Bad policy or bad luck? Asset busts due to asymmetric transitory shocks

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Abstract

The paper provides a fresh explanation for the recent housing crisis. Specifically, it analyzes the roles of asymmetric transitory components in housing, REIT, and stock price returns from a dynamic perspective. Extending an asymmetric correlated unobserved component, we investigate lead-lag interrelationships between metropolitan housing cycles and business cycles as well as cross-asset linkages through Markov-switching low-growth regimes. We find that asymmetric shocks are evidently significant for all asset price returns given the exogenous nature, and the shock to the REIT market is more persistent than that to the stock market. Noticeably, in housing markets of New York, Los Angeles, Chicago, Washington, and Boston, asymmetric transitory shocks acted as the underlying driver of their housing price dynamics by 2005. It implies that monetary policies could play important roles before the onset of the recent bubble-like housing bust. However, weak powers of asymmetric shocks suggest the low effectiveness of monetary policies in New York and Los Angeles during the recent housing crisis.

Keywords: Asymmetric transitory component; REIT price return; asymmetric correlated unobserved components model; Markov-switching low-growth regime; metropolitan housing cycle
1. Introduction

The recent housing crisis in the US, which turned out to be a globalized financial crisis, has raised great concerns regarding underlying drivers and possible resolution of the remarkable housing bust. Do the housing and financial crises result from a “bad policy” or a “bad luck”? In other words, is there any effective monetary policy which is capable of mitigating considerable disturbances of the recent housing market? Can monetary policies play powerful roles in protecting us from the bubble-like housing bust? All of these questions remain ongoing debates.

To address these issues, the paper emphasizes the significant roles of asymmetric transitory components in three varieties of asset markets: housing, REIT (real estate investment trust), and stock assets during 1976-2010. The low-growth phases of the three asset markets, which are driven by asymmetric transitory shocks, shed insight into the time-varying monetary policy effectiveness. Moreover, we investigate lead-lag interrelationships between metropolitan housing cycles and the nationwide business cycle, as well as those across different assets by means of specifying Markov-switching low-growth regimes of the metropolitan housing markets. The integrated analyses, which facilitate our investigations into the natures of asset price dynamics, deliver important implications of risk management and the monetary policy effectiveness.

The comparisons of housing, REIT and stock asset dynamics have attracted intensive attention, particularly motivated by the recent housing and financial crises. The real housing and REIT price indexes both displayed upward movements until 2007(Figure 1). Noticeably, they enjoyed remarkable booms since approximately 2001 despite the economic recession during the year. Otherwise, the real stock index went up before 2000, and it declined since the 2001 recession. All of the three asset price indexes peaked before the most recent recession in the late-2007, and they dropped afterwards. In general, the downward movements in housing and REIT prices were sharper than that of the stock price index. The REIT and stock price
indexes both rebounded before the end of the most recent recession, while the housing price index remained sinking till the sample period, 2010. The price dynamic similarities and differences across the three assets, as well as their implications of risk management and policy-making, are worthy of our closer analyses.

The study extends the asymmetric unobserved components models in Kim et al. (2008, hereafter KPS) and Sinclair (2010) to investigate multiple asset markets. The framework decomposes the variable of interest into a cycle and a trend, and incorporates the correlation between symmetric transitory (cycle) and permanent (trend) components, and that between asymmetric transitory and permanent components. Specifically, the asymmetric transitory shocks to asset markets are characterized by Markov-switching components in the dynamics of cyclical components, in the spirit of Kim and Nelson (1999, hereafter KN) and Sinclair (2010). Furthermore, Friedman’s “plucking” concept, which refers to “the occasional event producing contractions and subsequent revivals rather than a self-generating cyclical process”, is introduced to reflect the asymmetric shock to asset markets analyzed. Similar to the different dynamic patterns between macroeconomic recessions and expansions emphasized in the literature, the plucking feature differentiates crisis periods from normal times of asset markets. Asset bubbles are commonly regarded as occasional events, and they are typically driven by investors’ “temporary” over-optimistic expectations instead of a fundamental permanent shock. Hence, the framework is capable of shedding insight into the recent bubble-like asset dynamics primarily because it captures the “transitory” nature of asset bubbles.

