A Cross-Sectional Analysis of Cap Rates by MSA

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Abstract There are a number of global factors driving capital markets and required rates of return that help to explain observed capitalization rates or "cap rates" over time, but little is known about the factors driving the geographical cross-sectional variation of these cap rates. This paper uses data from Real Capital Analytics for multifamily properties to explore several models that combine the expected influences from housing demand growth, supply constraints, liquidity risk and the interaction of these. The findings reveal a very strong and robust relation between supply constraints and cap rates, as well as evidence of capital flowing from larger markets to smaller markets in recent years. There is also weak but generally supportive evidence of influences from expected growth rates, liquidity, and other risk factors.

> "While research we are doing at Torto Wheaton Research (TWR) leads us to believe real estate is priced correctly today, we find that pricing is very inefficient across markets. When we line up cap rates with our estimates of market gross income growth, we do not see the relationship that ought to be there—a negative correlation that shows low cap rates in markets expected to do better in the future and high cap rates in markets expected to do less well in the future. In other words, according to TWR's outlook for markets and property types, pricing is not efficient."
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> Raymond Torto and William Wheaton
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Defined as the net operating income over transaction price, capitalization rates or "cap rates" are widely used in various investment analysis methodologies to derive a property's likely resale price and current investment value. Basically interpreted as return on asset or current yield for commercial real estate, this measure can provide important information about the equilibrium behavior of real estate market pricing and expected trends in supply. When values exceed the cost of construction, construction rates should continue or even accelerate; when the reverse is true, construction should stop. If markets are informationally efficient, then cap rates can theoretically be a priori indicators of changes in construction or rental growth rates. These cap rates can also be used to reverse engineer the growth rates or the risks implied assuming equilibrium conditions.

While cap rates have received a lot of attention in recent empirical real estate literature, most research has focused on explaining the patterns in cap rates over time or the variation in cap rates across different property types. Our study extends the existing literature by addressing a question that has received far less attention than needed, namely what are the factors driving the geographical cross-sectional variation in these cap rates.

Capital is usually considered fungible and will flow towards the highest returns relative to perceived risks. Yet, all real estate is essentially local. Segmentation (geographic market allocation) of real estate markets along Metropolitan Statistical Areas (MSAs) makes it important to know the extent to which cap rates vary geographically across MSAs for similar property types, as well as the specific factors generating such variation. Why are some cap rates for similar size and type property so much lower or higher in one MSA than in another? Does the data provide support for the theoretical relations that would lead to the conclusion that pricing across markets for similar type properties is efficient? How can those markets that seem to be (at least temporarily) out of equilibrium be identified? These questions are particularly important from the point of view of institutional investors with geographically diversified holdings. Such investors are certainly seeking multi-period returns from both period yields and appreciation. This paper hopes to reveal the implicit assumptions or factors that help explain differences in current pricing between segmented markets. Moreover, understanding the reasons behind these differences can help people better predict how relative cap rates would change with underlying changes in local demand/supply factors.

Using data from Real Capital Analytics for multifamily properties, this study explores several models that combine the expected influences from demand growth, supply constraints, liquidity, risk and the interaction of these. Starting from real transaction data, this study provides a compelling analysis that considers most of the factors previously taken into account in the literature, as well as additional factors that were not given appropriate attention in earlier work.

The main contribution of this study is two fold. First, substantial geographical variation across MSAs is documented for the gap between apartment cap rates and the risk-free rate. For the sample, the range that the average cap rate exceeds the risk-free rate varies from a minimum of 0.66% (obtained for San Diego, CA) to a maximum of 3.99% (obtained for Columbus, OH) during the study period. Given that macroeconomic factors should affect all cap rates similarly, it follows that only geographically-specific characteristics can be responsible for this wide variation.

Second, guided by theory [the classic Gordon model (1962)], several factors that could potentially cause this variation are considered, such as demand growth, supply constraints, liquidity, risk, capital flows or the interaction of these. A very strong and robust relation is found between supply constraints and cap rates (i.e., more stringent supply constraints for a given MSA are reflected by lower cap rates). This relation is both statistically and economically significant. Moreover, evidence is provided that supports previous literature showing that the liquidity of the market is an important determinant of cap rates (specifically, more liquid markets have lower cap rates). Supportive evidence of capital flowing from larger markets to smaller markets is also provided (large markets lead smaller markets in terms of cap rate behavior[1]).

The study contributes to key unanswered questions in the literature with interesting results. Theory implies that rental growth rates should be one of the determining factors for the variation in cap rates. While previous work tried to capture this effect, most studies have focused on direct growth measurements that only capture the demand driver of rental growth rates; the results obtained were mixed and the conclusion was that data provides very weak support for the theory. However, the current study makes the point that expected rental growth depends on both supply and demand factors. For a given rate of growth in the demand driver, the expected rental growth rate will be higher the tighter the supply. The results suggest that supply-side constraints have a more discernable impact on cap rate variations relative to direct growth measurements. Hence, not including the supply-side aspect in the context of the Gordon model may be responsible for the weak results obtained in previous reported studies.[2]

Beyond answering the question of cross-sectional variation in cap rates, studying this issue helps to understand or identify conditions of disequilibria among different markets. If it is assumed that real estate markets are on average fairly priced, then it can be uncovered how factors that drive going-in yields affect current pricing. Consequently, the impact of faster growth rates, or tighter supply constraints on real estate values could be estimated using the models. In addition, insight could be gained into which markets seem out of alignment with the others, hopefully leading to a greater understanding of the general issue of the pricing process of real estate markets. In agreement with the quote that prefaces this study, the findings show that pricing across geographical markets for apartments does not reflect relations that ought to be there according to theoretical models. This point is illustrated in more detail by showing how the methodology can be applied to identify markets that seem to be (temporarily) out of equilibrium, a question that can be of great potential interest to practitioners targeting areas for acquisition or for sale.

The remainder of the paper is organized as follows. First there is a discussion of the contribution of this study in the context of current literature. Next the theoretical background is presented along with the hypotheses. A discussion of the data and methodology used follows. A wide cross-sectional variation in average apartment cap rates across MSAs is documented next, followed by an investigation of the factors causing this variation. The paper closes with concluding remarks.

Literature Review

Considering their widespread application in the pricing of real estate and the increasing availability of more reliable localized data, there is more empirical work using national and regional cap rates being published. Studies exploring the behavior of cap rates can be classified in two broad categories. The first identifies the role different factors play in driving intertemporal movements in cap rates (Evans, 1990; Ambrose and Nourse, 1993; Jud and Winkler, 1995; and Fisher, 2000). These studies document relations between national market cap rates and interest rates, stock earnings-price ratio, changes in tax codes, etc.

A major theme of this time series category of research focuses on the intertemporal relation between cap rates and proxies for expected real rental growth rates (Chen, Hudson-Wilson, and Nordby, 2004; and Hendershott and MacGregor, 2005a, 2005b). While theory predicts a strong relation between these two variables, previous literature provides contexts telling a different story.[3] The results obtained to this point are mixed and the general conclusion is that data provides weak support of the theory. This naturally leads into the deeper question of temporary fluctuations around equilibrium values and of whether investors act rationally and correct these deviations. This issue is still under debate in the literature. On one hand, Hendershott and MacGregor (2005a) confirm previous results showing that investors in the United States behave irrationally;[4] on the other hand, the same authors (2005b) obtain the opposite results for office and retail cap rates in the United Kingdom, while Chen, Hudson-Wilson, and Nordby (2004) conduct a thorough analysis of the connection between cap rates, pricing, risk, and fundamentals over time and show that real estate in most property types in the U.S. is rationally priced.

The second stream of literature features determinants of cross-sectional variation in cap rates. Most studies examine variations in cap rates across broad property types (Dokko, Edelstein, Pomer, and Urdang, 1991; and Ambrose and Nourse, 1993). These articles show that differences across property types are important in evaluating cap rates and failure to account for these differences can lead to biased results. Other studies in this category (including the current study) focus on the geographical variations in cap rates for the same type of properties.

Early studies in this area simply identified variation in cap rates across broadly defined regions or submarkets within a given MSA (Hartzell, Hekman, and Miles, 1987; and Saderion, Smith, and Smith, 1994). Consequently, the reasons why some cap rates for similar sized and type property are so much lower or higher in one MSA versus another remain largely unexplored in previous literature. However, in two notable papers, Sivitanidou and Sivitanides (1996, 1999) focused on the cross-sectional variation of office cap rates and identified specific factors underlying such variation. In their more recent paper, they show that, despite evidence for some degree of market integration, the office asset market is segmented to a significant extent across metropolitan boundaries and that metropolitan office asset markets are inefficient in varying degrees.

The current study is different from theirs in several important aspects, including the methodology involved, type of data used, the focus on apartment (multifamily) cap rates, and more importantly the fact that the supply side effect on expected growth rates is examined in the context of the Gordon model. Although time dummies are incorporated to control for temporal effects, the focus is not on these longer term drivers of cap rate movement, and the study is cross-sectional in nature. Nevertheless, put in the context of the investor rationality debate previously described, the results gain an intertemporal flavor—assuming that investors do behave rationally, the methodology can be applied to identify markets that seem to be temporarily out of equilibrium, thus spotting potential profit opportunities.[5]

Cap Rates Models and Hypotheses

This section presents the theoretical underpinning of the hypotheses by connecting them to the theoretical models previously used in the finance and real estate literature. The model most often employed in previous work is the classic Gordon growth model applied to commercial real estate as a particular class of financial assets.

For example,[6] if the price of an apartment building at the end of period t is denoted by P_t and its net rent from period t to $t + 1$ by H_{t+1}, then the gross return from holding the apartment building from t to $t + 1$ can be defined as $1 + R_{t+1} = (P_{t+1} + H_{t+1})/P_t$. This definition of the return to commercial real estate is similar to that of common stock (except that a commercial property provides real estate services at a market value H_{t+1} instead of paying dividends).

