Analyzing Capital Expenditure in Commercial Real Estate Assets

by

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ABSTRACT

The ability of Commercial Real Estate to provide strong current income returns has long been one of its benefits of inclusion into a long-term portfolio. Capital Expenditures can significantly hamper this income return of commercial properties and mislead the investors into making misguided decisions. However, there has long been an informational vacuum about capital expenditure and the current available literature can best be described as non-existent. This thesis focuses entirely on capital expenditure to understand the future implications of Capital Expenditure Spending, and to understand the co-relation between different property characteristics and capital expenditure.

The thesis uses contingency tables to understand the behavior of commercial properties over a span of nine years. The goal was to understand if capital expenditure spends have an impact on future spends. If an investor invests high (low) capital expenditure in the present do they keep spending high (low) all throughout their hold periods or their spending changes over time. Secondly, regression analyses is used to better understand the relationship between different property characteristics and capital expenditures and this exercise helps build an intuition about capital expenditure spends.

The contingency tables and regression analyses revealed distinguishing trends about capital expenditure and helped understand its behavior. It was revealed that investors currently spending high on capital expenditures are not necessarily successful in saving capital expenditure spends in the future. The regression analyses defined a positive co-relation for capital expenditure with respect to age, sq. ft, NOI and market value and it defined a negative co-relation with respect to cap rate and location considering the property was located in the top six markets in the country.

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Professor of Real Estate Finance, Department of Urban Studies & Planning and Center for Real Estate
Acknowledgement

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CHAPTER 1: Introduction

There are no academic journal papers or industry white papers published specifically on capital expenditure. Practitioners have often neglected cap-ex\(^1\) primarily due to the significant expertise as well as the time and effort required in obtaining relevant cap-ex data. This thesis focuses entirely on capital expenditure, as existing literature on capital expenditure can at best be described as non-existent.

There is no systematic process in place to understand the value generated with capital expenditures. Real estate asset managers and investors often have a notion that capital expenditures will reduce future spending and will increase the value of an asset, but there has been no study undertaken to examine this belief. In fact, there has not been any significant study to understand even what parameters affect capital expenditure spending in a real estate asset. Parameters such as age, sq. ft., NOI, location, cap rate, etc., should, at least in theory, have some impact on the decision making of cap-ex spending. However, there is no literature available to understand the co-relation of these parameters to cap-ex. Hence, the main focus of this thesis will be to analyze the future implications of capex spends and to understand the co-relation of different property characteristics with capex.

Cap-ex reserves have traditionally been accommodated into DCF modeling assumptions but they have seldom been categorized based on property type or market location to attain an accurate measure of capital expenditure. The general market thumb rule is to make provision for 20\% of the NOI as cap-ex reserves\(^2\). It is alarming to see that this magic number of 20\% is used across property types and market locations but there is no research to understand its existence in the first place.

Renewal probability is another factor, which directly affects capital expenditure reserves and DCF analyses. While it is difficult to accurately estimate how many tenants will renew their leases, it is evident that no research has even attempted to categorize this important parameter considering the historic trends for renewal probability. The general rule of thumb is to consider that 75\% of tenants will renew their leases. Also, it is not uncommon for optimistic managers to assume that 100\% of the leases will get renewed. In reality, however, optimal vacancy is greater than zero on average.

From an investment perspective, DCF analysis is widely used for valuation and analyses of commercial real estate assets\(^3\). It is a system based on assumptions; any change in these assumptions will significantly influence the final estimated value. Starting with accurate assumptions is therefore of prime importance. Growth in NOI is often estimated using thumb rules. These rules are flawed as they do not account for accurate changes in

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1 In this thesis capital expenditure is referred as either capex or cap-ex.
2 Discussion with Hines Research team, 2014
rent, capital expenditure, operating expenses, probability of renewal and depreciation and thus affect the valuation process.

For instance, it is generally assumed that rents will grow at inflation, when in reality they don't. Exhibit 1 compares NCREIF NOI growth to CPI for same property and shows that NOI growth rate can actually be lower than the growth rate in inflation. These flawed assumptions generally lead to unrealistic expectations of revenue streams and eventually erroneous investment decisions.

At times cash flow proformas and DCF analyses based on flawed assumptions deliberately use biased numbers. Buyers presumably try to err on the conservative side while sellers try to be more liberal about their cash flow projections. Although a useful exercise, it violates the basic purpose of DCF analyses based on economic and statistical theory, which is to employ realistic (unbiased) expectations focused on realistic (unbiased) implications about cash flow and value. It puts the analyst out on "soft ground", removing analysis from objective reality and opens the door for abuse. This thesis believes that the best practice for DCF is transparency and realism based on sound empirics and theory.