The Markov-switching process determines the asset price dynamics into low-growth (asset price bust) and high-growth (asset price boom) regimes, and classifies the cycle of housing price returns into symmetric and asymmetric components. The low-growth regimes characterize the periods during which asymmetric shocks hit asset markets and dampen asset prices. As the asymmetric transitory component is the main driver of the asset price dynamics,
the asset markets suffer bust phases. Fortunately, monetary policies can be effective in mitigating the negative impacts of the adverse transitory shock on asset markets. On the other hand, as a permanent component plays a dominant role in the asset market dynamics, there is little room for monetary policies to influence the asset price movements. Conceptually, the asset markets with predominant permanent shocks are more vulnerable to asset bubbles than those with powerful transitory shocks. Thus, the Markov-switching transitory component delivers interesting implications of asset bubbles and policy-making from a dynamic perspective.

We select housing price indexes of the 10 MSAs (Metropolitan Statistical Areas) with the largest population in the US, in order to investigate possibly divergent vulnerability patterns to housing bubbles across metropolitan housing markets. Importantly, we find that exogenous asymmetric shocks are all highly significant for the ten MSA-level housing markets, and Markov-switching low-growth and high-growth phases are both significant for housing and REIT price returns. By the onset of the recent housing crisis (the year of 2005), the asymmetric transitory shocks acted as the underlying drivers of the metropolitan housing busts of New York, Los Angeles, Chicago, Washington, and Boston, but only housing busts of the latter three cities result from the shocks during the housing crisis (the period of 2007-2008). The results provide one possible explanation that New York and Los Angeles are more subject to housing crises than other MSAs: monetary policies only play powerful role in housing prices of these two cities “before” their recent housing busts, but weak after the housing crisis developed to a mature stage.

The rest of the paper is organized as follows. “Literature review” reviews the literature which motivates this study. “Data & Model” presents the data and the methodology. “Empirical results” reports the main empirical findings, including the relative importance of permanent and transitory components, the roles of asymmetric transitory shocks, and the lead-lag relationships between metropolitan housing cycles and business cycles for the ten
selected MSA-level housing markets. Finally, “Conclusion” makes concluding remarks.

2. Literature review

Many empirical studies discuss whether relaxed monetary policies are attributed to the recent housing boom (e.g., Campbell et al. (2009), Case and Shiller(2003), Mayer and Quigley (2003), Negro and Otrok (2007), Veld et al. (2011), etc.). Particularly, Campbell et al. (2009) argue that interest rate fluctuations fail to fully explain the housing price dynamics at MSA levels, and suggest that real risk-free interest rates are not highly associated with housing price movements. Otherwise, some studies hold the opposite points of view, including Agnello and Schuknecht(2011), Chen et al. (2012), Edelstein and Tsang(2007), Himmelberg et al.(2005), Jin and Zeng (2004), Lai and Van Order (2010), McDonald and Stokes(2012), Shiller(2009), among others. Recently, Chang et al. (2011) suggest that monetary policies exert different influences on REIT and un-securitized housing market dynamics during the same period. They find that REIT returns respond to either the federal funds rate or the interest rate spread more significantly but less persistently than housing price returns. They further show that the interest rate spread appears to strengthen the monetary policy effect on REIT returns but to reduce the effect on housing asset returns.

Noticeably, the time-varying monetary policy effectiveness is hardly discussed in details in the previous literature. Among few examples, Chen et al.(2012) advocate that the Fed would exert an impact on the housing boom by means of an interest rate increase in 2003Q1, but it fails to influence the subsequent drop in the housing prices. Interestingly, we deliver some findings which highly correspond to those in Chen et al.(2012): Monetary policies could be effective “before” the recent bubble-like housing bust (the year of 2005) but ineffective “during” the crisis period of 2007-2008 for New York and Los Angeles.

A growing body of the literature addresses nonlinearities for price dynamics of housing, REIT, and stock assets. For instance, Ceron and Suarez (2006) and Roche (2001) apply
two-state Markov-switching frameworks to examine housing price dynamics. Miles (2008) mentions that a nonlinear framework, the generalized autoregressive model (GAR), delivers good performances of out-of-sample forecasts for highly-volatile housing price dynamics. Recently, Chang et al. (2011) propose a regime-switching framework, in an attempt to emphasize that a nonlinear model characterizes asset returns in a more satisfactory manner than a linear one. Zhou and Gao (2012) argue that the linear correlation among asset markets is insufficient in explaining housing market dynamics during crisis periods, and employ a semi-parametric method to the analysis of real estate returns. Zhou (2010) suggests that we are likely to have a misleading result as we ignore the presence of nonlinear cointegration relationships between housing price and economic fundamentals. Motivated by the above research, the study aims to contribute to the literature on nonlinear dynamics of housing prices.

