Mispricing Income Growth: Exploring Inefficiencies in Commercial Real Estate Pricing

by

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ABSTRACT

This paper is an investigation into the relationship between real estate capitalization rates and income growth. The paper includes a cross-sectional analysis of approximately 25 markets in the United States. The paper analyzes apartment and office markets separately, for two different periods of time. Multi-variable regression techniques are used to explore the relationships between cap rates in different markets and rent growth, appreciation, and employment growth, as well as Liquidity and Supply Constraint factors.

For this analysis, periods of time were chosen ranging from 1996 to 2002 so that subsequent rental growth, appreciation, and employment growth data was available. With this information, future growth of these variables is back tested. The results of the regressions are then compared to the theoretical relationships that should exist between cap rates and future income growth and appreciation. The results show that market pricing does not accurately price future income growth in a consistent manner. This provides significant evidence that the real estate capital market is inefficient in its pricing of assets in different markets based on the future rental behavior in individual markets.

The last aspect of the thesis is the development of an investment strategy that capitalizes on the inefficiencies discovered in the analysis. The strategy enables the investor to make investments that should demonstrate superior risk-adjusted returns based on the space market fundamentals in individual markets.

Thesis Supervisor: William Wheaton
Title: Professor of Economics

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Introduction

The term "capitalization rate" is defined as a properties' net operating income divided by its value. This term is widely used by the commercial real estate investment community as a way to measure the relationship between a property's value and its current income. The capitalization or 'cap' rate has been the subject of a significant amount of both academic and industry research. This study will investigate causes for cap rate variation across markets, known as a cross-sectional analysis.

The impetus of this study is the apparent inconsistency between the theoretical relationship between cap rates and future income growth and the empirical evidence of market pricing and cap rates based on sales data. This study will focus on data from two periods of time for two different property types. The dates have been selected so that subsequent rental growth data is available ex-post for an extended period of time following the years being studied. This study will analyze office cap rates across approximately 25 markets in the years of 1996 and 2001 as well as apartment cap rates across approximately 25 markets in the years 1998 and 2002. The years studied have been chosen due to limitations of existing data and have been selected to provide the best possible opportunity to study as many markets as possible in the United States, given the data available.

The main focus of the study will be to attempt to gain a better understanding of which local market factors the market is using to price real estate assets. The study will focus on both historical as well as ex-post future changes and variation of rent growth, employment growth, and asset appreciation as well as other factors including liquidity and a supply constraint factor assessment. The results of the regressions will be compared to the theoretical relationships that should exist based on finance and investment theory. An attempt will also be made to assess the apparent 'efficiency' of the real estate market, and, more specifically, whether or not the market is accurately pricing future rent growth. It should be noted that this analysis is exclusively a cross-sectional analysis and no study of time series effects has been included. In addition to an assessment of the market's ability to price future income growth, the paper will also

attempt to determine if there are any investment strategies that may be developed to capitalize on the inefficiencies discovered in this study.

Relevant Financial Theory

Commercial real estate is one asset class amongst many that investors have to choose from. For this reason, real estate investments must compete with other investment types for capital and thus function within the greater capital market. It is the capital market that determines real estate asset pricing. One of the fundamental principles of the integrated capital market is the relationship between risk and expected return. The riskier an investment is, the higher the expected return must be to compensate the investor for the risk. The market's perception of the riskiness of an asset will dictate the market's required expected return, otherwise known as the discount rate, which is applied to the expected future cash flows.

The discount rate (shown as i in the equation below) is comprised of two components – the risk-free rate plus a risk-premium.

$$\text{Discount Rate}=i=\text{Risk-Free rate }+\text{alpha }*\text{Risk Premium}=i_f+\alpha * R_P$$

Modern investment and finance theory uses discounted cash flow models to develop asset pricing models. This methodology is widely used in the capital markets for all asset types, including real estate. The following mathematical derivation illustrates the theory behind real estate market value and its components based on discounted cash flow methodology.

Exhibit 1 - Discounted Cash Flow Model Derivation of Real Estate Pricing

$$(1) P = \int_0^T r_0 e^{-(i-g)t} dt = r_0 e^{-(i-g)t} * \left(\frac{-1}{i-g}\right)\Big|_0^T$$

$$(2) = \frac{-r_0}{i-g} * (e^{-(i-g)T} - 1)$$

$$Therefore, as T \to \infty$$

$$(3) P = \frac{r_0}{i-g}$$

P=Price, r_0=income at time zero, i=discount rate, g=future annual income growth, T=Time

This equation can be reorganized to show that

$$(4) i = \frac{r_0}{P} + g \to \frac{r_0}{P} = i - g$$

$$(5) \frac{r_0}{P} = i_f + \alpha * r_p - g$$

This form of the equation shows that the discount rate or expected return is a function of the current yield plus the expected future income growth. This equation is instructive because it highlights the two most important theoretical causes for variations amongst cap rates across different markets. One is that different markets are perceived as being 'riskier' than others and thus require a higher discount rate. The other potential theoretical reason is that the expected future cash flow growth is different, which would also justify significant differences in cap rates. The intent of this paper is to explore these two theoretical causes for cap rate variation based on the market data available and attempt to asses to what degree the market pricing behavior is consistent with the theoretical models.

It should also be noted that the convention in the real estate world is to look at cap rates, not cash flow yield. This convention is slightly different than other investment classes and the more generic investment world. The relationship between cap rates and cash flow yield is that the cap rate uses the income of a property before any costs are

subtracted for Capital Expenditures, Leasing Commissions or Tenant Improvement Expenses. This distinction would be very important if we were comparing real estate multiples to other investment types. However because this study is a cross sectional study of real estate cap rates, the definition is the same across all of the study markets and the assumption has been made that the level of cap ex, leasing costs, and TI are going to vary but in a random way across properties and markets and thus should not bias the results of this study. It is important to note and understand this distinction, but it will not be focused on for the remainder of the study.

The other pertinent financial theory that is relevant to this paper is the concept of asset specific risk. This paper is based on an assumption that the capital market is pricing asset specific risk and volatility. This assumption conflicts with the CAPM theory which suggests that the market only prices an asset's Beta, which is its market risk. The CAPM theory would suggest that idiosyncratic risk of individual assets can be diversified away, and therefore is not considered in asset pricing models. A sound CAPM model for Real Estate valuation has not been proven however. The author of this paper believes that idiosyncratic risk is considered in commercial real estate pricing. While this concept is not the topic for this paper, it is important to note that the paper is based on the assumption that the market prices individual asset specific risk, not Beta.

As discussed previously, the intent of this paper is to explore differences in cap rates across markets and compare the findings to the theoretical model. The financial theory would suggest that differences in cap rates should be caused by differences in future income growth or perceived 'risk' of a market. This paper focuses on these variables, but also tests several other factors that the market could potentially be using to price assets. The variables which have been tested are explained in greater detail in the Methodology section of this paper.

Literature Review

To date the cap rate research can be categorized in three broad categories 1) studies of chronological variation of cap rates, 2) studies of variation in cap rates across product types, 3) studies of variation in cap rates across different geographical markets. A majority of the research has focused on the first two categories and has uncovered important results.[1] This thesis is a cross-sectional analysis and falls under the third category, however, previous research in this area and on related topics forms the basis for the current understanding of cap rates that help to shape this study.

The 1999 study by Sivitanidou and Sivitanides helped to demonstrate that both national capital markets as well as local space market factors are important in determining office cap rates.[2] The 1999 paper differed from this analysis significantly however, in that it analyzed both national capital market factors as well as local space market factors such as absorption and vacancy levels. An additional paper written by these authors in 1996 included a cross-sectional analysis of variation in cap rates in office properties.[3] The 1996 paper tested several independent space market variables including total stock, completions, and vacancy rate in each MSA during the years tested. This study differs from the 1996 study in that this study will test actual subsequent growth of both rent and appreciation to see whether or not the market cap rate is related to subsequent income growth or property appreciation, as theory suggests it should.

While the link between cap rates and capital market factors (as has been researched by Sivitandou and Sivitanides and others) is important, the effects should be consistent across all markets in the United States. In a cross-sectional analysis like this thesis, the capital market factors should not have any relationship to the cross sectional variation

[1] Chichernea, Miller, Fisher, Sklarz and White, *A Cross-Sectional Analysis of Cap Rates by MSA*, March 2007
[2] Sivitanidou and Sivitanides, *Office Capitalization Rate: Real Estate and Capital Market Influences*, 1999
[3] Sivitanidou and Sivitanides, *Office Capitalization Rates: Why do the vary across Metropolitan markets?*, 1996

between cap rates in different markets. For this reason, capital market factors are not included or focused on in this study.

This analysis employs a method of testing similar to that outlined by Shiller and Campbell (1986). While their study was focused on stock market and bond returns, the important conclusion was the idea of using what is called a Wald test to determine whether or not market pricing is correlated to subsequent income behavior.[4] As an example, the 1986 paper suggested that a measure of the efficiency of the market would be if stocks with high price to earnings ratios showed significantly higher subsequent earnings growth compared to stocks with lower price to earnings ratios. This is a way to measure how effectively the market is pricing future income growth. This paper uses the same type of test, by testing actual subsequent local market rent growth and appreciation as independent variables with cap rate as a dependent variable. This is done to determine whether or not the market's pricing in any way accurately reflects future income and value growth.

The study by Yu (2004) compared cap rates across sub-markets within a single MSA market. This study used property level data within the Atlanta market to show that property characteristics as well as market dynamics can be used to accurately predict cap rates for that market. These results are important in increasing the understanding of cap rate determinants and causes for variation.[5] While her results are relevant to this study, this paper represents a cross-sectional analysis that looks at MSA level data, not property level data. While this investigation does not consider specific property level characteristics or differences in the stock within each MSA, it is important to acknowledge that these factors have been shown to impact cap rates. However, since this paper focuses on institutional quality assets and uses data from NCREIF, property specific attributes are less likely to vary as greatly compared to other data sets that incorporate all commercial assets.

[4] Campbell and Shiller, *Cointegration and tests of Present Value Models*, 1986
[5] Yu, The Variation of Capitalization Rates across Submarkets within the Same Metropolitan Area, 2004

The Pai (2006) paper develops an asset pricing model using a three-factor CAPM model. The results of this study were highly significant, but counterintuitive.[6] The study results showed that product type was the most important factor influencing real estate pricing, although market size and property size were also important. While his study did not explicitly look at cap rates, it still provides important insight into the market's pricing of real estate assets. Interestingly, market size, as a proxy for liquidity, showed results opposite of those suggested by the theory. That is to say – larger, more liquid markets required a return premium, compared to other markets. Another surprising result from this study was that larger properties required a high return premium. This is the opposite of the large-cap affect observed in the stock market and captured by the Fama-French model.

Another relevant aspect of the Pai study is the ability to develop an asset pricing model that does not incorporate the local space market factors except for market size. This provides significant support to the theory that the real estate market is an inefficient market that is not accurately pricing assets based on future income streams.

The most recent study related to cap rates is also the most similar to this study. The Chichernea study attempts to investigate the same issue as this paper, but uses a slightly different methodology. Their study uses property level cap rate data from RCA and studies apartments only. The study also uses regression techniques and uses proxies for liquidity, supplied constraint markets, and rent growth.[7] The study found that supplied constraint factor was a significant factor. One factor that the study found not to be significant was the proxy for rent growth. Their study did not look at actual rent growth levels, however, and instead used proxies for rent growth including employment growth and GDP growth, as predicted by other sources. The study used predictions from economy.com as the proxy. While that study is similar to this one, this study will use the Shiller method of testing actual subsequent rental growth. This analysis will clearly demonstrate that the market pricing method is not accurately capturing future income

[6] Arvin Pai, *Stocks are from Mars, Real Estate is from Venus, An Inquiry into the determinates of long-run investment performance*, [missing info]
[7] Chichernea, Miller, Fisher, Sklarz and White, *A Cross-Sectional Analysis of Cap Rates by MSA*, 2007

performance of different markets in the United States. The Chichernea study is still helpful in identifying several factors that the market appears to be using to help price real estate assets.

