 1), and that higher volatility of income growth is inversely related to subsequent capital expenditures (hypothesis 2).

Our results support hypothesis 1 for expansion and improvement CAPEX. The estimates suggest that a one standard deviation increase in growth expectations is associated with a $0.07 increase in CAPEX per square foot. Relative to the mean of expansion and improvement CAPEX of $0.91, that equates to an increase of approximately 7.5 percent. Our results support the notion that investors carry out expansion and improvement CAPEX in strong occupier markets in order to benefit from the uplift in income associated with restoring the asset to its undepreciated state.

This positive relation between increases in growth expectations and subsequent capital expenditures is based on the relative strength of two competing factors, income and obsolescence, in determining the return to CAPEX. If expected income increases, then the payoff to restoring the asset to an undepreciated state is higher because the income that may be captured after a completed investment is higher.

If physical depreciation and economic obsolescence increase, then the payoff to capital expenditures is also higher. Thus, both factors act to increase the likelihood of capital expenditures. However, higher income growth is likely to occur jointly with lower rates of physical depreciation and economic obsolescence. As a result, the observed increase in the income growth expectation may stem from higher income growth or lower depreciation and obsolescence. At any given point in time, these two factors could counteract each other in the overall effect on subsequent capital expenditures. Yet, our results suggest that the income effect outweighs the depreciation and obsolescence effects, likely because the latter effects materialize through the availability of competing undepreciated supply, which arguably takes time to enter the market given the lengthy construction process.

Consistent with hypothesis 2, we find that a one standard deviation increase in the volatility of growth expectations is associated with a decline in expansion and improvement CAPEX of \$0.12, or approximately 12.8 percent relative to the mean. Our results are consistent with standard option theory in that volatility increases the value of the option to carry out CAPEX, reducing the likelihood of exercising the option.

As far as tenant incentives and lease commissions are concerned, our results suggest again that these expenditures follow different patterns. Our estimates suggest that a one standard deviation in growth expectations is associated with a reduction in CAPEX of almost \$0.11, or almost 14 percent relative to the mean of tenant incentives and lease commissions of \$1.27. Our results imply that a stronger leasing market with higher growth expectations relieves pressure on owners to compete for tenants via tenant incentives and lease commissions.

We find that tenant incentives and lease commissions are inversely related to volatility of growth expectations. In economic terms, a one standard deviation increase in volatility reduces these expenditures by almost \$0.12, or 10.3 percent relative to the mean. Our results imply that the option of employing tenant incentives and lease commissions becomes more valuable when uncertainty is higher, consistent with standard option theory.

As for the control variables, consistent with expectations we find that CAPEX are typically associated with lower occupancy, as they are unlikely to occur in a fully occupied building. Our results further suggest that CAPEX are higher in older and larger properties with lower income returns. These findings are generally consistent across expansion and improvement CAPEX as well as tenant incentives and lease commissions.

4.2 Capital expenditures and capital value

Table 7 presents the estimated coefficients for the OLS regression of equation (5), that is, the natural logarithm of market value as a function of CAPEX. CAPEX are measured over the year prior to the measurement of market value as actual value effects of CAPEX may enter valuations with a delay. The Table reports results for the full study period. We also replicate our estimations across recession versus non-recession sub-periods as defined by NBER recession dates for comparison.

As per hypothesis 3, we expect increases in capital expenditures to be positively related to subsequent market value. A relevant question for investors is whether CAPEX are capitalized fully into market values, or what proportion of CAPEX is capitalized into market values.

[Table 7 about here.]

We find that a one percent increase in expansion and improvement CAPEX is associated with an increase in market value of 27.7 percent. For tenant incentives and lease commissions, the economic effect is similar at 26.2 percent. These economic effects are smaller in expansionary periods and larger during recessions. These differences may suggest that investors commit to only the most profitable CAPEX projects during recessions.

Overall, our findings suggest that CAPEX are partially capitalized into market values. Thus, while CAPEX may increase market value, they may not increase capital appreciation returns. Investors may use our estimates to form expectations about the expected return to CAPEX.

Our findings in this section and the previous section relate to the literature on the optionality of capital expenditures as follows. For example, Bond, Shilling, and Wurtzebach (2014) find that CAPEX increase with market lease rates and our work is consistent with their findings. In addition, Peng and Thibodeau (2011) and Ghosh and Petrova (2015) find that capital expenditures decrease in the level of economic uncertainty, which increases the value of the option to delay improvements. Our work extends these prior studies in two ways. First, we study income and volatility specific to asset market segments rather than general economic uncertainty. Second, we consider a full set of investor choices that includes the capital expenditure option and the disposition decision. As a result, we derive a different set of predictions, underscoring the value of recognizing a fuller set of investor choices. Further, these previous studies find mixed evidence for whether, and if so, to what extent, capital expenditures are capitalized into asset values. Our results are more consistent with Ghosh and Petrova (2015), who find that CAPEX are to some extent incorporated into values. Next, we turn to the relationships between CAPEX and subsequent sales decisions, evidence for which is absent from the existing literature to date.

4.3 Disposition decisions and evidence for the disposition effect

Table 8 presents the coefficients from the estimation of equation (6) testing our hypothesis concerning disposition decisions as a function of capital expenditures. To reiterate hypothesis

(4), we expect that the likelihood of sale declines in CAPEX. This step of our analysis also allows us to reexamine the evidence for the disposition effect.

