

Are There Bubble Potentials in the U.S. Retail Property Market?

Ko Wang* and Jing Yang**

Unlike the U.S. residential property markets, U.S. commercial property markets, including the retail property market, have received little attention in the recent debates about real estate bubbles. This oversight seems odd, especially since commercial property markets are also important in the economy and have more obvious capital market asset features. In this study, we conducted indirect tests to detect behaviors that might cause wide price oscillations and promote “bubbles” in the U.S. retail property market, through an examination of the long-term excess momentum of retail property price changes, controlling for economic fundamentals. We accomplished this with a regression of the rates of price change on fundamental economic variables and historical price change rates. From calculated momentum, contrarians, and flips indicated from the effects of historical price changes, we examined not only the significance of price deviations from fundamentals, but also the nature of these deviations. In this case, excess momentum without flips in the price but not rent can be considered behavior that would create multiple price bubbles in the market. We find evidence of long-term excess price momentum in national data and data for some major metropolitan areas. The results are mainly driven by regional and super-regional retail property submarkets, and large geographical markets such as Los Angeles, Chicago, and Orange County. From these results, we challenge the traditional supposition that price bubbles are less relevant to commercial property markets than to residential property markets.

Introduction

In the past decade, real estate price movements have been a hot topic for the U.S. public, regardless of whether prices were experiencing skyrocketing growth rates or significant slide in value. It has been an old question whether there have been bubbles in real estate prices, and the opinions are largely inconsistent. Two years ago, David Lereah, the chief economist for the National Association of Realtors, argued that “there is no national price bubble; never has been; never will be,” and he also saw no sure signs of local bubbles, either (Lewis, 2004). His arguments are consistent with several real estate studies (e.g., McCarthy and Peach, 2004), but inconsistent with several others (e.g., Case and Shiller, 2003), and partially consistent with still others (e.g., Abraham and Hendershott, 1996), who found that bubbles exist only in the markets of coastal regions.

Meanwhile, real estate bubble studies have been conducted almost exclusively on residential property markets, while commercial property markets, an equally important component of real estate markets and with probably more capital asset market features than residential property markets, have been almost completely ignored. This astonishing oversight could possibly be attributed to more severe data constraints for price bubble studies for commercial property markets, as well as the common suppositions that commercial property investors are more professional and

* Baruch College, City University of New York, New York, NY 10010, or
Ko_Wang@baruch.cuny.edu

** California State University at Fullerton, Fullerton, CA 92831, or jyang@fullerton.edu

experienced. Also, commercial property price changes are more constrained due to common phenomena such as natural vacancy rates and non-rent substitutes such as up-front deposits, which would also suggest that bubbles would be less common. Our study explores this interesting and yet untouched research question by examining possible evidence of long-term excess price momentum that might create bubbles in U.S. retail property markets.

Interesting Facts from the U.S. Retail Property Market

There are two primary reasons why retail property price movements deserve a more thorough examination. First, there is a sharp contrast between the volatile demand and rigid supply for retail properties. The volatility in demand mainly comes from the volatility in retail business. As shown in Figure 1, since the early 1980s the volume of real seasonally adjusted retail sales (that is, the volume of retail sales with inflation and seasonal effects controlled) has oscillated over time. During the same period, however, the retail property stock grew at a stable rate. It is not very difficult to interpret that the stability of retail property stocks results from the unusual rigidity of retail property supply. Retail properties such as malls and supermarkets are particularly large and have distinguishing usage specializations; therefore, building lifespans are normally long and deinvestment is usually difficult, contributing to a rigidity in supply. Given the sharp contrast between the demand and supply for retail properties, price movements should be distinctive.

In addition, just as with other real estate properties, retail properties are both space assets for terminal users and capital assets for investors, aspects which are characterized by rent and price, respectively. In the retail property market, however, rent and price are not as correlated as in other major commercial property markets, and this lack of correlation has been persistent over time. As shown in Table 1, Panel A, among the five major commercial property markets (apartment, office, industrial, retail, and hotel), the retail property market has a very low correlation between price changes and rent changes, with a correlation coefficient $r = 0.324$, second-lowest next to the hotel market ($r = 0.188$). As shown in Table 1, Panels B and C, this lack of correlation has been persistent in the retail property markets, and has experienced a persistent trend of continuously decreasing correlation, unlike in other markets, where the magnitude of correlation between price and rent is unstable over different periods.

Finally, the aggregate retail property market can be decomposed into different property types: community, regional, super-regional, single-tenant, power center, fashion/special, and neighborhood. Cross-submarket heterogeneities are obvious between these groups, as there are significant differences in property size, function, and development cycles. It is conceivable, therefore, that these different property types have very divergent change patterns in price and rent, which should be explored.

In this research, we explore the following research questions. First, do movements in retail property prices deviate from the movements of their fundamentals, and if so, what is the nature of this deviation? Are there similar patterns with retail property rent movements? Are local factors more influential to rent than to price, as

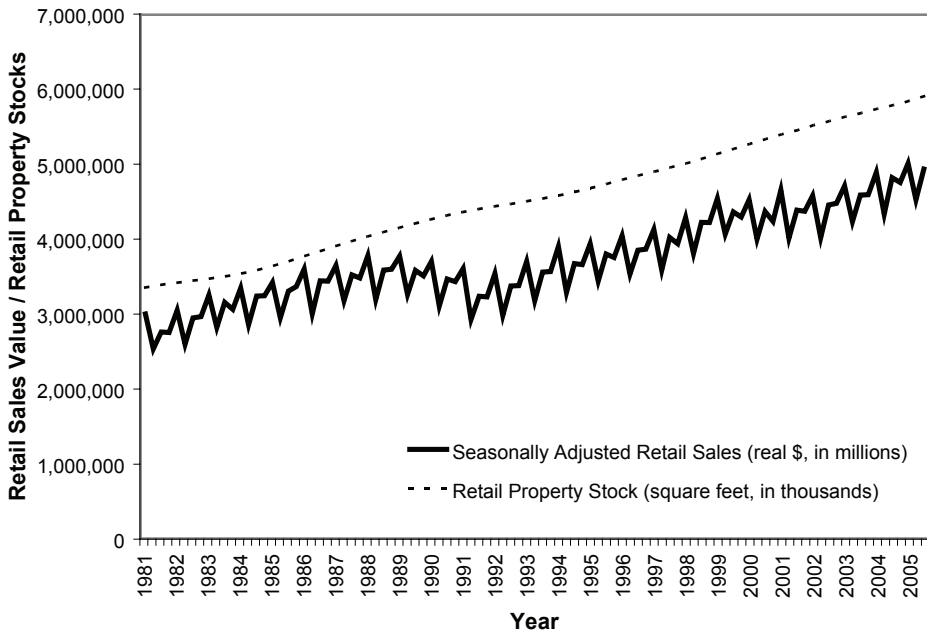


Figure 1.
Time Trends of Retail Sales and Property Stocks.

suggested by the literature? How do these results differ across retail property type? How do these results differ across other commercial property types?

Literature Review

Studies of price “bubbles” have a long history in finance and real estate literature, and their definition varies between studies and over time. The term “bubble” can be used to diagnose price changes from a pure mathematical perspective: growth in prices at an extremely high rate. For example, Zhou and Sornette (2003), borrowing ideas from the science of complexity, suggest that a housing market bubble occurs when house prices fit some exponential function of time, a situation where “the growth rate itself grows, signaling an unsustainable regime.” Following this definition, they find that bubble signatures are present in historical data for U.K. housing prices, but not with house prices in the U.S. Although this definition captures an important feature of bubble, the abnormal price increase, they are not economically intuitive, and hence unsatisfactory.

Some studies relate bubbles to speculative investment behaviors. For instance, Scheinkman and Xiong (2003) modeled a situation with short-sale constraints and heterogeneity in investors’ expectations on stock market. In this model, some investors are willing to pay prices that exceed their own valuation of future dividends simply because they believe that in the future they will find optimistic buyers willing to pay

Table 1.
Correlation Coefficients of Quarterly Price Change Rates and Quarterly Rent Change Rates in Five Commercial Property Markets.

| Panel A 1989:4-2006:2 | <i>Price</i> | | | | | <i>Rent</i> | | | | |
|--------------------------|--------------|---------|--------|--------|-------|-------------|---------|--------|--------|-------|
| | Apert. | Indust. | Office | Retail | Hotel | Apert. | Indust. | Office | Retail | Hotel |
| <i>Price</i> | | | | | | | | | | |
| Apartment | 1.000 | | | | | | | | | |
| Industrial | 0.860 | 1.000 | | | | | | | | |
| Office | 0.803 | 0.918 | 1.000 | | | | | | | |
| Retail | 0.708 | 0.620 | 0.604 | 1.000 | | | | | | |
| Hotel | 0.457 | 0.515 | 0.537 | 0.273 | 1.000 | | | | | |
| <i>Rent</i> | | | | | | | | | | |
| Apartment | 0.430 | 0.523 | 0.531 | 0.055 | 0.409 | 1.000 | | | | |
| Industrial | 0.462 | 0.512 | 0.484 | 0.213 | 0.445 | 0.774 | 1.000 | | | |
| Office | 0.322 | 0.440 | 0.445 | 0.107 | 0.418 | 0.792 | 0.839 | 1.000 | | |
| Retail | 0.406 | 0.465 | 0.431 | 0.324 | 0.385 | 0.567 | 0.829 | 0.835 | 1.000 | |
| Hotel | 0.128 | 0.039 | 0.043 | 0.025 | 0.188 | 0.155 | 0.290 | 0.212 | 0.263 | 1.000 |

| Panel B 1989:4-1999:4 | <i>Price</i> | | | | | <i>Rent</i> | | | | |
|--------------------------|--------------|---------|--------|--------|-------|-------------|---------|--------|--------|-------|
| | Apert. | Indust. | Office | Retail | Hotel | Apert. | Indust. | Office | Retail | Hotel |
| <i>Price</i> | | | | | | | | | | |
| Apartment | 1.000 | | | | | | | | | |
| Industrial | 0.810 | 1.000 | | | | | | | | |
| Office | 0.777 | 0.931 | 1.000 | | | | | | | |
| Retail | 0.716 | 0.682 | 0.706 | 1.000 | | | | | | |
| Hotel | 0.452 | 0.536 | 0.567 | 0.271 | 1.000 | | | | | |
| <i>Rent</i> | | | | | | | | | | |
| Apartment | 0.783 | 0.800 | 0.715 | 0.489 | 0.515 | 1.000 | | | | |
| Industrial | 0.719 | 0.741 | 0.641 | 0.384 | 0.515 | 0.865 | 1.000 | | | |
| Office | 0.738 | 0.849 | 0.760 | 0.481 | 0.569 | 0.840 | 0.784 | 1.000 | | |
| Retail | 0.734 | 0.815 | 0.723 | 0.439 | 0.585 | 0.834 | 0.792 | 0.884 | 1.000 | |
| Hotel | 0.105 | -0.027 | -0.014 | -0.116 | 0.116 | 0.187 | 0.267 | 0.102 | 0.242 | 1.000 |

Table 1. (continued)

| Panel C 2000:1-2006:2 | <i>Price</i> | | | | | <i>Rent</i> | | | | |
|--------------------------|--------------|---------|--------|--------|-------|-------------|---------|--------|--------|-------|
| | Apert. | Indust. | Office | Retail | Hotel | Apert. | Indust. | Office | Retail | Hotel |
| <i>Price</i> | | | | | | | | | | |
| Apartment | 1.000 | | | | | | | | | |
| Industrial | 0.900 | 1.000 | | | | | | | | |
| Office | 0.891 | 0.881 | 1.000 | | | | | | | |
| Retail | 0.530 | 0.351 | 0.389 | 1.000 | | | | | | |
| Hotel | 0.702 | 0.680 | 0.619 | 0.522 | 1.000 | | | | | |
| <i>Rent</i> | | | | | | | | | | |
| Apartment | 0.367 | 0.516 | 0.609 | -0.052 | 0.298 | 1.000 | | | | |
| Industrial | 0.349 | 0.375 | 0.386 | 0.259 | 0.341 | 0.693 | 1.000 | | | |
| Office | 0.172 | 0.250 | 0.278 | 0.073 | 0.273 | 0.746 | 0.903 | 1.000 | | |
| Retail | 0.129 | 0.116 | 0.072 | 0.286 | 0.191 | 0.418 | 0.899 | 0.845 | 1.000 | |
| Hotel | 0.262 | 0.234 | 0.253 | 0.259 | 0.322 | 0.110 | 0.310 | 0.306 | 0.297 | 1.000 |

even more, which leads to price bubbles. This approach has received wide attention and has been applied to a number of real estate bubble studies. The bubble detection following this type of definition usually relies on asset trading information. For instance, Wong (2007) examined the speculative price components and turnover rates in the Hong Kong housing market, and found evidence of speculation generated by investor overconfidence.

A more popular definition of bubble is the deviation of price from its fundamentals. Traditionally, any deviation from the fundamentals, or, “mispricing”, can be counted as a “bubble.” For instance, Flood and Garber (1980) defined a price bubble as a situation where “the arbitrary self-fulfilling expectation of price changes may drive actual price changes independently of market fundamentals.” Meese (1986) tests for the presence of bubbles in exchange rates, using their deviations from values implied by market fundamentals. Other studies following the similar bubble definition include Garber (1989), Stiglitz (1990), and Werner (1997).

Some studies also pay attention to the features of the deviations. DeLong et al. (1990) and Barberis et al. (1998) posit that one type of deviation may take the form of momentum trading, where investors buy and sell assets based on historical price alone, that is, buy “winners” and sell “losers.” This is commonly thought of as an “irrational” bubble (Black, Fraser, and Hoesli, 2006). In contrast, Froot and Obstfeld (1991) defined a “rational” or “intrinsic” bubble as being when the deviation from the actual fundamental value is consistent with the rational expectation on the fundamentals, which is usually a “stable and highly persistent over- or undervaluations,” as compared to a “fad,” which is largely determined by non-fundamentals and causes short-term deviation and long-term reversal.

Consistently, however, real estate bubbles have been defined as the deviations of property prices from their economic fundamentals, where the fundamentals are

analyzed in two ways: against a set of fundamental economic factors (such as Abraham and Hendershott, 1996, McCarthy and Peach, 2004, and Black, Fraser and Hoesli, 2006); and against rent (such as Baker, 2002). Explicitly or implicitly, however, a market bubble is regarded as the difference between the actual price and the real price predicted from fundamental economic variables.

Following this traditional definition, the literature provides inconsistent answers on the existence of a bubble in the U.S. real estate market, primarily in the residential real estate market. For instance, Baker (2002) reported a deviation of the housing price index from the CPI rent index, indicating that the real cost of owning a house was higher than the real cost of renting, an evidence of bubble. McCarthy and Peach (2004) reject the bubble hypothesis by showing that the national housing price increases in the 1990s were largely caused by falling mortgage rates and a strong US economy, and the housing price fluctuations in areas like California over the period of 1975 to 1999 were largely due to the changing demands fundamentals and inelastic supply in these areas. Abraham and Hendershott (1996) compared actual U.S. house prices with fundamental prices predicated from regressions on CPIs, real income growth, after-tax interest rates growth, real construction costs growth, and employment growth, and conclude that bubble exists only in coastal regions. Case and Shiller (2003) conducted a survey from which they demonstrated that the general indicators of bubbles (including price expectations and investors' sentiments) are very strong.

In our study, we use a new approach to detect bubble potentials in the real estate market. Instead of examining the residuals of property price regression models on fundamental variables, we regressed property price indices on both fundamentals economic variables and historical price trends. As we will define later, the effects of the trend variables may indicate momentum, contrarians, and their reversals, allowing us to investigate not only the significance of the price deviations from fundamentals, but also the nature of these deviations, and whether they suggest the presence of price momentum which could lead to market bubbles. This provides a more stringent test for bubbles than those found in the current real estate literature.

Before our study, there has been no research that has addressed the issue of bubbles in the commercial property markets. Only a few works investigate the relations between commercial property markets and economic fundamentals. For instance, Wheaton and Rossoff (1998) demonstrate that hotel demand moves closely with the U.S. economy albeit at a much higher cyclic frequency, which rejects the popular notion that the hotel industry experienced two large building booms from 1969 to 1994. Voith and Crone (1988) and Mills (1992) both suggest that the office market is affected by location and building characteristics much more than by macroeconomic fundamentals. Clapp, Pollakowski, and Lynford (1992) and Mourouzi-Sivitanidou (2002) show that the supply of office space is responsive to lagged expected demand and the office rental adjustments tend to be sluggish. Several other studies suggest that commercial property rent changes are constrained by the common practices such as the natural vacancy rate, the non-rental substitutes like rental up-front deposits, and so on. These studies include Shulman (1981), Smith and Tomlinson (1981), Hohm (1983), all on apartment markets; Benjamin, Shilling and Sirmans (1992) on office markets;

and Wheaton (2000) and Benjamin, Boyle, and Sirmans (1990) on retail property markets.

Data

Our study uses four groups of data: national macroeconomic data, metropolitan economic data, national property data, and metropolitan property data. Our national macroeconomic data set includes variables such as retail sales, interest rates, unemployment rate, gross domestic product (GDP), consumer price index (CPI), and S&P500 index, from sources including BEA (Bureau of Economic Analysis), St. Louis Fed (Federal Reserve Bank of St. Louis), U.S. Census Bureau, Finance Yahoo, and the Federal Reserve Board. Our metropolitan economic data include variables such as gross metropolitan product (GMP), population, per capita personal income, and bankruptcies (business and personal), from a private source that collects data from Bureau of Labor Statistics, Bureau of Census, Federal Reserve Board, The Conference Board, National Association of Realtors, Dow Jones, and various other government and private sources. Our national and metropolitan property data include variables such as property price indexes (from NCREIF), property rent indexes and property stocks (from PPR-Research). All of the data are quarterly-based. The notations, definitions, and information sources for major economic variables are given in Table 2.