The intent of this paper is to add to the body of knowledge that already exists in this area of study. This paper uses the knowledge learned from previous research done in the field as a foundation, and expands that knowledge to improve the understanding of real estate capital market pricing and local space market dynamics. By testing subsequent rent growth and appreciation using the Campbell Shiller test, this study is unique and provides important insight into how the real estate capital market has functioned in the past. This study will also provide insight into the efficiency, or lack thereof, of the real estate capital market that will hopefully be important as the real estate capital market continues to evolve and mature.

Data and Methodology

Property Type Selection:

This thesis studies both office and apartment markets. Apartments were chosen because they generally have short contractual leases which allow property income levels to fluctuate based on the market conditions as opposed to embedded leases. The office sector was selected as well, although it does typically have embedded leases which can vary in length of time. Office leases are typically not as long as in industrial or retail properties and office properties are also generally multi-tenant buildings. Neither retail nor industrial properties were included in this study due to the single-tenant nature and long lease structure of many properties of these types.

Date Selection:

Office Properties: The intent of the study was to study two different periods of time for each property type. In addition, the goal was to study whether the market is forward looking or backward looking with regard to income growth, appreciation, or employment growth. One of the difficulties of this analysis is the lack of data in many markets with a significant history. For office markets the time periods used are 1996 and

2001. The 2001 data set is slightly larger than the 1996 analysis because the data allows for more markets to be included, allowing for a more robust analysis.

Apartment Properties: Two different periods of time were used in the study of the apartment market compared to the office market. This was done due to data constraints and a lack of appreciation data from the NCREIF database in many of the secondary markets. The dates selected for the Apartment market were the years 1998 and 2002.

Data:

The two main data sources for this paper were NCREIF and Torto Wheaton Research.

NCREIF

NCREIF property index information was used for both the office and apartment markets. The NCREIF index consists of institutional quality assets that are owned by NCREIF members. The data was used both to estimate MSA level cap rates in each year that was being studied, as well as for appreciation performance over time.

Torto Wheaton

Additional data was provided by Torto Wheaton Research. Data used in this study included the Torto Wheaton Rent Index for both apartments and office properties, as well as employment levels and 2006 office inventory.

Malpezzi Index

Professor Stephen Malpezzi from the University of Wisconsin developed an index which estimates the degree to which a market is supply-constrained. This is important because overbuilding is one of the major causes of real estate risk. The Malpezzi index is important in that it enables us to help control for this risk and asses whether or not the capital market is pricing the fact that a market is 'supply constrained' or not. This paper uses the updated 1998 version of the index, which is the instrumental variables version of the original index.

Methodology

As mentioned previously, this paper employs the Shiller Test to see whether or not the market is accurately predicting future rent and if this is influencing pricing. To conduct this test, several multi-variable regressions were run for each property type and each year. Due to data constraints, the study analyzes approximately 25 MSA markets in each year. Each regression has been run with cap rate as the dependent variable and several independent variables. Below is a review of each of the variables used in the study and how the variables were calculated.

Cap Rate

The Cap Rate is calculated from the quarterly NCREIF index. For each market, the quarterly income is divided by the beginning market value to get the quarterly cap rate. For each year being studied, the four quarterly cap rates are then averaged for an estimate of the cap rate for that year for that market. This is used as the dependent variable in each of the regressions.

Rent Growth

Theoretical models suggest that the future rent growth should have a significant impact on cap rates. For this study, three different independent variables related to rent growth were tested. The first variable is the average rent growth over the previous five years, the second variable is the average rent growth over the subsequent five years after the time being studied, and the third variable is the standard deviation of the rent growth over the time period for which rent data is available. The three characteristics that are being tested related to rent growth are the same three characteristics that are tested for both appreciation and employment growth (forward looking, backward looking, standard deviation). The reason for testing these factors is to test if the market is backward looking or forward looking in its pricing (as theory suggests it should) or if cap rates appear to have no relation to rent growth. The standard deviation is being tested to represent the risk of the market based on the variation in the market rent.

Appreciation

The variables related to appreciation are much the same as the rent growth variables – backward looking, forward looking, and standard deviation. The appreciation is calculated from the NCREIF property capital index and is calculated on an annual basis as the percentage difference between the index values as of Q1 of each year.

Employment Growth

Employment growth variables are tested in much the same way as rent growth and appreciation. The reason for testing this variable is that employment has been shown to increase the demand for apartments and office space, and thus is potentially being priced by the market. One distinction between the two studies is that for the office study we used the Torto Wheaton office using service employment index. For the apartment study the total employment has been used.

Supply Constraint

The Malpezzi index is used as a proxy for the degree to which the market is supply constrained. It should be noted that the index did not have a value for Washington D.C. because the D.C. market covers several states as well as the District of Columbia. For this study, the average value from the other markets has been applied to the D.C. market in order to not have to remove this market from the study.

Liquidity

The last variable that has been tested is the liquidity of a market. Different variables have been used as a proxy for liquidity in the two studies. For the office analysis, 2006 office stock was used, while 2006 employment was used for the apartment study. These variables are meant to represent the size of the market. Market size is considered to be a proxy for the liquidity of the market and is an important factor in all investment decisions.

Regression Methodology

For this study, several regressions have been run for each year. Due to data limitations each cross-section has approximately 25 observations. Instead of testing all of the

individual variables together, each 'group' of variables (rent growth, appreciation, employment growth) was separately tested, while including the proxies for liquidity and supply constraint in each regression. Each regression has been run for each year that has been studied. For each group of independent variables three regressions were run – one with both variables, and then one each with only one of the trends included.

As mentioned above, each of the variables of Rent Growth, Appreciation, and Employment growth are all being tested in three ways, backward looking, forward looking as well as for the standard deviation over time. One distinction between the office market and apartment market analyses is that the office study uses a five-year average for both the backward-looking history and forward-looking future growth of each variable, while the apartment analysis uses a four year average for each of these variables. The reason for the different time periods is due to data constraints in the apartment data and the desire to include as many markets as possible.

Results

Rent Growth

1996 Office Market – The results of these regressions are quite surprising in that none of the rent growth variables are significant. The combined model has an R-squared of only 17.2%. The most significant variable is the 2006 Inventory (liquidity), but even this variable is insignificant at a 95% confidence interval, although with a t-stat of -1.87 the result is important and shows that the 1996 office market did appear to be pricing liquidity or market size. Interestingly, the future rent variable actually has a positive coefficient, which is the opposite of what the theory suggests, however the variable is insignificant with a t-stat near zero.

Exhibit 2 - 1996 Office Market - Rental Growth Regression Results

1996 Office - Rent Regression with all Rent Variables

Regression Statistics	
Multiple R	0.415454063
R Square	0.172602079
Adjusted R Square	-0.057230677
Standard Error	0.011807951
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.000523544	0.000104709	0.750989902	0.596095991
Residual	18	0.002509699	0.000139428		
Total	23	0.003033243			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.101136383	0.02308865	4.380350597	0.000360812	0.052628929	0.149643837
Rent History	-0.038996067	0.105760262	-0.368721349	0.716636557	-0.261190132	0.183197999
Future Rent	-0.005113519	0.077996762	-0.065560658	0.94845028	-0.168978635	0.158751596
Rent SD	0.003893855	0.100855491	0.038608263	0.9696277	-0.207995668	0.215783379
Supply Constraint	-0.000176408	0.001192664	-0.147911281	0.884057083	-0.002682102	0.002329285
2006 Inventory	-5.08024E-08	2.70498E-08	-1.878104796	0.076665218	-1.07632E-07	6.02717E-09

1996 Office - Rent Regression with Future Rent

Regression Statistics	
Multiple R	0.407863551
R Square	0.166352676
Adjusted R Square	-0.009152023
Standard Error	0.011536338
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000504588	0.000126147	0.947853116	0.458153609
Residual	19	0.002528655	0.000133087		
Total	23	0.003033243			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.099369913	0.022066607	4.503180423	0.000243421	0.053183974	0.145555853
Future Rent	-0.002060441	0.075772015	-0.027192643	0.978589669	-0.160653091	0.156532208
Rent SD	-0.019086563	0.077469623	-0.246374799	0.808034268	-0.181232347	0.143059221
Supply Constraint	-7.98801E-05	0.001136812	-0.070266768	0.944715646	-0.002459254	0.002299494
2006 Inventory	-4.81011E-08	2.54399E-08	-1.890775934	0.074003825	-1.01347E-07	5.14517E-09

1996 Office - Rent Regression with Historic Rent

Regression Statistics	
Multiple R	0.415216215
R Square	0.172404505
Adjusted R Square	-0.001826125
Standard Error	0.011494388
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000522945	0.000130736	0.989518921	0.437039841
Residual	19	0.002510298	0.000132121		
Total	23	0.003033243			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.101861306	0.019730508	5.16262956	5.53585E-05	0.060564877	0.143157734
Rent History	-0.03825998	0.10236999	-0.37374215	0.712734016	-0.252522831	0.176002871
Rent SD	0.003367276	0.09786542	0.03440721	0.972911338	-0.201467401	0.208201953
Supply Constraint	-0.0002299	0.000846806	-0.271490717	0.788941534	-0.002002285	0.001542485
2006 Inventory	-5.09781E-08	2.6202E-08	-1.9455834	0.066651768	-1.05819E-07	3.86323E-09

2001 Office Market - The results of the rental growth regression for the 2001 office data set are somewhat consistent with the results from the 1996 office data in that none of the rent growth variables are significant. The R-squared for the combined regression was 25.6%. For this regression however, the only variable that is significant at all is the supply constraint variable. This variable had a t-stat of -1.88. This result is in line with other research, but inconsistent with the expectation of future rent growth being significant. Also of note is the fact that for this data set the liquidity variable is no longer significant. The one consistency between the two analyses is that again the future rent is not significant, although this time the coefficient is negative, which is consistent with the expectation.