[Table 8 about here.]

Column 1 of Table 8 shows a baseline specification where we model the likelihood of sale as a function of past appreciation returns and the control variables. The disposition effect implies that properties with stronger past appreciation returns are more likely to be sold. The coefficient estimate of 0.732 on the appreciation return translates into an odds ratio of approximately 2.08. In economic terms, this implies that for a one standard deviation increase in appreciation returns, the odds of an asset being sold over the subsequent year increase by 13.9 percent. Our baseline finding suggests that there is evidence consistent with the disposition effect.

Column (2) shows the results when taking into account active management in the form of capital expenditures. Consistent with hypothesis (4), we find that expansion and improvement CAPEX reduce the likelihood of sale. We find that the coefficient estimate for expansion and improvement CAPEX is -0.055, translating into an odds ratio of approximately 0.95. In economic terms, this implies that for a one standard deviation increase in CAPEX, the odds of an asset being sold over the subsequent year decline by 12.2 percent. This change in the likelihood of sale is comparable in economic terms to the change induced by a one standard deviation increase in appreciation returns, but the effect is in the opposite direction.

Further, we find that an increase in tenant incentives and lease commissions by one standard deviation increases the likelihood of sale over the subsequent year by approximately 17.5

percent. Our results highlight fundamental differences between expansion and improvement CAPEX and tenant incentives and lease commissions. Our findings imply that expansion and improvement CAPEX increase the HBU valuation vis a vis the SBU valuation, reducing incentives for trade. Our evidence on tenant incentives and lease commissions is more consistent with a strategy of leasing up a building and selling with a higher occupancy rate.

Column (3) shows the results when taking into account market-level rental growth expectations and their volatility. These variables are the exogenous drivers of the real options available to the owner, where these real options include active management as well as the sale of the property. We find that, after controlling for these exogenous drivers of active management choices, the effect of past appreciation returns becomes insignificant.

Genesove and Mayer (2001) are the first to document loss aversion in real estate. Using data on the Boston housing market, they find that homeowners subject to losses on the sale of their home set higher asking prices, attain higher selling prices, and are significantly less likely to sell than other owners. They conclude that, consistent with the disposition effect, homeowners are reluctant to realize losses. Bokhari and Geltner (2011) extend this evidence to commercial real estate investors, who may be more sophisticated and thus less sensitive to loss aversion. Using a data set of US commercial real estate transactions, they confirm that investors facing a loss set higher asking prices, achieve higher transaction prices and experience a longer time-on-market, implying a lower likelihood of sale. Finally, Crane and Hartzell (2010) explore the evidence for the disposition effect in corporate-level REIT investments. They find that REIT managers also tend to sell strongly performing properties while continuing to hold poorly performing investments.

Prior work rules out some alternative explanations for the observed patterns, particularly in relation to the likelihood of sale, such as optimal tax timing, mean reverting property returns, and asymmetric information (Crane and Hartzell, 2010).[12] However, the literature does not consider the effect of active management choices, including follow-on investments and the choice to sell the property, and their underlying fundamental drivers. Our findings suggest that the evidence on the disposition effect in real estate depends on accounting for the exogenous drivers of the real options embedded in the active management choices that are available to real estate owners.

In order to account for the coexistence of the follow-on investment and disposition decisions, we also estimate a multinomial logit. Table 9 presents the results.

[Table 9 about here.]

The results from this analysis are consistent with the previous OLS results. We generally find a positive impact of higher growth expectations on CAPEX, and an inverse relationship between CAPEX and the volatility of growth expectations. We also find that higher growth expectations reduce the likelihood of selling relative to the baseline outcome of continuing to hold the property. This finding is consistent with our hypotheses as higher income growth increases the likelihood that the HBU value remains above the SBU value, reducing incentives to trade. Furthermore, we find no evidence that past appreciation returns are associated with a change in the likelihood of sale relative to the baseline outcome of doing nothing.

[12] Another stream of literature examines disposition patterns when considering different property types (Collett, Lizieri, and Ward, 2003), national, regional and local economic drivers (Fisher, Gatzlaff, Geltner, and Haurin, 2004), and the role of tax-efficient transactions such as 1031 exchanges (Ling and Petrova, 2015).

Our results suggest that the evidence for the disposition effect in real estate vanishes when accounting for the full set of real options available to investors in terms of active management choices, as well as their exogenous drivers (market-level rental growth expectations and their volatility).

We find that past appreciation returns are significantly associated with CAPEX. This finding points towards active value-add investment strategies where poorly performing properties are held until sufficient capital expenditures have been carried out to realize a gain on sale. This strategy may result in outcomes that are observationally similar to the disposition effect, possibly explaining why previous studies, which did not account for the full set of active management choices, documented evidence in favor of this behavioral bias among real estate investors.

4.4 Additional implications

We now explore two additional perspectives on our main findings. First, we study the possibility that the effects of growth expectations and their volatility on CAPEX differ across property types. In other words, we now identify the property sectors that drive our main finding of a positive relationship between income growth expectations and subsequent CAPEX, as well as an inverse relationship between the volatility of growth expectations and subsequent CAPEX, by adding interaction terms to the regression model from Equation (4). Table 10 presents the results. Apartment properties are the omitted category.

[Table 10 about here.]

