

Economic Fundamentals, Capital Expenditures and Asset Dispositions

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Outline

Introduction

Hypothesis Development

Method

Data

Results

Conclusion

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- ▶ Disposition effect (loss aversion) is a behavioral bias that may affect investors (Shefrin and Statman, 1985)
- ▶ Documented in *passive* investments, stocks and mutual funds (Coval and Shumway, 2005, Dhar and Zhu, 2006, Frazzini, 2006; Ivkovic, Poterba and Weisbenner, 2005; Odean, 1998)
- ▶ Some evidence points to a disposition effect in real assets such as real estate (Bokhari and Geltner, 2011; Crane and Hartzell, 2010; Genesove and Mayer, 2001)
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This Paper

- ▶ We model the set of active management choices in real estate
 - ▶ Model capital expenditures (CAPEX) as a real option
 - ▶ Consider real option to sell the asset
- ▶ We develop testable hypotheses
 - ▶ Occurrence of CAPEX depending on economic environment
 - ▶ Implications for asset value
 - ▶ Likelihood of sale following CAPEX investments
- ▶ Empirically analyze data on investments involving CAPEX and property sales throughout the cycle
- ▶ Contrast findings to the existing evidence for disposition effect

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Set-Up

- ▶ Real option analysis for incremental investment problems from Bertola (1998); Dixit and Pindyck (1994); Pindyck (1988)
- ▶ Property generates profit flow (net operating income)

$$\pi_t = HM(K) \quad (1)$$

where $M(K)$ is a concave function of capital (K) invested (specialized Cobb-Douglas form) and H is a random shift variable reflecting uncertainty over future NOI. We assume

$$dH_t = \alpha_H H_t dt + \sigma_H H_t dz_H \quad (2)$$

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Depreciation and the Value of the Property

- ▶ Depreciation/economic obsolescence as Poisson process
 - ▶ Over dt , invested capital will depreciate with probability λKdt
- ▶ Assuming no CAPEX
 - ▶ Periodic rate of depreciation is $dK = -\lambda Kdt$
 - ▶ Profit flow at time t is $H_t M(Ke^{-\lambda t})$
- ▶ Expected value of the property at the date of purchase is

$$V(K, H) = \hat{E} \int_0^{\infty} H_t M(Ke^{-\lambda t}) e^{-\rho t} dt \quad (3)$$

where ρ is the discount rate

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Capital Expenditures

From Dixit and Pindyck (1994)

- ▶ Income shock (H^*) that triggers CAPEX in response to depreciation declines as market rental growth increases
- ▶ Higher volatility surrounding market rent (σ) increases H^* , results in longer delay between capital expenditure investments

Hypothesis 1

Higher market rental growth rates reduce the delay between capital expenditure investments

Hypothesis 2

Higher volatility of market rents increases the delay between capital expenditure investments

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Dispositions

Highest and Best Use versus Second Best Use

- ▶ Current owner deploys building at HBU, else incentive to trade and redeploy at SBU with profit flow and value driven by S
- ▶ Current owner's opportunity to sell is a perpetual put option with payoff at any time t of $\max[0, V(K, S, t) - V(K, H, t)]$
- ▶ Option value depends on past CAPEX because asset value to current owner is a function of past CAPEX

Hypothesis 3

An increase in CAPEX increases asset value

Hypothesis 4

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Method

- ▶ Hypothesis 1 & 2: OLS model of annual $CAPEX_{i,t}$ per sq. ft.

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

- ▶ Hypothesis 3: OLS model of log of market value per sq. ft.

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

- ▶ Hypothesis 4: Logit model of sale decision

$$Sale_{i,t} = \gamma_0 + \gamma_1 CAPEX_{i,t-1} + \gamma_2 \mathbf{X}_{i,t-1} + u_{it \cdot i,t-1} \quad (6)$$

- ▶ Alternatively: Multinomial logit of current owner's choices, including different types of CAPEX investment and disposition

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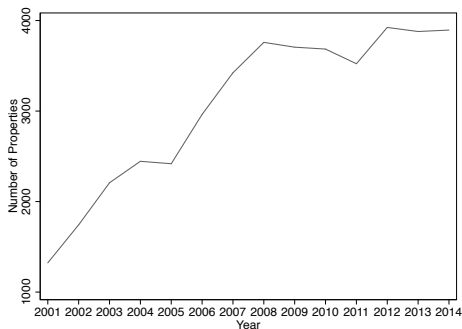
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Sample Selection