Exhibit 3 - 2001 Office Market- Rental Growth Regression Results

2001 Office - Rent Growth Regression with all Rent Growth Variables

Regression Statistics	
Multiple R	0.506856322
R Square	0.256903331
Adjusted R Square	0.088017725
Standard Error	0.010493424
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.000837494	0.000167499	1.521167711	0.223950829
Residual	22	0.002422463	0.000110112		
Total	27	0.003259957			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.128107758	0.018748975	6.832787233	7.28602E-07	0.089224764	0.166991
Rent History	0.033101185	0.07152341	0.462802106	0.648051351	-0.115229287	0.181432
Future Rent	-0.053328633	0.093743867	-0.568875966	0.575202484	-0.247741514	0.141084
Rent SD	-0.030116642	0.06844264	-0.440027481	0.664209913	-0.17205799	0.111825
Supply Constraint	-0.00186195	0.000987932	-1.884694249	0.07275098	-0.003910797	0.000187
2006 Inventory	-1.66437E-08	2.27342E-08	-0.732098078	0.471836483	-6.37916E-08	3.05E-08

2001 Office - Rent Growth Regression with Future Rent Growth

Regression Statistics	
Multiple R	0.499668642
R Square	0.249668752
Adjusted R Square	0.119176361
Standard Error	0.010312608
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000813909	0.000203477	1.913282071	0.142316234
Residual	23	0.002446047	0.00010635		
Total	27	0.003259957			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.122455344	0.013980052	8.759290881	8.74648E-09	0.093535403	0.151375
Future Rent	-0.05706457	0.09178632	-0.621711062	0.540246072	-0.246939039	0.13281
Rent SD	-0.016307402	0.060534633	-0.269389632	0.790031904	-0.14153283	0.108918
Supply Constraint	-0.001537439	0.000683957	-2.247859186	0.034471382	-0.002952312	-0.000123
2006 Inventory	-1.33494E-08	2.12191E-08	-0.629122956	0.535467858	-5.72445E-08	3.05E-08

2001 Office - Rent Growth Regression with Historic Rent Growth

Regression Statistics	
Multiple R	0.49595603
R Square	0.245972384
Adjusted R Square	0.114837146
Standard Error	0.010337978
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000801859	0.000200465	1.875715396	0.148937048
Residual	23	0.002458097	0.000106874		
Total	27	0.003259957			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.129368388	0.018341763	7.053214533	3.46819E-07	0.091425561	0.167311215
Rent History	0.036604887	0.07020215	0.521421167	0.607058332	-0.108619323	0.181829097
Rent SD	-0.019601822	0.064923371	-0.30192243	0.765424402	-0.153906046	0.114702403
Supply Constraint	-0.0019547	0.000959952	-2.03624732	0.053399816	-0.003940512	3.11123E-05
2006 Inventory	-1.80858E-08	2.22578E-08	-0.812559843	0.42480162	-6.41295E-08	2.79579E-08

1998 Apartment Market - Neither the historic nor future rent growth are significant factors in the apartment rental regressions. Interestingly, the only variable that appears related to pricing is the rent growth standard deviation variable which has a t-stat of approximately -1.62 in the combined regression. This result is in direct contrast to the expectations. The result implies that the market was paying higher prices for assets in markets that have higher rent volatility. Although the statistic is not significant at a 95% confidence interval, it remains a perplexing result. Overall the rent variable regressions have R-squared values of approximately 16%, showing that the rent variables had little relation to pricing.

Exhibit 4 - 1998 Apartment Market – Rental Growth Regression Results

1998 Apartment - Rent Growth Regression with all Rent Growth Variables

Regression Statistics	
Multiple R	0.402644628
R Square	0.162122696
Adjusted R Square	-0.084311805
Standard Error	0.008699658
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.000248953	4.97905E-05	0.657873371	0.659962182
Residual	17	0.001286629	7.56841E-05		
Total	22	0.001535581			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.08806742	0.010384482	8.480675135	1.63452E-07	0.066158078	0.109976762
Rent History	0.082870808	0.111436222	0.743661317	0.467236004	-0.152239068	0.317980683
Future Rent	0.100030764	0.114460639	0.873931546	0.394333966	-0.141460074	0.341521602
Rent SD	-0.385953765	0.238241375	-1.62001149	0.123630085	-0.888599124	0.116691595
Supply Constraint	9.31955E-05	0.00042845	0.217517868	0.830394116	-0.000810754	0.000997145
2006 Employment	-7.80062E-07	2.31279E-06	-0.337282314	0.740032614	-5.65962E-06	4.09949E-06

1998 Apartment - Rent Growth Regression with Future Rent Growth

Regression Statistics	
Multiple R	0.367240324
R Square	0.134865455
Adjusted R Square	-0.057386666
Standard Error	0.008590966
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000207097	5.17742E-05	0.701503082	0.601020281
Residual	18	0.001328485	7.38047E-05		
Total	22	0.001535581			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.086308536	0.009985219	8.643630126	8.00322E-08	0.065330371	0.107286702
Future Rent	0.07882322	0.10946619	0.72006909	0.480729101	-0.151156711	0.308803151
Rent SD	-0.303678228	0.208358377	-1.457480294	0.162209835	-0.741422933	0.134066477
Supply Constraint	0.000219129	0.000388646	0.563826816	0.579829649	-0.000597386	0.001035645
2006 Employment	-2.79948E-07	2.18521E-06	-0.128110587	0.899481932	-4.8709E-06	4.311E-06

1998 Apartment - Rent Growth Regression with Historic Rent Growth

Regression Statistics	
Multiple R	0.352816543
R Square	0.124479513
Adjusted R Square	-0.070080595
Standard Error	0.00864238
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000191148	4.77871E-05	0.639799774	0.640910414
Residual	18	0.001344433	7.46907E-05		
Total	22	0.001535581			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.087624002	0.01030379	8.504055722	1.01559E-07	0.065976543	0.109271461
Rent History	0.058606785	0.107211543	0.546646221	0.591334508	-0.166636308	0.283849877
Rent SD	-0.318705962	0.22398803	-1.422870505	0.17187433	-0.789287351	0.151875427
Supply Constraint	0.000205993	0.000405857	0.507552284	0.61792982	-0.00064668	0.001058666
2006 Employment	-2.96514E-07	2.23084E-06	-0.132915909	0.895734525	-4.98334E-06	4.39031E-06

2002 Apartment Market - The results for the 2002 rent growth show more significant relationships than the 1998 data. The most surprising result is that the future rent growth variable has a t-stat of 1.81. This is significant at a 90% confidence interval, but not 95%, but is the opposite relationship than is expected. This means that markets with higher subsequent rent growth were selling at higher cap rates. This result directly contradicts the theory that we are testing, and gives significant support to the idea of the real estate market being inefficient. Furthermore, the rent growth standard deviation has a negative coefficient, which also contradicts the expectation. However, this variable is not significant. One other interesting result is that again the supply constraint and liquidity variables do not appear to be significant.

Exhibit 5 - 2002 Apartment Market-Rental Growth Regression Results

2002 Apartment - Rent Growth Regression with all Rent Growth Variables

Regression Statistics	
Multiple R	0.553865665
R Square	0.306767175
Adjusted R Square	0.102875167
Standard Error	0.005450526
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.000223489	4.46977E-05	1.504557135	0.24037709
Residual	17	0.00050504	2.97082E-05		
Total	22	0.000728529			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.072220794	0.005789166	12.47516371	5.54258E-10	0.060006722	0.084434867
Rent History	-0.026985544	0.085200174	-0.316731091	0.755304002	-0.206742196	0.152771108
Future Rent	0.104881142	0.060086025	1.745516418	0.098941324	-0.021889287	0.231651572
Rent SD	-0.075983005	0.110876137	-0.685296286	0.502395382	-0.309911205	0.157945194
Supply Constraint	-1.27638E-05	0.000256949	-0.049674417	0.960960814	-0.000554879	0.000529351
2006 Employment	-4.71942E-07	1.51965E-06	-0.310559672	0.759910688	-3.67812E-06	2.73424E-06

2002 Apartment - Rent Growth Regression with Future Rent Growth

Regression Statistics	
Multiple R	0.550160289
R Square	0.302676343
Adjusted R Square	0.14771553
Standard Error	0.005312565
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000220508	5.51271E-05	1.953244423	0.145187564
Residual	18	0.00050802	2.82234E-05		
Total	22	0.000728529			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.072448459	0.005598971	12.93960289	1.48561E-10	0.060685457	0.08421146
Future Rent	0.097096522	0.053441485	1.816875446	0.08592546	-0.015179872	0.209372916
Rent SD	-0.097599837	0.085169503	-1.145948181	0.266823617	-0.276534323	0.081334649
Supply Constraint	-2.14153E-05	0.000249026	-0.085996348	0.932418687	-0.0005446	0.000501769
2006 Employment	-6.4506E-07	1.38206E-06	-0.46673724	0.646287461	-3.54866E-06	2.25854E-06

2002 Apartment - Rent Growth Regression with Historic Rent Growth

Regression Statistics	
Multiple R	0.427226423
R Square	0.182522417
Adjusted R Square	0.000860732
Standard Error	0.005752081
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000132973	3.32432E-05	1.004738102	0.430854689
Residual	18	0.000595556	3.30864E-05		
Total	22	0.000728529			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.076525158	0.005527481	13.84448927	4.89075E-11	0.06491235	0.088137965
Rent History	0.03384724	0.08204767	0.412531391	0.684821892	-0.138528519	0.206222998
Rent SD	-0.16304908	0.104501346	-1.560258184	0.136107975	-0.38259826	0.0565001
Supply Constraint	-4.72463E-05	0.000270362	-0.174751659	0.863225368	-0.000615256	0.000520764
2006 Employment	-1.6849E-06	1.42623E-06	-1.181363792	0.252832159	-4.6813E-06	1.3115E-06

The regression results related to rent growth are surprising in both their inconsistencies as well as their contrast with the theoretical relationships that should exist. The most surprising aspects of these results is the fact that none of the four markets studied appeared to have any significant relationship between future rent growth and cap rate. In addition, each market appears to have priced different factors. The R-squared values for each market is quite low showing that the variables being tested cannot explain much of the variation in cap rates.

Appreciation

1996 Office Market - The appreciation regression has a somewhat higher R-squared value of 25.4% compared to the rent growth regression. Interestingly, the results are similar to the rent growth regression, although the appreciation standard deviation variable has a t-stat of -1.43. While not significant at a 95% confidence interval, it is still meaningful. This means that the market was pricing historic property value fluctuation in its pricing. The inventory variable has a t-stat of -1.41, further evidence that the market was pricing market size somewhat. It is interesting that the appreciation variable had slightly more impact on pricing than rent. Neither regression exhibit the expected relationship of future rent growth/appreciation and cap rate.

Exhibit 6 - 1996 Office Market – Appreciation Regression Results

1996 Office - Appreciation Regression with all Appreciation Variables

Regression Statistics	
Multiple R	0.503729321
R Square	0.253743229
Adjusted R Square	0.046449681
Standard Error	0.011214024
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.000769665	0.000153933	1.22407683	0.33824071
Residual	18	0.002263578	0.000125754		
Total	23	0.003033243			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.109891868	0.020829221	5.275851005	5.13035E-05	0.066131298	0.153652439
Appreciation History	0.004770665	0.059963549	0.079559413	0.937465525	-0.121208078	0.130749407
Future Appreciation	0.009317493	0.074930102	0.124349127	0.90241699	-0.14810481	0.166739796
Appreciation SD	-0.118630231	0.082599248	-1.436214407	0.168094096	-0.292164812	0.054904351
Supply Constraint	-0.000183145	0.001103095	-0.166028692	0.869985027	-0.002500661	0.00213437
2006 Inventory	-3.97559E-08	2.80094E-08	-1.419377456	0.172875206	-9.86015E-08	1.90897E-08

1996 Office - Appreciation Regression with Future Appreciation

Regression Statistics	
Multiple R	0.503468775
R Square	0.253480807
Adjusted R Square	0.096318872
Standard Error	0.010916848
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000768869	0.000192217	1.612863871	0.21203009
Residual	19	0.002264374	0.000119178		
Total	23	0.003033243			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.109859747	0.02027343	5.418902814	3.14631E-05	0.06742697	0.152292523
Future Appreciation	0.009861104	0.072640515	0.13575212	0.893445201	-0.142177242	0.16189945
Appreciation SD	-0.119490099	0.079719015	-1.498890801	0.150333977	-0.286343915	0.047363718
Supply Constraint	-0.000196473	0.001061407	-0.185106075	0.855107478	-0.002418024	0.002025078
2006 Inventory	-4.01345E-08	2.68709E-08	-1.493604067	0.15170064	-9.63759E-08	1.61069E-08

1996 Office - Appreciation Regression with Historic Appreciation

Regression Statistics	
Multiple R	0.503092601
R Square	0.253102165
Adjusted R Square	0.095860515
Standard Error	0.010919617
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.00076772	0.00019193	1.609638194	0.212829091
Residual	19	0.002265522	0.000119238		
Total	23	0.003033243			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.108472038	0.016963424	6.394466149	3.92553E-06	0.072967185	0.143976892
Appreciation History	0.005450605	0.058146026	0.093739935	0.926297209	-0.116250426	0.127151635
Appreciation SD	-0.116273345	0.078284557	-1.485265417	0.153877007	-0.280124805	0.047578115
Supply Constraint	-8.16002E-05	0.000722123	-0.113000303	0.911215723	-0.001593022	0.001429821
2006 Inventory	-4.12606E-08	2.45978E-08	-1.67741123	0.109836806	-9.27443E-08	1.02231E-08

2001 Office Market - This regression had the most surprising results of any of the regressions discussed so far. The regression's R-squared is 44.3%, the highest of the three 2001 regressions. In addition, two of the variables are significant at a 95% confidence interval. These variables are the appreciation history, and the appreciation standard deviation. The appreciation history has a t-stat of -2.75. This would imply that the market believed that the recent appreciation 'momentum' would continue and were pricing the assets according to this expectation. The appreciation standard deviation has a t-stat of 2.32. This is highly significant and in line with the expectation. Assets with higher historical price volatility were being priced lower based on the 'riskiness' of the market. The other surprising aspect of this result is the fact that the supply-constraint variable is insignificant, with the t-stat dropping to -.03. The surprising aspect of this result is that the variable was significant in the rent regression. This shows that the appreciation history has a significant correlation to the supply constraint factor and is being priced by the market.