We formed a national data set for price regressions for major commercial property markets during the period from 1978:1 to 2006:2. However, due to the availability of data on rents and prices, especially in some metropolitan areas, we also developed several data sets for a shorter period of time, from 1989:3 to 2006:2. We used this data set for national rent regressions, national retail property submarket price regressions, and metropolitan level price and rent regressions.

Methodology

Our primary empirical results rely on a linear regression model of price and rent index change rates predicted by the change rates of fundamental economic variables and historical price and rent change rates. At the national level, we created regression models based on the following price and rent regressions:

$$\left(\frac{\Delta p}{p}\right)_t = \mu_p + \sum_{i=1}^k \gamma_{pi} \left(\frac{\Delta p}{p}\right)_{t-i} + \sum_{j=1}^l \lambda_{pj} \left(\frac{\Delta g_j}{g_j}\right)_t + \varepsilon_{pt} \quad (1)$$

$$\left(\frac{\Delta r}{r}\right)_t = \mu_r + \sum_{i=1}^k \gamma_{ri} \left(\frac{\Delta r}{r}\right)_{t-i} + \sum_{j=1}^l \lambda_{rj} \left(\frac{\Delta g_j}{g_j}\right)_t + \varepsilon_{rt} \quad (2)$$

Table 2.
Variable Definitions and Sources.

| Notation | Definitions | Sources |
|-------------------------------|--|--------------------|
| National variables | | |
| <i>perinc</i> | per capita personal income | BEA |
| <i>popu</i> | population | BEA |
| <i>unemploy</i> | unemployment rate | BEA |
| <i>interest</i> | 1-year treasury constant maturity rate | St. Louis Fed |
| <i>GDP</i> | gross domestic product | St. Louis Fed |
| <i>retail</i> | retail sales | U.S. Census Bureau |
| <i>CPI</i> | consumer price index (seasonally adjusted) | St. Louis Fed |
| <i>rsloan</i> | real estate loan values at all commercial banks (seasonally adjusted) | St. Louis Fed |
| <i>SP500</i> | S&P 500 total return index | Finance Yahoo |
| <i>defrisk</i> | default risk, measured by the difference between Moody's seasoned AAA corporate bond rate and the composite long term treasury bond rate | Fed Board |
| <i>rsalevar</i> | 2-year retail sales standard deviation | |
| Metropolitan variables | | Private Source |
| <i>mbusbry</i> | bankruptcy number: total business | |
| <i>mCPI</i> | CPI: all urban consumers | |
| <i>munemrt</i> | household survey: unemployment rate | |
| <i>GMP</i> | gross metropolitan product | |
| <i>mnhhd</i> | number of households | |
| <i>mperinc</i> | per capita personal income | |
| <i>mperbry</i> | personal bankruptcy number | |
| <i>mpopu</i> | population | |
| <i>mretail</i> | retail sales | |
| <i>mrsalevar</i> | 2-year retail sales standard deviation | |
| Other Abbreviations | | |
| <i>Price or P</i> | NPI capital index | NCREIF |
| <i>Rent or R</i> | PPR-Research rent index | PPR-Research |
| <i>apt</i> | apartment | |
| <i>ofc</i> | office | |
| <i>ind</i> | industrial property | |
| <i>ret</i> | retail property | |
| <i>hil</i> | hotel | |
| <i>retcom</i> | community retail property | |
| <i>retnei</i> | neighborhood retail property | |
| <i>retreg</i> | regional retail property | |
| <i>retsup</i> | super-regional retail property | |
| <i>retsgl</i> | single tenant retail property | |
| <i>lag₁</i> | dependent variable lagged by 1 quarter | |
| <i>lag₂</i> | dependent variable lagged by 2 quarters | |
| <i>lag₃</i> | dependent variable lagged by 3 quarters | |
| <i>lag₄</i> | dependent variable lagged by 4 quarters | |
| <i>lag₅</i> | dependent variable lagged by 5 quarters | |
| <i>lag₆</i> | dependent variable lagged by 6 quarters | |

where p is the NPI capital index (a proxy for price); Δp is the change in the capital index; r is the PPR-Research rent index; Δr is the change in the rent index; g_j is the j th of l national fundamental variables; Δg_j is the change in the j th of l national fundamental variables; μ_p and μ_r are constants; $\gamma_p, \lambda_p, \gamma_r,$ and λ_r are coefficients; ε_p and ε_r are the error terms; t is the quarter index; and i is the i th of k time lags in the equations. Year and quarter fixed effects are controlled in the model.

Then, for each metropolitan area, we developed a regression model based on the following time-series price and rent equations:

$$\left(\frac{\Delta p}{p}\right)_t = \alpha_p + \sum_{i=1}^k \beta_{pi} \left(\frac{\Delta p}{p}\right)_{t-i} + \sum_{j=1}^l \kappa_{pj} \left(\frac{\Delta g_j}{g_j}\right)_t + \sum_{s=1}^w \zeta_{ps} \left(\frac{\Delta h_s}{h_s}\right)_t + \pi_{pt} \quad (3)$$

$$\left(\frac{\Delta r}{r}\right)_t = \alpha_r + \sum_{i=1}^k \beta_{ri} \left(\frac{\Delta r}{r}\right)_{t-i} + \sum_{j=1}^l \kappa_{rj} \left(\frac{\Delta g_j}{g_j}\right)_t + \sum_{s=1}^w \zeta_{rs} \left(\frac{\Delta h_s}{h_s}\right)_t + \pi_{rt} \quad (4)$$

where h_s is the s th of w local fundamental variables; Δh_s is the change in the s th of w local fundamental variables; $\alpha_p, \alpha_r, \beta_{pi}, \beta_{ri}, \kappa_{pj}, \kappa_{rj}, \zeta_{ps},$ and ζ_{rs} are coefficients; π_p and π_r are the error terms; and other notations are defined similarly as earlier. To be consistent, we chose metropolitan-level variables that were the same as those in the national-level time-series regressions. Year and quarter fixed effects are controlled in the model.

Finally, we pooled all of the metropolitan areas and ran panel regressions for price and rent based on the following equations:

$$\left(\frac{\Delta p}{p}\right)_{m,t} = \phi_p + \sum_{i=1}^k \omega_{pi} \left(\frac{\Delta p}{p}\right)_{m,t-i} + \sum_{j=1}^l \theta_{pj} \left(\frac{\Delta g_j}{g_j}\right)_t + \sum_{s=1}^w \eta_{ps} \left(\frac{\Delta h_s}{h_s}\right)_{m,t} + \sigma_{pm,t} \quad (5)$$

$$\left(\frac{\Delta r}{r}\right)_{m,t} = \phi_r + \sum_{i=1}^k \omega_{ri} \left(\frac{\Delta r}{r}\right)_{m,t-i} + \sum_{j=1}^l \theta_{rj} \left(\frac{\Delta g_j}{g_j}\right)_t + \sum_{s=1}^w \eta_{rs} \left(\frac{\Delta h_s}{h_s}\right)_{m,t} + \sigma_{rm,t} \quad (6)$$

where m is the metropolitan area index; $\phi_p, \phi_r, \omega_{pi}, \omega_{ri}, \theta_{pj}, \theta_{rj}, \eta_{ps},$ and η_{rs} are coefficients; σ_p and σ_r are the error terms, and other notations are defined similarly as earlier. To be consistent with national-level and metropolitan level time-series regressions, we chose variables that were the same as in the previous regressions. Year, quarter, and area fixed effects are controlled in the model.

Overall, the data sets include eleven national fundamental variables and ten local fundamental variables. In addition, six time-trend variables are included in the models, with prices and rents lagged from one to six quarters incorporated as independent variables to investigate the short- and intermediate-term excess autocorrelations in price and rent movements.

Following Froot and Obstfeld (1991), we can differentiate the deviations of a property price from its fundamentals into several types: momentums without flips,

contrarians without flips, and flips, which indicate potentials for bubbles, adjustments and fads, respectively. Detailed definitions are as follows:

We test the following hypotheses for each case:

$$\left(\frac{\Delta p}{p}\right)_{t-1} = 0 \quad (H1)$$

$$\sum_{i=1}^2 \left(\frac{\Delta p}{p}\right)_{t-i} = 0 \quad (H2)$$

$$\sum_{i=1}^3 \left(\frac{\Delta p}{p}\right)_{t-i} = 0 \quad (H3)$$

$$\sum_{i=1}^4 \left(\frac{\Delta p}{p}\right)_{t-i} = 0 \quad (H4)$$

$$\sum_{i=1}^5 \left(\frac{\Delta p}{p}\right)_{t-i} = 0 \quad (H5)$$

$$\sum_{i=1}^6 \left(\frac{\Delta p}{p}\right)_{t-i} = 0 \quad (H6)$$

Definition 1. A property market has **excess momentum without flips** if there exists at least one positive integer c that satisfies all the following conditions:

$$(1) \sum_{i=1}^c \left(\frac{\Delta p}{p}\right)_{t-i} = 0$$

(2) in the set of coefficients for the time-trend variables in a price regression, generally notated as $\{y_p, \dots, y_\omega\}$ (where y is γ , β , and ω in Equations 1, 3, and 5, respectively), the dominating effect (in terms of the magnitudes of coefficient and p -value) is positive; and

(3) there does not exist a j where $y_j < 0$ that dominates the other elements in set $\{y_p, \dots, y_\omega\}$ (in terms of the magnitudes of coefficient and p -value).

Definition 2. A property market has an **excess contrarian without flips** if there exists at least one positive integer c that satisfies all the following conditions:

$$(1) \sum_{i=1}^c \left(\frac{\Delta p}{p} \right)_{t-i} = 0$$

(2) in the set $\{y_p, \dots, y_\delta\}$ (where y is $\gamma, \beta,$ and ω in Equations 1, 3, and 5, respectively), the dominating effect (in terms of the magnitudes of coefficient and p -value) is negative; and

(3) there does not exist a j where $y_j > 0$ that dominates the other elements in $\{y_p, \dots, y_\delta\}$ (in terms of the magnitudes of coefficient and p -value).

Definition 3. A property market has **flips** if at least one c exists that satisfies all the following conditions:

$$(1) \sum_{i=1}^c \left(\frac{\Delta p}{p} \right)_{t-i} = 0$$

(2) in the set $\{y_p, \dots, y_\delta\}$ (where y is $\gamma, \beta,$ and ω in Equations 1, 3, and 5, respectively), the dominating effect (in terms of the magnitudes of coefficient and p -value) is positive (or negative); and

(3) there exists a j where $y_j < 0$ (or $y_j > 0$) that dominates the other elements in set $\{y_p, \dots, y_\delta\}$ (in terms of the magnitudes of coefficient and p -value).

These definitions provide us with a foundation to explore the potentials of price bubbles. If there is a time lag variable that positively affects the current price change rate, and for longer lags, this positive effect is sustained, strengthened, or disappears for longer lags, but does not flip, this positive feedback effect could be called “excess momentum.” If price movements in a market have excess momentum with no flipping, while rent does not, it is a strong signal that price movements might promote bubble events in that market. The intuition is that this kind of excess momentum could cause a rapid growth in price, and without the economic foundations to support that growth through rent increases, this explosive growth will burst.

Note that, however, what we aim to do is to detect long-term excess momentum between 1978 and 2006 that would cause wide price oscillations and promote multiple bubble events, not any price movement feature that is associated with a distinct bubble event. Note that a distinct bubble event would last over a much shorter period of time, and the price would eventually collapse.

Descriptive Analysis

Price Movement for All Commercial Property Types

We first examined the movement in the national aggregate retail property price index from 1978:1 to 2006:2, and compared them to the price movements in other commercial property markets (apartment, office, industrial, and hotel). Because of data availability, our analysis of the hotel market covers a shorter time period (1981:1 to 2006:2).

Figure 2 illustrates the trends in the NPI capital index in these five markets. During the study period, the price cycles for the retail property market are similar to the apartment, office, and industrial property markets in two periods: 1978 to 1990 (steady growth), and 2003 to 2006 (fast growth). The retail property market shows stronger growth than the other three markets in both periods. In 1990, prices in all four markets drop significantly, but after a short period of time, the retail market stabilizes in price and remains at this price level until increasing again in 2003, unlike the apartment, office, and industrial property markets where prices continue to fall significantly until reaching a minimum. The hotel market experiences a steady decline until 1996, then grew for a short period and declined again in 2001. In general, property prices have always moved more markedly in the retail property market than in other commercial property markets.

Figure 3 illustrates the time trend of quarterly change rate in NPI capital index in the five commercial property markets, which confirms our findings shown in Figure 2. Clearly, the retail property market leads growth from 1985 to 1989, as well as growth after 2002. Meanwhile, the retail property market does not decline as much when other markets decline such as during the period from 1991 to 1996. This also shows that price changes in office and hotel markets are more volatile relative to other markets.

Table 3 displays the correlation coefficients of NPI index change rates in five markets from 1981:1 to 2006:2. The price changes in the retail property market are not strongly correlated to those in the apartment ($r = 0.547$), industrial ($r = 0.588$), office ($r = 0.526$), and hotel ($r = 0.177$) market, unlike the correlations between apartment, industrial, and office markets, which have correlation coefficients consistently greater than 0.70. Therefore, the retail property market seems to have price movements that are relatively independent of other commercial property markets, confirming our earlier findings that retail property prices follow a pattern different from that in other commercial property markets.

Price Movements in Retail Property Submarkets

An important characteristic of the retail property (here after RP) market is the great diversification among building types. For instance, according to NCREIF data at 2006:4, the average size of the super-regional RPs is 1.34 million square feet, significantly larger than the average size of the community RPs (about 200,000 square feet) and that of the neighborhood RPs (about 110,000 square feet). Given the

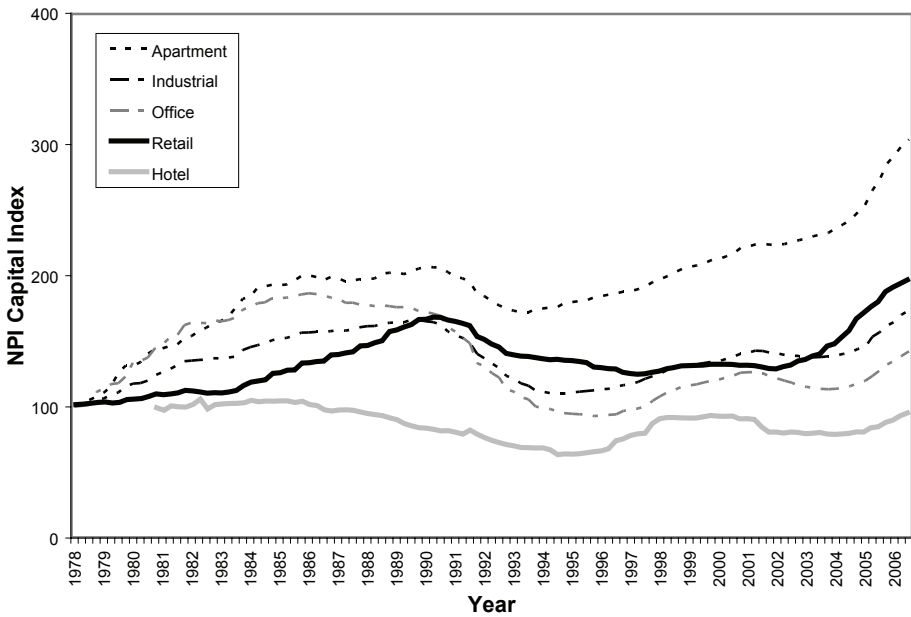


Figure 2. *NPI Capital Index by Commercial Property Type.*

strong price movements in the aggregate retail property market, heterogeneity in price movements between different retail property submarkets will undoubtedly result from this diversity.

Figure 4 displays the time trend of NPI capital index movement in five major RP submarkets: community, regional, super-regional, neighborhood, and single-tenant. These submarkets were examined during different periods between 1978:1 and 2006:2 due to data availability, with the shortest coverage for single-tenant type RPs (1991:1 to 2006:2). In general, these submarkets have similar price cycles, with steady growth rates from the beginning time of the period to 1990, dramatic drops after 1990, and some adjustments before strong growths from 2002. During the first growth period (before 1990), the super-regional RP submarket has the fastest growth, with the NPI capital index increasing from 99.3 at 1983:1 to 182.63 at 1990:3. Afterwards, this submarket still leads price increases in the retail property market. The neighborhood RP submarket has the highest NPI capital index until 1986, with average price increases afterwards as compared to super-regional and regional submarkets. The single-tenant submarket has the lowest NPI capital index consistently over the period where data for the submarket is available.

Figure 5 illustrates the time trend of the quarterly change rates for NPI capital indexes in the five RP submarkets, which supports observations from Figure 4. Between the five submarkets, the price growth leader is the neighborhood submarket before 1981, and the super-regional submarket for the 1984 to 1989 period. In recent years, price growth rates in the regional submarket and the single-tenant submarket have increased.