To narrow the scope and have a realistic expectation from investments, this paper concentrates only on capital expenditures and tries to understand the different parameters affecting cap-ex and understand the future implications of cap-ex spending. The thesis is mainly divided into 2 main sections namely:

Part 1: Understanding the Future Implications of Capital Expenditure Spending, and
Part 2: Understanding the co-relation between property characteristics and capex

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CHAPTER 2: Background and Significance

One of the strengths of commercial real estate as an asset class is its ability to provide current income to the investor and the investor's beneficiaries. A common method of showing this is to display cap rates with bond yields and dividend yields, as shown in Exhibit 1. Real estate income returns surpass dividend yields from equities and are more stable than yields on bonds. However, this is misleading. While the bond yield and the dividend yield are truly "cash" measures, the cap rate (shown here as the Income Return on the NCREIF U.S. Commercial Index) is not truly cash.

Exhibit 2: Income Across Asset Classes

Source: Thomson Reuters Datastream. All figures are annual.
Note: Quarterly NPI income returns are annualized by multiplying by four.

Bonds, stocks and real estate yields are all based on income relative to current prices; hence the measures are really a representation of income potential for a newly initiated position. Hence, for an investor with an existing position, standard measures of income return merely do any justice. For a fair evaluation of income returns from real estate, due importance must be given to capital expenditure and depreciation as they take a big bite out of the actual dollar income of investors. Exhibit 2 shows that if cap-ex is considered, real estate income returns do not surpass the dividend yields from equities. Comparing exhibit 1 and 2 we can clearly understand the role of capital expenditure in measuring property investment performance. Similarly, depreciation also affects both, the returns from, and pricing of real estate assets.

For cap-ex and depreciation to receive their due importance, possibly the biggest challenge will be breaking the myth that NOI is a stable source of income; in reality it is very volatile and depends largely upon property types, market locations and economic cycles. Exhibit 3 does justice in showing this volatility of NOI. Considering that actual dollar income is most worthwhile to investors, it is safe to conclude that anything that affects NOI will be very important to the investors.

This white paper considers capital expenditure as one of the most important factors contributing to the volatility of the NOI. Hence, it will make an effort to study this topic in depth starting with an overview of cap-ex.
CHAPTER 3: A Brief Overview of Capex

Capital expenditure is defined as the cost incurred by property investors/owners to lease or upgrade their real estate assets. It can be divided into two main categories as shown below:

- **Leasing Costs**
  - Tenant build outs or improvement expenditures
  - Leasing commissions to brokers

- **Property Improvements**
  - Major repairs
  - Replacement of major equipment (e.g., HVAC, elevators)
  - Major remodeling of building, grounds, and fixtures
  - Expansion of rentable area

Exhibit 5: Cap-Ex Components as per Property Type

Source: Hines Research

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This list of cap-ex components is not exhaustive, yet this area does not receive the attention it deserves within the real estate industry. Industry professionals have downplayed its significance and there is no strategy in place to counter the effects of capital expenditure on NOI. It is more appropriate to take the view that the amount of capital that owners need to reinvest in their properties over long periods of time is systematically underestimated throughout the real estate industry.

As defined above, capital expenditure comprises of costs associated with property improvements and leasing. Now, it is only logical to assume that both renewal probability and lease duration will affect capital expenditure and provide a good starting point for this paper. If lease duration is short, the corresponding capital expenditure associated with leasing costs will be higher due to higher frequency of leasing. Similarly, if renewal probabilities are low, more capital expenditure associated with property improvements will be required to attract and cater to the demands of new tenants.

1. Renewal Probability

**All leases do not get renewed and Capital Expenditure required for upgrading existing properties is a necessity, not a luxury.**

Exhibits 6, 7 and 8 give a broad overview of the renewal probabilities as per tenant industry, as per tenant size and as per the length of lease\(^{10}\).

It is very evident that neither industry, nor any size of tenant, nor any length of lease has a 100% renewal probability.

Note: For simplicity of interpretation and accuracy reasons, all information for global cities is segregated from US Cities. Primary reason being all the US data is received from NCREIF sources and all the Global data is received from IPD.

\(^{10}\) Hines Research 2014
This probability varies in between 54% to 67% for different industries, but what is notable is that on an average at least 40% tenants do not renew their leases.

Results for renewal probability as per tenant size revealed that tenants occupying more than 50,000 square feet of space have a higher probability of renewing their leases\(^\text{11}\).