Previous empirical studies have incorporated nonlinearities as they discuss stock and REIT returns. For instance, Ang and Bekaert (2002) adopt a multivariate Markov-switching model to examine the hypothesis of a constant condition correlation across international stock markets, and find that the cross-country correlation is generally higher in the high-volatility regime than the low-volatility regime. Turner et al. (1989) develop a framework that variance of the stock excess return is governed by an unobservable Markov-switching state variable. Since investors are unable to predict stock market volatility precisely, the regime-switching phenomena of the stock return provide investors with important information. Considerable attention is given to nonlinearities of REIT asset dynamics recently. For instance, Sa-Aadu et al. (2010) employ Hamilton’s (1989) Markov-switching framework to analyze regime-dependent asset-allocation strategies. Also, Chang et al. (2011) document that returns to REIT and housing assets follow a Markov regime-switching process.

Importantly, asymmetry and exogeneity of shocks to asset returns are supported in the literature. For example, Michayluk et al. (2006) document the asymmetric effects of shocks
on the volatility and correlation between REIT markets of the US and UK. Peng and Schulz (2012) examine the dynamics of the covariance matrix of returns to REITs, stocks and bonds for eight countries, and find the asset returns exhibit time-varying volatilities and display asymmetric responses to news. Regarding the exogenous nature of shocks to housing price dynamics, Andrew and Meen (2003) assume that influential variables of housing prices are exogenous. Stein (1995) emphasizes that an exogenous shock to house prices has an infinite and huge impact on household liquidity. Wheaton (1990) provides evidence that exogenous variables, such as demand shocks, affect vacancy, sales time and prices in housing markets. Recently, Arsenault et al. (2012) provide strong evidence for a positive feedback loop between property prices and the mortgage supply. They find that property cap rates are significantly reduced by exogenous increases in the mortgage supply. In addition, Chen et al. (2011) propose that housing prices in Taipei, which is one of the most economic sectors in Asia, display exogenous dynamic features. Motivated by the above studies, we assume that there are asymmetric and exogenous shocks to the asset market.

Furthermore, the decomposition of asset returns is supported in the previous literature. Although the related studies only indirectly address cyclical housing price dynamics, they highly motivate this paper. For instance, Cocco (2004) establishes a model to discuss the portfolio choice between housing and financial wealth, and assumes a positive correlation between cyclical housing price movements and aggregate labor income shocks. Capozza et al. (2004) suggest the definitions for “housing cycles” and “housing bubbles”, and differentiate “price-overshooting” and “cycles” in housing markets by analyzing the parameters of correlation and reversion. Chen (2006), Lettau and Ludvigson (2004), and Sun et al. (2007) all address how both transitory and permanent changes in housing wealth influence consumption. Moreover, Clark and Coggin (2009) apply the basic unobserved components framework, which refers to the “trend plus cycle structural time series model”, to their analysis of mixed convergence patterns across regional housing markets. Also, Fadiga and
Wang (2009) identify that regional housing price dynamics display three common cyclical and two common trend components under a multivariate state-space framework. All the literature suggests that the division of housing price dynamics into cyclical and trend components is able to facilitate our investigations into housing markets. With respect to decomposition of stock prices, Adrian and Rosenberg (2008) decompose equity market volatility into short-term and long-term components. Senyuz (2011) proposes that there are sustainable time-varying lead-lag correlations between the trend of the stock market and the permanent component of the economic aggregate, and finds that the transitory component of the stock market signals the business cycle one quarter in advance.

A number of empirical studies discuss differences of housing price dynamics and existences of housing bubbles across MSA-level housing markets. The representative papers consist of Fratantoni and Schuh (2003), Ghent and Owyang (2010), Goodman (2005), Goodman and Thibodeau (2008), Hwang and Quigley (2006), IV et al. (2008), Leung and Teo (2011), McDuff (2011), Saiz (2010), among others. For instance, Goodman and Thibodeau (2008) notify that house prices in some California cities increased by more than 50% per year, while those in Texas cities slightly went up by 4%. They find that most speculative activities of housing markets occur within seventy-five miles of the Atlantic or California Pacific coasts. Also, Ghent and Owyang (2010) analyze the association between the business cycle and housing cycles in fifty-one cities of the U.S, and they argue that housing prices fail to work as good indicators for either the national or the MSA-level employment. Motivated by their findings, the study explores the potentially different roles of asymmetric transitory shocks to MSA-level housing markets and their monetary-policy implications.