Table 3.
Correlation Coefficients of Quarterly Price Change Rates in Five Commercial Property Markets, 1981:1-2006:2.

| | Apartment | Industrial | Office | Retail | Hotel |
|------------|-----------|------------|--------|--------|-------|
| Apartment | 1.000 | | | | |
| Industrial | 0.760 | 1.000 | | | |
| Office | 0.748 | 0.903 | 1.000 | | |
| Retail | 0.547 | 0.588 | 0.526 | 1.000 | |
| Hotel | 0.376 | 0.416 | 0.455 | 0.177 | 1.000 |

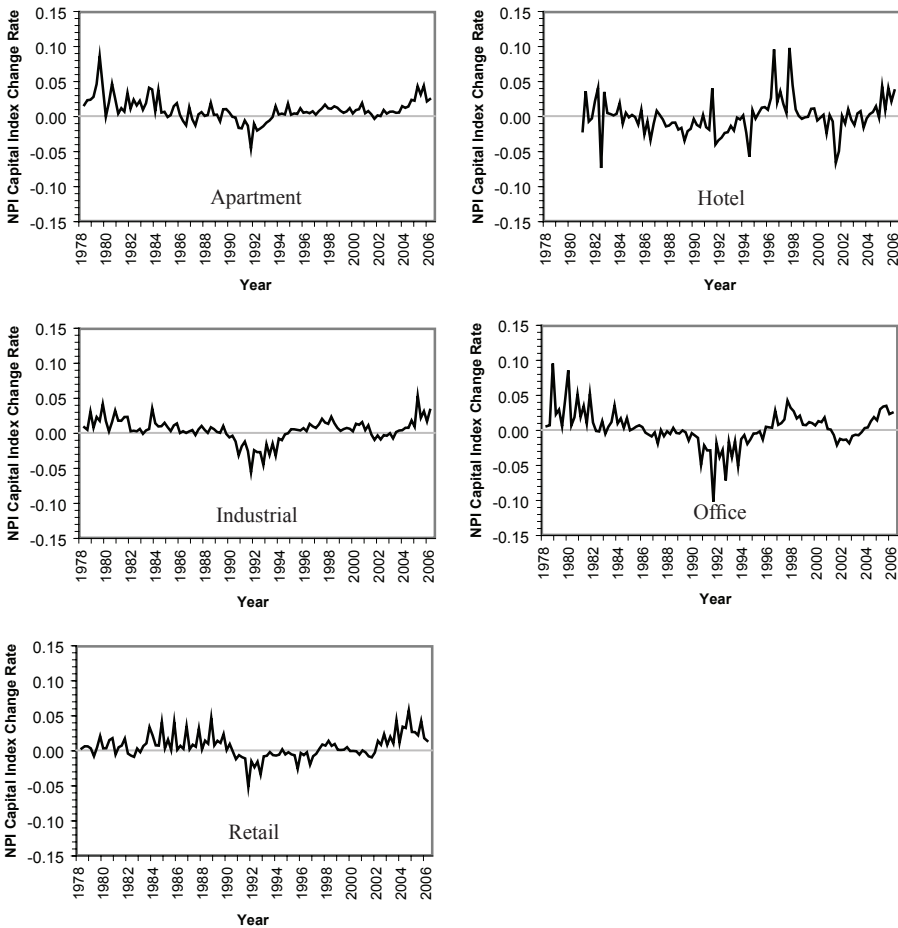


Figure 3.
NPI Capital Index Quarterly Change Rate by Commercial Property Type.

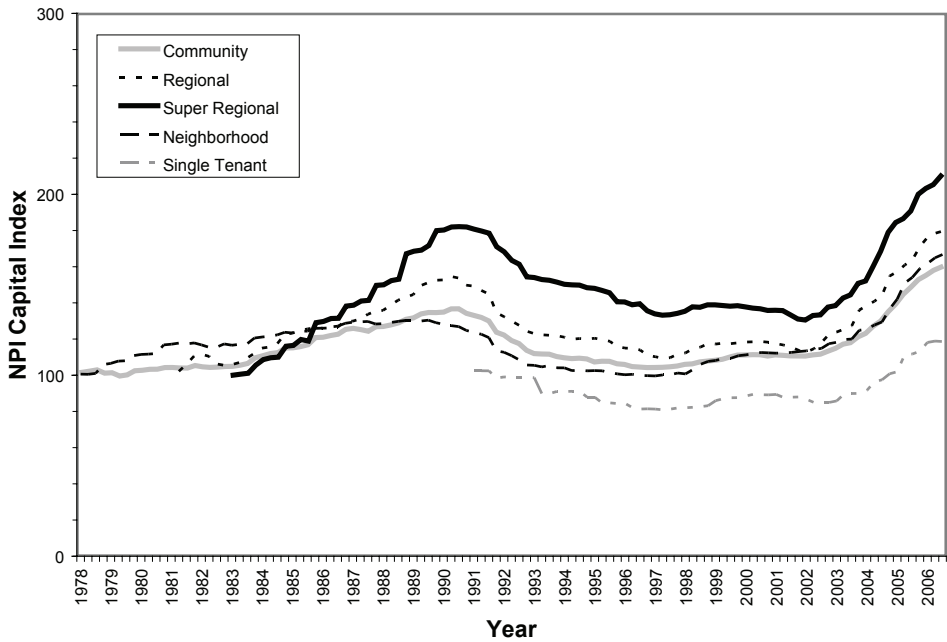


Figure 4.
NPI Capital Index by Property Type.

Overall the price changes are more volatile in the super-regional submarket and the single-tenant submarket than in other markets, while the least volatile submarket is the community submarket.

Table 4 shows the correlation coefficients between the five RP submarkets and the aggregate retail property market in terms of price change rate during 1983:2-2006:2. Due to data availability, the single-tenant submarket was not included. From the analysis, the price movement in the super-regional submarket can be seen to be the most correlated to the aggregate market, with a coefficient 0.939, which is not surprising given this submarket is the dominating RP submarket as we note later. The aggregate market is also highly correlated with community, regional, and neighborhood submarkets, with coefficients of 0.896, 0.879, and 0.746, respectively. All four submarkets are quite correlated to each other except the super-regional submarket and the neighborhood submarket, which is easy to understand given the dramatic property differences between these two submarkets.

Table 5 shows the correlation coefficients for a more recent time period (1991:2-2006:2), with the single-tenant submarket data included. The results also indicate that the price changes in the super-regional submarket are the most correlated with that in the aggregate retail property market. The super-regional, regional, community, and neighborhood RP submarkets are also highly correlated with each other, while the single-tenant submarket is less correlated with all of the other submarkets.

Table 6 shows the value distribution in the retail property market. At 2006:2, the dominating submarket is the super-regional submarket, which occupies 37.7% of

Table 4.
Correlation Coefficients of Quarterly Price Change Rates in the Retail Property Market and Submarkets, 1983:2-2006:2.

| | Aggregate | Community | Regional | Super-regional | Neighborhood |
|----------------|-----------|-----------|----------|----------------|--------------|
| Aggregate | 1.000 | | | | |
| Community | 0.896 | 1.000 | | | |
| Regional | 0.879 | 0.789 | 1.000 | | |
| Super-regional | 0.939 | 0.765 | 0.699 | 1.000 | |
| Neighborhood | 0.746 | 0.819 | 0.764 | 0.542 | 1.000 |

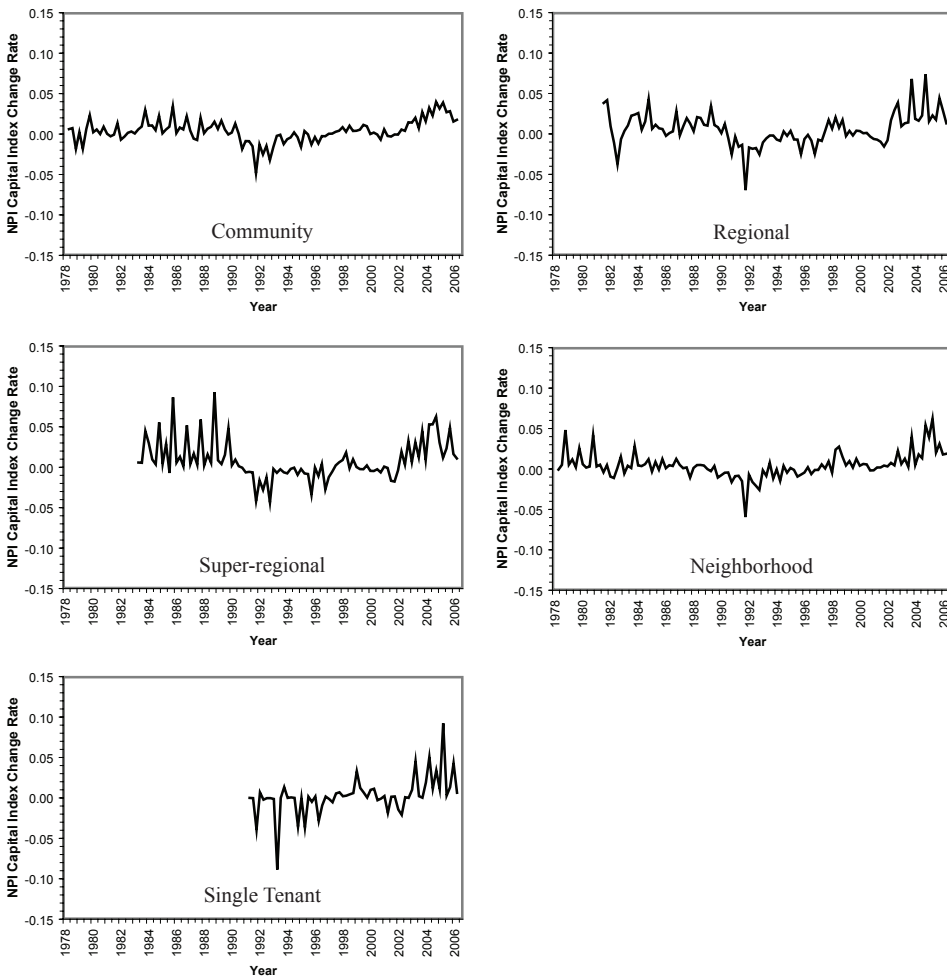


Figure 5.
NPI Capital Index Quarterly Change Rate by Retail Property Type.

Table 5.
Correlation Coefficients of Quarterly Price Change Rates in the Retail Property Market and Submarkets, 1991:2-2006:2.

| | Aggregate | Community | Regional | Super-regional | Neighborhood | Single Tenant |
|----------------|-----------|-----------|----------|----------------|--------------|---------------|
| Aggregate | 1.000 | | | | | |
| Community | 0.926 | 1.000 | | | | |
| Regional | 0.943 | 0.821 | 1.000 | | | |
| Super-regional | 0.963 | 0.849 | 0.869 | 1.000 | | |
| Neighborhood | 0.875 | 0.886 | 0.841 | 0.748 | 1.000 | |
| Single Tenant | 0.486 | 0.537 | 0.407 | 0.420 | 0.550 | 1.000 |

Table 6.
Property Values in the Retail Aggregate Market and Submarkets, 2006:2.

| | Value (million \$) | % In Aggregate |
|-------------------|--------------------|----------------|
| Aggregate | 47,885 | 100.0% |
| Community | 8,521 | 17.8% |
| Regional | 9,494 | 19.8% |
| Power | 3,658 | 7.6% |
| Fashion/Specialty | 1,701 | 3.6% |
| Single Tenant | 271 | 0.6% |
| Super-regional | 18,057 | 37.7% |
| Neighborhood | 5,752 | 12.0% |

the aggregate market in terms of property value, almost double that of the next largest type, the regional submarket (19.8%). These two are followed by the community submarket (17.8%) and the neighborhood submarket (12.0%), while the single-tenant submarket only occupies a trivial 0.6% of the aggregate market.

Price Movement versus Rent Movement

We also examined whether strong price movements in the retail property market have been supported by similarly strong rent movements in the same market. Rent in this analysis is quantified with the PPR-Research rent index. Since the PPR-Research rent reports start from 1989:3, this analysis was conducted for the aggregate market for the period between 1989:3 and 2006:2, and four commercial property markets (apartment, office, hotel, and industrial) were examined as well.

Figure 6 illustrates the time trend of rent movements in these markets. In general, all five commercial property markets have experienced quite consistent rent cycles, with minima around 1994, steady growth after 1994 peaking around 2001, and then declines afterwards. These rent curves are quite different from the price curves for the same time period. As shown in Figure 7, prices generally exhibit continuous growth, or they tend to remain constant over a long period. The markets which have

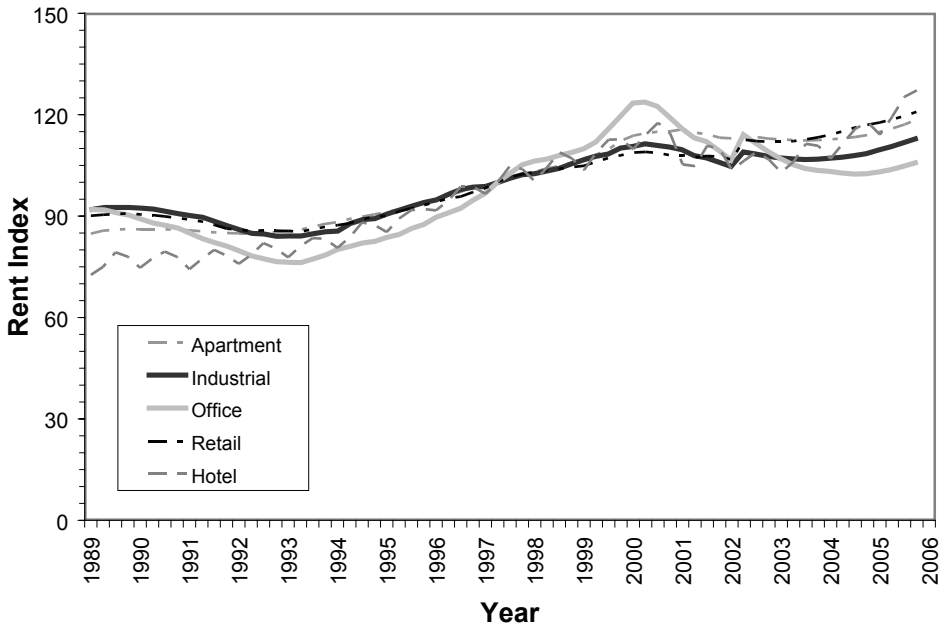


Figure 6.
Rent Index Time Trend by Commercial Property Type.

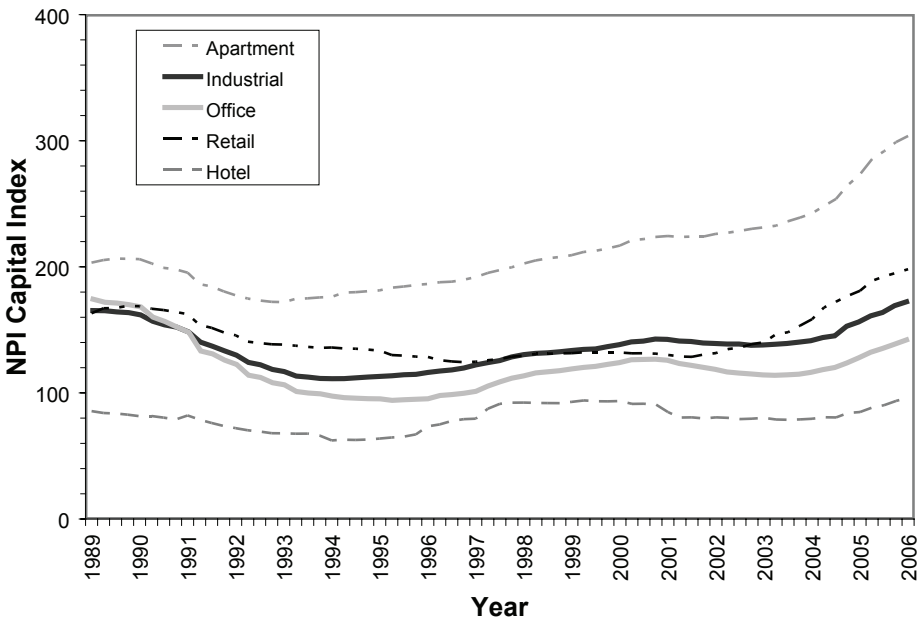


Figure 7.
Price Index Time Trend by Commercial Property Type.

the most significant price-rent divergences are the retail property market and the hotel market. This is confirmed by Table 1, which shows the correlations between price change rates and rent change rates for the five commercial property markets. The retail property market has a price-rent correlation lower than all but the hotel submarket, with a correlation coefficient $r = 0.324$. The industrial property market has the highest price-rent correlation ($r = 0.512$).

With limited data, we also examined two traditional variables that measure the relation between price and rent: the going-in cap rate and the terminal cap rate. Data on these two rates were obtained from the Real Estate Research Corporation (RERC), covering the period between 1989:1 and 2002:4. In the market, higher cap rates correspond to lower price-rent ratios. RERC data provides data for major commercial property markets, as well as data for major retail property submarkets. As shown in Figures 8 and 9, the regional mall submarket has the lowest going-in cap rate and highest price-rent ratio (8.1% going-in cap rate by mean). This is a lower cap rate than that for all sectors (9.1% by mean). The power center submarket has the highest going-in cap rate (9.6% by mean), and the neighborhood/community submarket has a going-in cap rate in the middle (9.4% by mean). This suggests that there are variations in the price-rent ratio between property submarkets, probably due to the vast differences of their property features.

Figure 10 and Figure 11 display the two cap rates in the retail property aggregate market and submarkets, as compared to other commercial property markets including apartment, hotel, and industrial property markets. We find that indeed the regional mall submarket used to be the one with the highest price/rent ratio, although it was second to the apartment submarket after 2000. Hotel was the submarket with the lowest price/rent ratio, followed by the power centers.

Summary of Descriptive Analysis

Our descriptive analysis suggests that the price movements in the retail property market have been quite independent of the price movements on the other commercial property markets, and these price movements cannot be justified by the rent income changes over time. The retail property market is also quite diverse, and a large proportion of aggregate price changes in the retail market have been driven by strong price movements in the super-regional and regional submarkets.