![Exhibit 7: Renewal Probability by Tenant Size](image)

One reason for this might be the issue of space availability for large space occupiers. Although these occupiers have a higher renewal probability, results do not show 100% renewal probability for even the largest space occupiers.

**Takeaway #1** - Larger Tenants actually do have retention probabilities in line with underwriting expectations.

Finally, it was noticed that length of the lease has an inverse relation with the renewal probability. While small term leases have a higher probability of renewal, retention for small term leases stands at 70%. This translates into a need for allocation of capital expenditure reserves for property owners and investors. These reserves are required to cover costs related to tenant improvements and

\(^{11}\) Kirby, Mike, and Peter Rothemund. "Sector Allocation - Special Report." *Green State Advisors* (2011)
customization of space as per the needs of the new tenant\textsuperscript{12}. 

Source: Hines Research.

Upgradation of existing properties will enable them to compete with other newer properties in the market place. At times this reserve can also be used for providing free rent for a limited time in order to attract new tenants.

| Takeaway # 2 – Smaller lease lengths do have retention probabilities in line with underwriting expectations. |

2. Lease Duration

\textit{Higher frequency of leasing comes at a price}

As discussed above, length of lease is inversely proportional to renewal probability. This might tempt investors to have shorter lease durations but like anything else, this option comes at a price - leasing commissions. Higher leasing frequency increases transaction costs and broker commissions substantially.

Average lease terms vary according to market locations; exhibits 9 and 10 provide an overview of lease duration for office spaces in US and global cities. In theory, market locations with longer lease durations should have lower capital expenditure requirements. High barrier markets such as New York and London show evidence of longer lease durations and should technically account for lower cap-ex\textsuperscript{13}. However, further results showing cap-ex as a percentage of NOI for different market places will prove whether high barrier markets in general provide superior cap-ex/NOI growth profile compared to low barrier markets.

\textsuperscript{12} Baum, Anita, and Anita McElhinney. "The Causes and Effects of Depreciation in Office Buildings: A Ten Year Update."

\textsuperscript{13} Hines Research 2014
Takeaway #3 – Short-term leases substantially increase capital expenditure costs

Finally, both lease duration and renewal probabilities differ as per market location and as per property type\textsuperscript{14}. Hence, their direct co-relation to systematic categorization of capital expenditure

cannot be undermined. Primary emphasis on lease duration and lease renewal probabilities should be directed towards categorizing capital expenditure as per property types and market locations.

3. Capital expenditure as per market location

A further categorization of capital expenditure as per market type was necessary due to various reasons. Firstly, leasing costs are not identical across cities - costs in cities like New York are very different from costs in Tampa\textsuperscript{15}. Secondly, costs associated with property improvements are also partly dependent on local labor and material costs\textsuperscript{16}. Finally, this categorization was necessary to validate the hypothesis that capital expenditure in high barrier markets is lower than capital expenditure in low barrier markets.

Exhibit 11: Cap-ex as % of NOI – US Cities

It was found that the best markets have the lowest capital expenditure needs as a percentage of NOI because buildings in those locations tend to have longer and economically useful lives\textsuperscript{17}. Land (as a % of total value) is the biggest driver of the capital expenditure spread between the best and worst markets\textsuperscript{18}. Land in high-barrier markets is typically supply-constrained. Thus, land acts as a "store of value" for buildings in these markets (i.e. greater % of the investment is land) and this also extends the economic life of a building’s “shell”. High barrier markets also benefit from lower leasing costs as a percentage of NOI.

Source: Hines Research

\textsuperscript{15} Salway, Francis. "Depreciation of Commercial Property." \textit{College of Estate Management}


\textsuperscript{17} Crosby, Neil, Steven Devaney, and Vicki Law. "Benchmarking and Valuation Issues in Measuring Depreciation for European Office Markets." \textit{Journal of European Real Estate} 4.1 (2011)

Hence, high barrier markets have consistently outperformed low barrier markets. However, cap rate spreads between high barrier and low barrier markets are very tight and do not reflect this difference in superior capital expenditure to long-term NOI growth profile. For e.g. in New York cap-ex accounts for only 20% of NOI; on the other hand in Dallas it accounts for almost 50% of NOI, however, their cap rates do not reflect this significant difference.

Conclusively, it can be stated that: greater barriers to entry = longer useful life = better long-term growth.


Low Barrier Markets: Dallas, Atlanta, Tampa, Oslo and Cape Town.