Exhibit 7 - 2001 Office Market – Appreciation Regression Results

2001 Office - Appreciation Regression with all Appreciation Variables

Regression Statistics	
Multiple R	0.666157182
R Square	0.443765391
Adjusted R Square	0.317348435
Standard Error	0.009078698
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.001446656	0.000289331	3.510331235	0.017491919
Residual	22	0.001813301	8.24228E-05		
Total	27	0.003259957			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.085270521	0.018185207	4.689004781	0.000112162	0.047556711	0.122984331
Appreciation History	-0.207210304	0.075262356	-2.753173232	0.011603033	-0.363294877	-0.051125732
Future Appreciation	-0.05163086	0.054041309	-0.955396176	0.349758603	-0.163705675	0.060443955
Appreciation SD	0.185665489	0.080035533	2.319788234	0.030023644	0.019681952	0.351649026
Supply Constraint	-2.58636E-05	0.000900707	-0.02871474	0.977350997	-0.001893815	0.001842088
2006 Inventory	-1.76002E-08	2.02838E-08	-0.8676973	0.394926523	-5.96661E-08	2.44658E-08

2001 Office - Appreciation Regression with Future Appreciation

Regression Statistics	
Multiple R	0.502113757
R Square	0.252118224
Adjusted R Square	0.122051829
Standard Error	0.010295761
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000821894	0.000205474	1.938380956	0.138061382
Residual	23	0.002438062	0.000106003		
Total	27	0.003259957			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.121088206	0.014409756	8.40320977	1.82615E-08	0.091279354	0.150897058
Future Appreciation	0.007343998	0.056265886	0.130523094	0.897287481	-0.109050855	0.123738851
Appreciation SD	0.048117057	0.070909755	0.67856752	0.504182918	-0.098570947	0.19480506
Supply Constraint	-0.001793598	0.000716359	-2.50377152	0.019828438	-0.003275499	-0.000311698
2006 Inventory	-1.01833E-08	2.27992E-08	-0.446653259	0.659302738	-5.7347E-08	3.69803E-08

2001 Office - Appreciation Regression with Historic Appreciation

Regression Statistics	
Multiple R	0.648604017
R Square	0.42068717
Adjusted R Square	0.319937113
Standard Error	0.009061468
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.001371422	0.000342855	4.175552665	0.010958674
Residual	23	0.001888535	8.21102E-05		
Total	27	0.003259957			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.092021488	0.016724432	5.50221892	1.35394E-05	0.057424364	0.126618612
Appreciation History	-0.178708732	0.068966345	-2.591245513	0.016326537	-0.321376486	-0.036040978
Appreciation SD	0.170926398	0.078385583	2.180584648	0.039698805	0.008773467	0.33307933
Supply Constraint	-0.000376793	0.000820846	-0.459030474	0.650520968	-0.002074843	0.001321257
2006 Inventory	-2.05138E-08	2.00151E-08	-1.024912275	0.316063974	-6.19182E-08	2.08907E-08

1998 Apartment Market - The R-squared values of the appreciation regressions are quite low and also are similar to the rent growth results. None of the independent variables are significant to any degree of importance. The only variable with a t-stat with an absolute value above one is the appreciation standard deviation. Overall, the results show that market pricing in 1998 showed a minimal relationship to appreciation. The other surprising result is that neither supply constraint nor liquidity appears to be significant in any of the regressions.

Exhibit 8 - 1998 Apartment Market – Appreciation Regression Results

1998 Apartment - Appreciation Regression with all Appreciation Variables

Regression Statistics	
Multiple R	0.371729264
R Square	0.138182645
Adjusted R Square	-0.115293047
Standard Error	0.008823067
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.000212191	4.24381E-05	0.545151466	0.739785575
Residual	17	0.001323391	7.78465E-05		
Total	22	0.001535581			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.081474403	0.008596662	9.477446201	3.38016E-08	0.063337032	0.099612
Appreciation History	0.015056933	0.068737461	0.219049893	0.829219535	-0.129966431	0.16008
Future Appreciation	0.058475071	0.065516565	0.89252346	0.384572503	-0.079752796	0.196703
Appreciation SD	-0.09703727	0.076027936	-1.276337043	0.218998174	-0.257442192	0.063368
Supply Constraint	0.000242892	0.000409644	0.592934123	0.561031024	-0.000621382	0.001107
2006 Employment	7.11932E-07	2.30244E-06	0.309207952	0.760920933	-4.14578E-06	5.57E-06

1998 Apartment - Appreciation Regression with Future Appreciation

Regression Statistics	
Multiple R	0.368442869
R Square	0.135750148
Adjusted R Square	-0.056305375
Standard Error	0.008586572
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000208455	5.21139E-05	0.70682762	0.597653234
Residual	18	0.001327126	7.37292E-05		
Total	22	0.001535581			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.081169215	0.008255632	9.831980583	1.15843E-08	0.063824776	0.098514
Future Appreciation	0.058628615	0.063756799	0.919566478	0.369959003	-0.075319449	0.192577
Appreciation SD	-0.087759261	0.061444372	-1.428271754	0.170335957	-0.216849097	0.041331
Supply Constraint	0.000259869	0.000391464	0.663837245	0.515208129	-0.000562568	0.001082
2006 Employment	6.53299E-07	2.22553E-06	0.293547646	0.772461314	-4.02236E-06	5.33E-06

1998 Apartment - Appreciation Regression with Historic Appreciation

Regression Statistics	
Multiple R	0.312728306
R Square	0.097798993
Adjusted R Square	-0.10269012
Standard Error	0.008773075
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000150178	3.75446E-05	0.487802015	0.7446149
Residual	18	0.001385403	7.69668E-05		
Total	22	0.001535581			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.080086547	0.008406953	9.526227895	1.87489E-08	0.062424195	0.097749
Appreciation History	0.01571331	0.068344075	0.229914735	0.820750544	-0.127872264	0.159299
Appreciation SD	-0.079856232	0.073133823	-1.091919284	0.289268736	-0.233504693	0.073792
Supply Constraint	0.000300811	0.00040218	0.747950043	0.464151055	-0.000544138	0.001146
2006 Employment	1.47948E-06	2.1237E-06	0.696649657	0.494921156	-2.98226E-06	5.94E-06

2002 Apartment Market - The appreciation data for 2002 shows no significant relationships and have extremely low R-squared values (under 10%). The market was very clearly not factoring appreciation into its pricing consistently. The contrast between the rent data and appreciation data suggests that the subsequent relationship between rent and appreciation was minimal in the subsequent years after 2002. This is an interesting result which shows the appreciation post 2002 was caused by factors other than income growth, most likely capital market impacts.

Exhibit 9 - 2002 Apartment Market – Appreciation Regression Results

2002 Apartment - Appreciation Regression with all Appreciation Variables

Regression Statistics	
Multiple R	0.318846124
R Square	0.101662851
Adjusted R Square	-0.162553957
Standard Error	0.006204668
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	7.40643E-05	1.48129E-05	0.384770566	0.852336856
Residual	17	0.000654464	3.84979E-05		
Total	22	0.000728529			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.071632509	0.007311586	9.797122739	2.0891E-08	0.05620641	0.087058607
Appreciation History	-0.044441402	0.053591709	-0.829258908	0.418450161	-0.157510023	0.068627219
Future Appreciation	0.016409237	0.032754568	0.500975515	0.622812821	-0.052696861	0.085515335
Appreciation SD	0.033066039	0.062428385	0.529663533	0.603194473	-0.098646339	0.164778416
Supply Constraint	-0.000184728	0.000286957	-0.643747504	0.528329125	-0.000790155	0.000420699
2006 Employment	-2.80728E-07	1.81585E-06	-0.154598901	0.878958153	-4.11184E-06	3.55038E-06

2002 Apartment - Appreciation Regression with Future Appreciation

Regression Statistics	
Multiple R	0.255585678
R Square	0.065324039
Adjusted R Square	-0.14238173
Standard Error	0.006150602
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	4.75904E-05	1.18976E-05	0.314502765	0.864524449
Residual	18	0.000680938	3.78299E-05		
Total	22	0.000728529			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.07388939	0.006727057	10.98391018	2.06806E-09	0.059756368	0.088022413
Future Appreciation	0.007405405	0.030633349	0.241743224	0.811711759	-0.056952874	0.071763683
Appreciation SD	0.006899749	0.053397667	0.129214432	0.898620885	-0.105284586	0.119084085
Supply Constraint	-0.000209107	0.00028296	-0.738996132	0.469437126	-0.000803584	0.000385371
2006 Employment	-9.60684E-07	1.60606E-06	-0.598161422	0.557184499	-4.33489E-06	2.41353E-06

2002 Apartment - Appreciation Regression with Historic Appreciation

Regression Statistics	
Multiple R	0.297322066
R Square	0.088400411
Adjusted R Square	-0.114177276
Standard Error	0.006074201
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	6.44022E-05	1.61006E-05	0.436377828	0.780634207
Residual	18	0.000664127	3.68959E-05		
Total	22	0.000728529			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.073685708	0.005927628	12.43089192	2.85392E-10	0.061232223	0.086139193
Appreciation History	-0.035541618	0.049498465	-0.718034753	0.481952292	-0.139534033	0.068450797
Appreciation SD	0.029678206	0.060756061	0.488481403	0.631106808	-0.097965542	0.157321953
Supply Constraint	-0.000196401	0.000279996	-0.701442238	0.491997229	-0.000784651	0.000391849
2006 Employment	-7.05113E-07	1.57237E-06	-0.448438418	0.659188151	-4.00855E-06	2.59832E-06

Overall, the results of the appreciation regressions vary greatly. Interestingly, the apartment market appeared more consistent in that none of the appreciation variables were significant in either of the years studied and both had very low R-squared values. The office markets clearly priced appreciation more significantly than the apartment markets, but again the results varied significantly. Future appreciation was not significant for any of the markets studied, which is not consistent with the theoretical relationship that should exist and is a further demonstration of market pricing inefficiency.

Employment Growth

1996 Office Market - The employment growth regression produced an R-squared of 27.8%, the highest of the three regressions for that year. Interestingly, the 2006 Inventory has a t-stat of -2.17, the highest of the three regressions, showing it to be significant at a 95% confidence interval. The only other variable that appears to have any significance at all is the employment's future growth which has t-stat of -1.26. This result is interesting in that the market appears to be able to predict future employment growth and is factoring this into its pricing somewhat.