3. Data & Model

This section describes the asset price data, including the ten MSA-level housing price
indexes, the REIT and stock price indexes. In addition, it outlines the asymmetric UC-UR model which is utilized to investigate asset price dynamics.

### 3.1 Data

The indexes of MSA-level housing prices, REITs, and the stock price span from 1976Q1 to 2010Q4. The MSA-level housing price data are the Conventional Mortgage Home Price Indexes (CMHPIs) from Freddie Mac. The ten most populous MSAs are selected based on the population estimates of the US Census Bureau in 2010: New York (NY), Los Angeles (LA), Chicago (CH), Dallas (DA), Philadelphia (PH), Houston (HO), Miami (MI), Washington, DC. (WA), Atlanta (AT), and Boston (BO) (Table 1). The REIT index is obtained from FTSE NAREIT US Real Estate Index Series, and the stock index is S&P stock index from WRDS database. The asset indexes are seasonally-adjusted and deflated by the core CPI (Consumer Price Index for all urban consumers: all items less food and energy) which comes from U.S. Department of Labor: Bureau of Labor Statistics. The real asset price returns are computed as the first differences of log of the real asset price indexes.

As shown in Table 2, the means, medians, and standard deviations of price returns to REIT and stock assets are all higher than the selected MSA-level housing price returns. Among the ten cities, BO has the highest (0.75) and HO has the lowest (-0.11) mean; LA has the highest (0.83) and DA has the lowest (0.05) median. Regarding volatility of the housing price return, the four cities whose standard deviations are higher than two include MI, LA, BO and NY, and WA; volatility in AT is the lowest(1.30). As Jarque-Bera statistics show, real housing price returns in most cities (except NY, LA and PH) and price returns to REIT and stock assets are not normally-distributed during the sample period.

### 3.2 Model

The study utilizes an asymmetric correlated unobserved components model, which is an extension version of the model developed by Morley et al. (2003, hereafter MNZ). The model
incorporates an asymmetric transitory component which follows a Markov-switching process, motivated by KN which extend Friedman’s (1993) plucking model. The model assumes a correlation between the shocks to symmetric transitory and permanent components. Importantly, asymmetric transitory shock which determines the realization of the Markov-switching state variable is assumed to be exogenous. Specifically, the asymmetric transitory and permanent components are assumed to be uncorrelated.

The asset price return is composed of the two unobserved components:

\[ y_t = \tau_t + c_t \]  

where \( \tau_t \) stands for the permanent (or trend) component, and \( c_t \) stands for the transitory (or cycle) component.

A suggested by Friedman (1993), a random walk allows the trend of the time series to follow the permanent movements. Importantly, the drift (\( \mu \)) in the permanent component captures the “plucking” nature, which represents the maximum feasible level of the asset price return. The permanent component is presented as below:

\[ \tau_t = \mu + \tau_{t-1} + \theta_t \]  

According to MNZ and KN, the transitory component follows AR(2). The difference between this model and MNZ lies in the asymmetric component (\( \gamma S_t \)) of the cycle as follows:

\[ c_t = \phi_1 c_{t-1} + \phi_2 c_{t-2} + \gamma S_t + \epsilon_t \]  

where \( \theta_t \) and \( \epsilon_t \) are assumed to be jointly normally-distributed random variables, with mean zero and a general covariance matrix (\( \Sigma \)), which contains the correlation between \( \theta_t \) and \( \epsilon_t \).
MNZ is the special case of the asymmetric framework since MNZ assumes $\gamma = 0$. In the study, we use $\gamma$ to reflect the asymmetrical degree of the transitory component for asset price returns.