Regression Models

To examine whether the strong price movements noted by our descriptive analysis suggest that there are potentials for price bubbles, we incorporate terms for excess momentum into price regression models following Equations 1, 3, and 5. We compared these models to rent regression models which we developed following Equations 2, 4, and 6.

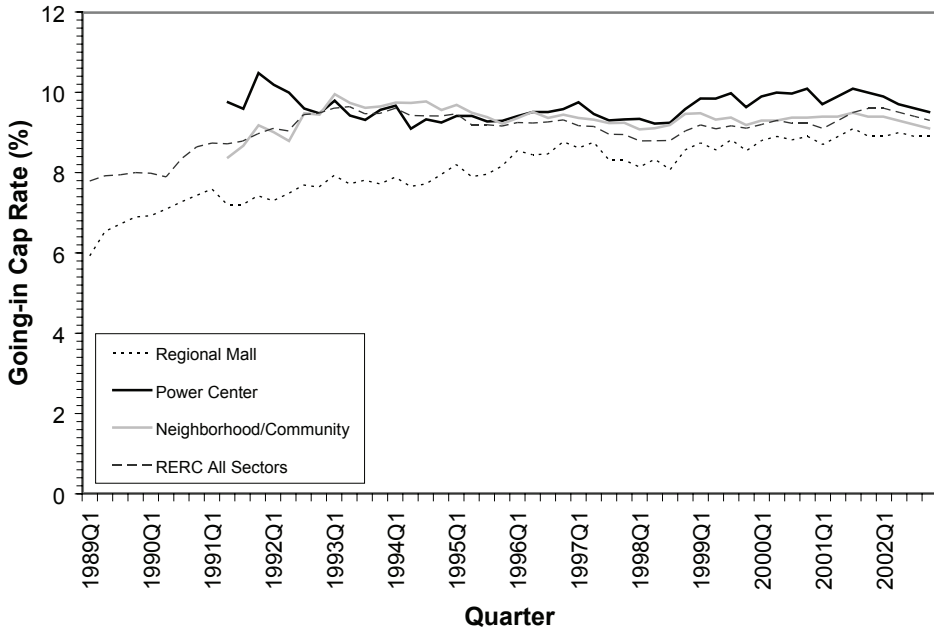


Figure 8.
RERC Retail Property Going-in Cap Rate.

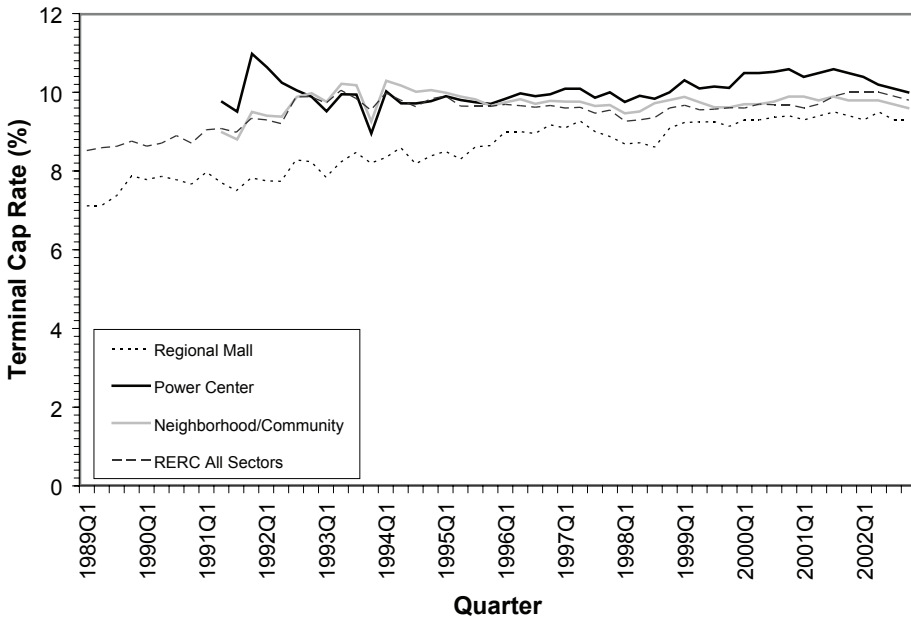


Figure 9.
RERC Retail Property Terminal Cap Rate.

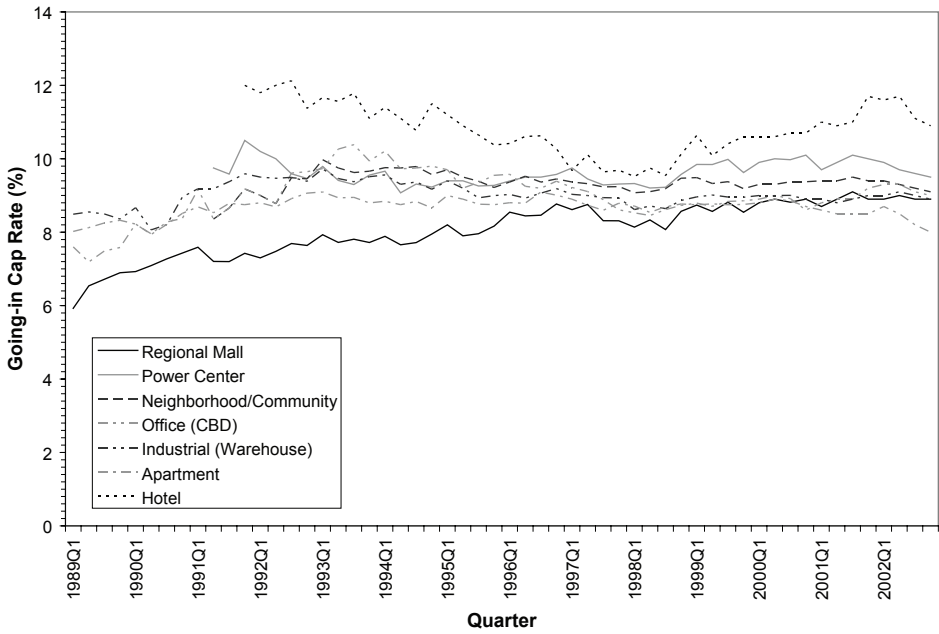


Figure 10.
NPI Capital Index Quarterly Change Rate by Retail Property Type.

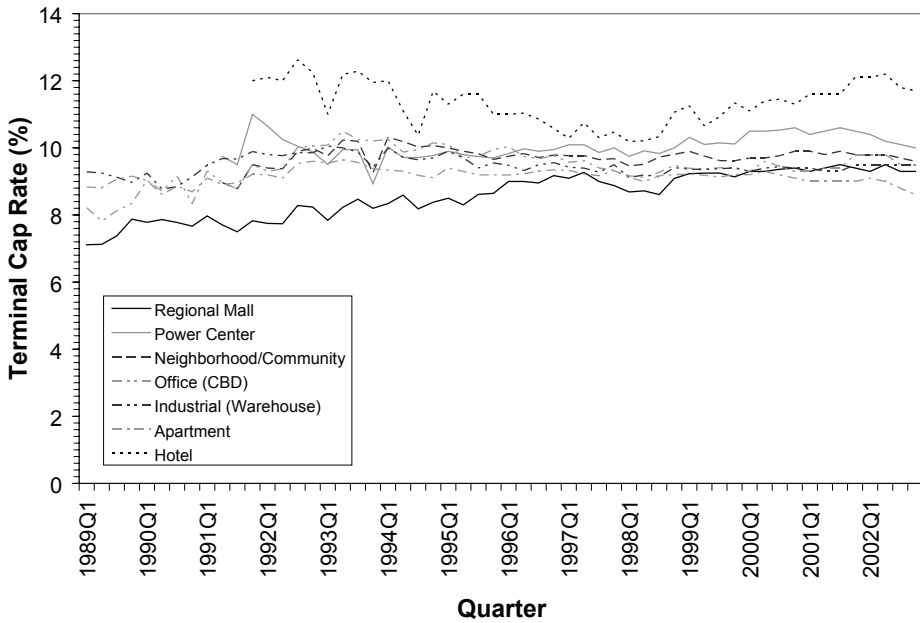


Figure 11.
NPI Capital Index Quarterly Change Rate by Retail Property Type.

National Level Time-Series Regressions: Excess Price Momentum Detected

We first analyzed the excess momentum in national retail property price movements by developing a national time-series price index regression model as described in Equation 1, using national data covering the longest time period in our study, from 1978:1 to 2006:2. To compare the retail property market to other commercial property markets, we developed regression models for four aggregate commercial property markets: retail, apartment, office, and industrial. Additionally, we created models for two retail property submarkets: community and neighborhood. Due to data availability issues, we did not analyze other commercial property markets or retail property submarkets for this period.

The regression results are displayed in Table 7. We find that the retail property aggregate market has significant excess momentum, as hypotheses *H2*, *H3*, *H4*, *H5*, and *H6* can be rejected at a 1% significance level. The significant time-trend variables, lag_4 and lag_2 , are both exerting positive effects on the current price change rate. This excess momentum on the retail property market is stronger than the excess momentum in the industrial property market (where hypothesis *H3* can be rejected at the 1% level, *H4* at the 5% level, and *H5* at the 10% level), and is absent in the models for the apartment and office markets. In fact, unlike the price change in the retail property market, the price changes in the other three commercial property markets are all significantly and negatively impacted by some lagged price change variables.

Meanwhile, among the four commercial property markets, the retail market is the one least affected by macroeconomic fundamentals, with only the coefficients for unemployment and CPI significant (and negative), while other markets are all influenced by at least three macroeconomic fundamentals, and usually with much larger normalized coefficient magnitudes. The most influential determinant for the price change in the retail property market is lag_4 (+) (with a normalized coefficient 0.0127), followed by lag_2 (+), unemployment (-), and CPI (-) (with normalized coefficients of 0.0061, -0.0030, and -0.0022, respectively), suggesting that a large proportion of the change in prices is driven by momentum.

The excess momentum in price movement is weaker in the community RP submarket, however, and totally disappears in the neighborhood RP submarket. In the community submarket, only hypotheses *H4* and *H5* are rejected at the 5% and 10% significance level, respectively, with lag_4 as the dominant, positive time trend variable. Another time trend variable, lag_6 , however, negatively affects current price change. The most influential determinant for the price change in this submarket is lag_4 (+) (with a normalized coefficient 0.0074), followed by GDP (+), lag_6 (-), real estate loan value (+), and interest rates (-) (with normalized coefficients of 0.0041, -0.0026, 0.0023, and -0.0021, respectively), suggesting that the community submarket is more affected by fundamentals than the aggregate retail market. Deviations from the aggregate market are more obvious in the neighborhood submarket, where hypothesis *H3* is rejected, and the signs of the time trend variable coefficients indicate there is actually an excess contrarian in the price movement.

Our analysis on retail property price movements over the period from 1978:1 to 2006:2 is summarized in Table 7. Although this incorporates information on retail

Table 7.
Time Series Regressions of Property Price Changes at the National Level, 1978:1-2006:2.

| | Papt | P | Pofc | P | Pind | P | Pret | P | Pretcom | P | Pretnei | P |
|---------------------|---------|-------|--------|-------|--------|-------|--------|-------|---------|-------|---------|-------|
| Intercept | 0.062 | 0.032 | -0.007 | 0.879 | -0.025 | 0.284 | -0.036 | 0.269 | -0.004 | 0.872 | 0.020 | 0.566 |
| perinc | 0.223 | 0.024 | 0.316 | 0.010 | 0.159 | 0.055 | -0.038 | 0.690 | 0.025 | 0.762 | 0.005 | 0.955 |
| popu | -11.133 | 0.124 | 11.632 | 0.413 | 7.881 | 0.188 | 5.831 | 0.505 | -1.914 | 0.805 | -3.570 | 0.657 |
| unemploy | 0.005 | 0.884 | -0.093 | 0.043 | -0.131 | 0.000 | -0.067 | 0.029 | 0.021 | 0.477 | -0.080 | 0.021 |
| interest | -0.003 | 0.677 | -0.001 | 0.932 | -0.005 | 0.540 | -0.008 | 0.353 | -0.022 | 0.005 | -0.002 | 0.797 |
| GDP | 0.909 | 0.106 | 0.243 | 0.792 | 0.431 | 0.353 | 0.234 | 0.695 | 0.819 | 0.076 | 1.078 | 0.150 |
| retail | -0.031 | 0.386 | -0.076 | 0.168 | -0.043 | 0.129 | 0.000 | 0.993 | -0.001 | 0.985 | 0.036 | 0.399 |
| CPI | -0.635 | 0.001 | -0.401 | 0.227 | -0.342 | 0.035 | -0.291 | 0.072 | -0.001 | 0.994 | -0.290 | 0.310 |
| rsloan | 0.062 | 0.234 | 0.125 | 0.197 | 0.125 | 0.020 | 0.116 | 0.179 | 0.174 | 0.008 | 0.008 | 0.936 |
| SP500 | -0.014 | 0.124 | -0.033 | 0.013 | -0.005 | 0.521 | -0.007 | 0.440 | -0.005 | 0.668 | 0.017 | 0.225 |
| defrisk | -0.001 | 0.036 | 0.000 | 0.885 | 0.000 | 0.596 | 0.000 | 0.544 | -0.001 | 0.089 | 0.000 | 0.434 |
| rsalevar | -0.014 | 0.304 | -0.025 | 0.204 | -0.025 | 0.051 | 0.013 | 0.397 | -0.001 | 0.943 | 0.002 | 0.922 |
| lag ₁ | -0.091 | 0.462 | -0.244 | 0.033 | 0.114 | 0.424 | 0.150 | 0.187 | 0.027 | 0.844 | -0.123 | 0.351 |
| lag ₂ | -0.143 | 0.061 | -0.054 | 0.683 | 0.147 | 0.232 | 0.355 | 0.002 | 0.189 | 0.129 | -0.107 | 0.341 |
| lag ₃ | -0.022 | 0.846 | -0.081 | 0.463 | 0.090 | 0.262 | 0.148 | 0.128 | 0.036 | 0.708 | -0.212 | 0.058 |
| lag ₄ | 0.072 | 0.578 | 0.484 | 0.001 | 0.585 | 0.000 | 0.767 | 0.000 | 0.526 | 0.000 | 0.265 | 0.058 |
| lag ₅ | -0.057 | 0.592 | 0.218 | 0.062 | -0.122 | 0.186 | 0.014 | 0.901 | -0.063 | 0.562 | -0.080 | 0.462 |
| lag ₆ | 0.052 | 0.520 | -0.050 | 0.651 | -0.170 | 0.099 | -0.085 | 0.365 | -0.200 | 0.037 | 0.047 | 0.597 |
| lag ₁ | | 0.462 | | 0.033 | | 0.424 | | 0.187 | | 0.844 | | 0.351 |
| lags 1-2 | | 0.163 | | 0.156 | | 0.223 | | 0.007 | | 0.340 | | 0.226 |
| lags 1-3 | | 0.302 | | 0.199 | | 0.187 | | 0.012 | | 0.392 | | 0.077 |
| lags 1-4 | | 0.601 | | 0.796 | | 0.009 | | 0.000 | | 0.050 | | 0.628 |
| lags 1-5 | | 0.552 | | 0.425 | | 0.013 | | 0.000 | | 0.089 | | 0.524 |
| lags 1-6 | | 0.654 | | 0.519 | | 0.062 | | 0.001 | | 0.205 | | 0.617 |
| Adj. R ² | | 0.643 | | 0.701 | | 0.802 | | 0.711 | | 0.699 | | 0.539 |
| n | | 108 | | 108 | | 108 | | 108 | | 108 | | 108 |

(p-values are adjusted for heteroscedasticity with the White test.)

- * significant at the 10% level
- ** significant at the 5% level
- *** significant at the 1% level

property price movements over the longest time period, it is not clear if this excess momentum is indeed associated with bubbles, because there is no rent data to compare to the price growth.

However, we also analyzed a more recent period (1989:3 to 2006:2), where both price and rent data are available. We also used data for more commercial markets and retail property submarkets. Table 8 displays the price regressions following Equation 1 for five major commercial property markets (apartments, hotel, office, industrial, and retail) and five retail property submarkets (community, regional, single-tenant, super-regional and neighborhood), while Table 9 displays the rent regressions following Equation 2 for the same markets.

Table 8 shows that as in the 1978:1-2006:2 period, prices in the retail property aggregate market have strong excess momentum without flips. Five hypotheses are rejected at the 1% significance level and another hypothesis is rejected at the 5% significance level, which indicates excess momentum given that the signs of the six time trend variables are consistently positive. However, significant differences exist between the retail property submarkets. The regional submarket has the most significant excess momentum without flips, followed by the community and super-regional submarkets. The neighborhood submarket is not affected by excess autocorrelation, however, while the single-tenant submarket has strong excess contrarian.

A comparison with the shorter period (1989:3 to 2006:2) also provides some interesting insights. Unlike in the period from 1978:1 to 2006:2, where prices in the apartment market are unaffected by excess autocorrelation, prices in this model for the shorter time period show strong excess momentum, indicating that significant changes may have occurred in this market since 1989. Other differences between the two sample periods suggest that the office market has stronger momentum in the shorter period, while the industrial property market has weaker excess momentum than in the 1978:2-2006:2 period.

Regarding the influence of macroeconomic variables, GDP (+) is the prevalent determinant in most property markets and submarkets. In addition, default risk (-), interest rate (-), CPI (-), and unemployment (-) are also generally influential. However, it is surprising that the retail property aggregate market is negatively affected by retail sales volume and population, and the positive effect of retail sales variance differs from its negative effects in other property markets. Interestingly, the hotel market is the least affected by national fundamentals among all the markets and submarkets.