- ▶ Data from *NCREIF*, over 2000–2015, focus on operating properties that form part of NCREIF's NPI and where the values for CAPEX are non-negative
- ▶ Evolution of the number of properties in the final sample

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Descriptive Statistics

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
Appreciation Return	0.006	0.129	-0.244	-0.042	0.010	0.075	0.202	-0.408	0.408
Income Return	0.065	0.025	0.019	0.051	0.065	0.079	0.104	0.000	0.140
Log Sq Ft	12.191	0.880	10.678	11.654	12.236	12.765	13.614	9.433	14.228
Percent Leased	0.914	0.117	0.660	0.880	0.953	1.000	1.000	0.400	1.000
Property Age at Acquisition	14.077	14.619	0.000	3.000	11.000	20.000	39.000	0.000	83.000

CAPEX as a Function of Growth Expectations and Volatility

Variables	Expansion & Improvement		Tenant Incentives & Lease Commissions	
	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
Appreciation Return	0.121	1.13	0.131	1.21
Income Return	-5.592***	-9.05	-5.034***	-8.34
Log Sq Ft	0.040*	1.91	0.082***	4.74
Percent Leased	-1.175***	-8.75	-3.554***	-24.66
Property Age at Acquisition	0.020***	13.34	0.010***	8.24
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	

Market Value as a Function of CAPEX

Variables	Full study period		Non-Recession		Recession	
	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
Appreciation Return	0.677***	19.22	0.667***	17.81	0.790***	6.23
Income Return	-5.614***	-23.08	-5.468***	-21.00	-6.443***	-14.42
Log Sq Ft	-0.056***	-6.31	-0.059***	-6.17	-0.034***	-2.80
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
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	

Likelihood of Sale as a Function of CAPEX

Variables	(1)		(2)		(3)	
	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
Log Sq Ft	-0.106***	-3.12	-0.112***	-3.23	-0.109***	-3.17
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
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	

Multinomial Logit Model of Current Owner's Choices

Variables	(1) Exp/Imp	(2) TI/LC	(3) Both CAPEX	(4) Sell
Growth Expectation	3.531*** (2.85)	2.836** (2.48)	-0.834 (-0.82)	-12.403*** (-2.63)
Volatility of Growth Expectation	-7.102 (-0.98)	-14.855** (-2.15)	-19.172*** (-3.28)	-4.683 (-0.14)
Appreciation Return	-0.450*** (-2.77)	-0.572*** (-3.69)	-0.089 (-0.67)	-0.390 (-0.51)
Income Return	-1.174 (-1.09)	1.679* (1.77)	-1.561* (-1.78)	4.141 (1.09)
Log Sq Ft	0.090** (2.51)	0.088*** (2.75)	0.541*** (16.78)	-0.278*** (-3.37)
Percent Leased	-1.200*** (-3.48)	-4.019*** (-13.69)	-5.268*** (-18.21)	-2.807*** (-3.08)
Property Age at Acquisition	0.006** (2.11)	0.005* (1.95)	0.032*** (11.81)	-0.014* (-1.79)
Constant	0.945 (1.64)	2.410*** (4.70)	-2.288*** (-4.47)	3.415*** (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			

Conclusion

- ▶ Existing evidence on the disposition effect in real estate ignores active management options, which include follow-on investments as well as disposition of the property
- ▶ When accounting for a richer choice set, we find that:
 - ▶ Investors increase expansion and improvement CAPEX during periods of higher expected income growth and reduce CAPEX in periods of higher volatility
 - ▶ Depending on the type of CAPEX, approximately 26 to 28 percent of the investment are capitalized into values
 - ▶ CAPEX influence subsequent disposition decision
 - ▶ Evidence for disposition effect depends on accounting for capital expenditures as alternative option, and for underlying economic drivers of the exercise of those real options

Conclusion

- ▶ Existing evidence on the disposition effect in real estate ignores active management options, which include follow-on investments as well as disposition of the property
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