Exhibit 10 - 1996 Office Market – Employment Growth Regression Results

1996 Office - Employment Growth Regression with all Employment Growth Variables

Regression Statistics	
Multiple R	0.527172905
R Square	0.277911272
Adjusted R Square	0.077331069
Standard Error	0.011030942
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.000842972	0.000168594	1.385536899	0.276181524
Residual	18	0.00219027	0.000121682		
Total	23	0.003033243			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.096726853	0.021231052	4.555914318	0.000244887	0.052122068	0.141331637
Supply Constraint	0.000566574	0.001005466	0.563494132	0.580051343	-0.001545831	0.002678979
Employment history	0.023580779	0.143758659	0.164030319	0.871535093	-0.278444956	0.325606513
Employment future growth	-0.206728799	0.164419108	-1.257328306	0.224704338	-0.552160527	0.138702929
Employment SD	0.035381408	0.337338088	0.104884118	0.917627674	-0.673339615	0.744102431
2006 Inventory	-5.91425E-08	2.72073E-08	-2.173774271	0.043309253	-1.16303E-07	-1.98211E-09

1996 Office - Employment Growth Regression with Future Employment Growth

Regression Statistics	
Multiple R	0.526148184
R Square	0.276831912
Adjusted R Square	0.124585998
Standard Error	0.010744752
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000839698	0.000209925	1.818320804	0.166981342
Residual	19	0.002193544	0.00011545		
Total	23	0.003033243			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.098748986	0.016836881	5.865040434	1.19715E-05	0.06350899	0.133988982
Supply Constraint	0.00046569	0.000774787	0.601055948	0.554906369	-0.001155958	0.002087338
Employment future growth	-0.191432581	0.131903243	-1.451310644	0.163005115	-0.467509241	0.084644079
Employment SD	0.041916598	0.326286349	0.128465681	0.899130524	-0.641008577	0.724841773
2006 Inventory	-6.07228E-08	2.47842E-08	-2.450059438	0.024145772	-1.12597E-07	-8.84884E-09

1996 Office - Employment Growth Regression with Historic Employment Growth

Regression Statistics	
Multiple R	0.526148184
R Square	0.276831912
Adjusted R Square	0.124585998
Standard Error	0.010744752
Observations	24

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000839698	0.000209925	1.818320804	0.166981342
Residual	19	0.002193544	0.00011545		
Total	23	0.003033243			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.098748986	0.016836881	5.865040434	1.19715E-05	0.06350899	0.133988982
Supply Constraint	0.00046569	0.000774787	0.601055948	0.554906369	-0.001155958	0.002087338
Employment future growth	-0.191432581	0.131903243	-1.451310644	0.163005115	-0.467509241	0.084644079
Employment SD	0.041916598	0.326286349	0.128465681	0.899130524	-0.641008577	0.724841773
2006 Inventory	-6.07228E-08	2.47842E-08	-2.450059438	0.024145772	-1.12597E-07	-8.84884E-09

2001 Office Market - The R-squared for the employment growth regression is 25.2%, which is similar to the rent regression, and significantly lower than the appreciation regression. The only significant variable for this regression is the supply constraint variable which has a t-stat of -1.88. This results contrasts with the 1996 office market results in that future employment growth is no longer significant.

Exhibit 11 - 2001 Office Market – Employment Growth Regression Results

2001 Office - Employment Growth Regression with all Employment Growth Variables

Regression Statistics	
Multiple R	0.502954588
R Square	0.252963318
Adjusted R Square	0.083182253
Standard Error	0.010521206
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.000824649	0.00016493	1.489938343	0.233431258
Residual	22	0.002435307	0.000110696		
Total	27	0.003259957			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.126163618	0.015942292	7.913769186	7.0635E-08	0.093101329	0.159225908
Supply Constraint	-0.00160878	0.000856783	-1.877699342	0.073743698	-0.003385638	0.000168078
Employment history	0.033206716	0.118760495	0.279610788	0.782388108	-0.213087475	0.279500907
Employment future growth	-0.034525682	0.110986325	-0.311080502	0.758667862	-0.26469723	0.195645867
Employment SD	-0.158197278	0.257806444	-0.613628098	0.545754134	-0.692855116	0.37646056
2006 Inventory	-1.53614E-08	2.25349E-08	-0.681670148	0.502561248	-6.20958E-08	3.13731E-08

2001 Office - Employment Growth Regression with Future Employment Growth

Regression Statistics	
Multiple R	0.500308451
R Square	0.250308546
Adjusted R Square	0.119927424
Standard Error	0.01030821
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000815995	0.000203999	1.919821994	0.14119478
Residual	23	0.002443962	0.000106259		
Total	27	0.003259957			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.126063364	0.015615598	8.072912821	3.6696E-08	0.093760038	0.15836669
Supply Constraint	-0.001556508	0.000819212	-1.90000758	0.070041075	-0.003251177	0.00013816
Employment future growth	-0.031257668	0.108134842	-0.289061943	0.775123432	-0.254951631	0.192436296
Employment SD	-0.11980265	0.213777361	-0.560408496	0.580619257	-0.562034813	0.322429514
2006 Inventory	-1.67648E-08	2.1524E-08	-0.778887283	0.443986528	-6.12907E-08	2.77611E-08

2001 Office - Employment Growth Regression with Historic Employment Growth

Regression Statistics	
Multiple R	0.499677234
R Square	0.249677338
Adjusted R Square	0.11918644
Standard Error	0.010312549
Observations	28

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000813937	0.000203484	1.913369764	0.142301136
Residual	23	0.002446019	0.000106349		
Total	27	0.003259957			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.123915894	0.013929019	8.896239938	6.61913E-09	0.095101523	0.152730264
Supply Constraint	-0.001479165	0.000733798	-2.01576482	0.055653133	-0.002997143	3.88126E-05
Employment history	0.029316217	0.115757978	0.253254395	0.802321601	-0.210147404	0.268779838
Employment SD	-0.156175454	0.252613296	-0.618239247	0.542492039	-0.678745868	0.36639496
2006 Inventory	-1.57843E-08	2.20477E-08	-0.715917271	0.481248406	-6.13935E-08	2.98248E-08

1998 Apartment Market - The employment growth results are again similar in that the R-squared values are around 15% and almost none of the independent variables appear significant. The only variable that shows any significance is the employment growth standard deviation and this variable has a t-stat of approximately -1.4. This result is again counterintuitive and conflicts with the theory. Theory suggests that the employment growth standard deviation t-stat should have a positive sign in that the larger the variance, the more demand risk exists, and therefore the higher the cap rate should be.

However, these statistical results show market pricing behavior was the opposite of the expectation.

Exhibit 12 - 1998 Apartment Market – Employment Growth Regression Results

1998 Apartment - Employment Growth Regression with all Employment Growth Variables

Regression Statistics	
Multiple R	0.392001951
R Square	0.153665529
Adjusted R Square	-0.095256374
Standard Error	0.008743453
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.000235966	4.71932E-05	0.617324259	0.688397999
Residual	17	0.001299616	7.6448E-05		
Total	22	0.001535581			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.08294435	0.010798627	7.681008755	6.32325E-07	0.060161238	0.105727461
Supply Constraint	0.000426423	0.000408573	1.043688975	0.311244459	-0.000435591	0.001288437
Employment history	0.011224186	0.173749972	0.064599642	0.94924633	-0.355356208	0.37780458
Employment future growth	0.162820807	0.167559133	0.971721472	0.344813223	-0.190698058	0.516339672
Employment SD	-0.528665537	0.375618076	-1.407454993	0.177314237	-1.321150398	0.263819324
2006 Employment	8.67438E-07	2.23043E-06	0.388909867	0.702170907	-3.83837E-06	5.57324E-06

1998 Apartment - Employment Growth Regression with Future Employment Growth

Regression Statistics	
Multiple R	0.391736868
R Square	0.153457774
Adjusted R Square	-0.034662721
Standard Error	0.008498152
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000235647	5.89117E-05	0.81574192	0.531641544
Residual	18	0.001299935	7.22186E-05		
Total	22	0.001535581			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.083197263	0.009781569	8.505513494	1.01305E-07	0.06264695	0.103747576
Supply Constraint	0.000422882	0.00039352	1.074613972	0.296742252	-0.000403873	0.001249637
Employment future growth	0.165360724	0.158311165	1.044529764	0.310066005	-0.167238691	0.497960138
Employment SD	-0.517619829	0.325060382	-1.592380549	0.128707895	-1.200546349	0.16530669
2006 Employment	8.34893E-07	2.11183E-06	0.395340203	0.697237904	-3.60191E-06	5.27169E-06

1998 Apartment - Employment Growth Regression with Historic Employment Growth

Regression Statistics	
Multiple R	0.326583826
R Square	0.106656995
Adjusted R Square	-0.091863672
Standard Error	0.008729901
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000163781	4.09451E-05	0.5372589	0.710233173
Residual	18	0.001371801	7.62112E-05		
Total	22	0.001535581			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.084020907	0.010724995	7.834120699	3.29857E-07	0.061488528	0.106553285
Supply Constraint	0.000355796	0.000401433	0.886314344	0.387136567	-0.000487584	0.001199175
Employment history	0.050841751	0.168637048	0.301486249	0.766498996	-0.303451539	0.405135041
Employment SD	-0.43644152	0.362866773	-1.202759667	0.244652183	-1.198796321	0.325913281
2006 Employment	5.29664E-07	2.19977E-06	0.240782012	0.812445276	-4.09187E-06	5.1512E-06

2002 Apartment Market - The employment growth results show the highest R-squared values of any of the regressions for that market with a value of 37%. Surprisingly however, the results of this regression are again completely counterintuitive. Both future employment growth and employment growth standard deviation have t-stats with an absolute value above 2. Both variables have coefficients with the opposite sign of the expectation. Standard deviation of employment growth has a negative coefficient, implying that markets with higher employment growth volatility are priced higher than markets with lower volatility. Furthermore, the future employment growth variable has a positive coefficient, meaning that markets with higher subsequent employment growth were being priced lower than markets with lower future rent growth. This result is clearly surprising and cannot be explained or justified.

Exhibit 13 - 2002 Apartment Market – Employment Growth Regression Results

2002 Apartment - Employment Growth Regression with all Employment Growth Variables

Regression Statistics	
Multiple R	0.615599144
R Square	0.378962306
Adjusted R Square	0.196304161
Standard Error	0.005158909
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.000276085	5.5217E-05	2.074707952	0.118945916
Residual	17	0.000452444	2.66143E-05		
Total	22	0.000728529			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.07832211	0.006377393	12.28121025	7.05417E-10	0.064866986	0.091777234
Supply Constraint	0.000249687	0.000291026	0.857955108	0.402851672	-0.000364323	0.000863697
Employment history	0.010394506	0.161136001	0.064507657	0.949318494	-0.329572737	0.350361748
Employment future growth	0.171384631	0.146246606	1.171887922	0.2574045	-0.137168734	0.479937996
Employment SD	-0.645453043	0.261335195	-2.46982823	0.02440699	-1.196822104	-0.094083982
2006 Employment	-1.20889E-06	1.33469E-06	-0.905749281	0.377727315	-4.02484E-06	1.60705E-06

2002 Apartment - Employment Growth Regression with Future Employment Growth

Regression Statistics	
Multiple R	0.615475661
R Square	0.37881029
Adjusted R Square	0.240768132
Standard Error	0.005014172
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000275974	6.89935E-05	2.744163778	0.060727751
Residual	18	0.000452555	2.51419E-05		
Total	22	0.000728529			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.078390619	0.006111917	12.82586475	1.71594E-10	0.065549958	0.09123128
Supply Constraint	0.000256366	0.000264351	0.9697968	0.34499968	-0.000299014	0.000811747
Employment future growth	0.179269359	0.07804695	2.296942519	0.033836834	0.015298801	0.343239917
Employment SD	-0.65241147	0.231355794	-2.819948697	0.011341	-1.138471956	-0.166350984
2006 Employment	-1.21511E-06	1.29386E-06	-0.939133879	0.360094405	-3.9334E-06	1.50319E-06

2002 Apartment - Employment Growth Regression with Historic Employment Growth

Regression Statistics	
Multiple R	0.573404431
R Square	0.328792642
Adjusted R Square	0.179635451
Standard Error	0.005212132
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.000239535	5.98837E-05	2.204336516	0.109473891
Residual	18	0.000488994	2.71663E-05		
Total	22	0.000728529			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.078303627	0.006443168	12.15296962	4.11444E-10	0.064767033	0.091840221
Supply Constraint	7.61329E-05	0.00025311	0.300789647	0.767021588	-0.000455631	0.000607897
Employment history	0.168216775	0.089387945	1.881873176	0.076125208	-0.019580327	0.356013878
Employment SD	-0.46892445	0.215756127	-2.173400387	0.043341393	-0.922211252	-0.015637648
2006 Employment	-1.3142E-06	1.3454E-06	-0.976810586	0.341609298	-4.14077E-06	1.51238E-06

Results Summary

When considered as a whole, the combined results of the regressions run are somewhat vexing. The two most striking aspects of the results are the inconsistencies between the various markets studied in terms of significant variables, as well as the complete conflict of results with the expected results based on the financial and economic theory. The table below summarizes which variables were found to be significant for each of the markets studied. The table demonstrates the inconsistencies in the results of the regressions. There are no pricing patterns or similarity that are an indication of a broader market pricing mechanism related to any of the variables tested in this study.