Following a first-order Markov-switching process, the unobserved state variable, $S_t$, is assumed to evolve as follows:

$$
Pr(S_t = 1 \mid S_{t-1} = 1) = p \quad (4)
$$
$$
Pr(S_t = 0 \mid S_{t-1} = 0) = q \quad (5)
$$

Importantly, the asymmetric coefficient, $\gamma$, is restricted to be non-positive in order to have a zero mean in the persistent “normal times”. Morley and Piger (2012) refer the permanent component to the steady state as the normal times with a zero-mean transitory component. Thus, the existence of the asymmetric coefficient ($\gamma$) is associated with the occurrence of a low-growth regime for the asset price return. The two regimes of the asset market, which are high-growth ($S_t = 0$) or low-growth ($S_t = 1$) regimes, are determined endogenously in the model.

Based on KPS, the state is assumed to be serially dependent, and the lagged state variable works as the instrument for the current state if the lagged state variable is assumed to be exogenous from the contemporaneous error term. We assume that state process is represented by a probit specification as below:

$$
S_t = \begin{cases} 
0 & \text{if } S_t^* < 0 \\
1 & \text{if } S_t^* \geq 0
\end{cases}
$$

$$
S_t^* = a_0 + a_1 S_{t-1} + \omega_t \quad (6)
$$

Since the study is devoted to analyzing the role of the exogenous shocks, $\omega_t$ is assumed to be not correlated with $\theta_t$ and $\varepsilon_t$ as follows:
\[
\begin{bmatrix}
\omega_t \\
\theta_t \\
\epsilon_t
\end{bmatrix}
\sim N(0, \Sigma),
\Sigma =
\begin{bmatrix}
1 & 0 & 0 \\
0 & \sigma_{\theta}^2 & \sigma_{\theta\epsilon} \\
0 & \sigma_{\theta\epsilon} & \sigma_{\epsilon}^2
\end{bmatrix}.
\]

In this case, the expectation of \( \begin{bmatrix} \theta_t \\ \epsilon_t \end{bmatrix} \) conditional on \( S_t, S_{t-1}, \) and \( I_{t-1} \) is equal to zero. \( I_{t-1} \) is the information available at time \( t-1. \) Thus, unconditional variance of \( \begin{bmatrix} \theta_t \\ \epsilon_t \end{bmatrix} \) is equal to the conditional variance. Specifically, the conditional mean is presented as follows:

\[
E\left( \begin{bmatrix} \theta_t \\ \epsilon_t \end{bmatrix} \bigg| S_t = i, S_{t-1} = j, I_{t-1} \right) = \begin{bmatrix} 0 \\ 0 \end{bmatrix}
\]

And, the conditional variance is of the following form:

\[
\text{Var}\left( \begin{bmatrix} \theta_t \\ \epsilon_t \end{bmatrix} \bigg| S_t = i, S_{t-1} = j, I_{t-1} \right) = \begin{bmatrix} \sigma_{\theta}^2 & \sigma_{\theta\epsilon} \\
\sigma_{\theta\epsilon} & \sigma_{\epsilon}^2 \end{bmatrix}.
\]

4. **Empirical results**

The section reports the main findings in three aspects (Table 3). Firstly, it compares the relative powers of permanent and transitory components of asset price returns. Next, the time-varying roles of asymmetric shocks and their interesting implications of monetary policies are addressed. Finally, it discusses lead-lag relationships between MSA-level housing cycles and nationwide business cycles.

4.1 **Permanent vs. transitory shocks**

The findings suggest that all price returns to MSA-level housing and REIT (7.59) assets have significant permanent shocks, while only four MSAs have significant transitory shocks during the sample period. On the other hand, the stock price return has the significant transitory shock (5.75), but its permanent one is insignificant. For housing price returns, \( MI \) has the largest permanent (1.43) and transitory (1.04) shocks among all cities; only \( NY \) and \( PH \) have significant correlations between the two components. Noticeably, the significant permanent components in the four MSA-level housing markets (i.e., \( NY, PH, HO, MI \)) are all
larger than their corresponding transitory shocks. Hence, in average, the findings imply that the effectiveness of monetary policies is limited in the MSA-level housing markets during 1976-2010.

4.2 Asymmetric transitory shocks: A monetary-policy paradox in 2005

The main finding of the study lies in evidently significant roles of asymmetric shocks because coefficients of Markov-switching components ($\gamma$) in the price returns to REIT, stock, and metropolitan housing assets are all significant. Interestingly, absolute values of asymmetric shocks for REIT (18.91) and stock (20.07) price returns are larger than those for other MSA-level housing price returns except MI (15.25). The Markov-switching low-growth ($p$) and high-growth ($q$) phases are both significant for housing and REIT price returns, but not for the stock price return. Besides, similar to housing asset markets, the REIT market experienced a low-growth phase in 2005, while the stock market displayed its low-growth phase much earlier-- just a little lagged the recession 2001. The results suggest that the REIT price return is more synchronized with some MSA-level housing price dynamics than with the stock price return around the onset of the recent bubble-like housing bust.