There was significant variance across global cities, but in general high barrier markets fared better than suburbs.

Takeaway #4 – High barrier markets in general are a better bet compared to low barrier markets.

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 Kirby, Mike, and Peter Rothemund. "Sector Allocation - Special Report." Green State Advisors (2011)
4. Capital expenditure as per property type

Real estate properties comprise of various asset classes such as offices, retail, residential and industrial; it is important to realize that capital expenditure requirements (both leasing costs as well as tenant improvement costs) also vary according to the property type. While in an office building almost all tenants require improvements in the space they want to lease, this might not be the case in residential properties.

A review of cap-ex for different property types will help identify variances in NOI growth rates that are likely to persist and set better "betting lines" on cap rates.
It is clear through Exhibit 14 that the trend for cap-ex as a percentage of NOI remains fairly constant across US and global cities. Exhibit 15 further shows conversion of NOI to cash for different property types in US cities. A direct co-relation exists between capital expenditure and systematic overpricing. If no one understands the issue, it is likely that it's not reflected properly in valuations.
1. Office

Traditionally office properties are considered efficient cash flow generators and their cap rates have always reflected this story\(^20\). However, results from Exhibit 13 indicate that office properties are capital intensive and that they have been less efficient cash flow generators. They consume more than 35% of NOI, a number significantly higher than the assumed 20% that is used as a rule of thumb for valuation purposes. This paper believes that office cap rates are inexplicably low considering the sector’s low growth history and high cap-ex requirements. Also, CBD offices offer a superior combination of NOI growth and capital expenditure in comparison to suburban offices\(^21\). Given this, the cap rate spreads between CBD and suburban office markets should be larger than what they currently are. There is an immediate need to correct the prevailing office cap rates for both US as well as global cities to reflect these cap-ex results. However, investing in High Barrier markets, which have far lower capital expenditure needs than Low Barrier markets, may help mitigate this to an extent\(^22\).

**Takeaway # 5 - Office Properties have been less efficient cash flow generators.**

2. Residential and Retail

For US cities residential cap-ex accounts for 23% of NOI and for global cities it accounts for only 14%. Malls and apartments consistently offer a superior combination of NOI growth and capital expenditure. They have increased long-term growth projections and relatively lower cap-ex\(^23\). Hence, apartment and mall cap rates should be much lower than has historically been the case.

**Takeaway # 6 - Residential and Retail have been most efficient at turning NOI into cash. However, the question remains - do investors fully appreciate grade A malls and apartments?**

3. Industrial and Hotels

Industrial properties and hotels reflect lower long-term growth projections in their cap rates due to higher capital expenditure requirements. Capital expenditure for hotels consumes as much as 40% of the NOI, and makes it the most capital-intensive asset class\(^24\). Cap rates typically account for high capital expenditure as hotels are usually considered a capital-intensive industry.

**Takeaway # 7 - Cap rates for hotel and industrial properties are correctly adjusted considering their capital expenditure requirements.**


\(^{22}\) Kirby, Mike, and Peter Rothemund. "Sector Allocation - Special Report." *Green State Advisors* (2011)


\(^{24}\) Hines Research
CHAPTER 4: Methodology

Part 1: Understanding the Future Implications of Capital Expenditure Spending

To make an informed decision about capital expenditures it is important to understand how a property behaves over time. This exercise brings clarity to questions such as: Do cap-ex spends imply that if you spend on your asset today you will indeed spend less in the future? Or does it guarantee a reduced capital expenditure budget in the future?

To answer these questions this thesis uses contingency tables to understand how properties with cap-ex spending behave over time. For these analyses NCREIF data was used and as of now the analyses are based only on office properties.

1. We only selected properties that were in the NCREIF database for the entire time period of 2005-2014.
2. We divided the data into three time zones 2005-2008, 2009-2011 and 2012 to 2014.
3. All the quarters that the asset was in the NCREIF database were aggregated to obtain cumulative cap-ex for each unique property id.
4. Market value was calculated by dividing the MVLag1 by the cap rate.
5. All the properties with negative cap-ex values and properties having more than 20% cap-ex as a percentage of Market Value were dropped.
6. All the properties with major renovations and remodeling work were also dropped.
7. Capital expenditure was divided by the MV to obtain a percentage to understand CEV (Capital expenditure to Market Value)
8. Finally there were a total 310 properties that were used in the analyses.
9. These properties were then classified in to four main categories; Top halves and Bottom Halves and top quartiles and bottom quartiles.
10. The rationale was to then track the properties which were in top quartile or bottom quartile of capex spends and see how they behaved over time; whether they remained in the same quartile they started in 2005-2008 period or changed substantially post the cap-ex spends.
11. Chi squared test was used to understand if the null hypothesis is true or in other words to understand if there was any co-relation in the data results that were found.
12. Finally the entire test was repeated with only non-leasing capital expenditures to understand if there was any difference in the results. In this, the leasing expenses as given in the NCREIF database were removed while considering cumulative capital expenditure for a property.
Part 2: Understanding the co-relation between property characteristics and capex