Table 9 shows that strong excess momentum without flips in retail property price movements can not be justified with time-lagged changes in rent. In fact rent shows excess contrarian in the medium term, with hypothesis *H6* rejected at the 5% significance level and lag_6 (-) as the only influential time trend variable. Population (+) is the unique influential macroeconomic determinant for rent according to the equation. In the other four commercial property markets, population (+) and unemployment (-) are the primary macroeconomic determinants for rent.

Overall, our time series regressions with national data show that price movement in the retail property aggregate market have strong excess momentums without flips, which are not observed for rent movements. Retail property price movements are also very insensitive to changes in national macroeconomic factors,

making the retail property market different from other commercial property markets. This strong excess momentum is mainly driven by regional, community, and super-regional submarkets, while the effect is noticeably weaker, if not totally absent, in the neighborhood submarket and totally contrasts the excess contrarian in the single-tenant submarket. Therefore, there are potentials of price bubbles in the retail property aggregate market and certain major retail property submarkets.

Metropolitan Level Time-Series Regressions: Excess Price Momentum Detected for Some Major MSAs

We further investigated the cross-area differences in price movements using metropolitan level data. Table 10 shows the total retail property values for major metropolitan areas at 2006:4: the MSA with the largest retail property market is Chicago, with a total value of \$800 million, significantly larger than Atlanta (\$562 million), Washington DC (\$455 million), Orange County (\$392 million), Los Angeles (\$385), and New York (\$359 million). Due to the data constraints, we only investigate the aggregate retail property markets in 23 major MSAs during the period from 1989:3 to 2006:2. This area list includes major MSAs such as Chicago; Washington, D.C.; Orange County, Calif.; Los Angeles; San Diego; Baltimore; and Boston, and covers all five regions in the U.S. (East, South, Midwest, Mountain, and West). Unfortunately, this data set excludes the New York MSA, but represents areas traditionally interesting to real estate researchers, such as California and Florida, which have seven and three MSAs, respectively, on the list.

As with the analysis for national data, we compare the price movement with the rent movement after controlling the same sets of fundamentals for each MSA. However, in this analysis we controlled for not only the macroeconomic fundamentals, but also the metropolitan-level economic fundamentals. The regression models follow Equations 3 and 4 and the results of these regressions are reported in Tables 11 and 12.

Table 11 displays the metropolitan level time-series price regression model results, and Table 12 displays the metropolitan level time-series rent regression model results. Panel A for both tables reports the effects of the intercept and the time-trend variables. Among the 23 MSAs, Los Angeles shows the strongest excess momentum without flips with price movements: hypotheses $H3$, $H4$, $H5$, and $H6$ are rejected (at the 10%, 5%, 1%, and 1% levels, respectively), and the model has positive coefficients for all significant time-trend variables. Prices in Orange County, Calif. MSA also have strong excess momentum without flips after a short term temporary excess contrarian, however: hypotheses $H3$, $H4$, $H5$, and $H6$ are rejected (all at the 1% level) and most of the influential time trend variable coefficients are positive. The prices for the biggest retail property market, Chicago, have medium-term excess momentum, with only hypothesis $H6$ rejected (at the 5% level) and all influential time trend variables positive in coefficients. Although there is no way to detect whether this momentum in the Chicago market will be flipped even later, given that only lags of up to six quarter lags were incorporated into the models, the continuity in the momentum shown from positive lag_5 and lag_6 suggests that a flip is unlikely for the near future. Prices in

Table 8.
Time Series Regressions of Property Price Changes at the National Level, 1989:3-2006:2.

| | Papt | p | Phtl | p | Pofc | p | Pind | p | Pret | p |
|---------------------|--------|-------|-------|-------|-------|-------|-------|-------|--------|-------|
| Intercept | -0.01 | 0.61 | -0.12 | 0.25 | -0.02 | 0.64 | -0.02 | 0.51 | 0.01 | 0.83 |
| perinc | 0.27 | 0.00 | 0.28 | 0.48 | 0.22 | 0.07 | 0.23 | 0.09 | -0.13 | 0.13 |
| popu | -13.81 | 0.13 | 61.41 | 0.22 | 7.74 | 0.68 | 3.44 | 0.77 | -20.39 | 0.09 |
| unemploy | -0.02 | 0.45 | -0.16 | 0.23 | -0.09 | 0.16 | -0.13 | 0.00 | -0.10 | 0.03 |
| interest | -0.03 | 0.00 | -0.02 | 0.58 | -0.04 | 0.02 | -0.02 | 0.17 | -0.02 | 0.13 |
| GDP | 1.53 | 0.06 | 3.99 | 0.34 | 2.44 | 0.14 | 1.57 | 0.06 | 2.78 | 0.02 |
| retail | 0.04 | 0.27 | -0.09 | 0.60 | -0.11 | 0.31 | 0.06 | 0.33 | -0.10 | 0.08 |
| CPI | -0.64 | 0.00 | -1.61 | 0.04 | -0.33 | 0.49 | -0.80 | 0.03 | -0.36 | 0.20 |
| rsloan | 0.04 | 0.34 | 0.11 | 0.69 | -0.06 | 0.50 | 0.02 | 0.77 | -0.01 | 0.86 |
| SP500 | -0.03 | 0.02 | -0.05 | 0.36 | -0.01 | 0.58 | 0.01 | 0.42 | 0.01 | 0.34 |
| defrisk | -0.02 | 0.00 | -0.03 | 0.22 | -0.02 | 0.05 | 0.00 | 0.88 | -0.01 | 0.06 |
| rsalevar | -0.07 | 0.00 | -0.03 | 0.52 | -0.04 | 0.09 | -0.06 | 0.00 | 0.03 | 0.06 |
| lag ₁ | 0.66 | 0.00 | -0.07 | 0.60 | 0.11 | 0.60 | 0.07 | 0.73 | 0.33 | 0.01 |
| lag ₂ | 0.10 | 0.44 | -0.24 | 0.17 | -0.02 | 0.92 | -0.03 | 0.85 | 0.39 | 0.00 |
| lag ₃ | 0.27 | 0.03 | -0.08 | 0.51 | -0.01 | 0.92 | 0.15 | 0.18 | 0.00 | 0.98 |
| lag ₄ | 0.52 | 0.00 | -0.20 | 0.18 | 0.59 | 0.00 | 0.63 | 0.00 | 0.53 | 0.00 |
| lag ₅ | 0.18 | 0.18 | 0.18 | 0.21 | 0.11 | 0.45 | -0.26 | 0.10 | 0.15 | 0.29 |
| lag ₆ | -0.03 | 0.74 | 0.18 | 0.17 | 0.02 | 0.83 | -0.07 | 0.72 | 0.04 | 0.73 |
| lag 1 | 0.00 | 0.00 | 0.00 | 0.60 | 0.60 | 0.60 | 0.73 | 0.73 | 0.01 | 0.01 |
| lags 1-2 | 0.00 | 0.00 | 0.00 | 0.09 | 0.09 | 0.73 | 0.91 | 0.91 | 0.00 | 0.00 |
| lags 1-3 | 0.00 | 0.00 | 0.00 | 0.13 | 0.13 | 0.83 | 0.60 | 0.60 | 0.01 | 0.01 |
| lags 1-4 | 0.00 | 0.00 | 0.00 | 0.11 | 0.11 | 0.18 | 0.08 | 0.08 | 0.00 | 0.00 |
| lags 1-5 | 0.00 | 0.00 | 0.00 | 0.28 | 0.28 | 0.07 | 0.18 | 0.18 | 0.00 | 0.00 |
| lags 1-6 | 0.00 | 0.00 | 0.00 | 0.59 | 0.59 | 0.07 | 0.21 | 0.21 | 0.00 | 0.00 |
| Adj. R ² | 0.841 | 0.102 | 0.18 | 0.102 | 0.757 | 0.816 | 0.816 | 0.816 | 0.785 | 0.785 |
| n | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 |

(p-values are adjusted for heteroscedasticity with the White test.)

- * significant at the 10% level
- ** significant at the 5% level
- *** significant at the 1% level

Table 8. (continued)

| | Pretcom | P | Pretreg | P | Pretsgl | P | Pretsup | P | Pretnei | P |
|---------------------|---------|-------|---------|-------|---------|-------|---------|-------|---------|------|
| Intercept | -0.05 | 0.10 | 0.13 | 0.00 | -0.02 | 0.81 | 0.02 | 0.62 | 0.09 | 0.05 |
| perinc | -0.11 | 0.14 | -0.10 | 0.49 | 0.39 | 0.07 | -0.24 | 0.03 | -0.06 | 0.68 |
| popu | 3.18 | 0.78 | -70.22 | 0.00 | 23.66 | 0.41 | -18.65 | 0.31 | -40.57 | 0.01 |
| unemploy | 0.00 | 0.98 | -0.17 | 0.00 | -0.16 | 0.05 | -0.12 | 0.06 | -0.05 | 0.36 |
| interest | -0.04 | 0.00 | -0.05 | 0.00 | -0.01 | 0.82 | 0.00 | 0.98 | -0.05 | 0.00 |
| GDP | 2.80 | 0.00 | 5.46 | 0.00 | 5.83 | 0.00 | 3.07 | 0.05 | 4.70 | 0.01 |
| retail | 0.04 | 0.38 | -0.01 | 0.95 | -0.06 | 0.66 | -0.22 | 0.01 | -0.01 | 0.93 |
| CPI | -0.25 | 0.31 | -0.37 | 0.38 | -2.68 | 0.00 | -0.49 | 0.18 | -0.69 | 0.19 |
| rslloan | 0.06 | 0.30 | -0.19 | 0.08 | -0.19 | 0.23 | -0.01 | 0.88 | -0.19 | 0.07 |
| SP500 | 0.01 | 0.58 | 0.03 | 0.16 | 0.05 | 0.14 | 0.03 | 0.08 | 0.00 | 0.85 |
| defrisk | -0.02 | 0.00 | -0.02 | 0.05 | 0.01 | 0.60 | -0.01 | 0.27 | -0.03 | 0.03 |
| rsalevar | 0.01 | 0.65 | 0.04 | 0.15 | -0.10 | 0.04 | 0.05 | 0.02 | 0.00 | 0.87 |
| lag ₁ | -0.13 | 0.45 | 0.31 | 0.01 | -0.37 | 0.01 | 0.08 | 0.45 | 0.08 | 0.65 |
| lag ₂ | 0.52 | 0.00 | 0.19 | 0.14 | -0.80 | 0.00 | 0.24 | 0.01 | -0.11 | 0.30 |
| lag ₃ | 0.10 | 0.37 | -0.06 | 0.50 | -0.23 | 0.22 | -0.25 | 0.12 | -0.27 | 0.09 |
| lag ₄ | 0.40 | 0.00 | 0.58 | 0.00 | -0.16 | 0.36 | 0.13 | 0.34 | 0.17 | 0.30 |
| lag ₅ | 0.22 | 0.07 | 0.00 | 0.99 | -0.10 | 0.61 | 0.36 | 0.00 | -0.11 | 0.68 |
| lag ₆ | -0.19 | 0.08 | 0.02 | 0.81 | 0.13 | 0.58 | 0.06 | 0.59 | 0.21 | 0.11 |
| lag ₁ | | 0.45 | | 0.01 | | 0.01 | | 0.45 | | 0.65 |
| lags 1-2 | | 0.07 | | 0.01 | | 0.00 | | 0.04 | | 0.88 |
| lags 1-3 | | 0.04 | | 0.08 | | 0.00 | | 0.79 | | 0.30 |
| lags 1-4 | | 0.00 | | 0.00 | | 0.00 | | 0.56 | | 0.72 |
| lags 1-5 | | 0.00 | | 0.00 | | 0.01 | | 0.06 | | 0.62 |
| lags 1-6 | | 0.00 | | 0.00 | | 0.07 | | 0.07 | | 0.96 |
| Adj. R ² | 0.833 | 0.680 | 0.346 | 0.680 | 0.346 | 0.692 | 0.692 | 0.557 | 0.557 | 61 |
| n | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 |

(p-values are adjusted for heteroscedasticity with the White test.)

- * significant at the 10% level
- ** significant at the 5% level
- *** significant at the 1% level

Table 9.
Time Series Regressions of Property Rent Changes at the National Level, 1989:3-2006:2.

| | Rapt | p | Rhtl | p | Rofc | p | Rind | p | Rret | p |
|---------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Intercept | -0.02 | 0.41 | -0.07 | 0.24 | -0.12 | 0.06 | 0.03 | 0.38 | -0.04 | 0.20 |
| perinc | 0.14 | 0.02 | 0.18 | 0.32 | 0.27 | 0.08 | -0.20 | 0.07 | 0.08 | 0.48 |
| popu | 13.16 | 0.09 | 47.85 | 0.05 | 50.85 | 0.06 | -6.72 | 0.67 | 25.24 | * |
| unemploy | -0.03 | 0.09 | -0.09 | 0.06 | 0.00 | 0.94 | -0.12 | 0.00 | -0.04 | 0.18 |
| interest | 0.01 | 0.46 | 0.00 | 0.95 | 0.10 | 0.01 | -0.01 | 0.71 | 0.02 | 0.36 |
| GDP | 0.31 | 0.48 | -0.73 | 0.66 | 0.67 | 0.65 | 2.27 | 0.07 | 1.38 | 0.25 |
| retail | -0.06 | 0.01 | -0.08 | 0.17 | -0.12 | 0.11 | -0.18 | 0.00 | -0.11 | 0.12 |
| CPI | -0.09 | 0.44 | -0.12 | 0.72 | -0.73 | 0.05 | 0.11 | 0.60 | -0.21 | 0.35 |
| rsloan | 0.06 | 0.15 | 0.04 | 0.70 | 0.20 | 0.26 | -0.05 | 0.62 | 0.05 | 0.65 |
| SP500 | 0.00 | 0.45 | 0.01 | 0.50 | 0.05 | 0.06 | 0.03 | 0.13 | 0.03 | 0.12 |
| defrisk | 0.00 | 0.64 | 0.00 | 0.51 | 0.01 | 0.53 | -0.01 | 0.07 | 0.00 | 0.97 |
| rsalevar | -0.01 | 0.20 | -0.04 | 0.01 | -0.02 | 0.48 | 0.02 | 0.09 | -0.01 | 0.24 |
| lag ₁ | -0.10 | 0.36 | -0.06 | 0.69 | 0.10 | 0.18 | 0.10 | 0.36 | -0.16 | 0.29 |
| lag ₂ | -0.13 | 0.47 | -0.07 | 0.62 | 0.09 | 0.26 | -0.13 | 0.33 | -0.14 | 0.33 |
| lag ₃ | -0.10 | 0.51 | 0.16 | 0.40 | -0.14 | 0.10 | 0.20 | 0.17 | -0.04 | 0.75 |
| lag ₄ | -0.09 | 0.51 | 0.21 | 0.18 | 0.12 | 0.44 | -0.44 | 0.04 | -0.20 | 0.14 |
| lag ₅ | -0.15 | 0.34 | 0.21 | 0.16 | -0.09 | 0.34 | 0.20 | 0.12 | -0.12 | 0.21 |
| lag ₆ | -0.43 | 0.01 | 0.27 | 0.07 | -0.55 | 0.02 | -0.26 | 0.16 | -0.41 | 0.04 |
| lag ₁ | | 0.36 | | 0.69 | | 0.18 | | 0.36 | | 0.29 |
| lags 1-2 | | 0.29 | | 0.59 | | 0.13 | | 0.91 | | 0.27 |
| lags 1-3 | | 0.17 | | 0.93 | | 0.70 | | 0.50 | | 0.35 |
| lags 1-4 | | 0.11 | | 0.60 | | 0.49 | | 0.49 | | 0.23 |
| lags 1-5 | | 0.12 | | 0.44 | | 0.75 | | 0.88 | | 0.16 |
| lags 1-6 | | 0.02 | ** | 0.29 | | 0.20 | | 0.54 | | 0.02 |
| Adj. R ² | | 0.670 | | 0.903 | | 0.531 | | 0.490 | | 0.146 |
| n | | 61 | | 61 | | 61 | | 61 | | 61 |

(p-values are adjusted for heteroscedasticity with the White test.)

- * significant at the 10% level
- ** significant at the 5% level
- *** significant at the 1% level

Table 10.