Exhibit 14 – Regression Results Summary Table

	Significant Variables
1996 Office	**2006 Inventory (Liquidity)**
2001 Office	**Appreciation History, Appreciation SD**
1998 Apartment	**None**
2002 Apartment	**Future Rent Growth, Employment SD**

The contrast between the regression results and the expectations based on theory are striking. As an example, the 2002 Apartment data suggests that future rent growth is significant with a positive sign, meaning that markets that are higher future rent growth are priced lower. Furthermore, the same year suggests that Employment Growth Standard Deviation is significant with a negative sign, implying that markets with higher employment growth variance are priced higher. Both of these results are puzzling and indicative of the general disconnect between the expectations and the results.

The one aspect of the results that is consistent is that none of the regressions demonstrated the expected relationship between cap rate and future rent growth or appreciation. This result is a demonstration of the market's inability to properly price future income growth as well as an indication of an inefficient market.

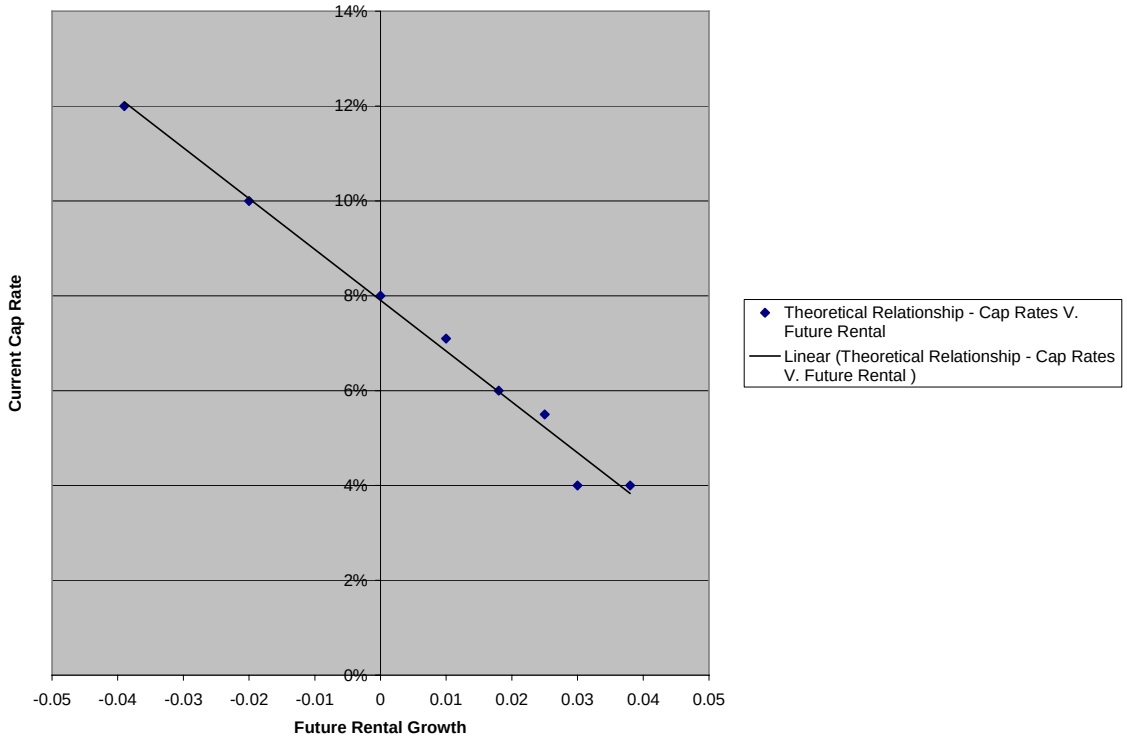
Implications- Investment Strategy

One of the aspirations of the author when this study began was to try to uncover some causes of the apparent inconsistencies of real estate market pricing and, secondly, to develop an investment strategy that capitalizes on the market inefficiencies. While the results of the regressions run did not uncover any specific factors that the market appears to be consistently pricing, the results do demonstrate a simple concept that can be very effective and powerful.

The concept is the fact that the real estate market appears to not be able to price future rental growth into its pricing of assets. This provides an opportunity for superior risk adjusted returns for investors who can study local space market factors and be able to understand what future rental growth is likely to be. Based on this understanding, investment strategies that focus on markets where significant rental growth is expected are likely to outperform the overall industry returns. This performance can be attributed to the fact that the capital market is inefficient in pricing assets and does not require the investor to pay a premium for assets in markets that are expected to have superior income growth going forward.

The graph below illustrates the theoretical relationship that should exist between cap rates and subsequent future rental growth (assuming similar risk profile).

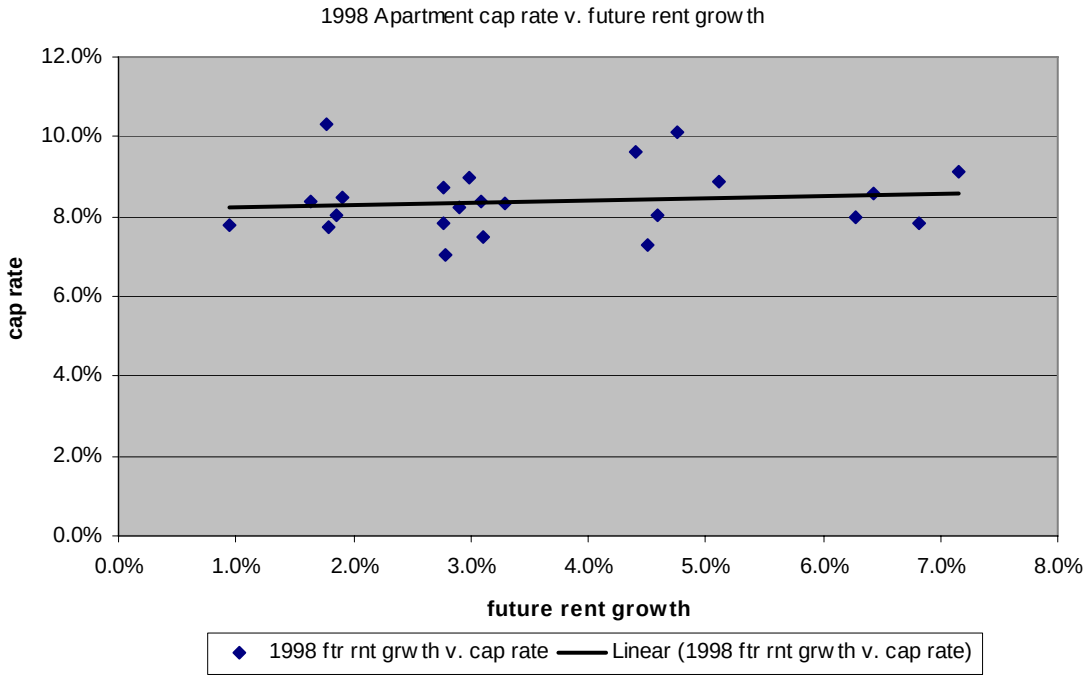
Exhibit 15- Theory – Current Cap Rate v. Future Rental Growth



The graph illustrates the inverse relationship between future income growth and cap rates that should exist based on the theory. The example data set shows a series of markets that have different future rental growth rates, but that all are clustered near the trend line which has a slope of -1. This can be thought of as the 'fair market price line'.

The four following graphs show the relationships for each of the markets studied, including a trend line based on the data.