This section of the thesis attempts to understand the co-relation between different property characteristics such as age, sq. ft., location, NOI, cap rate and Market Value with capex. This would help us understand which property characteristics contribute towards higher capex spends and vice versa. The methodology is outlined below:

1. The thesis only used NCREIF office properties for these analyses.
2. All the quarters that the asset was in the NCREIF database were aggregated to obtain cumulative cap-ex for each unique property id.
3. Market value was calculated by dividing the MVLag1 by the cap rate.
4. All the properties with negative cap-ex values and properties having more than 20% cap-ex as a percentage of Market Value were dropped.
5. All the properties with major renovations and remodeling work were also dropped.
6. Age of the properties was calculated as (current year) – (the year property of built).
7. Average NOI and average cap rates for each property were calculated based upon their holding periods.
8. To understand how location affects capex the thesis categorized all properties in the top six markets in a different set. The top six markets include New York, Washington DC, Los Angeles, San Francisco, Chicago and Boston.
9. Change in market value was calculated as (end market value) – (market value at the beginning).
10. Regression analyses were performed holding capex on one side of the equation and all the property characteristics on the other side.
11. Regression equation used: \( \ln \text{Capex} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + E \) where the betas are all the different property characteristics.
12. There were a total of four different regressions performed:
   a. Regress lnCumulativeCapex lnsqft Incaprate Age AgeSq lnAvgNOI lnChangeMV Location (Top Six).
   b. Regress lnCumulativeCapex/sqft lnsqft Incaprate/sqft Age AgeSq lnAvgNOI/sqft lnChangeMV/sqft Location (Top Six).
   c. Regress lnCumulativeCapex\_ti lnsqft Incaprate Age AgeSq lnAvgNOI lnChangeMV Location (Top Six). In this analyses the leasing costs were dropped and only tenant improvements were used to calculate cumulative capex.
   d. Regress lnCumulativeCapex\_ti/sqft lnsqft Incaprate/sqft Age AgeSq lnAvgNOI/sqft lnChangeMV/sqft Location (Top Six).
13. Finally after interpreting the results and understanding the relationship of property characteristics with capex bin scatter plots were created to facilitate better understanding.
CHAPTER 5: Results

Part 1: Hypothesis

When these analyses were undertaken the hypothesis was that relatively high (low) capex spends should have an impact on future capex spends. If a property owner incurs higher capex spends in an early period, theoretically he will save costs in the future and if he spends less in the early period he might incur higher costs in the future. Owner’s trend of spending high (low) will not always remain constant throughout the holding period of the property.

All properties that were in the top (bottom) quartiles for capex spends in 2005-2008 period were compared to their status in both 2009-2011 and 2012-2014 period to see if their capex spends changed considerably or whether they remained in their respective top (bottom) quartiles. Similarly properties in top (bottom) quartiles in 2009-2011 period were compared to their status in the 2012-2014 period. Along with tracking properties in the top (bottom) quartiles, a similar comparison was undertaken to see how properties in top (bottom) halves behaved over time.

Exhibit 16: Contingency table comparing 2005-2008 period to 2009-2011 period

<table>
<thead>
<tr>
<th>Quartiles 05-08:09-11</th>
<th>Top</th>
<th>Bottom</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td>37</td>
<td>17</td>
<td>54</td>
</tr>
<tr>
<td>Bottom</td>
<td>13</td>
<td>25</td>
<td>38</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>42</td>
<td>92</td>
</tr>
</tbody>
</table>

\[ E= 23 \]

\[ \text{Chi-square (1df): } 14.6087 \]

\[ p= 0.000132 \]

While comparing the top (bottom) quartile properties in 2005-2008 to 2009-2011 period the chi-squared statistic is 14.607 and the p-value is 0.045. This suggests that the p value is smaller than the conventionally accepted significance level of 0.05. This implies that there is a significant difference and we can reject the null hypothesis with 85% confidence.
Exhibit 17: Contingency table comparing 2005-2008 period to 2012-2014 period