If the simplifying conditions of the Gordon constant growth model are accepted,[7] the price can be expressed as $P = H/(r - g)$ and consequently cap rates can be defined as $CapRate = H/P$, where r is the nominal rate of return and g is the expected long-term (constant) income growth. In other words, assuming constant expected discount rates and a constant expected rate of growth in net rent, the cap rate can be expressed simply as their difference:

$$CapRate = \frac{H}{P} = r - g. \tag{1}$$

Based on the Gordon model discussed above, variables affecting r or g will in turn affect cap rates—the intuition being that a higher discount rate results in higher cap rates, while a higher expected real growth results in lower cap rates.[8] Hence the model suggests where to look for potential factors that can determine cross-sectional variation across MSAs. For example, suppose that the cap rate for apartments in Columbus is higher than the cap rate of similar apartments in San Diego. The Gordon model suggests that either expected real discount rates in Columbus are higher than those expected in San Diego or that future real rents in Columbus are expected to grow at a slower real rate than in San Diego or both. Furthermore, it follows that in order to explain cross-sectional variations in cap rates for similar type properties, the factors that can potentially generate differences in expected growth rates and risk premia across MSAs need to be identified.

Although the derivation above applies to any financial asset, one of the main aspects in which commercial real estate differs from common stock that must be taken into account is that prices of commercial properties are likely to be more sensitive than stocks to geographic, demographic, and local economic factors due to geographical market segmentation.

Following the intuition of the Gordon model and proxies used in previous literature, this study investigates the effect of several factors that could potentially influence cap rates (through their respective effect on expected growth rates and discount rates). The factors explored include expected growth of demand and supply constraints (as drivers of expected growth rate), along with liquidity, risk, and capital flows (as drivers of expected discount rates).

The Determinants of Expected Growth Rates

Most of previous empirical work has focused on demand driver proxies for the expected rental growth. This study also investigates the demand-side effect by considering variables such as *Employment Growth*, *GMP Growth*, *Income Growth*, and *Population Growth*. All of these variables are designed to capture the demand-side effect on the expected rental growth in the Gordon model, and thus a negative effect in relation to cap rates is expected. The data series from Economy.com is used to construct these proxies as annualized geometric averages over the next ten years (2006–2015) predictions.

However, it is important to note that the expected rental growth depends on both supply and demand factors. For a given rate of growth in the demand driver, the expected rental growth rate will be higher the tighter the supply. One of the main contributions of this study is to investigate and document a strong effect of supply factors in the context of the Gordon model (an issue that has received little attention in the previous literature).

The index reflecting stringency of regulation in a given MSA first built in Malpezzi (1996) and further developed in Malpezzi, Chun, and Green (1998) is used to proxy for supply constraints.[9] The index developed by Malpezzi is the main proxy for supply constraints and is available for 33 out of the 34 MSAs with available transaction data. In a more recent paper, Xing, Hartzell, and Godschalk (2006) make the point that it is important to differentiate between measurements regarding the supply-side of regulations and land management tools. While the former reflects the regulation development process and hence can respond to market conditions more quickly, the latter reflects growth management and its adoption takes longer and can affect both supply and demand of housing.

Accordingly, the authors build two separate indices: the Development Process Restrictiveness Index (DPRI) and the Growth Management Tools Index (GMTI). They provide evidence of a significant positive relation between DPRI, GMTI, and housing prices. The current study uses both of the indices to check for the robustness of the relation between cap rates and supply constraints as an alternative for the Malpezzi, Chun, and Green (1998) regulatory index. Although more refined, the main drawback of these indices for the current study is that only 22 out of the 34 MSAs for which transaction data is available in the data set can be matched.

The Determinants of Expected Discount Rates

Discount rates are mainly driven by investors' perceptions of risk across different MSA apartments markets. The perceived volatility of a metropolitan economy (proxied by variables such as the historical or expected variability of metropolitan growth rates) can be one potential driver of investors' risk perceptions. Standard deviation of the expected *Employment Growth*, *GMP Growth*, *Income Growth*, and *Population Growth* is used here as a proxy for uncertainty/volatility of a certain MSA.[10] The time series standard deviation of quarterly returns per MSA (provided by NCREIF) is another measure aimed at capturing differences in perceived risks across MSAs.

Theoretical models of risk premia, such as the classic CAPM for example, suggest that higher risk levels (measured by beta) result in high risk premia, which reflect in turn higher discount rates. Following previous literature, this study tries to build beta proxies for apartment markets across MSAs by using NCREIF data to calculate beta measures based on quarterly returns per MSA and the aggregate NPI Apartment index or the aggregate NPI National Index.[11] However, it is important to note that the relation between beta and cap rates is not clear cut. Very often high beta assets have high discount rates (from CAPM), but they also tend to have low dividend yields (their expected return is large because of the expected growth rate). Hence, although a positive relation is expected between beta and risk (and thus between beta and cap rates), growth rates and discount rates may not be independent and the relation between cap rates and beta will eventually reflect the net dominating effect between the change in growth rates and the change in discount rates.

Another risk-related factor that may affect discount rates is liquidity. Numerous studies have explored and documented the effect of liquidity in the context of real estate.[12] The intuition is that investments in less liquid markets are going to be deemed by investors as more risky and will reflect in higher required rates of return and hence higher discount rates applied to those respective markets. Consequently, investments in markets that are perceived to be more liquid may be associated with a lower cap rate. In order to capture liquidity, the average sales volume per MSA is calculated based on the transaction data that is available. Moreover, it is generally true that markets are more competitive and liquid when there's a lot of institutional interest. Institutional investors will want to be in markets where there are more transactions and where they will be able to sell a property quickly (most likely to another institutional investor), hence the probability of selling quickly would be greater in markets with greater institutional interest. Based on this argument, NCREIF data are used to obtain the aggregate dollar volume of institutional sales for the period of the study as an additional proxy designed to capture liquidity.

Also, Fisher, Gatzlaff, Geltner, and Haurin (2003) find evidence that transaction volume and liquidity is greater in rising markets when prices are increasing (cap rates are falling). They develop a model that shows how buyers' reservations prices increase relative to sellers' in an up market (and vice versa in a down market) thus leading to greater transactions. Furthermore, Fisher, Ling, and Naranjo (2007) also find evidence that there is a link between capital flows and returns for apartments at the national level and for MSAs that tend to have the most institutional capital. Thus, it might be expected that during an up market, increasing prices and lower cap rates would be observed first in the more liquid markets, which would be the larger MSAs with more institutional capital and greater transaction activity. It is easier for institutional investors to add capital where they already have investments, property managers in place, and an acquisition team already active in the market. Given the hypothesis that larger MSAs tend to attract capital sooner in a rising market (due to more investor activity, more liquidity, more information etc.), and considering existing evidence of a connection between capital flows and returns, it makes sense to investigate whether there is a connection between capital flows and cross-sectional differences in cap rates across MSAs.

In order to build a proxy that captures such capital flows, the following methodology was employed: based on average sales volume in the previous year (2004), the largest three MSAs out of the sample of 34 were picked (Los Angeles, Phoenix, and New York) and a comparison base was calculated as the average of all transaction cap rates available for 2004 for the three MSAs. Considering that larger markets are always easier for those executing new investments, it is reasonable to believe that capital will flow into these markets first. Thus, by calculating the ratio (difference) between the comparison base and the average cap rate for each MSA in 2004, a measure of cap rates in excess of the largest markets can basically be obtained. The larger this ratio is the closer is the MSA to the largest markets in terms of their cap rates, and investigating its connection with future cap rates can help examine whether capital rate compression occurs first in larger MSAs that are more liquid. A negative and significant relation between *CapRateRatio* (spread) and average cap rates in the 2005 cross-section can be interpreted as evidence that when the market is rising, capital tends to flow to the larger markets first (driving down those cap rates) and then to the smaller markets.

In summary, the previous paragraphs outline the intuition for several potential driving factors of cross-sectional variation in cap rates, through their respective effect on expected rent growths and expected discount rates. The hypotheses are summarized in the Exhibit 1.

Data and Methodology

This paper uses multifamily property transaction data obtained from Real Capital Analytics. The data set contains detailed information on 2,456 transactions that occurred in 2000–2005. After eliminating observations that are missing information for any of the variables of interest and MSAs without enough observations, 2,116 usable transaction observations that cover 34 MSAs are obtained.

The methodology used involves three steps. First, all transaction data available (2,116 observations) are used to build an apartment cap rate model that can best explain transaction level cap rates. Although the analysis is focused on the cross-section of cap rates across MSAs, the data are essentially panel data and hence care must be taken to make sure that time effects do not affect the conclusions. Taking into account that the sample period is characterized by big changes in the yield curve (see figure in Appendix A), the analysis is conducted on cap rates in excess of the risk-free rate, instead of simply using the level of cap rates as a dependent variable. The 10-year Treasury rate is used as a proxy for the risk-free

Exhibit 1 | Hypotheses

Factor	Proxy for Factor	Expected Effect	Rationale*
Expected Growth Rates	*Employment Growth, GMP Growth, Income Growth, Population Growth*	−	Demand driver for growth rate in the Gordon model.
Supply Constraints	*Malpezzi (1998) Index, Indices developed in XHG(2006)*	−	More restrictive supply constraints would result in a higher rent growth for a given increase in demand.
Liquidity	*Sales Volume, NCREIF dummy*	−	More liquidity implies less risk, which results in a lower discount rate in the Gordon model.
Risk Measures	*Std Dev of Growth Rates, Beta*	+	Higher risk results in a higher discount rate in the Gordon model.
Capital Flow Measures	*Cap Rate Ratio*	−	Capital flows from large markets towards smaller markets when capital allocated to real estate is expanding.

rate to match the characteristics of real estate as a long-term investment.[13] Also, at this stage property characteristics, such as square feet, purpose, age, distance to the center of the city etc., are controlled for while including dummies to control for location and time (other factors changing through time in addition to the risk-free rate).

Second, 2005 constant quality cap rates are determined by using 2005 averages per MSA in the model previously identified to construct a cross-section of average apartment cap rates in excess of the risk-free rate per MSA. Since the property characteristics were already controlled for, the variation in these average gaps between cap rates and the risk-free rate per MSA should be caused solely by different characteristics of the geographical markets on which the transactions occurred.

In the third step, several factors are identified that determine the cross-sectional variation in the average gaps between apartment cap rates and the risk-free rates. The intuition provided by the Gordon model is used to identify potential candidates that can influence the variable of interest through their respective effects on expected rental growth and discount rates. Two main categories of factors are examined: (1) potential drivers of expected growth rates, including both expected growth of demand proxies, as well as supply constraints factors; and (2) potential drivers of discount rates, such as risk, liquidity, and capital flows. Exhibit 2 presents a summary of definitions and data sources for the proxies employed. Exhibit 3 presents the descriptive statistics for the variables used in the cross-sectional tests.