Retail Property Values in Major Metropolitan Areas, 2006:4.

| Area | Retail Property Value (\$, in millions) | Share of Total 23 Areas |
|-------------------------|--|----------------------------|
| Atlanta, GA | 561.8 | 10.9% |
| Baltimore, MD | 296.5 | 5.7% |
| Boston, MA | 297.0 | 5.8% |
| Chicago, IL | 800.4 | 15.5% |
| Dallas - Fort Worth, TX | 284.9 | 5.5% |
| Denver, CO | 181.9 | 3.5% |
| Houston, TX | 137.2 | 2.6% |
| Los Angeles, CA | 385.0 | 7.4% |
| Orange County, CA | 391.9 | 7.6% |
| Orlando, FL | 151.9 | 2.9% |
| Phoenix, AZ | 135.8 | 2.6% |
| San Diego, CA | 305.5 | 5.9% |
| Seattle, WA | 222.6 | 4.3% |
| Washington, DC-NoVA-MD | 454.7 | 8.8% |
| East Bay, CA | 204.4 | 4.0% |
| New York, NY | 359.2 | 7.0% |
| Total, 23 areas | 5170.8 | 100.0% |

Table 11, Panel A.
Time Trend Variables from Time Series Regressions of Property Price Changes for 23 Metropolitan Areas, 1990:4-2006:2.

| Area | Metropolitan name | Intercept | lag1 | lag2 | lag3 | lag4 | lag5 | lag6 |
|------|-------------------------|-----------|--------|--------|--------|--------|--------|--------|
| 1 | Atlanta, GA | 0.002 | 0.062 | 0.233 | 0.043 | 0.145 | -0.297 | 0.196 |
| 2 | Austin, TX | 0.010 | -0.370 | -0.471 | -0.387 | -0.428 | 0.480 | 0.010 |
| 3 | Baltimore, MD | -0.070 | 0.205 | 0.484 | 0.072 | -0.001 | -0.359 | 0.376 |
| 4 | Boston, MA | 0.031 | -0.284 | -0.566 | -0.233 | 0.046 | 0.196 | 0.312 |
| 5 | Chicago, IL | -0.050 | 0.078 | 0.322 | 0.047 | 0.223 | 0.329 | 0.281 |
| 6 | Dallas - Fort Worth, TX | 0.016 | -0.201 | -0.632 | 0.331 | 0.020 | 0.192 | 0.193 |
| 7 | Denver, CO | -0.042 | -0.305 | 0.047 | -0.151 | -0.287 | -0.375 | 0.240 |
| 8 | Fort Lauderdale, FL | 0.027 | -0.830 | -0.644 | -0.444 | -0.484 | -0.264 | -0.122 |
| 9 | Houston, TX | -0.081 | 0.125 | -0.329 | 0.461 | 0.682 | 0.005 | 0.211 |
| 10 | Los Angeles, CA | 0.013 | -0.161 | 0.281 | 0.331 | 0.340 | 0.509 | 0.373 |
| 11 | Miami, FL | 0.031 | -0.022 | 0.207 | -0.191 | 0.076 | 0.183 | 0.084 |
| 12 | Minneapolis, MN-WI | 0.081 | -0.388 | -0.190 | -0.281 | -0.296 | -0.456 | 0.114 |
| 13 | Orange County, CA | -0.040 | -0.316 | 0.407 | 0.338 | 0.464 | -0.010 | 0.373 |
| 14 | Orlando, FL | 0.085 | -0.395 | -0.464 | -0.185 | -0.150 | 0.006 | -0.183 |
| 15 | Phoenix, AZ | 0.010 | -0.586 | -0.929 | -0.314 | -0.535 | 0.035 | -0.323 |
| 16 | Sacramento, CA | 0.016 | -0.537 | -0.494 | -0.016 | 0.305 | 0.057 | -0.099 |
| 17 | San Francisco, CA | 0.052 | -0.291 | -0.710 | 0.090 | 0.172 | 0.067 | -0.218 |
| 18 | San Jose, CA | 0.007 | -0.335 | 0.140 | 0.170 | 0.243 | -0.076 | 0.151 |
| 19 | San Diego, CA | 0.078 | -0.397 | 0.211 | 0.002 | -0.340 | -0.065 | 0.372 |
| 20 | Seattle, WA | 0.020 | 0.235 | -0.055 | 0.023 | -0.433 | -0.446 | -0.348 |
| 21 | Tampa, FL | 0.027 | -0.253 | 0.007 | 0.019 | -0.146 | -0.113 | -0.117 |
| 22 | Washington, DC-NoVA-MD | 0.081 | -0.345 | -0.285 | -0.748 | 0.000 | 0.274 | 0.194 |
| 23 | East Bay, CA | 0.005 | 0.001 | -0.193 | 0.054 | 0.212 | -0.027 | 0.198 |

(p-values are adjusted for heteroscedasticity with the White test.)

- * significant at the 10% level
- ** significant at the 5% level
- *** significant at the 1% level

Table 11, Panel A. (continued)

| Area | Metropolitan name | 1 | 1-2 | 1-3 | 1-4 | 1-5 | 1-6 |
|------|-------------------------|------|------|------|------|------|------|
| 1 | Atlanta, GA | 0.67 | 0.23 | 0.23 | 0.16 | 0.62 | 0.41 |
| 2 | Austin, TX | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | Baltimore, MD | 0.19 | 0.01 | 0.03 | 0.04 | 0.29 | 0.03 |
| 4 | Boston, MA | 0.03 | 0.00 | 0.01 | 0.02 | 0.13 | 0.39 |
| 5 | Chicago, IL | 0.58 | 0.15 | 0.31 | 0.29 | 0.11 | 0.03 |
| 6 | Dallas - Fort Worth, TX | 0.19 | 0.00 | 0.11 | 0.24 | 0.55 | 0.87 |
| 7 | Denver, CO | 0.01 | 0.11 | 0.06 | 0.02 | 0.02 | 0.12 |
| 8 | Fort Lauderdale, FL | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9 | Houston, TX | 0.47 | 0.46 | 0.54 | 0.08 | 0.18 | 0.12 |
| 10 | Los Angeles, CA | 0.14 | 0.49 | 0.06 | 0.02 | 0.00 | 0.00 |
| 11 | Miami, FL | 0.90 | 0.51 | 0.98 | 0.83 | 0.57 | 0.51 |
| 12 | Minneapolis, MN-WI | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 13 | Orange County, CA | 0.00 | 0.52 | 0.01 | 0.00 | 0.00 | 0.00 |
| 14 | Orlando, FL | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 15 | Phoenix, AZ | 0.05 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 |
| 16 | Sacramento, CA | 0.00 | 0.00 | 0.00 | 0.05 | 0.16 | 0.15 |
| 17 | San Francisco, CA | 0.01 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 |
| 18 | San Jose, CA | 0.02 | 0.48 | 0.96 | 0.73 | 0.83 | 0.66 |
| 19 | San Diego, CA | 0.02 | 0.34 | 0.49 | 0.21 | 0.19 | 0.66 |
| 20 | Seattle, WA | 0.20 | 0.42 | 0.59 | 0.58 | 0.15 | 0.05 |
| 21 | Tampa, FL | 0.21 | 0.59 | 0.73 | 0.65 | 0.58 | 0.49 |
| 22 | Washington, DC-NoVA-MD | 0.20 | 0.10 | 0.01 | 0.03 | 0.06 | 0.11 |
| 23 | East Bay, CA | 0.99 | 0.32 | 0.58 | 0.82 | 0.91 | 0.60 |

(p-values are adjusted for heteroscedasticity with the White test.)

- * significant at the 10% level
- ** significant at the 5% level
- *** significant at the 1% level

Table 11, Panel B.
 Macroeconomic Environmental Variables from Time Series Regressions of Property Price Changes for 23 Metropolitan Areas, 1990:4-2006:2.

| Area | Metropolitan name | perinc | popu | unemploy | interest | GDP | retail |
|------|-------------------------------|--------|--------|----------|----------|--------|--------|
| 1 | Atlanta, GA | 0.300 | -1.993 | 0.262 | *** | 1.735 | ** |
| 2 | Austin, TX | -0.133 | 2.285 | -0.161 | ** | 1.240 | 0.086 |
| 3 | Baltimore, MD | 0.375 | -3.214 | *** | ** | 1.474 | 0.165 |
| 4 | Boston, MA | -0.894 | 1.801 | *** | ** | 2.482 | -0.138 |
| 5 | Chicago, IL | -1.679 | -2.125 | ** | *** | 0.803 | -0.130 |
| 6 | Dallas - Fort Worth, TX | 0.079 | -0.703 | -0.026 | *** | -1.066 | -0.017 |
| 7 | Denver, CO | -0.359 | -2.224 | -0.299 | *** | 1.494 | 0.382 |
| 8 | Fort Lauderdale, FL | 0.086 | -0.769 | 0.127 | *** | -0.594 | 0.165 |
| 9 | Houston, TX | 1.019 | 2.521 | -0.167 | ** | -1.543 | 0.065 |
| 10 | Los Angeles, CA | -0.670 | 0.297 | -0.415 | *** | -3.863 | 0.047 |
| 11 | Miami, FL | -0.150 | 2.001 | 0.006 | ** | -1.320 | -0.072 |
| 12 | Minneapolis, MN-WI | -0.161 | 1.906 | -0.073 | *** | -0.008 | -0.109 |
| 13 | Orange County, CA | -0.546 | -2.735 | 0.159 | *** | -0.028 | 0.077 |
| 14 | Orlando, FL | 0.250 | -0.348 | -0.348 | *** | -2.752 | -0.097 |
| 15 | Phoenix, AZ | 0.533 | -0.895 | -0.115 | *** | -0.395 | 0.380 |
| 16 | Sacramento, CA | 0.216 | 6.082 | -0.135 | *** | -0.665 | -0.108 |
| 17 | San Francisco, CA | 0.114 | -1.450 | -0.131 | *** | -0.288 | -0.168 |
| 18 | San Jose, CA | -1.351 | 6.194 | -0.502 | *** | 3.541 | -0.113 |
| 19 | San Diego, CA | 0.977 | 2.310 | -0.024 | ** | -0.755 | -0.177 |
| 20 | Seattle, WA | 0.547 | -9.665 | -0.019 | *** | 0.073 | -0.166 |
| 21 | Tampa, FL | 0.065 | -5.960 | -0.136 | *** | 0.651 | 0.374 |
| 22 | Washington, DC-NoVA-MD | -0.150 | -0.731 | 0.096 | *** | 2.125 | -0.467 |
| 23 | East Bay, CA | -0.683 | -1.486 | -0.293 | *** | 0.778 | -0.222 |
| | # of areas: coef.>0 | 2 | 3 | 3 | 3 | 4 | 5 |
| | # of areas: coef.<0 | 6 | 5 | 6 | 5 | 3 | 3 |
| | # of areas: coef. not signif. | 42 | 42 | 41 | 42 | 43 | 42 |

(p-values are adjusted for heteroscedasticity with the White test.)

* significant at the 10% level
 ** significant at the 5% level
 *** significant at the 1% level

Table 11, Panel B. (continued)

| Area | Metropolitan name | CPI | rsloan | SP500 | defrisk | rsalevar |
|------|-------------------------------|--------|--------|--------|---------|----------|
| 1 | Atlanta, GA | -0.303 | 0.036 | -0.025 | -0.039 | -0.204 |
| 2 | Austin, TX | -0.474 | 0.336 | 0.144 | -0.027 | -0.021 |
| 3 | Baltimore, MD | 1.229 | 0.743 | 0.065 | -0.019 | 0.088 |
| 4 | Boston, MA | -0.675 | -0.046 | 0.037 | 0.013 | 0.048 |
| 5 | Chicago, IL | 0.229 | -0.381 | 0.097 | -0.019 | -0.016 |
| 6 | Dallas - Fort Worth, TX | -0.190 | 0.296 | 0.035 | 0.004 | 0.055 |
| 7 | Denver, CO | -1.646 | 0.667 | 0.044 | -0.020 | 0.042 |
| 8 | Fort Lauderdale, FL | -0.530 | 0.546 | -0.014 | -0.032 | -0.031 |
| 9 | Houston, TX | -3.093 | -0.066 | 0.096 | 0.086 | -0.100 |
| 10 | Los Angeles, CA | -0.213 | 0.622 | -0.026 | -0.009 | 0.038 |
| 11 | Miami, FL | 0.226 | 0.242 | -0.050 | -0.020 | 0.011 |
| 12 | Minneapolis, MN-WI | 0.094 | -0.262 | 0.029 | -0.022 | -0.015 |
| 13 | Orange County, CA | 0.608 | -0.501 | 0.009 | -0.056 | 0.130 |
| 14 | Orlando, FL | -0.536 | -0.275 | -0.056 | -0.029 | 0.122 |
| 15 | Phoenix, AZ | -1.980 | -0.047 | -0.010 | -0.039 | 0.029 |
| 16 | Sacramento, CA | 0.252 | 0.639 | 0.064 | -0.023 | 0.054 |
| 17 | San Francisco, CA | -1.101 | -0.021 | -0.047 | -0.043 | -0.076 |
| 18 | San Jose, CA | -1.165 | 0.466 | 0.091 | -0.007 | 0.113 |
| 19 | San Diego, CA | 0.095 | 0.820 | -0.080 | 0.002 | -0.045 |
| 20 | Seattle, WA | -1.100 | 0.228 | -0.047 | -0.031 | -0.127 |
| 21 | Tampa, FL | -2.136 | 0.335 | -0.029 | -0.009 | 0.033 |
| 22 | Washington, DC-NoVA-MD | -0.281 | -0.411 | 0.083 | -0.059 | -0.034 |
| 23 | East Bay, CA | -0.642 | 0.380 | -0.087 | -0.027 | 0.029 |
| | # of areas: coef.>0 | 0 | 7 | 7 | 1 | 5 |
| | # of areas: coef.<0 | 5 | 3 | 2 | 5 | 3 |
| | # of areas: coef. not signif. | 45 | 40 | 41 | 44 | 42 |

(p-values are adjusted for heteroscedasticity with the White test.)

* significant at the 10% level

** significant at the 5% level

*** significant at the 1% level

Table 11, Panel C.
Local Environmental Variables from Time Series Regressions of Property Price Changes for 23 Metropolitan Areas, 1990:4-2006:2.

| Area | Metropolitan name | <i>mbusby</i> | <i>mCPI</i> | <i>munemrt</i> | <i>GMP</i> | <i>mihhd</i> | | | |
|------|-------------------------------|---------------|-------------|----------------|------------|--------------|-----|--------|--------|
| 1 | Atlanta, GA | -0.042 | * | 1.138 | ** | -0.056 | * | 0.925 | *** |
| 2 | Austin, TX | 0.057 | ** | 1.146 | ** | 0.024 | | 0.035 | *** |
| 3 | Baltimore, MD | -0.009 | | 0.575 | ** | -0.180 | ** | -2.339 | *** |
| 4 | Boston, MA | -0.031 | *** | -0.959 | ** | -0.077 | | -0.617 | * |
| 5 | Chicago, IL | -0.102 | ** | 0.990 | ** | -0.034 | | 0.077 | * |
| 6 | Dallas - Fort Worth, TX | 0.023 | ** | -0.066 | * | 0.072 | * | -0.057 | * |
| 7 | Denver, CO | -0.030 | ** | 0.684 | | 0.008 | | -1.520 | *** |
| 8 | Fort Lauderdale, FL | -0.041 | ** | -0.759 | * | 0.024 | * | -1.024 | *** |
| 9 | Houston, TX | -0.007 | ** | -1.922 | | -0.258 | | 1.192 | 0.664 |
| 10 | Los Angeles, CA | 0.120 | ** | 0.989 | | -0.065 | | -0.589 | ** |
| 11 | Miami, FL | -0.013 | * | -0.391 | | -0.080 | *** | 1.139 | ** |
| 12 | Minneapolis, MN-WI | -0.048 | * | -0.447 | ** | -0.093 | *** | 0.262 | *** |
| 13 | Orange County, CA | 0.045 | * | 0.316 | | 0.249 | *** | 0.271 | ** |
| 14 | Orlando, FL | -0.119 | * | 0.292 | | -0.167 | * | -0.902 | * |
| 15 | Phoenix, AZ | -0.092 | | 0.434 | | -0.014 | *** | -1.464 | *** |
| 16 | Sacramento, CA | 0.009 | | 1.339 | *** | 0.105 | ** | -0.941 | 0.301 |
| 17 | San Francisco, CA | -0.072 | | 0.383 | | -0.062 | | 0.135 | -2.935 |
| 18 | San Jose, CA | 0.046 | | -0.701 | *** | -0.200 | | 0.056 | -3.451 |
| 19 | San Diego, CA | 0.054 | | -0.126 | | 0.006 | *** | 0.003 | -1.742 |
| 20 | Seattle, WA | -0.120 | * | -0.891 | | -0.031 | | 0.103 | 0.336 |
| 21 | Tampa, FL | 0.000 | | 0.987 | | -0.318 | *** | 0.735 | -1.493 |
| 22 | Washington, DC-NoVA-MD | 0.057 | | -0.285 | | -0.036 | *** | -0.647 | *** |
| 23 | East Bay, CA | | | | | | | 0.666 | 2.321 |
| | # of areas: coef.>0 | 2 | 4 | 1 | 1 | 3 | | | |
| | # of areas: coef.<0 | 7 | 2 | 5 | 7 | 7 | | | |
| | # of areas: coef. not signif. | 39 | 42 | 42 | 40 | 38 | | | |

(p-values are adjusted for heteroscedasticity with the White test.)