Exhibit 16 – Apartment Market Cap Rate Graphs



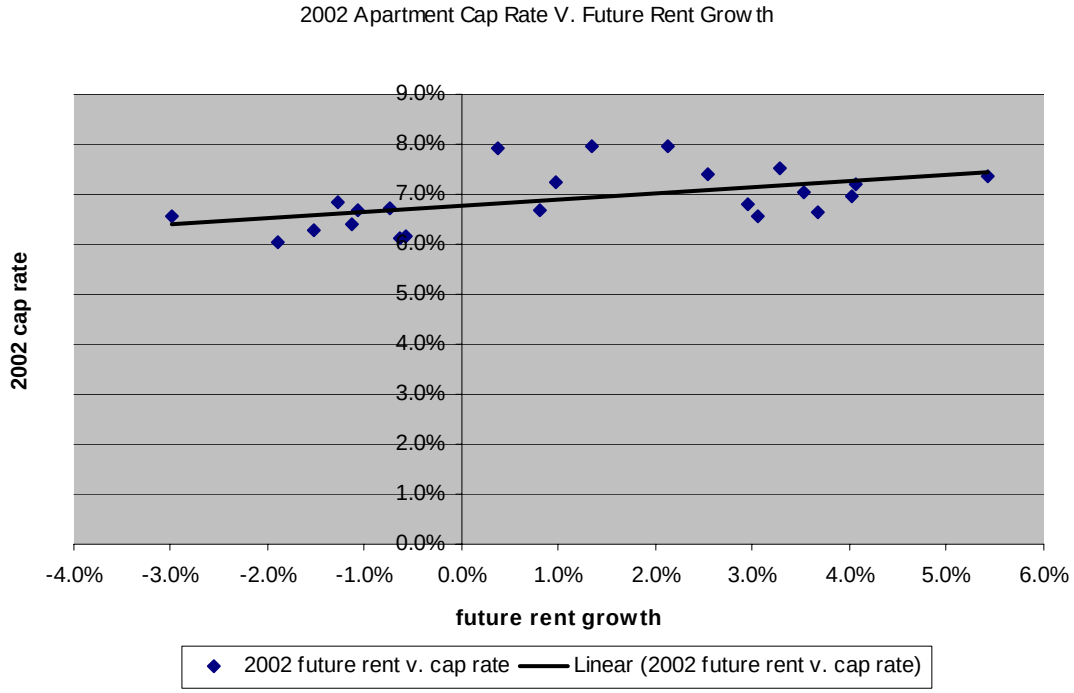
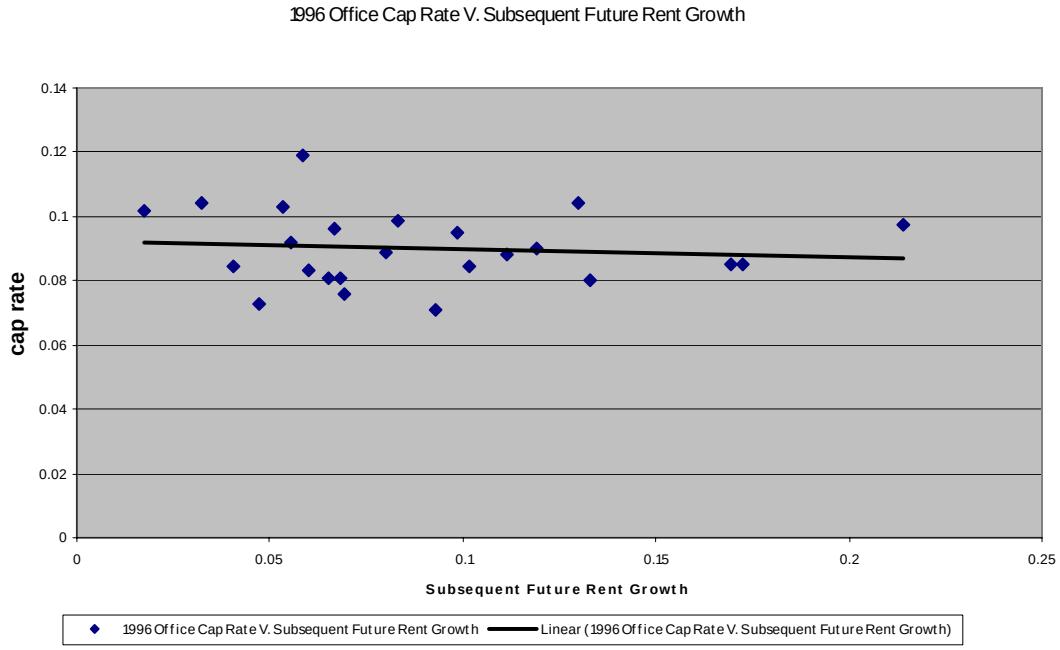
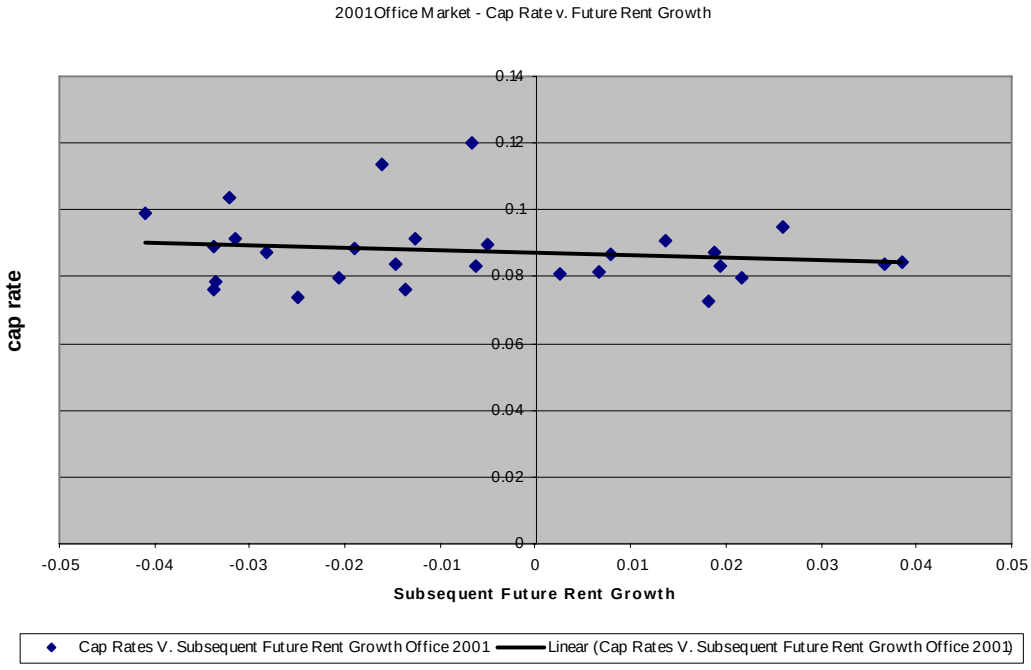


Exhibit 17 – Office Market Cap Rate Graphs





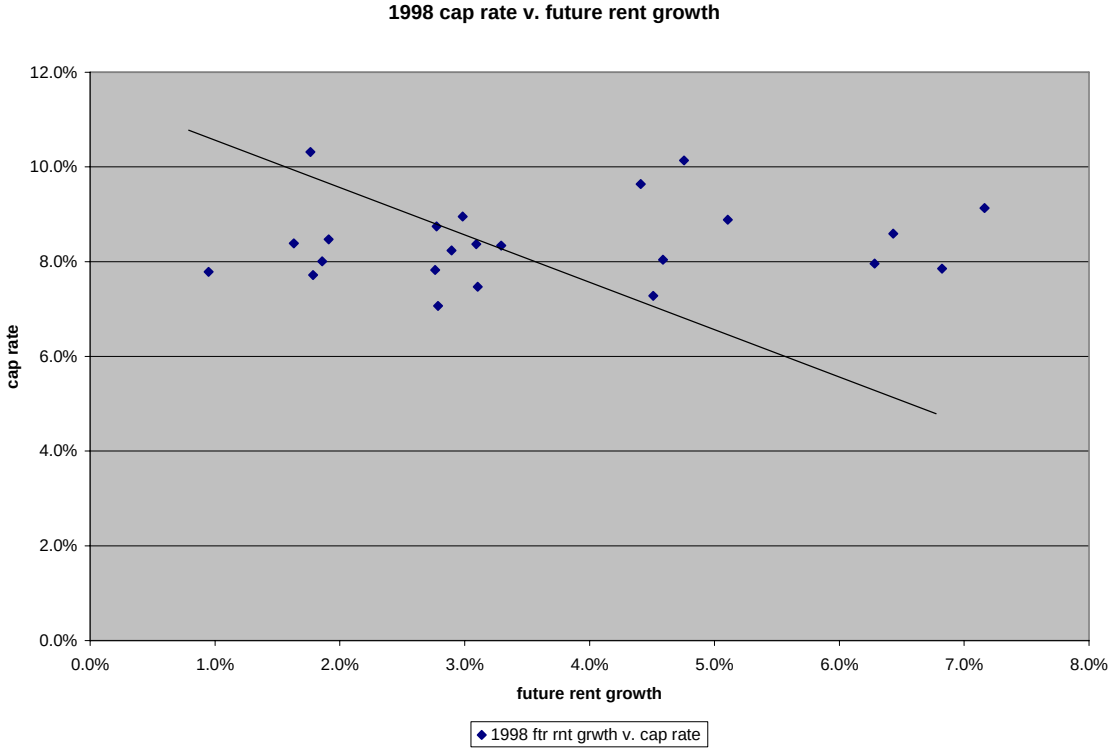
These graphs show that none of the markets have results that are in line with the expectation based on the theory. Interestingly, the two apartment markets have a slightly negative slope for the trend line, while the office markets each have a trend line with a

slightly positive slope. The theoretical relationship suggests that the slope of the trend line should be -1. The finance theory is a little misleading however, because it assumes constant and continuous growth at the same rate. Real estate economists have shown that rental rate is generally mean reverting with an average growth rate equal to inflation. Based on this fact, we would expect that the market should have a slope slightly higher than -1. [8]

The theoretical trend line is still a good tool to use to develop an investment strategy that capitalizes on the apparent inefficiency of real estate pricing market. The theoretical relationship is a good barometer from which to measure which markets are being priced higher and lower than the finance theory suggests is a fair price. In the following graphs, the same data points are shown, but this time instead of showing the data trend line, the 'fair market price' line is shown with a slope of -1 that comes close to bisecting the data set, with half of the sample markets being above and to the right of the line, and approximately half are below and to the left of the line.

[8] William Wheaton and Dennis DiPasquale, Urban Economics and Real Estate Markets, Prentice-Hall 1996