Average Cap Rate Estimation

In the absence of detailed empirical transaction data, factors determining equilibrium values can be modeled to estimate expected equilibrium cap rates, once an acceptable model has been developed. This work builds upon the previous literature with respect to this effort. However, in light of possible inefficiencies in the real estate asset and space markets, cap rates prevailing at any certain point in time may deviate from their equilibrium level and slowly adjust to longer term equilibrium values (see Sivitanidou and Sivitanides, 1996). So markets will exhibit some harmonic fluctuation around equilibrium cap rates leading to the usual cautions in the utilization of any cap rate models for valuation purposes.

To value individual properties, the cap rate should be based on recent sales of properties at the same location with similar cash flow and value characteristics. Hence attributes that affect the variation of transaction cap rates are considered, such as the size, age, and type of property sold, the purpose of the property, the distance from the property to the center of the city, and its location. These variables are included as proxies for things (otherwise uncontrolled for) that may affect risk or return growth and through that may have an effect on cap rates.[14] In order to control for the time variation five-year dummies are included in the model.

Exhibit 2 | Definitions and Data Sources for Variables Used in Cross-Sectional Analyses

Category	Variable	Definition	Data Source
	AverageExCapRate	Average Apartment Cap Rate (in excess of the 10-year Treasury rate) per MSA for 2005 calculated based on linear model described in Exhibit 5.	Linear model estimated based on apartment transaction data from Real Capital Analytics
Growth Rates	*Employment GrRate* *GMPGrRate* *PopulationGrRate* *IncomeGrRate*	2005 Expected Growth Rates per MSA calculated as annualized geometric averages over the next 10 years.	Quarterly Employment, Gross Metro Product, Population, and Income series per MSA from Economy.com (2006–2015)
Supply Constraints	*Malpezzi98*	Index reflecting stringency of regulation in a given MSA.	Malpezzi, Chun, and Green (1998)
	DPRI *GMTI*	Development Process Restrictiveness Index. Growth Management Tools Index.	Xing, Hartzell, and Godschalk (2006)
Liquidity	*AverageSalesVol*	Calculated from original data as the sum of transaction prices per MSA.	Apartment transaction data from Real Capital Analytics
	NCREIF *Sales*	Aggregate sales per MSA calculated based on NCREIF data for the study period.	NCREIF
	StdDevEmployment *StdDevGMP* *StdDev Population* *StdDevIncome*	Standard deviation of respective expected growth rates over the period 2006–2015 designed to capture uncertainty (risk).	Economy.com
	StdDev IntraMSA	Standard deviation of individual properties within a given MSA.	NCREIF

Exhibit 2 | (continued)

Definitions and Data Sources for Variables Used in Cross-Sectional Analyses

Category	Variable	Definition	Data Source
Risk Proxies	*TimeSeriesStdDev*	Time series standard deviation per MSA using quarterly MSA returns (time periods per MSA differ, depending on data availability)..	NCREIF
	BetaApts	Beta measure calculated using quarterly returns per MSA against the aggregate NPI Apartment Index (1990–2004).	NCREIF
	BetaNat	Beta measure calculated using quarterly returns per MSA against the aggregate NPI National Index (1990–2004).	NCREIF
	CapRateRatio *CapRateSpread*	The largest three MSAs (based on average sales in 2004) are used to calculate a 2004 *CapRateIndex* (average of all transaction cap rates for the three MSAs).	Apartment Transaction Data from Real Capital Analytics
Capital Flow Measures		For each MSA, the ratio (difference) between average *CapRate* of MSA in 2004 and index (the average *CapRate* per MSA for 2004 is obtained by averaging transaction data). To avoid endogeneity problems, every time this variable is used we re-estimate the dependent variable using only 2005 transaction data.	
Interaction Terms	*Empl_Interaction* *GMPInteraction* *IncomeInteraction* *PopInteraction*	Interaction of respective growth rate for 2005 and supply constraints (*Growth Rate* * *Malpezzi98*).	Economy.com and Malpezzi, Chun, and Green (1998)

Exhibit 3 | Descriptive Statistics for the Variables used in Cross-Sectional Tests

Category	Variable	*N*	Mean	Std. Dev.	Median	Min.	Max.
	AverageExCapRate	34	0.022	0.007	0.022	0.007	0.040
	logExCapRate	34	−3.859	0.377	−3.800	−5.028	−3.221
Growth Rates	*EmploymentGrRate*	34	0.020	0.010	0.020	0.005	0.049
	GMPGrRate	34	0.054	0.010	0.053	0.039	0.086
	PopulationGrRate	34	0.016	0.008	0.016	−0.003	0.033
	IncomeGrRate	34	0.032	0.004	0.033	0.025	0.041
Supply Constraints	*Malpezzi98*	33	21.045	2.343	20.626	17.139	26.639
	DPRI	22	11.277	5.715	10.000	3.600	25.000
	GMTI	27	3.415	1.908	3.000	0.500	7.000
Liquidity	*AverageSalesVol* (mil $)	34	267.156	346.439	159.233	7.806	1,742.000
	AggregNCREIFSales (mil $)	32	2,332.050	2,481.460	1,473.100	19.309	10,976.690
Risk Proxies	*StdDevEmployment* (%)	34	0.099	0.042	0.095	0.035	0.207
	StdDevGMP (%)	34	0.162	0.031	0.162	0.078	0.255
	StdDevPopulation (%)	34	0.046	0.024	0.042	0.015	0.143
	StdDevIncome (%)	34	0.116	0.057	0.102	0.073	0.410
	StdDevIntraMSA	34	0.113	0.071	0.083	0.051	0.327
	TimeSeriesStdDev	34	0.028	0.010	0.026	0.004	0.058
	BetaApts	30	1.095	0.461	1.174	0.143	2.372
	BetaNat	30	0.802	0.373	0.748	−0.006	1.773

Exhibit 3 | (continued)

Descriptive Statistics for the Variables used in Cross-Sectional Tests

Category	Variable	*N*	Mean	Std. Dev.	Median	Min.	Max.
Capital Flow Measures	*CapRateRatio*	34	1.138	0.130	1.132	0.825	1.412
	CapRateSpread	34	0.008	0.008	0.008	−0.011	0.025
Interaction Terms	*Empl_Interaction*	33	0.427	0.227	0.395	0.131	1.177
	GMP_Interaction	33	1.141	0.251	1.114	0.783	1.814
	Income_Interaction	33	0.681	0.117	0.659	0.501	0.929
	Pop_Interaction	33	0.349	0.186	0.332	−0.067	0.739

Notes: The table presents descriptive statistics for the variables used in cross-sectional regressions to explain the variation of cap rates across MSAs. Statistics are obtained for year 2005. The data sources and methodologies used to obtain each variable are as described in Exhibit 2.

Exhibit 4 | Correlation Table

	logExCap Rates	*Empl GrRate*	*Malp 98*	*DPRI*	*GMTI*	*Avg SalesVol*	*NCREIF Sales*	*StdDev GMP*	*TimeS StdDev*	*Beta Nat*	*CapRate Ratio*	*Empl Interact*
logExCapRates	1	0.192	−0.679	−0.761	−0.434	−0.360	−0.310	0.104	−0.088	−0.575	−0.629[a]	0.083
		(0.277)	<.0001	<.0001	(0.024)	(0.037)	(0.085)	(0.560)	(0.620)	(0.001)	<.0001	(0.644)
Employment GrRate		1	−0.008	−0.228	0.088	−0.253	−0.335	0.055	0.453	−0.364	0.192	0.982
			(0.964)	(0.308)	(0.664)	(0.149)	(0.061)	(0.758)	(0.007)	(0.048)	(0.277)	<.0001
Malpezzi98			1	0.671	0.109	0.338	0.249	−0.214	0.282	0.333	−0.568	0.161
				(0.001)	(0.597)	(0.054)	(0.177)	(0.232)	(0.112)	(0.078)	(0.001)	(0.371)
DPRI				1	0.213	0.379	0.386	0.181	0.222	0.630	−0.618	−0.106
					(0.342)	(0.082)	(0.076)	(0.422)	(0.320)	(0.002)	(0.002)	(0.649)
GMTI					1	−0.097	−0.284	−0.058	0.049	0.020	−0.402	0.124
						(0.630)	(0.151)	(0.776)	(0.809)	(0.919)	(0.038)	(0.545)
AverageSalesVol						1	0.438	0.142	−0.071	0.458	−0.331	−0.238
							(0.012)	(0.422)	(0.690)	(0.011)	(0.056)	(0.182)
NCREIFSales							1	0.149	−0.035	0.553	0.225	−0.310
								(0.417)	(0.851)	(0.002)	(0.216)	(0.089)
StdDevGMP								1	0.118	0.199	−0.036	0.022
									(0.505)	(0.292)	(0.838)	(0.903)

Exhibit 4 | (continued)

Correlation Table

	logExCap Rates	*Empl GrRate*	*Malp 98*	*DPRI*	*GMTI*	*Avg SalesVol*	*NCREIF Sales*	*StdDev GMP*	*TimeS StdDev*	*Beta Nat*	*CapRate Ratio*	*Empl Interact*
TimeSeriesStdDev									1	0.339	0.197	0.503
										(0.067)	(0.262)	(0.003)
BetaNat										1	−0.520	−0.344
											(0.003)	(0.068)
CapRateRatio											1	0.119
												(0.510)
EmplInteraction												1

Notes: This table presents Pearson correlation coefficients for selected variables used in the main cross-sectional regressions to explain variation of cap rates across MSAs (*p*-values are presented in parentheses). Variables refer to year 2005 and are obtained as described in Exhibit 2.

[a] Reported correlation is calculated using the 2005 average cap rate from the linear model, with the parameters estimated based on 2005 transaction data only (in order to avoid endogeneity problems).

The empirical model takes the following form:[15]

$$R_i - R_f = a_0 + a_1 SqFt_i + a_2 AgeatSale_i + a_3 GardenDummy_i + a_4 Mid/Highrise_i + a_5 CondConv_i + a_6 DistanceToCenter + \sum_{j=1}^{5} b_j YearDummy + \sum_{j=1}^{33} c_j MSADummy_i. \quad (2)$$

Exhibit 5 presents estimation results of Equation (2) applied to the whole sample of apartment transaction data. As can be seen from the *p*-values presented in the table, year dummies and property characteristics are highly significant in explaining transaction excess cap rates, which is consistent with the initial intuition and previous literature. Location is significant in explaining differences in transaction cap rates—the coefficients of approximately two-thirds of the 33 MSA dummies included are significant at the 5% level. Additionally, the joint test on the MSA dummies presented at the bottom of Exhibit 5 is highly significant, indicating that including location is necessary in explaining the cross-sectional variation of cap rates. Location within the MSA is also significant, as reflected by the low *p*-value of the coefficient on the *Distance to Center* variable.