Our analysis suggests that the baseline level of expansion and improvement CAPEX is highest for hotel properties, and lowest for industrial, confirming the results of our unconditional analysis. Further, we find that expansion and improvement CAPEX for hotel and retail properties are in line with apartments (omitted category) in terms of their sensitivity to variation in growth expectations. On the other hand, CAPEX for industrial and office properties are significantly less sensitive to variation in growth expectations than apartments. As for the effects of volatility, CAPEX for industrial properties are again the least sensitive, with the other property types in line with apartments.

For tenant incentives and lease commissions, the baseline level of these expenses is highest in office properties, confirming the unconditional analysis. Tenant incentives and lease commissions for industrial and retail properties are significantly less sensitive to growth expectations than apartments. Our finding of an inverse relationship between tenant incentives and lease commissions and the volatility of growth expectations is mainly driven by the office sector, highlighting the importance of these devices for managing adverse conditions in office leasing markets.

The relationships between growth expectations, their volatility, and subsequent CAPEX may also depend on the size of CAPEX projects. In order to explore this possibility, we estimate a quantile regression for Equation (4) which distinguishes between the median, 75^{th} percentile and 95^{th} percentile of the CAPEX distribution.[13] Table 11 presents the results.

[Table 11 about here.]

[13] Our models have very little explanatory power for small CAPEX projects below the median of the distribution.

We find that for expansion and improvement CAPEX, our findings are mainly driven by larger (75^{th} percentile) CAPEX, with the strongest effects for the largest CAPEX projects (95^{th} percentile of the CAPEX distribution). Conversely, for the relationship between growth expectations and tenant incentives and lease commissions, our findings are mostly driven by median sized and slightly larger expenditures (75^{th} percentile). For the relationship between the volatility of growth expectations and tenant incentives and lease commissions, our findings are mostly driven by the very largest expenditures (95^{th} percentile). Overall, our findings suggest that the dynamics of capital expenditures differ not only by the type of expenditure but also by the scope of the CAPEX investment project.

5 Conclusion

The existing evidence on the disposition effect in real estate ignores the active management decisions that occur during the holding period, notably capital expenditures, which exist as an alternative to selling the property. We develop testable predictions about the relationships between economic asset-market fundamentals, subsequent investments in different types of CAPEX, the implications for asset value, and the consequences for disposition decisions.

Our estimates support predictions from real option theory that investors increase expansion and improvement CAPEX during periods of higher expected income growth and reduce CAPEX in periods of higher volatility. We show that, depending on the type of CAPEX, approximately 26 to 28 percent of the investment are capitalized into values. We present novel evidence on the relationships between different types of CAPEX and subsequent disposition decision, a connection that is hitherto absent from the existing literature. Our findings suggest that the evidence for the disposition effect in real estate depends on accounting for the full set of active management choices, including capital expenditures, and the underlying economic drivers of the exercise of those real options, namely market-level income growth expectations and their volatility.

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6 Figures and Tables

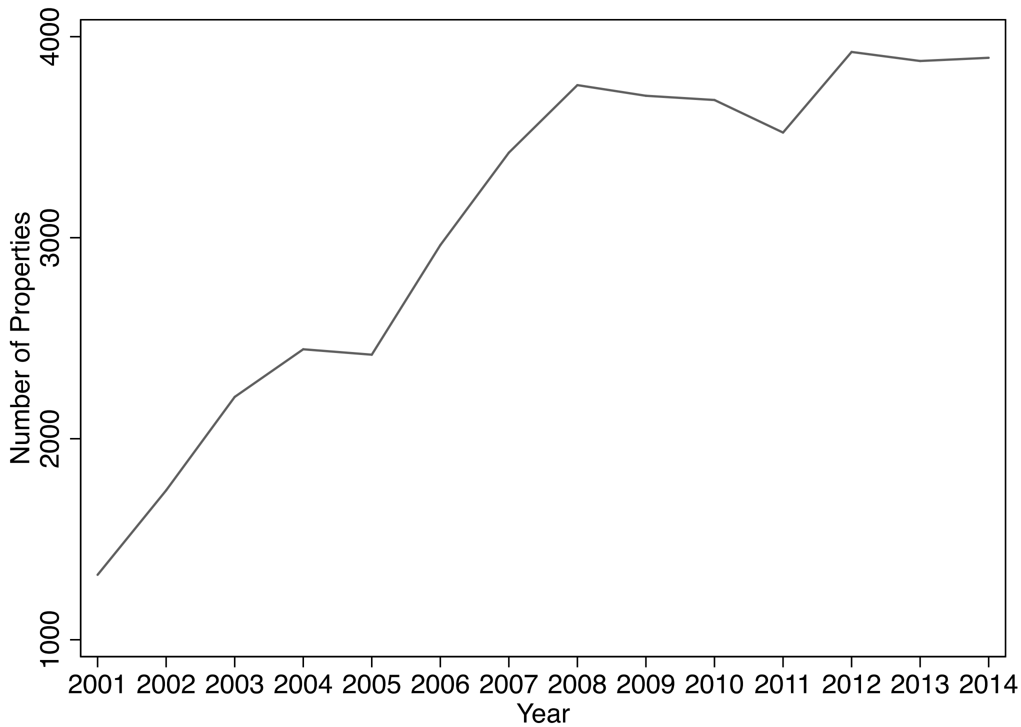


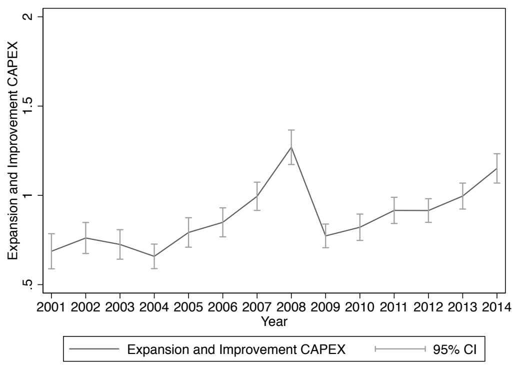
Figure 1: *Evolution of sample properties. The figure shows the evolution of the annual number of properties in our final sample over the period 2001 to 2014.*