Exhibit 18 – Apartment Market Investment Analysis



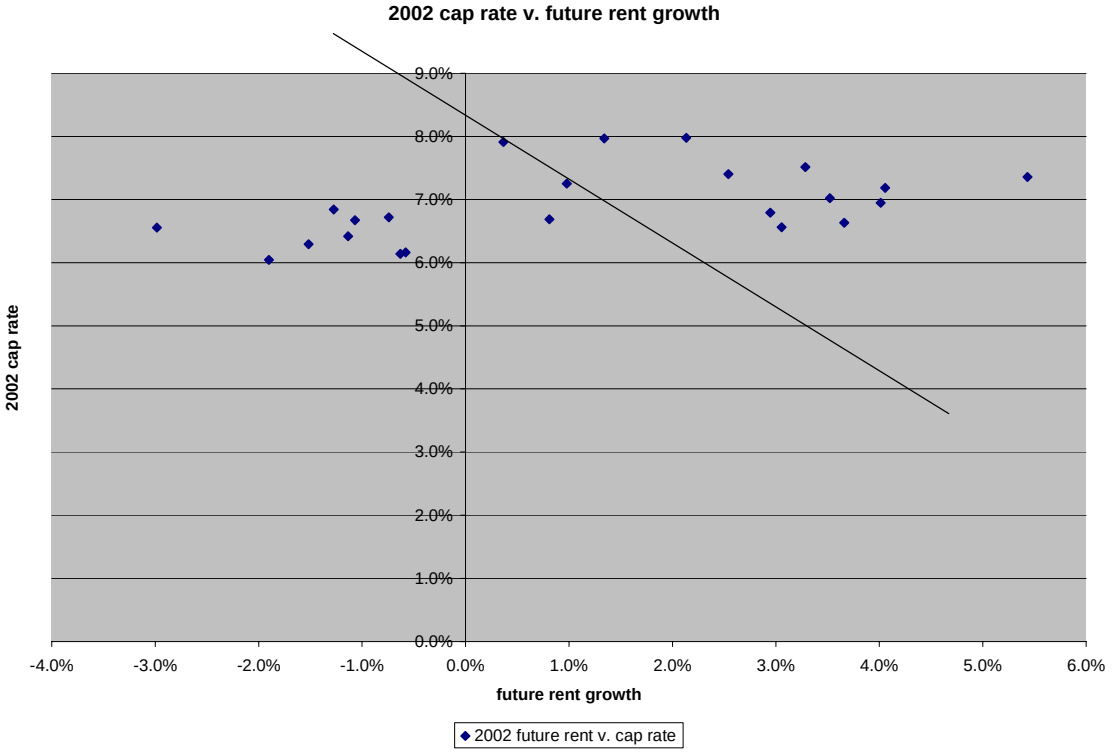
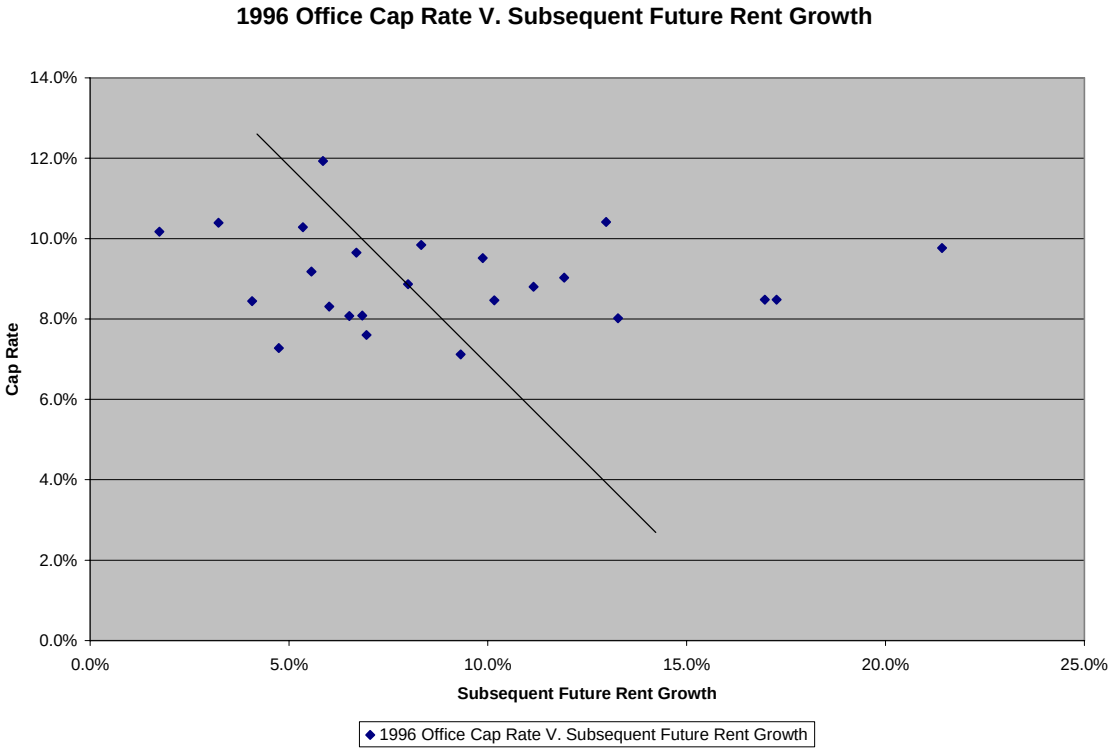
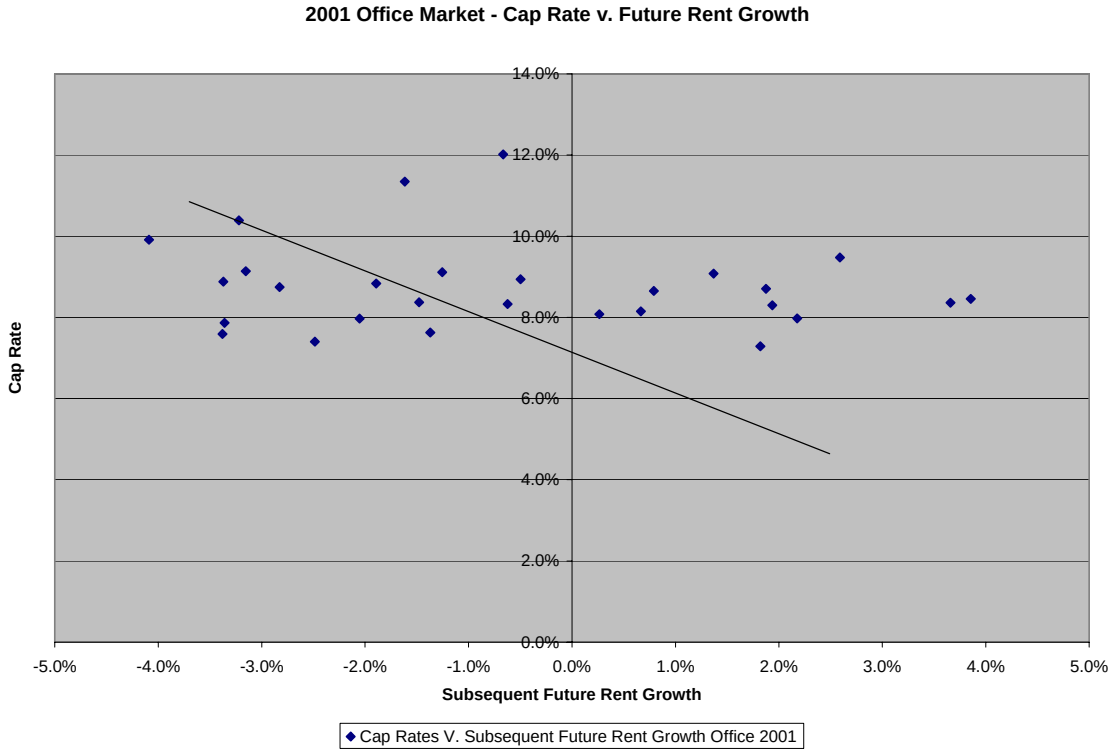


Exhibit 19 – Office Market Investment Graphs





Using the concept of the 'fair market price' line, it is now fairly simple to devise an investment strategy that takes advantage of the market inefficiencies. The strategy would be to buy assets in markets that are to the right of the line, and sell assets that are to the left of the line. One major obvious difference between the data analyzed for this paper is that the ex-post rent growth is already known for the following five years. While the market cannot know the exact near term rental growth figures, there are fairly accurate econometric models that have been developed to help predict future rental growth in specific markets. By using econometric models and predictions, an investor can use estimates of future market rent growth and perform a similar analysis to identify which markets appear to be trading at cheaper cap rates relative to the expected future income growth. While this investment strategy still includes significant risks, it should provide superior risk-adjusted returns compared to the general domestic real estate market as a whole.

Efficiency Test

The investment strategy described above also provides an opportunity for a test of the efficiency of the market. By tracking which markets were "buys" and which were "sells", it is possible to compare the results of the two time periods studied for each product type. The intent of this analysis is to see if the real estate capital market is consistently mis-pricing individual markets in the same way. The results of this test are shown in the two tables below.

Exhibit 20 – Office Market Efficiency Test

	1996 Office	2001 Office	Same?
Atlanta, Ga	Sell	Sell	Y
Austin, Tx	Sell	Sell	Y
Boston, Ma	Buy	Sell	N
Chicago, Il	Sell	Sell	Y
Dallas, Tx	Buy	Buy	Y
Detroit, MI	Buy	Buy	Y
Denver, Co	Sell	Sell	Y
Houston, Tx	Sell	Buy	N
Kansas City, Mo	Sell	Sell	Y
Los Angelos, CA	Buy	Buy	Y
Minneapolis, Mn	Sell	Buy	N
New York, NY	Buy	Buy	Y
Oakland, CA	Buy	Sell	N
Orange County	Buy	Buy	Y
Orlando	Sell	Buy	N
Philadelphia, PA	Sell	Sell	Y
Phoenix, AZ	Sell	Buy	N
Sacramento, CA	Sell	Buy	N
St. Louis, MO	Sell	Sell	Y
San Diego, CA	Buy	Buy	Y
San Fransisco, CA	Buy	Sell	N
San Jose, CA	Buy	Sell	N
Seattle, WA	Buy	Sell	N
Washington, DC	Buy	Buy	Y
Indianapolis	n/a	Buy	n/a
Miami	n/a	Buy	n/a
Nashville	n/a	Buy	n/a
San Antonio	n/a	Buy	n/a

Exhibit 21 – Apartment Market Efficiency Test

Market Name	1998 Apartment	2002 Apartment	Same?
Atlanta	Sell	Sell	Y
Boston	Buy	Sell	N
Chicago	Sell	Sell	Y
Dallas	Sell	Sell	Y
Denver	Buy	Sell	N
Fort Lauderdale	Sell	Buy	N
Houston	Buy	Buy	Y
Las Vegas	Sell	Buy	N
Memphis	Buy	Sell	N
Miami	Buy	Buy	Y
Minneapolis	Buy	Sell	N
Nashville	Sell	Sell	Y
Orange Country	Buy	Buy	Y
Orlando	Buy	Buy	Y
Philadelphia	Buy	Buy	Y
Phoenix	Sell	Sell	Y
Portland	Sell	Sell	Y
Riverside	Buy	Buy	Y
San Fransisco	Buy	Sell	N
Seattle	Sell	Sell	Y
Tampa	Sell	Buy	N
Washington DC	Buy	Buy	Y
West Palm Beach	Sell	Buy	N

The efficiency test results do not conclusively demonstrate inefficient market pricing. In the office market, 14 of the 24 markets had the same investment strategy, and in the apartment market, 14 of the 23 markets had the same investment strategy. While in both of these cases more than half of the markets had the same rating, the numbers are close to 50% in each instance and cannot be considered as evidence of inefficient market pricing. The results of this efficiency test are ultimately inconclusive. This result does not negate the previous results which demonstrated the inefficiency of the market in pricing future income growth.

Conclusion

The intent of this thesis was to further explore cap rate variation across markets within the United States, and more specifically, to study the relationship between cap rates and income growth to attempt to assess the efficiency of real estate asset pricing. The cross-sectional analysis studied two asset types, apartment and office buildings. The study investigated cap rates in two different years for each asset type and tested forward and backward looking variables as well as standard deviation related to rent growth, appreciation, employment growth, as well as market size (liquidity) and supply-constraint factors. The most striking result from this study is the apparent lack of a consistent relationship between cap rates and subsequent income growth. By back testing the actual subsequent rental growth, the study was able to show statistically that the market's pricing mechanism does a poor job of predicting future income growth. This result was consistent across both property types and time periods examined.

The lack of a relationship between cap rates and subsequent rental growth could have several plausible explanations. The most obvious explanation would be the idea that real estate rental growth is unpredictable and that thus the market can't price it into its expectations. This explanation probably has some grains of truth, but is unlikely to be a complete explanation. The reason this is unlikely is because rental rates are a result of supply and demand factors that are studied extensively and generally understood by market participants. While precise rental growth predictions are difficult, the general direction and magnitude of rental rate growth are generally understood.

A second possible explanation for the lack of a relationship is due to different perceptions of market risk and required discount rates that the market applies to different markets. While it is true that different markets have different levels of risk and volatility, it is unlikely that these differences completely offset rental growth impacts.

The other significant result from this study is the apparent lack of consistent pricing explanation or cause of cap rate inconsistencies. There were no consistent relationships between any of the independent variables tested and cap rates across either time or

property type. This result is surprising, especially in light of some of the other research done in this area of study. While this inconsistency cannot be completely explained, it is further evidence of potential inefficiencies of the market to be able price local space market factors into real estate asset pricing models.

The last aspect of this paper used a simple concept of 'fair market price line' to develop and investment strategy that takes advantage of the apparent inefficiencies and inability of the market to properly price future income growth into real estate asset prices. The investment strategy should enable investors to experience superior risk adjusted returns relative to the entire domestic real estate market as a whole.

Bibliography

Campbell, John Y., and Robert J. Shiller. "Cointegration and Tests of Present Value Models." National Bureau of Economic Research (1986).

Chichernea, Doina, Norm Miller, Jeff Fisher, Michael Sklarz, and Bob White. "A Cross Sectional Analsysis of Cap Rates by MSA." (2007).

Geltner, David M., Norman G. Miller, Jim Clayton, and Piet Eichholtz. Commercial Real Estate Analysis & Investments. USA: Thomson South-Western, 2007.

Pai, Arvin. Stocks are From Mars, Real Estate is From Venus: an Inquiry Into the Determinants of Long-Run Investment Performance. Diss. Massachusetts Institute of Technology, 2006.

Sivitanides, Petros, and Rena Sivitanidou. "Office Capitalization Rates: Why Do the Vary Across Metropolitan Markets." Real Estate Issues Aug (1996).

Sivitanidou, Rena, and Petros Sivitanides. "Office Capitalization Rates: Real Estate and Capital Market Influences." Journal of Real Estate Finance and Economics (1999).

Wheaton, William, and Dennis Dipasquale. Urban Economics and Real Estate Markets. Prentice Hall, 1996.

Yu, Yisheng. The Variation of Capitalization Rates Across Submarkets Within the Same Metropolitan Area. Diss. Massachusetts Institute of Technology, 2004.