In the next step transaction data are used to obtain 2005 MSA averages for each of the independent variables considered in Equation (2). These averages are presented in Exhibit 6. Using these averages together with the estimated coefficients from Exhibit 5, a cross-section of 2005 empirical average constant quality excess cap rates is constructed for each of the 34 MSAs considered in the analysis.

Exhibit 7 shows that there is considerable cross-sectional variation in the average excess apartment cap rates obtained as previously described. The mean of the sample is 2.24% with a standard deviation of 0.72%; individual average cap rates in excess of the 10-year Treasury rate vary from a minimum of 0.66% (San Diego, CA) to a maximum of 3.99% (Columbus, OH).

The methodology described so far basically follows the one described in Hendershott and Turner (1999), in the sense that transaction (property) specific characteristics are used to account for location, property type, etc., in order to obtain quality adjusted cap rates that are comparable across MSAs. Average quality adjusted cap rates per MSA are then calculated. Given that individual characteristics were already taken into account and controlled for in the process of obtaining these average values, it follows that only market-specific characteristics can be responsible for this geographical variation.

Exhibit 5 | Apartment Cap Rate Model Estimates

Variable	Coeff.	*t*-Stat.	*p*-Value
Constant	0.021	15.29	0.000
Sq Ft (mil)	−0.008	−3.58	0.000
Age at Sale	0.000	3.94	0.000
2000	0.008	3.51	0.001
2001	0.015	11.95	0.000
2002	0.016	18.05	0.000
2003	0.014	17.22	0.000
2004	0.005	7.03	0.000
Garden	0.002	3.23	0.001
Mid/Highrise	0.000	−0.34	0.736
Condo Conv.	−0.008	−7.52	0.000
DistanceToCenter	0.000	5.70	0.000
Albuquerque	0.010	3.35	0.001
Atlanta	0.004	2.63	0.009
Austin	0.001	0.50	0.620
Chicago	−0.006	−2.65	0.008
Columbus, OH	0.017	4.57	0.000
Dallas	0.009	6.18	0.000
Denver	−0.004	−1.72	0.085
Fort Myers	0.000	0.11	0.913
Fresno	0.007	2.02	0.044
Houston	0.006	4.43	0.000
Indianapolis, IN	0.005	1.48	0.140
Jacksonville	−0.001	−0.36	0.720
Kansas City	0.008	2.73	0.006
Las Vegas	0.008	4.59	0.000
Los Angeles	−0.014	−13.29	0.000
Miami	−0.006	−3.44	0.001
New York	−0.012	−5.90	0.000
Orlando	−0.002	−0.67	0.504
Portland	−0.003	−1.22	0.224
Raleigh	−0.002	−0.65	0.514
Reno, NV	0.003	0.93	0.351
Sacramento	−0.008	−4.94	0.000
Salt Lake City	0.003	0.77	0.440
San Antonio	0.008	3.00	0.003

Exhibit 5 | (continued)

Apartment Cap Rate Model Estimates

Variable	Coeff.	*t*-Stat.	*p*-Value
San Diego	−0.017	−10.90	0.000
San Francisco	−0.019	−12.86	0.000
Sarasota	0.001	0.42	0.672
Seattle	−0.004	−2.48	0.013
Stockton-Lodi, CA	−0.003	−0.81	0.417
Tampa	0.006	4.30	0.000
Tucson	0.004	1.46	0.146
Washington	0.001	0.56	0.576
West Palm Beach	−0.005	−2.16	0.031

Notes: There are 2,116 observations, adjusted $R^2 = 0.459$, SE = 0.012. For the joint test of MSA dummies, the F-value = 23.9 and Pr > F = >0001. In order to obtain average cap rates in excess of the risk-free rate per MSA, the apartment transaction data for the period 2000–2005 is used in a model of the following form:

$$R_i - R_f = a_0 + a_1 SqFt_i + a_2 AgeatSale_i + a_3 GardenDummy_i + a_4 Mid/Highrise_i$$

$$+ a_5 CondConv_i + a_6 DistanceToCenter + \sum_{i=1}^{5} b_i YearDummy + \sum_{i=1}^{33} c_i MSADummy_i.$$

The dependent variable is the cap rate in excess of the risk-free rate corresponding to each transaction (the risk-free rate is measured by the 10-year Treasury rate in the month of the respective transaction). The table presents the estimated coefficients, along with the *t*-statistics and respective *p*-values (two-tailed). *SqFt* represents the size of the property sold measured in square feet. *YearDummy* captures the time when the transaction was completed. *GardenDummy* and *Mid/Highrise* are dummy variables meant to capture property type. *CondConv* is a dummy variable meant to capture the purpose of the property (takes value 1 if property is used for condo conversion and 0 otherwise). *DistanceToCenter* is the distance to the center of the city measured in miles. 33 MSA dummies are included to capture geographic variations (the 34th MSA, Phoenix, is the reference group). The last part of the table presents a joint test for the 33 location dummies (the null hypothesis is that $c_1 = c_2 = \ldots = c_{33} = 0$ in the model above).

Exploring the Determinants of Cross-sectional Cap Rate Variation

Considering previous literature, several potential factors are considered that can be responsible for differences between geographical markets and hence for the cross-sectional variation in the average gap between apartment cap rates and the risk-free rate. Guided by the Gordon model, two categories are examined: (1) factors that can influence the expected rental growth (demand expected growth

Exhibit 6 | MSA Averages

MSA Description	Sq. Ft.	Age	Garden	Mid/ Highrise	Condo Conv	Distance To Center
Albuquerque, NM	217,286	22.40	0.70	0.15	0.00	5.57
Atlanta, GA	325,167	17.35	0.36	0.05	0.05	13.46
Austin, TX	244,777	12.21	0.62	0.03	0.03	8.23
Chicago, IL-IN-WI	173,463	43.52	0.45	0.29	0.10	16.71
Columbus, OH	255,104	31.73	0.45	0.09	0.00	7.36
Dallas, TX	285,634	17.63	0.61	0.04	0.00	15.07
Denver, CO	229,952	18.84	0.53	0.13	0.09	19.85
Fort Myers, FL	246,183	12.76	0.67	0.00	0.24	7.03
Fresno, CA	196,779	23.67	0.87	0.00	0.20	5.30
Houston, TX	281,765	18.08	0.78	0.05	0.03	13.79
Indianapolis, IN	272,061	26.00	0.92	0.00	0.08	19.18
Jacksonville, FL	275,435	22.55	0.50	0.00	0.20	7.54
Kansas City, MO-KS	281,343	9.78	0.50	0.00	0.17	12.74
Las Vegas, NV-AZ	226,886	17.35	0.73	0.00	0.11	5.54
Los Angeles, CA	95,439	31.68	0.67	0.10	0.03	24.06
Miami, FL	246,439	22.23	0.47	0.23	0.35	21.61
New York, NY-NJ-CT-PA	101,593	59.62	0.15	0.80	0.07	12.33
Orlando, FL	312,275	11.56	0.30	0.04	0.07	7.63
Phoenix, AZ	177,223	18.61	0.75	0.05	0.06	24.51
Portland, OR-WA	170,880	16.70	0.76	0.03	0.00	9.24
Raleigh, NC	271,252	13.05	0.19	0.00	0.00	15.98
Reno, NV	244,526	14.25	0.50	0.00	0.00	3.27
Sacramento, CA	155,535	23.92	0.68	0.01	0.07	9.70
Salt Lake City, UT	270,158	20.23	0.23	0.00	0.00	8.77
San Antonio, TX	231,770	16.65	0.65	0.04	0.00	9.26
San Diego, CA	73,003	26.66	0.62	0.05	0.26	17.99
San Francisco, CA	58,787	40.00	0.66	0.21	0.06	37.77
Sarasota, FL	254,863	17.43	0.50	0.00	0.50	8.24
Seattle, WA	177,387	18.42	0.57	0.15	0.05	14.08
Stockton-Lodi, CA	92,544	27.67	0.83	0.00	0.00	8.23
Tampa, FL	237,850	17.95	0.50	0.03	0.15	16.93
Tucson, AZ	161,100	19.50	0.88	0.00	0.00	6.80
Washington, DC-MD-VA-WV	324,090	23.69	0.42	0.51	0.00	20.43
West Palm Beach, FL	296,385	12.15	0.52	0.07	0.37	10.14

Notes: Averages for the variables included in the cap rate model (presented in Exhibit 5) are calculated for each MSA for year 2005. These averages are used with the estimated coefficients from Exhibit 5 in order to obtain the 2005 cross-section of average cap rates per MSA (see Exhibit 7).

Exhibit 7 | Estimated Average Apartment Cap Rates (in excess of risk-free rate)

MSA	Average Cap Rate In Excess of Risk-Free Rate (%)
Columbus, OH	3.990
Albuquerque, NM	3.228
Dallas, TX	3.218
San Antonio, TX	3.026
Las Vegas, NV-AZ	2.937
Houston, TX	2.921
Indianapolis, IN	2.913
Kansas City, MO-KS	2.857
Fresno, CA	2.837
Tampa, FL	2.830
Tucson, AZ	2.727
Atlanta, GA	2.562
Reno, NV	2.470
Phoenix, AZ	2.448
Salt Lake City, UT	2.424
Washington, DC-MD-VA-WV	2.395
Austin, TX	2.289
Stockton-Lodi, CA	2.188
Portland, OR-WA	2.052
Fort Myers, FL	2.043
Raleigh, NC	1.987
Jacksonville, FL	1.955
Sarasota, FL	1.954
Seattle, WA	1.917
Denver, CO	1.885
Orlando, FL	1.834
Chicago, IL-IN-WI	1.811
Sacramento, CA	1.546
Miami, FL	1.519
New York, NY-NJ-CT-PA	1.320
West Palm Beach, FL	1.319
Los Angeles, CA	1.224
San Francisco, CA	0.954
San Diego, CA	0.655

Notes: Estimated coefficients of the linear model presented in Exhibit 5 are used along with MSA averages presented in Exhibit 6. The estimated cap rate represents the average cap rate in excess of the risk-free rate per MSA for year 2005. The proxy used for the risk-free rate is the 10-year Treasury rate. Estimates are expressed in percentages and presented in descending order.

rates, supply constraints); and (2) factors that may influence the expected discount rate (liquidity, risk, capital flows). A description of the proxies used for each category of potential factors is presented in Exhibit 2, while summary statistics of the main variables are included in Exhibit 3 and univariate results in Exhibit 4.