Variable	Mean	SD	P5	P25	Median	P75	P95	Min	Max
Transaction indicator	0.027	0.161	0.000	0.000	0.000	0.000	0.000	0.000	1.000
Expansion and Improvement CAPEX psf	0.912	2.282	0.000	0.000	0.151	0.799	4.007	0.000	17.684
Tenant Incentives and Lease Commissions psf	1.194	2.413	0.000	0.000	0.171	1.180	6.056	0.000	14.231
Expansion and Improvement CAPEX to NOI	0.120	0.330	0.000	0.000	0.019	0.102	0.502	0.000	3.020
Tenant Incentives and Lease Commissions to NOI	0.159	0.368	0.000	0.000	0.023	0.153	0.738	0.000	2.787
Growth Expectation	-0.010	0.020	-0.037	-0.023	-0.014	-0.001	0.036	-0.053	0.048
Volatility of Growth Expectation	0.004	0.003	0.001	0.002	0.003	0.004	0.012	0.001	0.012
Percent Leased	0.914	0.117	0.660	0.880	0.953	1.000	1.000	0.400	1.000
Income Return	0.065	0.025	0.019	0.051	0.065	0.079	0.104	0.000	0.140
Appreciation Return	0.006	0.129	-0.244	-0.042	0.010	0.075	0.202	-0.408	0.408
Log Sq Ft	12.191	0.880	10.678	11.654	12.236	12.765	13.614	9.433	14.228
Property Age at Acquisition	14.077	14.619	0.000	3.000	11.000	20.000	39.000	0.000	83.000

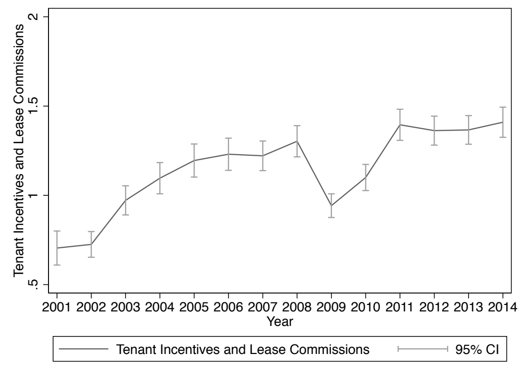
Table 1: *Descriptive statistics. The table presents the descriptive statistics on 42,894 property-year observations in our final sample. Transaction Indicator is an indicator that takes the value of 1 if the property was reported sold in a given year, 0 otherwise. Expansion and Improvement CAPEX as well as Tenant Incentives and Lease Commissions are measured per year and square foot (psf). Alternatively, annual CAPEX values are expressed as a percentage of annual NOI. Growth Expectation is the growth expectation implied in the difference between 10-year BBB corporate bond yields and the average capitalization rate corresponding to a given property's type and MSA at year-end. Volatility of Growth Expectation is the annual standard deviation of quarterly growth expectations, which we measure as the difference between 10-year BBB corporate bond yields and the average capitalization rate corresponding to a given property's type and MSA at quarter-end. Percent Leased is the average occupancy rate for a given property type and MSA. Income Return is measured over four quarters to year-end. Appreciation Return is measured over four quarters to year-end. Log Sq Ft is the natural logarithm of the size of the property. Property Age at Acquisition is measured as the difference in years between the year of construction and the year of acquisition. Interest rate data (for the calculation of growth expectations and their volatility) is obtained from the Federal Reserve Bank of St Louis's Economic Database (FRED). All continuous variables are winsorized at 1st and 99th percentile to mitigate undue influence of outliers.*

Variable	Apartment	Hotel	Industrial	Office	Retail
Expansion and Improvement CAPEX psf	1.18	4.10	0.35	1.32	1.04
	(2.53)	(5.36)	(1.20)	(2.53)	(2.75)
Tenant Incentives and Lease Commissions psf	0.20	0.07	0.60	3.03	1.17
	(1.18)	(0.81)	(1.26)	(3.49)	(2.19)
Expansion and Improvement CAPEX to NOI	0.15	0.39	0.09	0.14	0.09
	(0.32)	(0.73)	(0.31)	(0.35)	(0.32)
Tenant Incentives and Lease Commissions to NOI	0.02	0.01	0.16	0.32	0.10
	(0.08)	(0.15)	(0.37)	(0.50)	(0.24)