More importantly, we gain more insights into the underlying drivers of the asset markets through the time-varying roles of the asymmetric shocks (Figure 2). Spotlighting the recent housing boom-bust cycle, six out of the ten MSA-level housing markets display a rise in the probabilities of housing low-growth regimes around 2005, including NY, LA, CH, PH, WA, and BO. Particularly, housing-bust probabilities of LA, CH, WA and BO are higher than 0.5. The results suggest that in 2005 asymmetric transitory shocks hit housing markets of these cities, which are commonly regarded as the MSAs subject to housing bubbles in the literature (Case and Shiller(2003), Case(2008), Hwang and Quigley (2006), among others). Correspondingly, during the year of 2005 which is followed by a remarkable housing bust¹.

¹ Although the occurrence timing of local housing busts vary across local housing markets, most of housing
the Fed began to raise interest rates. Did the tighter monetary policy itself act as an “exogenous asymmetric transitory shock”? Or, did an “exogenous asymmetric transitory shock”, which was accompanied with the tighter monetary policy, jointly contribute to the collapse of the housing prices in some MSA-level housing markets? The results figure out the paradox, and the answers to these questions are worthy of our further research.

4.3 Lead-lag relationships between metropolitan housing cycles and business cycles

Metropolitan housing cycles are represented by Markov-switching low-growth regimes due to asymmetric transitory shocks at MSA levels, and nationwide business cycles are NBER-dated recessions. Overall, the time-varying lead-lag relationships between metropolitan housing cycles and nationwide business cycles are somehow different across the ten MSA-level housing markets. The findings suggest that most cities have the interactions between housing markets and macroeconomic aggregates before 1990, but only those of WA and AT are able to capture the housing bust in 1990s, the previous housing bubble suggested in Case and Shiller(2003)\(^2\) and Case(2008)\(^3\). Only AT has synchronization between the housing cycle and the business cycle in the 2001 recession. Noticeably, the asymmetric shock to the REIT market is generally more persistent than that to the stock market. The cyclical movement in the REIT price return slightly led the 1980 and 1990 recessions, while cyclical stock price dynamics did not exhibit any lead-lag relationship with the business cycle before the 2001 recession.

Nationwide housing busts occurred and led to the most recent recession in the late-2007. Spotlighting the year of 2007, we find that only the probabilities of low-growth regimes in \(CH, WA, AT\) are higher than 0.5, but the asymmetric shocks play dominant roles in both REIT

\(^2\) Case and Shiller (2003) had already pointed out that Los Angeles would suffer the most serious and longest housing-bubble burst among MSAs in the US.

\(^3\) Recently, Case (2008) documents the housing price boom in Boston during 1984-1988, as well as the bubbles of California and Massachusetts in the 1980s and 1990s.
and stock markets. The implications of the pattern are twofold. Firstly, there seemed little room for monetary policies to mitigate negative impacts of adverse exogenous shocks on some MSA-level housing markets. It is particularly true for NY and LA which are widely regarded as the cities with bubble-like housing busts. Asymmetric transitory shocks hit MSA-level housing markets of CH, WA and BO in both years of 2005 and 2007, but they play significant roles in housing price dynamics of NY and LA only around 2005. The results suggest that monetary policies are more likely to stabilize housing markets in CH, WA, BO than NY and LA, particularly as the housing crisis is evolving during the year of 2007. Secondly, REIT and stock markets also suffered low-growth phases during the years as the housing crisis eventually evolved to a globalized financial crisis which resulted from the collapse in the values of subprime mortgages and a nationwide surge in foreclosures.