Estimation Results

Expected Demand Growth

Given the relation illustrated by the Gordon model, areas that have high expected growth rates are expected to be characterized by low average cap rates. The results in this case are surprising, in the sense that there is no strong demand-side effect on cap rates. All variables considered as proxies for the expected growth of demand (*Employment Growth, GMP Growth, Income Growth, Population Growth*) are generally not significant as explanatory variables of *Excess Cap Rates* (see Exhibit 8). When used in conjunction with the Xing, Hartzell, and Godschalk (2006) supply constraints indices, *Employment Growth* rate seems to be marginally improving the explanatory power of the model (Exhibit 8, Panel A).

As the quote at the beginning of this article suggests, this is one of the relations implied by theory that is apparently not supported by the data. Several explanations could be offered for these results: (1) the proxies are noisy and although the relation exists, it is not captured by the models; (2) the theoretical models provide the wrong intuition; (3) the pricing across markets is inefficient for apartments at this particular point in time. Further detail for the third potential explanation is provided at the end of this section.

It is important to note that the results are maybe not so surprising if considered in the context of previous work that has also documented this weak connection between growth rates and cap rates (Hendershott and MacGregor, 2005a). This is precisely what led to the investigation of the next category of factors (supply constraints) as another driver of rental growth rates, which may capture rental growth effects better than the demand growth proxies discussed above.

Supply Constraints

The main point of this study is that rental growth rates are not only driven by demand-side effects, but also by supply-side characteristics. Previous literature has focused only on proxies designed to capture the demand growth, and hence concluded that the theoretical relation between growth rates and cap rates is not (or weakly) supported by the data. Supply constraints are shown here to have a more discernable impact on cap rate variations relative to direct growth measurements. Hence, not including the supply-side aspect in the context of the

Exhibit 8 | Cross-Sectional Regressions

Panel A: Main Cross-Sectional Tests

Model	1	2	3	4[a]	5	6	7[a]
Intercept	−0.252	0.213	−0.715	1.158	−2.298	−2.219	−0.415
	(−0.33)	(0.24)	(−0.56)	(1.00)	(−3.43)	(−3.05)	(−0.34)
EmplGrRate	5.301	5.804			11.284		
	(1.10)	(1.12)			(1.83)		
Malpezzi Index	−0.105	−0.106	−0.098	−0.067			
	(−5.29)	(−5.20)	(−4.53)	(−1.74)			
DPRI					−0.047	−0.052	−0.044
					(−5.19)	(−5.58)	(−2.36)
GMTI					−0.088	−0.075	−0.159
					(−2.96)	(−2.38)	(−3.20)
logSales	−0.080			−0.098	−0.081	−0.083	−0.132
	(−2.26)			(−1.69)	(−2.23)	(−2.04)	(−2.07)
logNCREIFSales		−0.094	−0.040				
		(−2.46)	(−0.64)				

Exhibit 8 | (continued)

Cross-Sectional Regressions

Model	1	2	3	4[a]	5	6	7[a]
BetaNat			−0.350 (−2.06)				
StdDevGMP					3.607 (2.42)	3.863 (2.39)	4.983 (1.91)
TimeSeriesStdDev						4.878 (0.54)	
CapRateRatio				−1.948 (−2.29)			−0.770 (−1.91)
Adj. R^2	53.07%	55.87%	60.23%	54.06%	78.84%	74.88%	71.56%
F-test	13.06	13.66	15.13	9.27	16.65	13.52	11.53
AIC	−84.68	−79.26	−75.55	−49.70	−65.26	−61.49	−41.62
BIC	−81.61	−76.12	−72.32	−46.56	−59.04	−55.27	−35.40
Obs.	33	31	29	33	22	22	22

Exhibit 8 | (continued)

Cross-Sectional Regressions

Panel B: Additional Cross-Sectional Tests using Malpezzi Index as Proxy for Supply Constraints

Model	1	2	3	4	5	6	7	8	9	10	11	12	13
Intercept	−0.143	−1.591	−1.588	−1.796	0.073	−0.030	−0.540	−1.198	−2.165	−1.697	−1.236	−1.571	6.063
	(−0.18)	(−2.53)	(−3.29)	(−2.92)	(0.10)	(−0.04)	(−0.62)	(−1.38)	(−3.62)	(−1.62)	(−0.40)	(−1.77)	(1.34)
EmplGrRate							8.648			8.051			
							(1.18)			(0.14)			
GMPGrRate		4.781									−5.335		
		(0.89)									(−0.09)		
PopulationGrRate			2.233									−0.515	
			(0.31)									(−0.01)	
IncomeGrRate				9.760					17.337				−2.307
				(0.84)					(1.56)				(−1.69)
Malpezzi98	−0.104	−0.114	−0.114	−0.110	−0.104	−0.106	−0.099	−0.098	−0.091	−0.110	−0.135	−0.113	−0.490
	(−5.11)	(−5.07)	(−5.07)	(−5.02)	(−5.08)	(−4.95)	(−4.13)	(−4.49)	(−4.31)	(−2.39)	(−0.96)	(−2.85)	(−2.26)
LogAverage	−0.086				−0.096	−0.087	−0.073	−0.018					
SalesVol	(−2.44)				(−2.54)	(−2.36)	(−1.56)	(−0.38)					
StdDev	0.726												
Employment	(0.64)												
StdDevGMP		−0.781											
		(−0.46)											
StdDevPopulation			1.955										
			(0.77)										

Exhibit 8 | (continued)

Cross-Sectional Regressions

Model	1	2	3	4	5	6	7	8	9	10	11	12	13
StdDevIncome				−0.512									
				(−0.56)									
StdDevIntraMSA					0.382								
					(0.54)								
TimeSeriesStdDev						0.862							
						(0.18)							
BetaApts							−0.060						
							(−0.45)						
BetaNat								−0.383	−0.459				
								(−2.37)	(−3.45)				
Empl_Interaction										−0.020			
										(−0.01)			
GMP_Interaction											0.446		
											(0.17)		
Pop_Interactionn												0.268	
												(0.10)	
Income_Interaction													11.533
													(1.76)
Adj. R^2 (%)	51.79%	42.34%	43.26%	42.27%	51.60%	51.16%	52.76%	59.80%	63.16%	44.79%	41.97%	42.10%	47.28%
F-test	12.46	8.83	9.13	8.81	12.37	12.17	8.82	14.89	17.00	9.65	8.72	10.56	8.76
AIC	−83.79	−77.88	−78.41	−77.84	−83.66	−83.36	−69.75	−75.24	−77.77	−79.31	−77.67	−80.83	−77.75
BIC	−80.72	−74.82	−75.35	−74.78	−80.59	−80.29	−65.75	−72.02	−74.54	−76.25	−74.61	−77.77	−74.68
Obs.	33	33	33	33	33	33	29	29	29	33	33	33	33

Exhibit 8 | (continued)

Cross-Sectional Regressions

Panel C: Additional Cross-Sectional Tests using Indices from Xing et al. (2006) as Proxies for Supply Constraints

Model	1	2	3	4	5	6	7	8	9	10	11	12
Intercept	−1.983	−3.802	−3.052	−3.683	−1.692	−1.932	−2.050	−3.383	−3.293	−3.233	−3.158	−3.919
	(−2.70)	(−8.31)	(−15.30)	(−7.05)	(−2.08)	(−2.38)	(−2.63)	(−3.27)	(−10.30)	(−3.20)	(−11.05)	(−3.59)
EmplGrRate							12.880		16.846			
							(1.73)		(1.09)			
GMPGrRate		6.529								5.115		
		(0.82)								(0.27)		
PopulationGrRate			8.265								11.244	
			(1.14)								(0.73)	
IncomeGrRate				18.863				30.825				29.304
				(1.17)				(1.92)				(0.84)
DPRI	−0.041	−0.056	−0.050	−0.059	−0.048	−0.049	−0.042	−0.043	−0.048	−0.052	−0.050	−0.057
	(−4.08)	(−5.86)	(−4.77)	(−6.01)	(−4.72)	(−4.64)	(−3.75)	(−3.73)	(−4.78)	(−5.18)	(−4.73)	(−5.57)
GMTI	−0.120	−0.081	−0.105	−0.077	−0.097	−0.100	−0.113	−0.071	−0.080	−0.190	−0.084	−0.020
	(−3.73)	(−2.37)	(−2.84)	(−2.20)	(−3.00)	(−2.97)	(−3.43)	(−2.09)	(−0.84)	(−0.57)	(−0.96)	(−0.07)
LogAverageSalesVol	−0.070				−0.076	−0.067	−0.064	−0.026				
	(−1.74)				(−1.68)	(−1.47)	(−1.46)	(−0.57)				
StdDevEmployment	2.878											
	(2.05)											
StdDevGMP		3.015										
		(1.74)										
StdDevPopulation			−1.460									
			(−0.47)									

Exhibit 8 | (continued)

Cross-Sectional Regressions

Model	1	2	3	4	5	6	7	8	9	10	11	12
StdDevIncome				1.066 (1.34)								
StdDevIntraMSA					0.819 (1.14)							
TimeSeriesStdDev						6.639 (0.65)						
BetaApts							−0.013 (−0.10)					
BetaNat								−0.283 (−1.42)				
Empl_Interaction									−1.474 (−0.34)			
GMP_Interaction										1.640 (0.27)		
Pop_Interaction											−1.319 (−0.30)	
Income_Interaction												−1.768 (−0.18)
Adj. R^2 (%)	73.66%	71.31%	66.23%	70.73%	69.45%	67.92%	71.10%	72.52%	68.86%	66.36%	67.72%	67.69%
F-test	15.68	14.05	11.29	13.69	12.94	12.12	11.33	12.08	12.61	11.36	12.00	11.18

Exhibit 8 | (continued)

Cross-Sectional Regressions

Model	1	2	3	4	5	6	7	8	9	10	11	12
AIC	−61.12	−59.24	−55.65	−58.80	−57.86	−56.78	−58.41	−59.52	−57.43	−55.73	−56.62	−55.48
BIC	−56.35	−54.47	−50.88	−54.03	−53.09	−52.01	−52.19	−53.30	−52.66	−50.97	−51.85	−50.72
Obs.	22	22	22	22	22	22	22	22	22	22	22	22

Notes: The table presents estimated coefficients for the main empirical models estimated for the 2005 cross-section of average cap rates in excess of the risk-free rate per MSA (corresponding *t*-values are presented in parentheses). The dependent variable is the natural logarithm of the average excess cap rates presented in Exhibit 7. F test values, along with the AIC and BIC values need to be treated with caution, since not all of the models are comparable. Variables are calculated as described in Exhibit 2. Panel A includes the models with the highest explanatory power. Additional models that were tested using Malpezzi98 Index as a supply constraints proxy are presented in Panel B. Panel C contains additional models using the two indices from Xing et al. (2006) as proxies for supply constraints. The dependent variable is the average cap rate obtained from the linear model described in Exhibit 4, except the parameters of the model are now estimated based on 2005 transaction data only (in order to avoid endogeneity problems).