- * significant at the 10% level
- ** significant at the 5% level
- *** significant at the 1% level

Table 11, Panel C. continued

| Area | Metropolitan name | <i>mperinc</i> | <i>mperbry</i> | <i>mpopu</i> | <i>mretail</i> | <i>mrsalevar</i> |
|------|-------------------------------|----------------|----------------|--------------|----------------|------------------|
| 1 | Atlanta, GA | 1.473 | -0.045 | -2.442 | -0.164 | -0.006 |
| 2 | Austin, TX | -0.544 | -0.027 | -0.595 | 0.287 | 0.000 |
| 3 | Baltimore, MD | 2.589 | -0.130 | -0.731 | -1.743 | -0.021 |
| 4 | Boston, MA | 0.284 | 0.002 | 2.473 | 0.552 | 0.001 |
| 5 | Chicago, IL | 2.448 | -0.003 | 1.038 | -1.023 | 0.009 |
| 6 | Dallas - Fort Worth, TX | 0.091 | 0.012 | -3.982 | -0.383 | -0.002 |
| 7 | Denver, CO | 0.544 | -0.137 | -2.590 | -0.222 | -0.003 |
| 8 | Fort Lauderdale, FL | 0.394 | -0.032 | 2.175 | -0.378 | -0.002 |
| 9 | Houston, TX | 3.161 | -0.128 | 5.538 | -3.102 | -0.003 |
| 10 | Los Angeles, CA | -1.163 | 0.099 | -14.348 | -0.108 | 0.023 |
| 11 | Miami, FL | -0.129 | 0.060 | 0.504 | -0.037 | 0.000 |
| 12 | Minneapolis, MN-WI | -0.432 | 0.124 | -1.607 | 0.595 | 0.002 |
| 13 | Orange County, CA | 1.123 | 0.104 | -1.275 | -0.344 | -0.004 |
| 14 | Orlando, FL | -2.168 | 0.056 | 3.279 | 1.700 | 0.001 |
| 15 | Phoenix, AZ | 0.359 | -0.132 | 2.463 | -0.346 | -0.002 |
| 16 | Sacramento, CA | 0.004 | 0.112 | 0.031 | 0.214 | -0.003 |
| 17 | San Francisco, CA | -0.034 | -0.084 | 2.928 | 0.045 | -0.003 |
| 18 | San Jose, CA | -0.127 | -0.007 | 1.881 | 0.150 | -0.008 |
| 19 | San Diego, CA | -0.290 | 0.072 | -2.839 | -0.064 | -0.007 |
| 20 | Seattle, WA | -0.073 | -0.068 | 1.934 | 0.976 | -0.013 |
| 21 | Tampa, FL | -0.574 | 0.056 | 2.120 | -0.017 | 0.011 |
| 22 | Washington, DC-NoVA-MD | 1.106 | 0.028 | 2.262 | 0.338 | 0.004 |
| 23 | East Bay, CA | -0.306 | 0.004 | -2.371 | -0.869 | -0.006 |
| | # of areas: coef.>0 | 6 | 6 | 6 | 3 | 3 |
| | # of areas: coef.<0 | 3 | 5 | 4 | 5 | 6 |
| | # of areas: coef. not signif. | 39 | 37 | 38 | 40 | 39 |

(p-values are adjusted for heteroscedasticity with the White test.)

- * significant at the 10% level
- ** significant at the 5% level
- *** significant at the 1% level

Table 12, Panel A.
Time Trend Variables for Time Series Regressions of Property Rent Changes for 23 Metropolitan Areas, 1990:4-2006:2.

| Area | Metropolitan name | Intercept | lag1 | lag2 | lag3 | lag4 | lag5 | lag6 |
|------|-------------------------|-----------|------------|------------|------------|------------|------------|------------|
| 1 | Atlanta, GA | 0.015 | 0.069 | 0.007 | -0.219 | -0.163 | -0.057 | -0.098 |
| 2 | Austin, TX | -0.070 | *** -0.046 | 0.104 | 0.373 | * | -0.129 | ** -0.291 |
| 3 | Baltimore, MD | -0.028 | ** -0.070 | -0.035 | 0.304 | ** | 0.228 | ** 0.033 |
| 4 | Boston, MA | -0.022 | ** -0.043 | -0.090 | 0.099 | -0.046 | 0.220 | -0.046 |
| 5 | Chicago, IL | -0.008 | 0.191 | -0.396 | 0.048 | -0.143 | -0.010 | -0.196 |
| 6 | Dallas - Fort Worth, TX | -0.011 | -0.057 | 0.071 | 0.083 | -0.070 | -0.223 | * -0.044 |
| 7 | Denver, CO | 0.049 | *** -0.683 | *** -0.854 | *** -0.988 | *** -0.956 | *** -0.461 | *** -0.701 |
| 8 | Fort Lauderdale, FL | 0.045 | *** -0.331 | *** -0.722 | *** -0.489 | *** -0.709 | *** 0.022 | *** -0.266 |
| 9 | Houston, TX | 0.175 | *** -0.365 | -0.261 | -1.034 | *** | ** 0.309 | ** 0.015 |
| 10 | Los Angeles, CA | 0.011 | *** -0.503 | *** -0.417 | *** 0.009 | 0.244 | * 0.079 | *** 0.425 |
| 11 | Miami, FL | 0.048 | ** -0.374 | ** -0.617 | *** -0.321 | ** -0.609 | *** -0.162 | ** -0.320 |
| 12 | Minneapolis, MN-WI | -0.014 | -0.160 | -0.292 | *** -0.063 | 0.297 | ** 0.133 | *** -0.022 |
| 13 | Orange County, CA | 0.059 | *** -0.353 | *** -0.459 | *** -0.357 | ** -0.279 | ** -0.352 | *** -0.415 |
| 14 | Orlando, FL | 0.013 | -0.408 | ** -0.431 | ** -0.411 | ** -0.287 | -0.301 | * 0.016 |
| 15 | Phoenix, AZ | 0.030 | * -0.842 | *** -0.174 | *** -0.337 | *** -0.440 | *** -0.409 | ** -0.293 |
| 16 | Sacramento, CA | 0.052 | *** -0.276 | *** -0.671 | *** -0.437 | *** -0.647 | *** -0.257 | ** -0.344 |
| 17 | San Francisco, CA | 0.025 | -0.962 | *** -0.600 | *** -0.649 | *** -0.645 | *** -0.478 | *** -0.349 |
| 18 | San Jose, CA | -0.027 | -0.379 | -0.756 | *** -0.718 | ** -0.790 | ** -0.019 | *** -0.377 |
| 19 | San Diego, CA | 0.025 | ** -0.291 | ** -0.439 | *** -0.474 | *** -0.246 | ** -0.332 | ** -0.158 |
| 20 | Seattle, WA | -0.002 | -0.433 | *** -0.011 | *** -0.272 | *** -0.222 | ** 0.227 | *** 0.251 |
| 21 | Tampa, FL | 0.020 | -0.071 | -0.652 | *** -0.182 | ** -0.815 | *** 0.039 | ** -0.332 |
| 22 | Washington, DC-NoVA-MD | 0.028 | * -0.550 | *** -0.202 | *** -0.226 | -0.049 | -0.095 | ** 0.017 |
| 23 | East Bay, CA | -0.045 | -0.630 | -0.043 | -0.290 | -0.432 | * 0.326 | *** -0.086 |

(p-values are adjusted for heteroscedasticity with the White test.)

- * significant at the 10% level
- ** significant at the 5% level
- *** significant at the 1% level

Table 12, Panel A. *continued*

| Area | Metropolitan name | 1 | 1-2 | 1-3 | 1-4 | 1-5 | 1-6 |
|------|-------------------------|------|------|------|------|------|------|
| 1 | Atlanta, GA | 0.85 | 0.90 | 0.87 | 0.79 | 0.76 | 0.71 |
| 2 | Austin, TX | 0.83 | 0.86 | 0.51 | 0.29 | 0.22 | 0.11 |
| 3 | Baltimore, MD | 0.49 | 0.86 | 0.26 | 0.12 | 0.07 | 0.16 |
| 4 | Boston, MA | 0.69 | 0.49 | 0.90 | 0.82 | 0.71 | 0.81 |
| 5 | Chicago, IL | 0.25 | 0.31 | 0.54 | 0.45 | 0.52 | 0.34 |
| 6 | Dallas - Fort Worth, TX | 0.73 | 0.96 | 0.83 | 0.72 | 0.44 | 0.42 |
| 7 | Denver, CO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | Fort Lauderdale, FL | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9 | Houston, TX | 0.18 | 0.12 | 0.01 | 0.01 | 0.02 | 0.02 |
| 10 | Los Angeles, CA | 0.00 | 0.00 | 0.00 | 0.02 | 0.08 | 0.71 |
| 11 | Miami, FL | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 12 | Minneapolis, MN-WI | 0.35 | 0.01 | 0.03 | 0.49 | 0.82 | 0.80 |
| 13 | Orange County, CA | 0.03 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| 14 | Orlando, FL | 0.05 | 0.01 | 0.01 | 0.03 | 0.03 | 0.06 |
| 15 | Phoenix, AZ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 16 | Sacramento, CA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | San Francisco, CA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 18 | San Jose, CA | 0.15 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 |
| 19 | San Diego, CA | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | Seattle, WA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 |
| 21 | Tampa, FL | 0.71 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | Washington, DC-NoVA-MD | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| 23 | East Bay, CA | 0.02 | 0.12 | 0.11 | 0.06 | 0.14 | 0.11 |

(p-values are adjusted for heteroscedasticity with the White test.)

* significant at the 10% level

** significant at the 5% level

*** significant at the 1% level

Table 12, Panel B.
 Macroeconomic Environmental Variables from Time Series Regressions of Property Rent Changes for 23 Metropolitan Areas, 1990-4-2006:2.

| Area | Metropolitan name | perinc | popu | unemploy | interest | GDP | retail |
|------|-------------------------------|--------|--------|----------|----------|--------|--------|
| 1 | Atlanta, GA | -0.525 | -5.221 | -0.006 | 0.043 | 4.077 | -0.197 |
| 2 | Austin, TX | 0.381 | -0.979 | -0.063 | 0.173 | 3.015 | 0.292 |
| 3 | Baltimore, MD | -0.451 | 3.911 | *** | 0.052 | 1.121 | 0.177 |
| 4 | Boston, MA | 0.049 | 0.596 | -0.134 | *** | -1.315 | 0.099 |
| 5 | Chicago, IL | -0.572 | -1.434 | * | -0.056 | 0.451 | 0.023 |
| 6 | Dallas - Fort Worth, TX | 0.459 | -3.402 | *** | 0.127 | 3.805 | 0.176 |
| 7 | Denver, CO | 0.428 | -4.671 | *** | -0.045 | 0.087 | -0.168 |
| 8 | Fort Lauderdale, FL | -0.115 | 0.356 | -0.239 | -0.005 | -1.004 | -0.160 |
| 9 | Houston, TX | -1.299 | -5.753 | -0.223 | 0.100 | 3.545 | -0.969 |
| 10 | Los Angeles, CA | -0.136 | -0.350 | 0.023 | 0.404 | 1.999 | -0.047 |
| 11 | Miami, FL | 0.238 | -2.258 | 0.109 | -0.037 | 0.742 | -0.141 |
| 12 | Minneapolis, MN-WI | 0.380 | 1.527 | -0.094 | -0.063 | 1.305 | 0.052 |
| 13 | Orange County, CA | -0.059 | 2.047 | 0.097 | -0.003 | -1.020 | -0.204 |
| 14 | Orlando, FL | 0.240 | -0.107 | 0.052 | 0.029 | 0.799 | 0.012 |
| 15 | Phoenix, AZ | 0.893 | 0.039 | 0.077 | -0.010 | -2.141 | -0.053 |
| 16 | Sacramento, CA | 0.433 | -1.345 | 0.013 | 0.011 | 1.166 | -0.201 |
| 17 | San Francisco, CA | 0.761 | 2.265 | -0.027 | -0.053 | 2.042 | -0.118 |
| 18 | San Jose, CA | -0.350 | -2.398 | 0.042 | 0.028 | 6.906 | -0.131 |
| 19 | San Diego, CA | 0.306 | -3.015 | 0.106 | 0.193 | 2.540 | 0.045 |
| 20 | Seattle, WA | -0.035 | -1.589 | -0.125 | 0.092 | 1.015 | -0.040 |
| 21 | Tampa, FL | -0.674 | -0.586 | 0.038 | -0.027 | 0.571 | -0.023 |
| 22 | Washington, DC-NoVA-MD | 0.574 | -0.398 | -0.166 | 0.061 | 1.730 | -0.400 |
| 23 | East Bay, CA | 1.249 | 4.474 | 0.145 | -0.005 | -3.672 | 0.453 |
| | # of areas: coef.>0 | 8 | 3 | 1 | 6 | 9 | 4 |
| | # of areas: coef.<0 | 2 | 4 | 6 | 4 | 4 | 6 |
| | # of areas: coef. not signif. | 38 | 41 | 41 | 38 | 35 | 38 |

(p-values are adjusted for heteroscedasticity with the White test.)

* significant at the 10% level
 ** significant at the 5% level
 *** significant at the 1% level

Table 12, Panel B. *continued*

| Area | Metropolitan name | CPI | rsloan | SP500 | defrisk | rsalevar |
|------|-------------------------------|--------|--------|--------|---------|----------|
| 1 | Atlanta, GA | 0.486 | 0.588 | -0.041 | -0.016 | -0.100 |
| 2 | Austin, TX | 0.740 | -0.144 | -0.019 | 0.077 | -0.132 |
| 3 | Baltimore, MD | -1.808 | *** | 0.035 | 0.016 | 0.008 |
| 4 | Boston, MA | 0.387 | 0.166 | -0.028 | 0.007 | 0.026 |
| 5 | Chicago, IL | -0.914 | * | 0.076 | 0.036 | -0.022 |
| 6 | Dallas - Fort Worth, TX | 1.207 | *** | 0.062 | -0.008 | -0.108 |
| 7 | Denver, CO | 1.278 | *** | 0.175 | -0.003 | -0.106 |
| 8 | Fort Lauderdale, FL | -0.533 | 0.457 | 0.105 | -0.003 | 0.021 |
| 9 | Houston, TX | -1.624 | -0.540 | 0.063 | 0.058 | 0.003 |
| 10 | Los Angeles, CA | 0.030 | 0.013 | -0.032 | -0.004 | -0.074 |
| 11 | Miami, FL | -0.170 | -0.043 | 0.024 | -0.033 | -0.003 |
| 12 | Minneapolis, MN-WI | 1.026 | -0.426 | -0.051 | -0.005 | -0.011 |
| 13 | Orange County, CA | 0.212 | 0.188 | 0.001 | 0.005 | 0.030 |
| 14 | Orlando, FL | 0.150 | 0.218 | 0.048 | -0.001 | -0.006 |
| 15 | Phoenix, AZ | 0.056 | -0.232 | 0.023 | -0.001 | -0.011 |
| 16 | Sacramento, CA | 0.747 | 0.467 | 0.057 | -0.026 | -0.017 |
| 17 | San Francisco, CA | 0.676 | -0.250 | 0.096 | 0.007 | -0.008 |
| 18 | San Jose, CA | -0.524 | 0.041 | 0.038 | 0.081 | -0.036 |
| 19 | San Diego, CA | -0.407 | 0.382 | -0.162 | 0.036 | -0.135 |
| 20 | Seattle, WA | -0.583 | -0.102 | 0.031 | -0.028 | 0.041 |
| 21 | Tampa, FL | -0.329 | -0.281 | 0.002 | -0.006 | -0.049 |
| 22 | Washington, DC-NoVA-MD | -0.987 | 0.097 | 0.083 | 0.004 | -0.057 |
| 23 | East Bay, CA | -0.909 | 0.134 | -0.046 | 0.007 | -0.014 |
| | # of areas: coef.>0 | 5 | 5 | 7 | 4 | 1 |
| | # of areas: coef.<0 | 4 | 2 | 2 | 3 | 6 |
| | # of areas: coef. not signif. | 39 | 41 | 39 | 41 | 41 |

(p-values are adjusted for heteroscedasticity with the White test.)

* significant at the 10% level

** significant at the 5% level

*** significant at the 1% level

Table 12, Panel C.
Local Environmental Variables from Time Series Regressions of Property Rent Changes for 23 Metropolitan Areas, 1990:4-2006:2.

| Area | Metropolitan name | mbsby | mCPI | munemrt | GMP | mnhhd |
|------|-------------------------------|--------|--------|---------|--------|--------|
| 1 | Atlanta, GA | 0.031 | -1.606 | -0.104 | 0.971 | -2.272 |
| 2 | Austin, TX | -0.090 | 0.618 | -0.230 | 0.028 | 0.733 |
| 3 | Baltimore, MD | -0.009 | -1.100 | 0.101 | 1.923 | 2.452 |
| 4 | Boston, MA | 0.044 | -0.906 | 0.185 | 0.455 | 0.511 |
| 5 | Chicago, IL | 0.076 | -0.499 | 0.071 | -0.316 | -3.041 |
| 6 | Dallas - Fort Worth, TX | 0.014 | 0.206 | -0.179 | -1.138 | -1.928 |
| 7 | Denver, CO | 0.012 | -1.623 | -0.064 | -0.208 | -0.078 |
| 8 | Fort Lauderdale, FL | 0.002 | -0.170 | -0.147 | -0.840 | -6.556 |
| 9 | Houston, TX | 0.052 | 1.018 | -0.398 | 1.094 | -5.926 |
| 10 | Los Angeles, CA | -0.004 | -2.370 | -0.113 | 1.184 | 1.214 |
| 11 | Miami, FL | -0.029 | 1.664 | -0.025 | -0.804 | 4.407 |
| 12 | Minneapolis, MN-WI | -0.028 | 0.589 | 0.090 | 0.191 | 0.145 |
| 13 | Orange County, CA | -0.064 | 0.084 | -0.175 | -0.669 | -0.296 |
| 14 | Orlando, FL | -0.017 | -0.139 | -0.068 | 0.353 | -2.250 |
| 15 | Phoenix, AZ | -0.016 | 0.505 | -0.093 | 0.107 | -2.758 |
| 16 | Sacramento, CA | -0.020 | 0.237 | -0.131 | -0.315 | 2.984 |
| 17 | San Francisco, CA | -0.037 | 0.015 | -0.156 | -0.415 | 6.932 |
| 18 | San Jose, CA | -0.063 | -0.157 | -0.078 | 0.670 | 14.064 |
| 19 | San Diego, CA | 0.127 | -1.614 | 0.024 | 1.405 | -2.803 |
| 20 | Seattle, WA | 0.027 | 1.119 | -0.112 | -0.412 | 4.079 |
| 21 | Tampa, FL | -0.015 | 0.934 | 0.015 | -0.543 | -0.335 |
| 22 | Washington, DC-NoVA-MD | 0.058 | 1.149 | -0.307 | -0.919 | -0.070 |
| 23 | East Bay, CA | 0.038 | -0.828 | 0.663 | 0.432 | 0.926 |
| | # of areas: coef.>0 | 2 | 4 | 4 | 2 | 6 |
| | # of areas: coef.<0 | 3 | 5 | 12 | 7 | 6 |
| | # of areas: coef. not signif. | 43 | 39 | 32 | 39 | 36 |

(p-values are adjusted for heteroscedasticity with the White test.)