<table>
<thead>
<tr>
<th>Quartiles 05-08:12-14</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Top</td>
<td>Bottom</td>
</tr>
<tr>
<td>Top</td>
<td>35</td>
<td>19</td>
</tr>
<tr>
<td>Bottom</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>44</td>
</tr>
</tbody>
</table>

\[ E = 23 \quad \text{Chi-square (1df): } 11.47826 \quad 0.000704 \]

While comparing the top (bottom) quartile properties in 2005-2008 to 2012-2014 period the chi-squared statistic is 11.478 and the p-value is 0.000. This suggests that the p value is smaller than the conventionally accepted significance level of 0.05. This implies that there is a significant difference and we can reject the null hypothesis with 88% confidence.

Exhibit 18: Contingency table comparing 2009-2011 to 2012-2014 period

<table>
<thead>
<tr>
<th>Quartiles 09-11:12-14</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Top</td>
<td>Bottom</td>
</tr>
<tr>
<td>Top</td>
<td>40</td>
<td>11</td>
</tr>
<tr>
<td>Bottom</td>
<td>13</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
<td>41</td>
</tr>
</tbody>
</table>

\[ E = 23.5 \quad \text{Chi-square (1df): } 24.7234 \quad 6.62E-07 \]

While comparing the top (bottom) quartile properties in 2009-2011 period to 2012-2014 period the chi-squared statistic is 24.723 and the p-value is 0.000. This suggests that the p value is smaller than the conventionally accepted significance level of 0.05. This implies that there is a significant difference and we can reject the null hypothesis with 75% confidence.

As we can see the results are statistically very strong that relatively high (low) capex in an early period is associated with still again relatively high (low) capex in a later period, either the next adjacent period in time or the one after.

<table>
<thead>
<tr>
<th>Halfes 05-08:09-11</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td>88</td>
<td>67</td>
<td>155</td>
</tr>
<tr>
<td>Bottom</td>
<td>67</td>
<td>88</td>
<td>155</td>
</tr>
<tr>
<td>Total</td>
<td>155</td>
<td>155</td>
<td>310</td>
</tr>
</tbody>
</table>

\[ E = 77.5 \]

\[ P = 0.017059 \]

\[ \text{Chi-square (1df): } 5.690323 \]

\[ 1.422581 \quad 1.422581 \]

\[ 1.422581 \quad 1.422581 \]

<table>
<thead>
<tr>
<th>Halfes 09-11:12-14</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td>90</td>
<td>65</td>
<td>155</td>
</tr>
<tr>
<td>Bottom</td>
<td>65</td>
<td>90</td>
<td>155</td>
</tr>
<tr>
<td>Total</td>
<td>155</td>
<td>155</td>
<td>310</td>
</tr>
</tbody>
</table>

\[ E = 77.5 \]

\[ P = 0.004514 \]

\[ \text{Chi-square (1df): } 8.064516 \]

\[ 2.016129 \quad 2.016129 \]

\[ 2.016129 \quad 2.016129 \]

Similarly the results observed while comparing top (bottom) of different time periods is was observed that results are statistically very strong that relatively high (low) capex in an early period is associated with still relatively high (low) capex in a later period, either the next adjacent period in time or the one after.
Part 2: Understanding the co-relation between Capex and Property Characteristics

a. Regression analyses with log of cumulative capex and property characteristics such as sq. ft., age, age square, cap rate, change in market value, log of average NOI and location which considers top six markets.

Exhibit 20: Regression analyses: Cumulative Capex with property characteristics

<table>
<thead>
<tr>
<th></th>
<th>InCumCapex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insqft</td>
<td>0.6403</td>
</tr>
<tr>
<td>lnCaprate</td>
<td>-1.0931</td>
</tr>
<tr>
<td>Age</td>
<td>0.0117</td>
</tr>
<tr>
<td>AgeSq</td>
<td>-0.0000</td>
</tr>
<tr>
<td>InChangeMV</td>
<td>0.4909</td>
</tr>
<tr>
<td>lnAvgNOI</td>
<td>0.7894</td>
</tr>
<tr>
<td>TopSix</td>
<td>-0.2104</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.0822</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.38</td>
</tr>
<tr>
<td>$N$</td>
<td>1977</td>
</tr>
</tbody>
</table>

* $p<0.05$; ** $p<0.01$

The results clearly show us that sq. ft., age, NOI and market value have a positive co-relation with cumulative capex and that age square, location and cap rate have a negative co-relation with capex. Intuitively, it makes sense that buildings with higher sq. ft. will require more capex and older buildings will also require more capex. However, it is counter-intuitive to see that buildings with high cap rates will require lower capex spends. The reason behind this may be that investors don’t see the value of spending more on higher cap rate buildings, as they may believe that cap rate is more a function of location, product type and other features and not capex. They must believe that even after spending more capex the cap rates are not going to get compressed significantly.