Gordon model may be responsible for the weak results obtained in previous literature.

Several early studies show that regulation/supply restrictiveness positively impacts housing prices and values (Malpezzi, 1996; Malpezzi, Chun, and Green, 1998; and Mayer and Sommerville, 2000a, 2000b). More recently, supply stories have been investigated in relation to prices with very promising results (see Gyourko, Mayer, and Sinai, 2006; and Niewerburgh and Weill, 2006). Hence it makes sense to investigate whether supply-side phenomena affect variation in cap rates across MSAs. Two sets of proxies for supply constraints are investigated: (1) the index built by Malpezzi (1996) and further refined in Malpezzi, Chun, and Green (1998) and (2) the two indices built by Xing, Hartzell, and Godschalk (2006), which are meant to capture supply restrictiveness (DPRI) and land management tools (GMTI). Given the empirical evidence that supply constraints positively affect prices, a negative relation is expected between supply constraints indices and cap rates (MSAs with the more restrictive supply constraints should have lower cap rates on average).

The univariate results (Exhibit 4) provide the first sign supportive of this hypothesis. The correlation between *logExCapRates* and *Malpezzi98* is strongly negative (−0.679) and very significant. The same story is observed when investigating correlations with *DPRI* and *GMTI*. Moreover, it seems that the two indices built by Xing, Hartzell, and Godschalk (2006) are able to capture additional information by comparison with *Malpezzi98*—although *DPRI* and *Malpezzi98* are highly positively correlated (0.671), the second index from Xing, Hartzell, and Godschalk, *GMTI*, is not significantly correlated with *Malpezzi98*, yet presents a strong negative correlation with *logExCapRates*.[16] However, univariate results are limited and cannot tell the whole story, so the investigation continues with a multivariate regression analysis.

The results in Exhibit 8 (Panel A) confirm the hypothesis that there is a very strong negative influence of supply constraints over *LogExCapRates*. Consistent with correlations presented in Exhibit 4, considering *DPRI* and *GMTI* as proxies for supply constraints significantly improves the explanatory power of the cross-sectional tests versus using *Malpezzi98* (Models 5, 6, 7 vs. Models 1, 2, 3, 4). However, only 22 out of the 34 MSAs could be matched when using the indices from Xing, Hartzell, and Godschalk (2006), while using *Malpezzi98* allows use of 33 out of the 34 MSAs in the sample. Additionally, Exhibit 4 shows a strong positive correlation between *DPRI* and the liquidity measures, indicating that some multi-collinearity problems may be encountered when using the Xing, Hartzell, and Godschalk indices in the analysis.

The data very clearly shows that there is a significant relation between the supply constraints in a given MSA and the estimated average *Excess Apartment Cap Rate* for that MSA. This relation is both statistically and economically significant and is robust to the proxy used for supply constraints. Also, the results show that this connection is not likely to be subsumed by other effects—the coefficients remain significant after including any other variables in the regression (Panels A, B, and C of Exhibit 8).

Liquidity

Considering that the liquidity of a market affects investors required risk premia, this should translate into an inverse relation between liquidity and cap rates (more liquidity for a given MSA should result in a lower cap rate). The first proxy to control for liquidity is the average sales volume per MSA, which is obtained from the transaction data. Secondly, considering that markets with more institutional participation are deemed to be more liquid, an attempt is made to capture liquidity by using the aggregate institutional sales volume for each respective MSA during the study period. However, it is important to note that this proxy based on institutional interest has high correlation with the Xing, Hartzell, and Godschalk (2006) DPRI index, which can create a potential multi-collinearity problem (this justifies the choice of using the *Sales Volume* versus NCREIF variables in models containing *DPRI* and *GMTI*).

Given the characteristics of the *Average Sales Volume* and *Aggregate NCREIF Volume* (see descriptive stats), the log of these variables is used in the multivariate regressions. Exhibit 8 shows that the coefficients are always statistically and economically significant. More liquid MSAs have significantly lower cap rates than the less liquid ones. This relation holds no matter what proxy is used for supply constraints and what other variables are included in the regression (Panels A, B, and C of Exhibit 8).

Risk

Uncertainty about future cash flows produced by a given property should affect the current value of that property. Accordingly, the higher the perceived risk for a given MSA, the higher the cap rate observed for that MSA should be (because of the higher discount rate). Several proxies were examined in an effort to capture uncertainty: standard deviation of growth rates, time series, and intra MSA standard deviation of apartment prices, as well as beta measures designed to capture covariance between MSA returns and two aggregate indices from the NCREIF website: NPI Apartments and NPI National.

While the standard deviation of *GMP* provides significant explanatory power in conjunction with the Xing, Hartzell, and Godschalk (2006) indices (Models 5, 6, and 7 of Exhibit 8, Panel A), the results are not robust when the Malpezzi (1996) index is used (Panel B, Exhibit 8). Overall, it cannot be concluded that either standard deviation of growth rates, time series, or intra MSA standard deviation of apartment prices have significant and robust explanatory power in explaining cross-sectional variation in cap rates across MSAs.

More interestingly, although the beta measures appear to be highly significant and do increase the adjusted R-squares when included in multivariate regressions, the direction of the relation is the opposite of what is expected, although this is not necessarily contradictory of theoretical predictions. As mentioned earlier, high beta assets often have not only high discount rates (from CAPM), but also low dividend yields (the expected growth rate drives the large expected return). So it could be that the negative sign of the beta coefficients captures the dominating effect of growth rates over the one of the discount rates.[17] It is also possible that the collinearity introduced by the significant correlation between the liquidity proxies and the beta variable is partially responsible for this result, although excluding the proxies for liquidity does not fix the problem with the risk coefficient (Model 9 of Exhibit 8, Panel B). Future research is needed to identify a more refined proxy for risk that can better capture the clear discount rate effect that generates cross-sectional variation in cap rates across MSAs.

Capital Flow

As discussed earlier, when there's a general economic uptrend, capital should first flow into bigger markets and once they are saturated it should gradually flow to the second and third tier markets. If this hypothesis is correct, large markets should lead smaller markets in terms of cap rate behavior. Of course, the reverse is true in a downturn cycle, but since the data only refers to one cross-section, it limits the scope of the study to identifying a flow from larger to smaller markets.

In order to eliminate any potential endogeneity problems, 2004 data are not used to explain average excess cap rates that were obtained based on the same information (observations from 2004 were used to estimate the coefficients for the model in Exhibit 5). Hence every time the *CapRateRatio* variable is included on the right-hand side, the dependent variable is re-estimated based on the same model but only using 2005 transaction data. The results estimated in Exhibit 8 are consistent with the capital flow hypothesis, since the coefficients on the *CapRateRatio* are negative and significant and including this variable increases the explanatory power of the cross-sectional regression.[18]

Interaction Terms

Previous literature suggests that the relation between cap rates, supply constraints and expected growth rates may not be linear [see discussion in Xing, Hartzell, and Godschalk (2006)]. Interaction terms calculated as the product of the supply constraint proxy and the expected growth rate for demand are included to control for the potential non-linearity of this relation. However, contrary to Xing, Hartzell, and Godschalk, the results do not show a significant improvement in terms of explanatory power when the interaction terms are included in the cross-sectional tests (Exhibit 8).

Discussion of Cap Rate Models Results

To summarize, the results show that supply constraints and liquidity of the market are strong explanatory variables for the cross-sectional variation in cap rates. Supply constraints have a more discernable impact on cap rate variations relative to direct demand growth measurements that were previously considered in the literature.

Robustness Checks

A single-step approach instead of the three-step procedure described above was also explored to make sure that the results are not solely driven by the methodology employed. Instead of obtaining average excess cap rates per MSA for year 2005, the transaction data were used directly, by replacing the location dummies with the factors that can be responsible for geographical cross-sectional variation in cap rates (supply restrictiveness indices, liquidity, expected demand growth, etc.). When the three steps are collapsed into one, the results remain qualitatively unchanged (see part D of the Appendix). Although the results are qualitatively unchanged, the main drawback of this methodology is that the results are harder to interpret, since the coefficients do not give a direct sense of the extent of cross-sectional geographical variation across MSA.

Given the strong theoretical support in favor of a connection between demand growth and cross-sectional variation in cap rates, there are several potential explanations for the surprisingly weak relation found in the data. On one hand, it is conceivable that the proxies do not satisfactorily capture the expected growth of demand. On the other hand, given that this is not the first report of this type of result (see quote at the beginning of this paper), it is also possible to infer that this weak relation is evidence of markets departing (at least temporarily) from equilibrium values. Interpreted this way, the results can lead to inferences about pricing efficiency across markets for the same type properties (in this study, apartments).

Pricing Implications

The methodology can provide insights beyond just identifying factors that generate cross-sectional variation in average apartment cap rates. The analysis can be applied to identify markets that seem to be temporarily out of equilibrium, thus spotting potential profit opportunities. The main cross-sectional models presented can be used to gain insight into which markets are out of alignment with the others at the point of the analysis, simply by identifying the MSAs with the greatest deviation from the model.