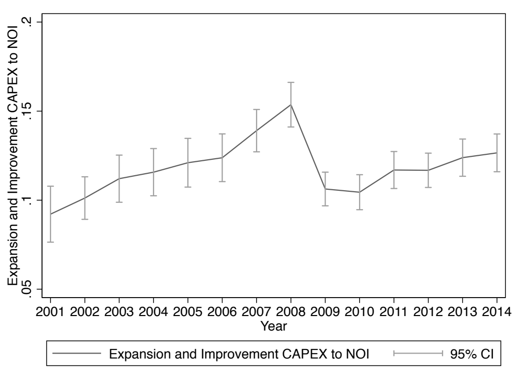
Table 2: *CAPEX statistics. The table presents the mean (standard deviation) of CAPEX by property type. CAPEX are measured by square foot and, alternatively, as a percentage of NOI.*



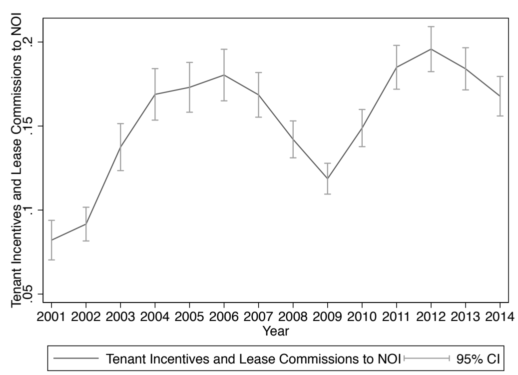
(a) *Expansion and improvement CAPEX measured psf*



(b) *Tenant incentives and lease commissions measured psf*



(c) *Expansion and improvement CAPEX as a percentage of NOI*



(d) *Tenant incentives and lease commissions as a percentage of NOI*

Figure 2: *Evolution of CAPEX components.The figure shows the evolution of expansion and improvement CAPEX per square foot (Panel (a)) and tenant incentive and lease commission CAPEX per square foot (Panel (b)) over the period 2001 to 2014. The figure also shows expansion and improvement as well as tenant incentive and lease commission CAPEX scaled by NOI (Panel (c) and Panel (d)).*

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Transaction indicator	1.0000											
(2) Expansion and Improvement CAPEX psf	-0.0056	1.0000										
(3) Tenant Incentives and Lease Commissions psf	0.0061	0.2489*	1.0000									
(4) Expansion and Improvement CAPEX to NOI	0.0140*	0.7205*	0.1400*	1.0000								
(5) Tenant Incentives and Lease Commissions to NOI	0.0244*	0.1205*	0.6958*	0.2732*	1.0000							
(6) Growth Expectation	-0.0380*	0.0350*	-0.0392*	0.0176*	-0.0643*	1.0000						
(7) Volatility of Growth Expectation	-0.0279*	-0.0368*	-0.0468*	-0.0262*	-0.0399*	0.5088*	1.0000					
(8) Percent Leased	-0.0300*	-0.1083*	-0.2367*	-0.2038*	-0.3930*	0.0537*	-0.0175*	1.0000				
(9) Income Return	0.0092	-0.1145*	-0.0721*	-0.1198*	-0.1090*	-0.2897*	-0.0199*	0.2491*	1.0000			
(10) Appreciation Return	0.0100*	0.0223*	-0.0223*	-0.0220*	-0.0771*	-0.0678*	-0.4950*	0.1611*	0.0016	1.0000		
(11) Log Sq Ft	-0.0089	0.0175*	0.0002	0.0068	-0.0316*	0.0301*	-0.0050	-0.0197*	-0.0597*	0.0364*	1.0000	
(12) Property Age at Acquisition	0.0111*	0.1573*	0.1172*	0.1162*	0.0737*	0.0369*	0.0223*	-0.0674*	-0.0930*	-0.0168*	-0.0825*	1.0000

Table 3: *Pairwise Pearson correlation table. The table presents the pairwise Pearson correlation coefficients on the variables in our study from the observations in Table 1. Exp/Imp stands for Expansion and Improvement CAPEX. TI/LC stands for Tenant Incentives and Lease Commissions. Variables are defined as in Table 1. The asterisks indicate significance at the 5% level.*

Multivariate analysis based on Exp/Imp	1	2	3	4	5	Difference	(t-statistic)
Expansion and Improvement CAPEX psf	0.0000	0.0222	0.1659	0.6519	3.7374	3.7370***	(114.35)
Growth Expectation	-0.0106	-0.0136	-0.0102	-0.0085	-0.0086	0.0020***	(7.31)
Volatility of Growth Expectation	0.0037	0.0032	0.0037	0.0037	0.0037	-0.0001	(-1.94)
Percent Leased	0.9385	0.9099	0.9085	0.9052	0.8866	-0.0519***	(-32.77)
Income Return	0.0684	0.0645	0.0640	0.0629	0.0603	-0.0080***	(-23.15)
Appreciation Return	0.0049	0.0178	0.0055	0.0085	0.0033	-0.0016	(-0.91)
Log Sq Ft	11.9908	12.3659	12.2917	12.3158	12.2614	0.2710***	(22.32)
Property Age at Acquisition	11.4413	12.9768	13.4368	14.7454	18.8872	7.4460***	(37.81)