- * significant at the 10% level
- ** significant at the 5% level
- *** significant at the 1% level

Table 12, Panel C. continued

| Area | Metropolitan name | <i>mperinc</i> | <i>mperbry</i> | <i>mpopu</i> | <i>mretail</i> | <i>mrsalevar</i> |
|------|-------------------------------|----------------|----------------|--------------|----------------|------------------|
| 1 | Atlanta, GA | 1.474 | -0.014 | 5.271 | -0.277 | -0.013 |
| 2 | Austin, TX | 0.512 | -0.173 | 1.559 | -0.295 | -0.008 |
| 3 | Baltimore, MD | -1.678 | *** | 0.399 | 1.198 | 0.009 |
| 4 | Boston, MA | 0.156 | -0.013 | -0.927 | 0.012 | 0.004 |
| 5 | Chicago, IL | 1.100 | ** | 3.994 | -0.977 | ** |
| 6 | Dallas - Fort Worth, TX | 1.484 | *** | -5.514 | -1.510 | *** |
| 7 | Denver, CO | -0.551 | 0.014 | 0.512 | 0.030 | 0.000 |
| 8 | Fort Lauderdale, FL | 0.103 | -0.007 | 3.198 | -0.109 | 0.004 |
| 9 | Houston, TX | -6.445 | 0.234 | -7.881 | 8.488 | -0.003 |
| 10 | Los Angeles, CA | 0.534 | ** | -3.445 | 0.054 | 0.001 |
| 11 | Miami, FL | 1.113 | -0.001 | -2.914 | -1.213 | 0.002 |
| 12 | Minneapolis, MN-WI | 0.259 | -0.129 | 4.170 | -0.215 | -0.008 |
| 13 | Orange County, CA | 0.254 | 0.016 | 3.996 | 0.112 | ** |
| 14 | Orlando, FL | 0.247 | -0.028 | 0.178 | -0.312 | *** |
| 15 | Phoenix, AZ | -0.442 | -0.021 | -0.760 | 0.580 | -0.003 |
| 16 | Sacramento, CA | 1.035 | 0.007 | 0.914 | -1.382 | -0.005 |
| 17 | San Francisco, CA | 0.235 | -0.052 | -0.610 | -0.287 | ** |
| 18 | San Jose, CA | 0.518 | -0.039 | -2.145 | -0.656 | -0.003 |
| 19 | San Diego, CA | 1.030 | -0.045 | 0.036 | -0.345 | -0.009 |
| 20 | Seattle, WA | 0.094 | -0.016 | -2.492 | 0.084 | -0.012 |
| 21 | Tampa, FL | 0.088 | -0.024 | -2.603 | -0.084 | -0.001 |
| 22 | Washington, DC-NoVA-MD | 0.336 | -0.073 | -0.187 | 1.008 | -0.001 |
| 23 | East Bay, CA | 0.494 | -0.058 | -1.322 | 0.649 | -0.004 |
| | # of areas: coef.>0 | 6 | 1 | 5 | 4 | 3 |
| | # of areas: coef.<0 | 3 | 9 | 6 | 5 | 9 |
| | # of areas: coef. not signif. | 39 | 38 | 37 | 39 | 36 |

(p-values are adjusted for heteroscedasticity with the White test.)

- * significant at the 10% level
- ** significant at the 5% level
- *** significant at the 1% level

Houston experience one-year excess momentum without flips, with hypothesis *H4* rejected (at the 10% level) and most influential time trend coefficients positive. Finally, Baltimore has a strong excess momentum without flips in price movement, with hypotheses *H2*, *H3*, *H4*, and *H6* rejected (all at the 5% level), and positive coefficients for most significant time-trend variables.

It seems that excess price momentum without flips is more common in big cities like Chicago, Los Angeles, and Houston. The effect likely indicates the existence of price bubble potentials in the retail property markets in these areas, as a similar autocorrelation pattern is absent in the rent movements in these markets. Only Baltimore has temporary excess momentum in rent movements, but the power of the momentum is much weaker than that for price movements, in terms of both normalized coefficient magnitude and momentum duration. In general, rent movements appear to be more associated with adjustments than price movements given that, among 23 MSAs on the list, 17 have persistent rent contrarians, while only 10 have persistent price contrarians. The five areas with excess momentum in price have a substantial value share (39%) of the total retail property market of 23 MSAs. As very large markets like Chicago and Los Angeles have great access to and influence on global capital flows, these areas exert significant impacts on national price movements.

We also examined the influences of national economy and local economy on the change rates in prices and rents for these 23 metropolitan areas. Panel B in Table 11 and in Table 12 reports the coefficients and *p*-values for macroeconomic fundamental variables in the regression models. In general, macroeconomic fundamentals impact rent more than price. The S&P500 return (+), real estate loan value (+), and CPI (-) affect the prices in some areas, and per capita income (+), GDP (+), S&P500 return (+), unemployment (-), and retail sales variance (-) affect the rents in a number of areas as well. It is interesting that stock return positively affects prices and rents in many areas, indicating that there are some positive correlations between the stock market and retail property market. This is similar to the positive correlation between the stock market and residential property markets found by Case and Shiller (2003), which may indicate that the stock market is an important income resource for investors to accumulate wealth for real estate investments, and vice versa.

Meanwhile, the impact of national retail business factors, including total retail sales and retail business risk (as measured by retail sales variance), on retail property price and rent are not consistent between areas. Reflecting the demands for the retail properties, retail sales might exert positive impacts on both price and rent, as shown in Baltimore. However, it might also exert opposite impacts on price and rent due to the substitutive relation between renting and buying a retail property, as shown in Denver, Fort Lauderdale and East Bay. Retail sales variance might reflect the instability of retail business hence negatively impact rent, but it might also reflect the speculative opportunities in the capital market and positively impact price. Consistent with these intuitions, retail sales variance positively affects rent in five areas, while it negatively affects rent in six areas.

Finally, we find that some macroeconomic variables exert abnormal effects in some areas, with a geographic concentration in big cities (such as Boston, Chicago, and Washington, D.C.) and coastal areas (such as California MSAs like Los Angeles,

Orange County, San Jose, and East Bay, and MSAs like Tampa and Seattle that are located in other coastal states). Those areas with excess price momentum without flips are affected by certain macroeconomic fundamentals in counter-intuitive ways: GDP (-) and per capita income (-) in Los Angeles; per capita income (-), unemployment (+), and real estate loan value (-) in Orange County; population (-) and per capita income (-) in Chicago; and interest rate (+) and default risk (+) in Houston.

Regarding the effects of the local economy on prices and rents, Panel C in Table 11 and Table 12 reports the coefficients and *p*-values for metropolitan-level economic fundamental variables in the time-series regressions for 23 MSAs. As with national fundamentals, local fundamentals are more influential on rent than on price. Business bankruptcies (-) and unemployment (-) affect price in quite a few areas, and personal bankruptcies (-), unemployment (-), and local retail sales variance (-) affect rent in some MSAs. Intuitively, given the large amount of money needed to purchase retail properties, these properties are more affordable to institutions than to individuals; therefore, the latter are more likely to rent rather than buy retail properties. Consequently, retail property prices can be expected to be more sensitive to local business bankruptcy number, while retail property rents would be more sensitive to local personal bankruptcy number.

It is, however, surprising to see that GMP exerts a negative impact on both price and rent, as this is not as intuitive as the impact of GDP on price and rent. This result is not biased because of any high correlation between GMP and GDP as their correlation coefficients in the 23 MSAs ranged from merely -0.18 to 0.19. These suggest that against expectation, local economy conditions might not necessarily provide more information about the drivers of price and rent movements in local retail property markets than the national economy conditions. (This result might be partially driven by the population flow of the community. For instance, in MSAs with higher immigration, such as Los Angeles, San Jose, San Diego, Dallas, and Washington D.C., retail property rent movements are more impacted by GDP than by GMP.) Supporting this argument, the volume of local retail sales does not provide more predictive power than national retail sales volumes in the models of price and rent. This result is not biased because of any high correlation between the national- and metropolitan-level retail sales as their correlation coefficients in the 23 MSAs ranged from merely -0.28 to 0.26.

Those areas experiencing excess price momentum without flips also appear to be strongly influenced by local economic fundamentals in counter-intuitive ways, similar to the impacts of national fundamentals. These abnormalities include: business bankruptcy number (+), per capita income (-), personal bankruptcy number (+), and population (-) for Los Angeles; unemployment (-), personal bankruptcy number (+), and retail (-) for Orange County; local CPI (+) and retail (-) for Chicago; GMP (-) and retail (-) for Baltimore; and retail (-) for Houston.

Overall, our time series regression models for the 23 MSAs in the data set imply that the price trends in the retail property markets of several big cities and coastal areas have noticeable excess momentum without flips which do not seem to be justified with their retail property rent movements. Those models of MSAs which include excess momentum in price movements, also describe significant counter-intuitive impacts for

some national and local fundamental variables. Due to the influence of these major MSAs in the national market, their price movements drive national prices to move in a similar way. Overall, the analysis of our metropolitan data suggests that national and local fundamentals are more influential on rent than on price. However, there is no strong evidence here to support the notion that local retail property markets are more influenced by local economic factors over national factors.

Panel Regressions with Metropolitan Data: Excess Price Momentum Detected

Finally, we pooled the data from the 23 MSAs and developed panel regression models for price and rent following Equations 5 and 6, for the period from 1989:3 to 2006:2. These models were created to assess retail property price bubble potentials at a national level. The results are displayed in Table 13.

Consistent with our findings from the analyses of national data, the panel regression models show strong and persistent excess price momentum without flips in retail property market prices, with hypothesis *H3* rejected at a 10% significance level, and hypotheses *H4*, *H5*, and *H6* rejected at a 1% significance level. The dominant time-trend variable, $lag_{p,t}$, exerts a positive effect on the current price change rate, and with a coefficient $\omega_4 = 0.162$. It is the most influential determinant for price change in the model (with a normalized coefficient 0.0044), followed by unemployment rate, CPI, and default risk (with normalized coefficients -0.0042, -0.0034, and -0.0021, respectively). Comparatively, retail property rent movements only have weak short-term momentum, with hypothesis *H1* rejected at a 10% significance level, and the dominant trend variable, lag_r , with a relatively small normalized coefficient 0.0012, compared to fundamental economic variables such as local population, GDP, and local personal bankruptcy number (with normalized coefficients 0.0146, 0.0032, and -0.0032, respectively).

Meanwhile, as in national-level regressions, economic fundamentals are more influential on rent than on price in the panel regressions. While six macroeconomic variables and five local economic variables exert significant effects on rent, including GDP (+), unemployment (-), the S&P500 return (+), CPI (-), local population (+), GMP (+), local personal bankruptcy number (-), and local unemployment rate (-), only three macroeconomic variables and no local economic variables exert significant impacts on price: CPI (-), unemployment (-), and default risk (-). From this, it appears that the national economy is more important than local economies to price movements. However, this is not necessarily true for rent movements, given that two national variables exert counter-intuitive effects on rent (population (-) and interest rate (+)), while local population (+) has a more intuitive economic effect. Interestingly, both national and local retail business factors (including retail sales volumes and retail sales variances) affect neither price nor rent.

Overall our panel regression models suggest that for the 23 MSAs there has been strong and persistent excess momentum without flips for retail property price movements, which can not be justified by changes in rent over time. Price is less impacted than rent by economic fundamentals, especially local economic fundamentals. These results support our findings from the national time-series analysis.

Table 13.
Panel Regressions of Metropolitan Retail Property Price/Rent

| | Price coef. | <i>p</i> -value | | Rent coef. | <i>p</i> -value | |
|--------------------------------|-------------|-----------------|-----|------------|-----------------|-----|
| Intercept | 0.007 | 0.30 | | -0.002 | 0.64 | |
| <i>perinc</i> | -0.124 | 0.25 | | 0.016 | 0.86 | |
| <i>popu</i> | 0.370 | 0.45 | | -0.986 | 0.04 | ** |
| <i>unemploy</i> | -0.106 | 0.00 | *** | -0.050 | 0.04 | ** |
| <i>interest</i> | 0.013 | 0.39 | | 0.021 | 0.04 | ** |
| <i>GDP</i> | -0.105 | 0.72 | | 0.991 | 0.02 | ** |
| <i>retail</i> | -0.043 | 0.23 | | -0.002 | 0.93 | |
| <i>CPI</i> | -0.732 | 0.00 | *** | -0.241 | 0.07 | * |
| <i>rsloan</i> | 0.098 | 0.14 | | 0.072 | 0.23 | |
| <i>SP500</i> | 0.018 | 0.14 | | 0.032 | 0.00 | *** |
| <i>derisk</i> | -0.011 | 0.08 | * | 0.005 | 0.25 | |
| <i>rsalevar</i> | 0.016 | 0.26 | | -0.012 | 0.14 | |
| <i>mbusbry</i> | -0.007 | 0.25 | | 0.000 | 0.95 | |
| <i>mCPI</i> | 0.123 | 0.34 | | 0.148 | 0.15 | |
| <i>munemrt</i> | 0.001 | 0.91 | | -0.028 | 0.00 | *** |
| <i>GMP</i> | 0.013 | 0.55 | | 0.039 | 0.04 | ** |
| <i>mnhhd</i> | -0.183 | 0.43 | | -0.544 | 0.01 | *** |
| <i>mperinc</i> | 0.035 | 0.36 | | 0.009 | 0.80 | |
| <i>mperbry</i> | 0.007 | 0.56 | | -0.034 | 0.00 | *** |
| <i>mpopu</i> | 0.211 | 0.38 | | 0.540 | 0.00 | *** |
| <i>mretail</i> | -0.018 | 0.64 | | -0.001 | 0.98 | |
| <i>mrsalevar</i> | -0.001 | 0.59 | | -0.001 | 0.23 | |
| <i>lag1</i> | 0.009 | 0.76 | | 0.052 | 0.08 | * |
| <i>lag2</i> | 0.037 | 0.20 | | -0.008 | 0.68 | |
| <i>lag3</i> | 0.044 | 0.11 | | -0.031 | 0.10 | * |
| <i>lag4</i> | 0.162 | 0.00 | *** | 0.000 | 0.99 | |
| <i>lag5</i> | -0.044 | 0.11 | | -0.035 | 0.11 | |
| <i>lag6</i> | 0.011 | 0.66 | | -0.025 | 0.28 | |
| Lag1 | | 0.76 | | | 0.08 | * |
| Lags1-2 | | 0.26 | | | 0.21 | |
| Lags1-3 | | 0.06 | * | | 0.75 | |
| Lags1-4 | | 0.00 | *** | | 0.79 | |
| Lags1-5 | | 0.00 | *** | | 0.65 | |
| Lags1-6 | | 0.00 | *** | | 0.41 | |
| Adjusted <i>R</i> ² | | 0.319 | | | 0.115 | |
| <i>n</i> | | 1449 | | | 1449 | |

Both the dependent variables and the explanatory variables are measured by quarterly change rates. The *p*-values are adjusted for heteroscedasticity with the White test. Data covers 1989:3-2006:2. The year, the quarter and the area fixed effects are controlled.

* significant at the 10% level
 ** significant at the 5% level
 *** significant at the 1% level

The Effects of Multicollinearity on the Results

Our regression models include major macroeconomic variables and metropolitan area economic variables. To compare the impacts of national fundamentals and local fundamentals on retail property price movements, we consider major economic variables at the two levels, such as per capita income, production, population, unemployment rate and retail sales. The correlation coefficients between national variables and their metropolitan-level comparables are, in general, reasonably low: for example, from -0.06 to 0.29 for population, from -0.18 to 0.19 for production, and from -0.28 to 0.26 for retail sales. We conducted robustness tests for the three groups of regression models (national, metropolitan, and panel types) after strictly controlling the multicollinearities of fundamental variables by excluding variables that have correlation coefficients with others higher than 50%, and the results on the time-trend variables and the remaining fundamental variables are all similar as we discussed earlier.

Conclusion

In this paper, we present our results from a new method to assess price bubble potentials in U.S. commercial property markets, specifically by investigating price movements in the retail property market. In general, there has been strong and persistent excess momentum in retail property price changes, which cannot be explained by fundamentals or justified by rent movements. This effect is notable, especially when the retail property market is compared to other commercial property markets. When the retail property market was decomposed into several submarkets, the excess momentum without flips in national price movements are shown to be largely driven by price movements in regional and super-regional retail submarkets, while some small submarkets, such as neighborhood and single-tenant submarkets, exhibit significantly less momentum. The national result appears to be largely driven by the excess price momentum in areas with large retail property markets, including Chicago, Orange Country, Calif., Los Angeles, Baltimore, and Houston. This suggests that there are price bubble potentials for certain geographical areas and property types in the U.S. retail property market. We also propose that fundamentals are less influential to retail property prices than to retail property rents. These conclusions are consistent with national- and metropolitan-level time-series regression models, and metropolitan data panel regression models. Our findings challenge the traditional perspective on commercial property price bubbles in real estate studies, and we hope that this study can provide valuable insights for the analysis of investments in retail properties.

In future research, we plan to investigate the possible drivers for the long-term excess momentum in the retail property price movements, by testing various existing bubble theories, including the price optimism theory, the mental anchoring theory, the panic buying theory, and so on. We will also explore the issue by studying the demand-side and supply-side features of the retail property market, the capital market characteristics, REIT market behaviors, and other related issues.

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