If the real estate markets are in equilibrium at least in the long run, high deviations from the model could identify potential mispricings across MSAs, which can

Exhibit 9 | Spreads Between Actual and Estimated Average Excess Cap Rates

Rank	MSA	Actual ExCapRate (%)	Predicted ExCapRate (%)	Spread (Residuals) (%)
1	San Diego	0.655	1.556	−0.901
2	Portland	2.052	2.763	−0.711
3	Denver	1.885	2.512	−0.627
4	Chicago	1.811	2.401	−0.590
5	West Palm Beach	1.319	1.722	−0.403
6	Sacramento	1.546	2.010	−0.464
7	Salt Lake City	2.424	3.029	−0.606
8	Orlando	1.834	2.146	−0.312
9	Jacksonville	1.955	2.286	−0.332
10	Sarasota	1.954	2.107	−0.153
11	Fort Myers	2.043	2.178	−0.135
12	Seattle	1.917	2.022	−0.105
13	Kansas City	2.857	3.003	−0.145
14	Raleigh	1.987	2.061	−0.073
15	Houston	2.921	2.993	−0.072
16	San Francisco	0.954	0.977	−0.023
17	Indianapolis, IN	2.913	2.789	0.124
18	Austin	2.289	2.160	0.130
19	Miami	1.519	1.431	0.087
20	Phoenix	2.448	2.218	0.230
21	Stockton-Lodi, CA	2.188	1.937	0.251
22	San Antonio	3.026	2.629	0.397
23	Los Angeles	1.224	1.053	0.171
24	Atlanta	2.562	2.193	0.370
25	Tucson	2.727	2.319	0.408
26	Albuquerque	3.228	2.703	0.525
27	Dallas	3.218	2.636	0.582
28	New York	1.320	1.055	0.265
29	Reno, NV	2.470	1.962	0.507
30	Fresno	2.837	2.199	0.638
31	Tampa	2.830	2.089	0.740
32	Columbus, OH	3.990	2.758	1.232
33	Las Vegas	2.937	2.019	0.918

Notes: The table presents MSA ranked based on the spread between the actual *ExCapRate* and the predicted *ExCapRate* obtained from Model 1 in Exhibit 8 / Panel A (values presented in the table are unlogged and expressed in percentages).

translate into profit opportunities given that the markets will eventually correct such mispricings (of course, this is true in the context of investors rationality).

For example, using Model 1 presented in Exhibit 8 (Panel A), the estimated residuals can be obtained and the MSAs ranked in order of these estimated residuals (Exhibit 9). Theoretically, the MSAs with the lowest (negative) residuals are those with cap rates lower than the model would predict, and those with the highest (positive) residuals have higher cap rates than predicted.

If the model predicts cap rates fairly accurate, conclusions can be drawn about multifamily properties values (prices) in certain MSAs as of 2005. Consequently, the apartment market for San Diego seems to be overpriced (has the lowest residuals). Conversely, apartment real estate values in Las Vegas, Columbus (OH), and Tampa are underpriced (have high positive residuals). Hence, if markets correct miss-pricings and return to equilibrium in the long run,[19] then prices in the first set of MSAs would be expected to decline in the future, while prices in the latter set of MSAs should increase.[20] The analysis is fairly robust over the choice of model as roughly the same conclusions are obtained using the other models including the Malpezzi (1996) index that are included in Panel A of Exhibit 8 (Exhibit 9 only includes results using Model 1, for illustration purposes).

Conclusion

This study documents and explores large geographical differences in apartment cap rates across MSAs. Empirical findings suggest that such variations are largely determined by the supply constraints and the liquidity of different geographical markets. Specifically, MSAs with more stringent supply constraints and more liquid MSAs have significantly lower cap rates than their counterparts. The results suggest that supply-side constraints have a more discernable impact on cap rate variations relative to direct growth measurements. Hence, not including the supply-side aspect in the context of the Gordon model may be responsible for the weak results obtained in previous reports.

Uncovering the driving factors behind geographic variation of cap rates is important as it can help us better understand and identify conditions of disequilibria among different markets. If real estate markets are assumed to be on average fairly priced, then it can be explained how factors that drive going-in yields affect current pricing. Consequently, the impact of faster growth rates can be estimated, or the effect of tighter supply constraints based on economic trends or new regulations on real estate values, mortgage risk or even property taxes as side effects. In addition, insight can be gained into which markets seem out of alignment with the others, hopefully leading to greater understanding of the general issue of the shorter-term dynamic pricing process of real estate markets.

Appendix

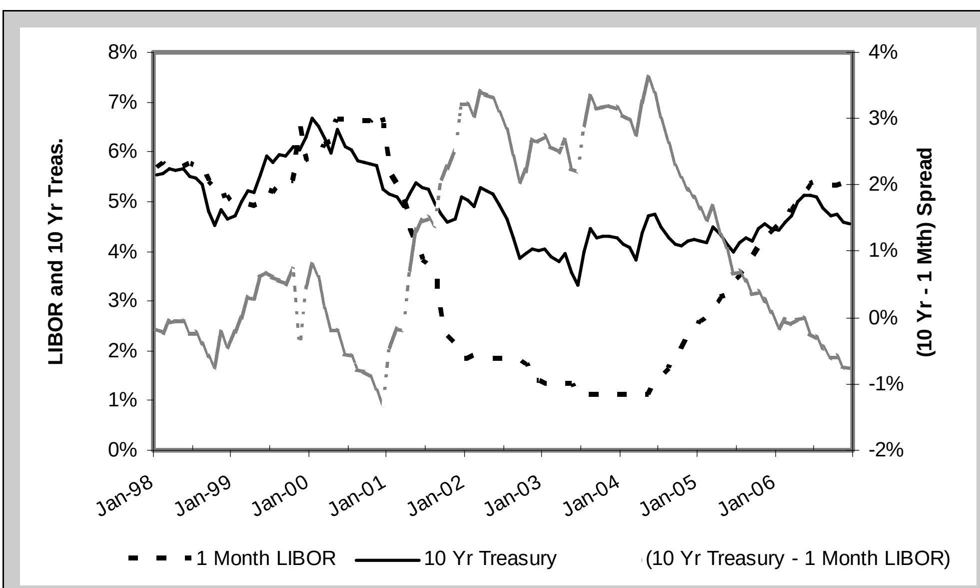
Robustness Checks

A. Changes in Yield Curve

Exhibit A1 presents the 1 month LIBOR, the 10-year Treasury, and the spread over the period 1998–2006. The sample period (2000–2006) is characterized by big fluctuations in the yield curve, which motivates us to look at the gap between cap rates and the risk-free rate versus just the level of the cap rates.

Exhibit A1 | One Month LIBOR vs. 10-year Treasury Yield

Levels and Spread



B. Using Monthly One Month LIBOR as Proxy for Risk-Free Rate

Given that real estate markets become more and more securitized, an argument can be made that they move with the market, and hence a short-term interest rate is a more suitable proxy for the risk-free rate. In Step 1, we replace the cap rate in excess of the 10-year Treasury rate with the one month LIBOR rate. All other variables are defined as in Exhibit 4. Exhibit A2 presents the estimated coefficients, along with the *t*-statistics and respective *p*-values.

Exhibit A2

Variable	Coeff.	Test Statistic	*p*-Value
Constant	0.021	15.29	0.000
Sq Ft (mil)	−0.008	−3.58	0.000
Age at Sale	0.000	3.94	0.000
2000	0.008	3.51	0.001
2001	0.015	11.95	0.000
2002	0.016	18.05	0.000
2003	0.014	17.22	0.000
2004	0.005	7.03	0.000
Garden	0.002	3.23	0.001
Mid/Highrise	0.000	−0.34	0.736
Condo Conv	−0.008	−7.52	0.000
Distance To Center	0.000	5.70	0.000
Albuquerque	0.010	3.35	0.001
Atlanta	0.004	2.63	0.009
Austin	0.001	0.50	0.620
Chicago	−0.006	−2.65	0.008
Columbus, OH	0.017	4.57	0.000
Dallas	0.009	6.18	0.000
Denver	−0.004	−1.72	0.085
Fort Myers	0.000	0.11	0.913
Fresno	0.007	2.02	0.044
Houston	0.006	4.43	0.000
Indianapolis, IN	0.005	1.48	0.140
Jacksonville	−0.001	−0.36	0.720
Kansas City	0.008	2.73	0.006
Las Vegas	0.008	4.59	0.000
Los Angeles	−0.014	−13.29	0.000
Miami	−0.006	−3.44	0.001
New York	−0.012	−5.90	0.000
Orlando	−0.002	−0.67	0.504
Portland	−0.003	−1.22	0.224
Raleigh	−0.002	−0.65	0.514
Reno, NV	0.003	0.93	0.351
Sacramento	−0.008	−4.94	0.000
Salt Lake City	0.003	0.77	0.440
San Antonio	0.008	3.00	0.003

Exhibit A2 | (continued)

Variable	Coeff.	Test Statistic	*p*-Value
San Diego	−0.017	−10.90	0.000
San Francisco	−0.019	−12.86	0.000
Sarasota	0.001	0.42	0.672
Seattle	−0.004	−2.48	0.013
Stockton-Lodi, CA	−0.003	−0.81	0.417
Tampa	0.006	4.30	0.000
Tucson	0.004	1.46	0.146
Washington	0.001	0.56	0.576
West Palm Beach	−0.005	−2.16	0.031

Notes: The R^2 is 0.471; Adj. R^2 is 0.459; SE is 0.012; and the number of observations is 2,116.

C. Controlling for Vacancy Rate

The data set contains occupancy rate (expressed as a percentage) for 1,408 out of the 2,116 usable transaction observations. To take advantage of this information, an attempt was made to model expected future growth rent as a function of vacancy rate. Several proxies were considered: (1) VR − simple vacancy rate expressed as a positive percentage (VR = 1 − occupancy rate); (2) VR1 − difference between the vacancy rate of a given transaction and the average vacancy rate of that market in the prior year ($VR1 = VR_{it} - \overline{VR_{t-1}}$); and (3) VR2 − proxy meant to capture the market's current vacancy rate relative to its long run or natural rate ($VR2 = VR_{it} - \overline{VR_i}$). Coefficients and *p*-values for each of the three models are included in Exhibit A3, along with the respective adjusted R square. The dependent variable is the cap rate in excess of the risk-free rate (10-year Treasury rate is used as proxy for the risk-free rate).