Multivariate analysis based on TI/LC	1	2	3	4	5	Difference	(t-statistic)
Tenant Incentives and Lease Commissions psf	0.0000	0.0165	0.2016	0.9235	4.8584	4.8580***	(185.92)
Growth Expectation	-0.0072	-0.0207	-0.0119	-0.0115	-0.0108	-0.0036***	(-13.29)
Volatility of Growth Expectation	0.0037	0.0024	0.0036	0.0037	0.0037	-0.0001	(-1.74)
Percent Leased	0.9434	0.9295	0.9247	0.9003	0.8575	-0.0859***	(-58.62)
Income Return	0.0639	0.0642	0.0665	0.0664	0.0621	-0.0018***	(-5.28)
Appreciation Return	0.0141	0.0225	0.0074	0.0032	-0.0090	-0.0231***	(-13.37)
Log Sq Ft	12.1581	12.1360	12.2288	12.2255	12.1915	0.0334**	(2.89)
Property Age at Acquisition	11.4909	13.5183	14.1723	15.8540	17.3601	5.8690***	(29.96)

Table 4: *Unconditional multivariate analysis based on CAPEX. The table presents the characteristics of the properties in our sample over the period 2001–2014 when sorted into quintiles by quarterly CAPEX values. Panel (a) sorts by Expansion and Improvement CAPEX values. Panel (b) sorts by Tenant Incentives and Lease Commissions. All variables are defined as in Table 1. The Table also shows the spread (Difference) between the mean variable values across the 5th (highest) and 1st (lowest) CAPEX quintiles alongside the corresponding t-statistic from a two-group mean-comparison test. For the transaction indicator, the Table presents the differences between sold and unsold properties. Significance is indicated as follows:* * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Multivariate analysis based on transaction indicator	0	1				Difference	(t-statistic)
Transaction Indicator	0.0000	1.0000				1	n/a
Expansion and Improvement CAPEX psf	0.9138	0.8343				-0.0906	(-1.55)
Tenant Incentives and Lease Commissions psf	1.1920	1.2830				0.149**	(2.62)
Growth Expectation	-0.0097	-0.0145				-0.0056***	(-10.90)
Volatility of Growth Expectation	0.0037	0.0031				-0.0006***	(-7.62)
Percent Leased	0.9144	0.8925				-0.0247***	(-7.99)
Income Return	0.0645	0.0659				0.0012	(1.88)
Appreciation Return	0.0059	0.0140				0.0083*	(2.54)
Log Sq Ft	12.1928	12.1442				-0.0916***	(-3.85)
Property Age at Acquisition	14.0498	15.0606				0.9260*	(2.28)
Multivariate analysis based on holding period	**1**	**2**	**3**	**4**	**5**	**Difference**	**(t-statistic)**
Holding Period	2.9337	5.3962	6.3389	8.5893	14.6976	11.7600***	(58.37)
Transaction Indicator	0.5789	0.5157	0.5000	0.4613	0.5146	-0.0643	(-1.94)
Expansion and Improvement CAPEX psf	1.2071	0.7665	0.6591	0.5665	0.7511	-0.4560**	(-2.85)
Tenant Incentives and Lease Commissions psf	0.2099	0.2146	0.2313	0.2003	0.2057	-0.0042	(-0.14)
Growth Expectation	-0.0138	-0.0142	-0.0150	-0.0166	-0.0147	-0.0009	(-0.70)
Volatility of Growth Expectation	0.0032	0.0032	0.0039	0.0029	0.0034	0.0003	(1.44)
Percent Leased	0.8825	0.8872	0.8932	0.8897	0.8956	0.0131	(1.49)
Income Return	0.0584	0.0676	0.0720	0.0694	0.0706	0.0122***	(6.77)
Appreciation Return	0.0195	0.0146	-0.0216	0.0051	-0.0016	-0.0211**	(-2.63)
Log Sq Ft	12.2478	11.9108	12.0933	12.1874	12.2855	0.0377	(0.64)
Property Age at Acquisition	18.3423	16.2537	14.7630	13.4792	9.8621	-8.4800***	(-8.04)

Table 5: *Unconditional multivariate analysis based on dispositions. The table presents the characteristics of the properties in our sample over the period 2001–2014 when sorted into quantiles based on dispositions. Panel (a) sorts by the value of the transaction indicator. Panel (b) sorts property-year observations into quintiles by time to sale (Holding Period) measured in years. All variables are defined as in Table 1. The Table also shows the spread (Difference) between the mean variable values across the 5th (highest) and 1st (lowest) CAPEX quintiles alongside the corresponding t-statistic from a two-group mean-comparison test. For the transaction indicator, the Table presents the differences between sold and unsold properties. Significance is indicated as follows: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

	Expansion & Improvement		Tenant Incentives & Lease Commissions	
Variables	Coefficient	t-statistic	Coefficient	t-statistic
Growth Expectation	3.429***	3.94	0.739	0.98
Volatility of Growth Expectation	-38.941***	-7.59	-41.182***	-8.71
Percent Leased	-1.175***	-8.75	-3.554***	-24.66
Property Age at Acquisition	0.020***	13.34	0.010***	8.24
Log Sq Ft	0.040*	1.91	0.082***	4.74
Income Return	-5.592***	-9.05	-5.034***	-8.34
Appreciation Return	0.121	1.13	0.131	1.21
Constant	1.747***	5.71	2.614***	9.73
Observations	42,894		42,894	
R-squared	0.086		0.249	
Property type FE	Y		Y	
Fund type FE	Y		Y	
Division FE	Y		Y	
No of property clusters	10,505		10,505	