On the other hand, when investors buy buildings at a lower cap rate they already believe that there is potential demand for the building and hence they make capex spends to fully realize the value of the building and maybe charge a premium for the spent capex. We also see that if a property is located in one of the top six markets, owners don’t spend much on capex. This may
be due to the fact that the location has a premium and hence owners are in a position to command higher rents even without spending money for the upkeep of their property. Finally, we see a negative co-relation with age square; this may be due to the fact that older properties have smaller value component in the structure as more value rests in the land; and only the structure component needs capex. It is concave function over age.

b. Regression analyses with log of cumulative capex per sq. ft. with property characteristics such as sq. ft., age, age square, cap rate per sq. ft., change in market value per sq. ft., log of average NOI per sq. ft. and location which considers top six markets.

Exhibit 21: Regression analyses: Cumulative Capex per sqft with property characteristics

<table>
<thead>
<tr>
<th></th>
<th>InCumCapexsqft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lnsqft</td>
<td>-1.0322</td>
</tr>
<tr>
<td>Incapratesqft</td>
<td>-1.0931</td>
</tr>
<tr>
<td>Age</td>
<td>0.0117</td>
</tr>
<tr>
<td>AgeSq</td>
<td>-0.0000</td>
</tr>
<tr>
<td>InAvgNOIsqft</td>
<td>0.7894</td>
</tr>
<tr>
<td>InChangeMVsqft</td>
<td>0.4909</td>
</tr>
<tr>
<td>TopSix</td>
<td>-0.2104</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.0822</td>
</tr>
<tr>
<td>R²</td>
<td>0.19</td>
</tr>
<tr>
<td>N</td>
<td>1,977</td>
</tr>
</tbody>
</table>

* p<0.05; ** p<0.01

The results show us that age, NOI and market value have a positive co-relation with cumulative capex per sq. ft. and age square, location, sq. ft. and cap rate have a negative co-relation with capex. It makes intuitive sense that older buildings will also require more capex. Also, we can understand the negative co-relation between sq. ft. and capex per sq. ft. in this case, a major reason might be the economies of scale. As seen in earlier results it is true that buildings with a larger foot print or higher sq. ft. will require more capex in totality but if we were to compare this on a per square feet basis, they might need lower capex spends per sq. ft.
Apart from this one difference in the result the other property characteristics have a similar correlation on a per sq. ft. basis as seen in the results for cumulative capex. It is safe to assume the same reasoning behind these results as described in the results for cumulative capex.

c. Regression analyses with log of cumulative capex excluding the leasing costs with property characteristics such as sq. ft., age, age square, cap rate, change in market value, log of average NOI and location which considers top six markets.

Exhibit 22: Regression analyses: Cumulative Capex with only tenant improvements with property characteristics

<table>
<thead>
<tr>
<th></th>
<th>lnCumCapex_ti</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insqft</td>
<td>0.5012</td>
</tr>
<tr>
<td></td>
<td>(5.05)**</td>
</tr>
<tr>
<td>Incaprate</td>
<td>-0.9817</td>
</tr>
<tr>
<td></td>
<td>(5.27)**</td>
</tr>
<tr>
<td>Age</td>
<td>0.0025</td>
</tr>
<tr>
<td></td>
<td>(1.01)</td>
</tr>
<tr>
<td>AgeSq</td>
<td>-0.0000</td>
</tr>
<tr>
<td></td>
<td>(1.02)</td>
</tr>
<tr>
<td>lnAvgNOI</td>
<td>0.8641</td>
</tr>
<tr>
<td></td>
<td>(4.50)**</td>
</tr>
<tr>
<td>lnChangeMV</td>
<td>0.4258</td>
</tr>
<tr>
<td></td>
<td>(11.94)**</td>
</tr>
<tr>
<td>TopSix</td>
<td>-0.1008</td>
</tr>
<tr>
<td></td>
<td>(1.09)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.6435</td>
</tr>
<tr>
<td></td>
<td>(0.88)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.26</td>
</tr>
<tr>
<td>$N$</td>
<td>1,695</td>
</tr>
</tbody>
</table>

* $p<0.05$; ** $p<0.01$

In this analyses leasing costs were dropped on a purpose. Leasing costs is not an indication of true capex as leasing costs mainly depend upon the macro economy of the market and location of the property. Hence, to validate the result for cumulative capex this set of regression was performed but with only tenant improvements classified as capex in this instance.