Exhibit A3

Proxy for Vacancy Rate:	VR		VR1		VR2	
Variable	Coeff.	*p*-Values	Coeff.	*p*-Values	Coeff.	*p*-Values
Constant	0.018	<.0001	0.019	<.0001	0.019	<.0001
Sq Ft (mil)	−0.010	0.00	−0.009	0.00	−0.010	0.00
Age at Sale	0.000	0.00	0.000	0.00	0.000	0.00
2000	0.006	0.07			0.006	0.07

Exhibit A3 | (continued)

Proxy for Vacancy Rate:	VR		VR1		VR2	
Variable	Coeff.	*p*-Values	Coeff.	*p*-Values	Coeff.	*p*-Values
2001	0.014	<.0001	0.011	<.0001	0.014	<.0001
2002	0.016	<.0001	0.015	<.0001	0.016	<.0001
2003	0.014	<.0001	0.014	<.0001	0.014	<.0001
2004	0.005	<.0001	0.005	<.0001	0.005	<.0001
Proxy for Vacancy Rate	0.011	0.00	0.009	0.01	0.011	0.00
Garden	0.003	0.00	0.003	0.00	0.003	0.00
Mid/Highrise	0.000	0.84	0.001	0.41	0.000	0.84
Condo Conv	−0.006	<.0001	−0.007	<.0001	−0.006	<.0001
Distance to Center	0.000	<.0001	0.000	<.0001	0.000	<.0001
Albuquerque	0.010	0.01	0.004	0.43	0.009	0.01
Atlanta	0.004	0.04	0.005	0.02	0.004	0.03
Austin	0.002	0.46	0.002	0.62	0.002	0.48
Chicago	−0.005	0.11	−0.010	0.02	−0.006	0.09
Columbus, OH	0.020	<.0001	0.023	0.00	0.020	<.0001
Dallas	0.011	<.0001	0.011	<.0001	0.011	<.0001
Denver	−0.004	0.18	−0.005	0.19	−0.004	0.16
Fort Myers	0.003	0.40	0.002	0.57	0.002	0.46
Fresno	0.006	0.11	0.007	0.07	0.007	0.05
Houston	0.007	<.0001	0.007	<.0001	0.007	<.0001
Indianapolis, IN	0.005	0.13	0.008	0.05	0.006	0.10
Jacksonville	0.002	0.62	−0.003	0.58	0.002	0.64
Kansas City	0.010	0.00	0.010	0.00	0.010	0.00
Las Vegas	0.010	<.0001	0.010	<.0001	0.010	<.0001
Los Angeles	−0.012	<.0001	−0.012	<.0001	−0.013	<.0001
Miami	−0.005	0.01	−0.006	0.00	−0.006	0.00
New York	−0.010	0.00	−0.008	0.04	−0.009	0.00
Orlando	−0.001	0.67	−0.002	0.61	−0.001	0.62
Portland	0.000	0.88	0.000	0.95	−0.001	0.83
Raleigh	0.000	0.96	−0.003	0.40	0.000	0.99
Reno, NV	0.007	0.19	0.011	0.21	0.007	0.22
Sacramento	−0.008	<.0001	−0.008	<.0001	−0.008	<.0001
Salt Lake City	0.005	0.56	0.007	0.54	0.004	0.60
San Antonio	0.007	0.02	0.008	0.02	0.007	0.02
San Diego	−0.014	<.0001	−0.015	<.0001	−0.015	<.0001

Exhibit A3 | (continued)

Proxy for Vacancy Rate:	VR		VR1		VR2	
Variable	Coeff.	*p*-Values	Coeff.	*p*-Values	Coeff.	*p*-Values
San Francisco	−0.017	<.0001	−0.018	<.0001	−0.018	<.0001
Sarasota	0.003	0.49	0.008	0.26	0.003	0.52
Seattle	−0.004	0.09	−0.004	0.05	−0.004	0.06
Stockton-Lodi, CA	−0.002	0.68	−0.003	0.45	−0.002	0.60
Tampa	0.007	<.0001	0.008	<.0001	0.007	<.0001
Tucson	0.004	0.20	0.004	0.19	0.004	0.20
Washington	0.002	0.51	0.000	0.92	0.001	0.64
West Palm Beach	−0.006	0.03	−0.007	0.02	−0.006	0.02

Notes: For VR, Adj. R^2 = 44.41% and the number of observations = 1,408; for VR1, Adj. R^2 = 44.06% and the number of observations = 1,268; and for VR2, Adj. R^2 = 44.43% and the number of observations = 1,408.

D. Alternative Methodology

An alternative method is considered to make sure that the results are not driven by the methodology employed. Instead of the three-step analysis employed in the main body of the paper, a single step analysis is used where the regression uses transaction level data (location dummies are replaced with variables meant to capture geographical cross-sectional differences). The model now takes the following form:

$$\begin{aligned} R_i - R_f = {} & a_0 + a_1 SqFt_i + a_2 AgeatSale_i + \sum_{j=1}^{5} b_j YearDummy_i \\ & + a_3 GardenDummy_i + a_4 Mid/Highrise_i + a_5 CondConv_i \\ & + a_6 DistanceToCenter_i + Malpezzi98_i + VacancyRate_i \\ & + LogSales_i + EmploymentGrRate_i. \end{aligned}$$

The expected employment growth rate is reestimated based on data from economy.com for each quarter of the period 2000–2005 and then matched with each transaction that occurred during that given quarter. Exhibit A4 contains coefficients and *t*-values for two models: one including occupancy rate and the other without the occupancy rate. The dependent variable is the cap rate in excess of the 10-year Treasury rate.

Exhibit A4

	Model 1	Model 2
Constant	0.096	0.078
	(12.63)	(13.90)
Sq Ft (mil)	−0.003	0.002
	(−1.32)	(0.09)
Age at Sale	0.000	0.000
	(3.23)	(3.76)
2000	0.007	0.011
	(1.73)	(4.14)
2001	0.016	0.016
	(9.84)	(12.30)
2002	0.017	0.017
	(14.72)	(17.53)
2003	0.014	0.014
	(13.99)	(16.35)
2004	0.004	0.004
	(4.54)	(5.52)
Garden	0.003	0.002
	(3.24)	(3.01)
Mid / Highrise	−0.000	−0.001
	(−0.28)	(−0.55)
Condo Conv	−0.007	−0.009
	(−5.67)	(−8.32)
DistanceToCenter	0.000	0.000
	(3.60)	(4.10)
Malpezzi98	−0.002	−0.002
	(−12.84)	(−16.24)
OccupancyRate	−0.014	
	(−3.55)	
logSales	−0.001	−0.001
	(−4.02)	(−3.60)
QEmplGrRate	0.005	0.005
	(4.36)	(5.57)

Notes: For Model 1, the Adj. R^2 is 39.51% and the number of observations is 1,375. For Model 2, the Adj. R^2 is 40.28% and the number of observations is 2,065.

Endnotes

1 Although this flow could reverse in the same process, the cycle data are insufficient for further pursuit.

[2] One could find a higher than average growth rate in a particular market but an even faster stream of supply as well, negating the expected impact on the cap rate and value with a demand-side only model.

[3] For example, Lusht and Fisher (1984) addressed a closely related topic and found that debt levels for commercial properties were largely independent of anticipated growth. Since the availability of debt is a major driver of market prices, their result is consistent with the weak relationship between growth and cap rates observed subsequently.

[4] The authors show that investors do not factor expectations of mean or trend reversion of real cash flows into their asset pricing, as reflected in cap rates.

[5] Of course, this interpretation hinges not only on the assumption of investor rationality, but also on the acceptance of the equilibrium cap rate models proposed.

[6] See Plazzi, Torous, and Valkanov (2006) for a more detailed discussion on returns in the context of real estate and cap rate models.

[7] The model assumes a constant income growth per period, as well as implying constant risk premia and risk-free rates over time [see Geltner, Miller, Eichholtz and Clayton (2007, p. 594) for a more detailed discussion of the Gordon model in the context of real estate literature].

[8] Generally, one should define these in real terms; however, since inflation for the period of study did not exhibit significant variation and the nature of the analysis is cross-sectional, there is no specific control for inflation.

[9] The authors are grateful to Stephen Malpezzi for supplying an updated version of the supply constraints index.

[10] The current study follows Sivitanidou and Sivitanides (1996) in using standard deviation of growth rates as a potential proxy that captures the perceived volatility of the metropolitan economy and hence shapes investors risk perceptions across MSAs.

[11] The current study follows the methodology described in Breidenbach, Mueller, and Schulte (2006) to calculate beta measures.

[12] Sivitanidou and Sivitanides (1999) explore liquidity in the context of office cap rates; Benveniste, Capozza, and Seguin (2001) investigate the value of liquidity in the context of REITs.

[13] Alternatively, it could be argued that since real estate becomes more and more securitized, cap rates tend to move with the market, in which case a short-term interest rate would be the appropriate proxy for the risk-free rate. Results remain qualitatively unchanged when the 1-month LIBOR is used as a proxy instead (see Appendix B)

[14] For example, age is a variable associated with location. Newer properties tend to be in growth areas and thus a possible growth effect factor is added that is locational in nature but it is captured via ‘‘age’’ since an index for the quality of the location is not available (same type of argument can be made for size, type of property etc.).

[15] Although other forms were also considered, the linear form seems to do the best job of capturing variation in the data. Several other deal-specific variables (such as vacancy rate) were considered but were not included in the final model since they did not provide significant improvement (see the Robustness Checks in Appendix C for results with the vacancy rate proxies included).

[16] Similar results are presented in Xing, Hartzell, and Godschalk (2006).

[17] While theoretically this issue could be addressed by including an interaction variable between growth and beta, untabulated results show unsatisfactory results regardless of the proxies involved.

[18] Since capital flows are not the main point of the paper, little time was spent on investigating this relation—the cross-sectional analysis receives priority instead.

[19] Of course, ''long-run'' cannot be defined based on the current analysis. An interesting future research question would be to investigate how long it does take for the markets to correct.

[20] A complete analysis to see if cap rates return to equilibrium values in time is not employed—the main focus of this paper is the determinants of the cross-sectional variation in cap rates across MSAs. However, as a preliminary investigation revealed that the average apartment cap rates for 2006 in San Diego did increase, while those for Tampa, Columbus, and Las Vegas decreased. It is a worthwhile study to examine the time to move towards long-term equilibrium estimates.

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