Table 6: *Regression results for capital expenditures as a function of growth expectations and volatility. The table presents the coefficient estimates and corresponding t-statistics from the OLS estimation of equation (4). Variables are defined as in Table 1. All right-hand side variables are lagged by one year to mitigate simultaneity bias as a potential source of endogeneity. Fixed effects for property type, fund type, and geographic division are included as indicated. Standard errors are clustered by property. Significance is indicated as follows: *** $p<0.001$, ** $p<0.01$, * $p<0.05$.*

	Full study period		Non-Recession		Recession	
Variables	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Ln(Exp/Imp)	0.277***	13.05	0.241***	11.23	0.392***	6.50
Ln(TI/LC)	0.262***	15.68	0.197***	13.46	0.504***	11.63
Percent Leased	1.408***	25.12	1.314***	22.38	1.772***	15.18
Property Age at Acquisition	-0.003***	-4.52	-0.002***	-3.07	-0.007***	-6.55
Log Sq Ft	-0.056***	-6.31	-0.059***	-6.17	-0.034***	-2.80
Income Return	-5.614***	-23.08	-5.468***	-21.00	-6.443***	-14.42
Appreciation Return	0.677***	19.22	0.667***	17.81	0.790***	6.23
Constant	4.044***	32.14	4.144***	30.78	3.574***	19.60
Observations	42,894		37,812		5,082	
R-squared	0.317		0.292		0.587	
Property type FE	Y		Y		Y	
Fund type FE	Y		Y		Y	
Division FE	Y		Y		Y	
No of property clusters	10,505		10,505		10,505	

Table 7: *Regression results for the natural logarithm of property market value as a function of CAPEX variables. The table presents the coefficient estimates and corresponding t-statistics from the OLS estimation of equation (5). Exp/Imp stands for Expansion and Improvement CAPEX per sq ft. TI/LC stands for Tenant Incentives and Lease Commissions per sq ft. Variables are defined as in Table 1. All right-hand side variables are lagged by one year to mitigate simultaneity bias. Fixed effects for property type, fund type and geographic division are included as indicated. Standard errors are clustered by property. Significance is indicated as follows: *** p<0.001, ** p<0.01, * p<0.05.*

	(1)		(2)		(3)	
Variables	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Exp/Imp			-0.055***	-2.89		
TI/LC			0.070***	5.37		
Growth Expectation					-13.796***	-6.95
Volatility of Growth Expectation					-28.060*	-1.92
Appreciation Return	0.732***	3.12	0.681***	2.91	0.417	1.42
Income Return	6.317***	4.62	6.906***	5.05	3.530**	2.53
Percent Leased	-1.791***	-7.38	-1.795***	-7.26	-1.525***	-6.19
Property Age at Acquisition	0.005**	2.43	0.005***	2.63	0.005***	2.62
Log Sq Ft	-0.106***	-3.12	-0.112***	-3.23	-0.109***	-3.17
Constant	-0.444	-0.94	-0.372	-0.77	-0.507	-1.06
Observations	42,894		42,894		42,894	
Property type FE	Y		Y		Y	
Fund type FE	Y		Y		Y	
Division FE	Y		Y		Y	
No of property clusters	10,505		10,505		10,505	

Table 8: *Regression results for the sale indicator as a function of CAPEX as well as growth expectations and volatility. The table presents the coefficient estimates and corresponding t-statistics from the Logit estimation of equation* (6). *Column (1) shows the baseline specification with only past appreciation return as a proxy for the disposition effect, control variables, and fixed effects. Column (2) includes capital expenditure variables. Variables are defined as in Table 1. Exp/Imp stands for Expansion and Improvement CAPEX per sq ft. TI/LC stands for Tenant Incentives and Lease Commissions per sq ft. All right-hand side variables are lagged by one year to mitigate simultaneity bias. Fixed effects for property type, fund type, and geographic division are included as indicated. Standard errors are clustered by property. Significance is indicated as follows: *** $p<0.001$, ** $p<0.01$, * $p<0.05$.*

Variables	(1) Exp/Imp	(2) TI/LC	(3) Both CAPEX	(4) Sell
Growth Expectation	3.531***	2.836**	-0.834	-12.403***
	(2.85)	(2.48)	(-0.82)	(-2.63)
Volatility of Growth Expectation	-7.102	-14.855**	-19.172***	-4.683
	(-0.98)	(-2.15)	(-3.28)	(-0.14)
Percent Leased	-1.200***	-4.019***	-5.268***	-2.807***
	(-3.48)	(-13.69)	(-18.21)	(-3.08)
Property Age at Acquisition	0.006**	0.005*	0.032***	-0.014*
	(2.11)	(1.95)	(11.81)	(-1.79)
Log Sq Ft	0.090**	0.088***	0.541***	-0.278***
	(2.51)	(2.75)	(16.78)	(-3.37)
Income Return	-1.174	1.679*	-1.561*	4.141
	(-1.09)	(1.77)	(-1.78)	(1.09)
Appreciation Return	-0.450***	-0.572***	-0.089	-0.390
	(-2.77)	(-3.69)	(-0.67)	(-0.51)
Constant	0.945	2.410***	-2.288***	3.415***
	(1.64)	(4.70)	(-4.47)	(2.65)
Observations	42,894			
Pseudo R-squared	0.193			
Property type FE	Y			
Fund type FE	Y			
Division FE	Y			
No of property clusters	10,505			