These results validated the earlier ones and capex (only tenant improvements) in these results have an exact same co-relation with property characteristics as we saw in the results for cumulative capex. The results show that sq. ft., age, NOI and market value have a positive co-relation with cumulative capex and age square, location and cap rate have a negative co-relation.
with capex. It makes intuitive sense that buildings with higher sq.ft. will require more capex and older buildings will also require more capex.

d. Regression analyses with log of cumulative capex per sq. ft. with property characteristics such as sq. ft., age, age square, cap rate per sq. ft., change in market value per sq. ft, log of average NOI per sq. ft. and location which considers top six markets..

Exhibit 23: Regression analyses: Cumulative Capex only tenant improvements per square feet with property characteristics

<table>
<thead>
<tr>
<th></th>
<th>InCumCapex_tisqft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insqft</td>
<td>-1.0580</td>
</tr>
<tr>
<td></td>
<td>(5.46)**</td>
</tr>
<tr>
<td>Incapratesqft</td>
<td>-0.9817</td>
</tr>
<tr>
<td></td>
<td>(5.27)**</td>
</tr>
<tr>
<td>Age</td>
<td>0.0025</td>
</tr>
<tr>
<td></td>
<td>(1.01)</td>
</tr>
<tr>
<td>AgeSq</td>
<td>-0.0000</td>
</tr>
<tr>
<td></td>
<td>(1.02)</td>
</tr>
<tr>
<td>InAvgNOIsqft</td>
<td>0.8641</td>
</tr>
<tr>
<td></td>
<td>(4.50)**</td>
</tr>
<tr>
<td>InChangeMVsqft</td>
<td>0.4258</td>
</tr>
<tr>
<td></td>
<td>(11.94)**</td>
</tr>
<tr>
<td>TopSix</td>
<td>-0.1008</td>
</tr>
<tr>
<td></td>
<td>(1.09)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.6435</td>
</tr>
<tr>
<td></td>
<td>(0.88)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.11</td>
</tr>
<tr>
<td>$N$</td>
<td>1,695</td>
</tr>
</tbody>
</table>

* $p<0.05$; ** $p<0.01$

In these analyses leasing costs were dropped on purpose. Leasing costs are not an indication of true capex as they mainly depend upon the macro economy of the market and location of the property. Hence, to validate the results for capex per sq. ft. analyses this set of similar regressions was performed, but with only tenant improvements classified as capex in this instance. The results show us that age, NOI and market value have a positive co-relation with cumulative capex per sq. ft. and age square, location, sq. ft. and cap rate have a negative co-relation with capex.

These results validated the earlier ones for capex per square feet. Capex (only tenant improvements) in these results have the same co-relation with property characteristics seen in the results for cumulative capex per sq. ft.
CHAPTER 6: Conclusions

Part 1

The results imply that present or past capex spends do not have a significant influence over future capex spends. Hence, it is safe to speculate that property characteristics, location and other parameters have a much stronger influence over capital expenditures. Another possibility could be that NCREIF members over spend on capex, because they are less incentivized to maximize profit than REITs are. REIT managers gain when REIT share prices rise, which is when REIT stockholders perceive that the REIT managers are maximizing property value. In contrast, NCREIF members are managing other people's money and they don't necessarily make more money themselves when they maximize property value, and indulging in excess capex may be a "lazy man's" way to do asset management. However, this is just a speculation but the second part of this thesis will analyze the property characteristics which have a strong influence over capex spends.

Part 2

The co-relation between property characteristics and capex has been outlined in depth in the results section of the thesis along with the reasoning behind the results. In this section of the thesis various self-explanatory graphs based on the results have been plotted to summarize the co-relation between property characteristics and capex.

Exhibit 24: Relationship between Sqft and Cumulative Capex
Exhibit 25: Relationship between Cap Rate and Cumulative Capex

Exhibit 26: Relationship between Age and Cumulative Capex

Exhibit 27: Relationship between Age square and Cumulative Capex
Exhibit 28: Relationship between Change in Market Value and Cumulative Capex

Exhibit 29: Relationship between Average NOI and Cumulative Capex
Exhibit 30: Relationship between Location (top six markets) and cumulative capex

Exhibit 31: Relationship between Sqft and Cumulative Capex per sqft
8. Bibliography


Salway, Francis. "Depreciation of Commercial Property." *College of Estate Management*