Table 9: *Regression results for the multinomial logit model. The table presents the coefficient estimates from the multinomial logit model for the active management decisions available to investors. The baseline outcome is to do nothing. The model is estimated using maximum likelihood. Variables are defined as in Table 1. Exp/Imp stands for Expansion and Improvement CAPEX per sq ft. TI/LC stands for Tenant Incentives and Lease Commissions per sq ft. All right-hand side variables are lagged by one year to mitigate simultaneity bias. Fixed effects for property type, fund type, and geographic division are included as indicated. Standard errors, shown in parentheses, are clustered by property. Significance is indicated as follows: *** p<0.001, ** p<0.01, * p<0.05.*

Variables	Expansion & Improvement Coefficient	t-statistic	Tenant Incentives & Lease Commissions Coefficient	t-statistic
Hotel	2.764***	3.58		
Industrial	-1.057***	-15.01	0.388***	8.40
Office	0.082	0.90	3.001***	35.35
Retail	-0.136	-1.11	1.020***	13.44
Growth Expectation	9.898***	4.37	3.116**	2.44
Hotel*Growth Expectation	-4.456	-0.32		
Industrial*Growth Expectation	-12.538***	-5.39	-3.901***	-2.82
Office*Growth Expectation	-5.104*	-1.89	1.371	0.63
Retail*Growth Expectation	-4.765	-1.44	-7.483***	-3.65
Volatility of Growth Expectation	-57.626***	-4.53	-21.959***	-2.81
Hotel*Volatility of Growth Expectation	-63.482	-0.54		
Industrial*Volatility of Growth Expectation	51.559***	4.05	5.771	0.72
Office*Volatility of Growth Expectation	-3.884	-0.26	-80.384***	-5.88
Retail*Volatility of Growth Expectation	14.470	0.83	-16.344	-1.39
Percent Leased	-1.154***	-8.59	-3.580***	-24.52
Property Age at Acquisition	0.020***	13.34	0.010***	8.03
Log Sq Ft	0.040*	1.92	0.084***	4.79
Income Return	-5.615***	-9.09	-5.035***	-8.23
Appreciation Return	0.159	1.50	0.097	0.89
Constant	1.805***	5.83	2.557***	9.46
Observations	42,894		42,545	
R-squared	0.087		0.251	
Fund type FE	Y		Y	
Division FE	Y		Y	
Year FE	Y		Y	
No of property clusters	10,505		10,380	

Table 10: *Regression results for capital expenditures with property type-specific effects. The table presents the coefficient estimates and corresponding t-statistics from the OLS estimation of equation (4). In the regression for tenant incentives and lease commissions, we omit Hotels, as Table 2 indicates that there are no meaningful capital expenditures of that type in the Hotel sector. Variables are defined as in Table 1. All right-hand side variables are lagged by one year to mitigate simultaneity bias as a potential source of endogeneity. Fixed effects for fund type and geographic division are included as indicated. Standard errors are clustered by property. Significance is indicated as follows: *** $p<0.001$, ** $p<0.01$, * $p<0.05$.*

	Expansion and Improvement CAPEX						Tenant Incentives and Lease Commissions					
	50th percentile		75th percentile		95th percentile		50th percentile		75th percentile		95th percentile	
Variables	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Growth Expectation	-0.125**	-2.30	0.533*	1.92	3.799**	2.05	-0.445***	-6.69	-0.556*	-1.80	0.810	0.57
Volatility of Growth Expectation	-2.697***	-7.56	-15.687***	-8.17	-57.538***	-4.76	-2.996***	-7.76	-14.227***	-6.85	-36.130***	-3.86
Percent Leased	-0.250***	-10.52	-0.936***	-11.21	-4.054***	-11.71	-2.048***	-34.76	-4.070***	-32.65	-7.846***	-25.96
Property Age at Acquisition	0.006***	24.27	0.021***	26.07	0.088***	16.45	0.003***	18.77	0.009***	16.63	0.022***	8.17
Log Sq Ft	0.026***	27.28	0.039***	7.53	-0.021	-0.54	0.036***	20.30	0.044***	5.49	-0.269***	-7.56
Income Return	-0.154***	-4.52	-1.601***	-8.17	-7.718***	-5.50	-0.466***	-8.48	-1.707***	-6.29	-7.923***	-6.19
Appreciation Return	0.026***	4.23	0.067	1.63	0.185	0.66	0.055***	5.87	0.124***	3.23	0.515**	2.35
Constant	0.304***	10.75	1.354***	12.53	7.373***	11.52	1.486***	23.63	3.469***	21.38	11.695***	20.95
Observations	42,894		42,894		42,894		42,894		42,894		42,894	
Property type FE	Y		Y		Y		Y		Y		Y	
Fund type FE	Y		Y		Y		Y		Y		Y	
Division FE	Y		Y		Y		Y		Y		Y	
No of property clusters	10,505		10,505		10,505		10,505		10,505		10,505	

Table 11: *Quantile regression results for capital expenditures as a function of growth expectations and volatility of growth expectations. The table presents the coefficient estimates and corresponding t-statistics from the OLS estimation of equation (4). Exp/Imp stands for Expansion and Improvement CAPEX. TI/LC stands for Tenant Incentives and Lease Commissions. Variables are defined as in Table 1. All right-hand side variables are lagged by one year to mitigate simultaneity bias as a potential source of endogeneity. Fixed effects for property type, fund type and geographic division are included as indicated. Standard errors are clustered by property. Significance is indicated as follows: *** $p<0.001$, ** $p<0.01$, * $p<0.05$.*