5. Conclusion

This study extends the unobserved components model of KPS and Sinclair (2010) to investigate whether asymmetric transitory components play important roles in the housing, real estate investment trust (REIT), and stock asset markets during 1976-2010. This model allows for the correlations between symmetric transitory and permanent components of asset price returns, and assumes exogenous asymmetric shocks to asset markets which are characterized by Markov-switching processes in the spirit of KN and Sinclair (2010). Thus, it enables us to further investigate whether there are lead-lag interrelationships between the metropolitan housing cycles and the nationwide business cycle, and cross-asset linkages by means of estimating Markov-switching low-growth regimes due to asymmetric transitory shocks in the MSA-level housing markets.

Noticeably, we find that exogenous asymmetric shocks are all highly significant. Additionally, all price returns to MSA-level housing and REIT assets have significant permanent shocks. The stock price return has a significant transitory shock but an
insignificant permanent shock; housing and REIT markets both experience significant Markov-switching low-growth and high-growth regimes. The findings suggest that the REIT price return is more synchronized with some MSA-level housing price returns than with the stock price return. Moreover, our findings only show lead-lag relationships between metropolitan housing cycles and nationwide business cycles before 1990: The roles of asymmetric transitory shocks are generally minor in many cities after 1990.

Most importantly, around the years of 2005 and 2007, the metropolitan housing price markets of Chicago, Washington, and Boston experienced low-growth regimes driven by asymmetric transitory shocks. Thus, it is possible for monetary policies to stabilize housing price dynamics bubble-like housing busts in the MSAs. Otherwise, our findings suggest that housing busts of New York and Los Angeles in 2007-2008 were not driven by asymmetric shocks, revealing the weak power of monetary policies in the two cities which are commonly documented as the ones highly subject to housing bubbles in the recent literature.

References


Studies, 18(2), 535-567.


**Tables**

**Table 1 - Estimates of Population for Metropolitan Statistical Areas (MSAs)**

<table>
<thead>
<tr>
<th>Metropolitan Statistical Areas</th>
<th>Population Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York (NY)</td>
<td>19,069,796</td>
</tr>
<tr>
<td>Los Angeles (LA)</td>
<td>12,874,797</td>
</tr>
<tr>
<td>Chicago (CH)</td>
<td>9,580,567</td>
</tr>
<tr>
<td>Dallas (DA)</td>
<td>6,447,615</td>
</tr>
<tr>
<td>Philadelphia (PH)</td>
<td>5,968,252</td>
</tr>
<tr>
<td>Houston (HO)</td>
<td>5,867,489</td>
</tr>
<tr>
<td>Miami (MI)</td>
<td>5,547,051</td>
</tr>
<tr>
<td>Washington D.C. (WA)</td>
<td>5,476,241</td>
</tr>
<tr>
<td>Atlanta (AT)</td>
<td>5,475,213</td>
</tr>
<tr>
<td>Boston (BO)</td>
<td>4,588,680</td>
</tr>
</tbody>
</table>

*Notes: The ten most populous MSAs in the US are selected based on the population estimates of the US Census Bureau up to July, 2009.*
<table>
<thead>
<tr>
<th></th>
<th>NY</th>
<th>LA</th>
<th>CH</th>
<th>DA</th>
<th>PH</th>
<th>HO</th>
<th>MI</th>
<th>WA</th>
<th>AT</th>
<th>BO</th>
<th>REITs</th>
<th>STOCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.67</td>
<td>0.66</td>
<td>0.19</td>
<td>0.02</td>
<td>0.31</td>
<td>-0.11</td>
<td>0.28</td>
<td>0.41</td>
<td>-0.01</td>
<td>0.75</td>
<td>2.64</td>
<td>1.10</td>
</tr>
<tr>
<td>Median</td>
<td>0.53</td>
<td>0.83</td>
<td>0.41</td>
<td>0.05</td>
<td>0.29</td>
<td>0.14</td>
<td>0.34</td>
<td>0.47</td>
<td>0.26</td>
<td>0.79</td>
<td>2.47</td>
<td>0.97</td>
</tr>
<tr>
<td>Maximum</td>
<td>6.61</td>
<td>9.84</td>
<td>7.82</td>
<td>6.38</td>
<td>5.38</td>
<td>5.09</td>
<td>16.11</td>
<td>8.15</td>
<td>4.18</td>
<td>10.27</td>
<td>23.32</td>
<td>18.59</td>
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<tr>
<td>Minimum</td>
<td>-5.46</td>
<td>-7.46</td>
<td>-4.81</td>
<td>-5.74</td>
<td>-4.26</td>
<td>-5.45</td>
<td>-19.53</td>
<td>-5.99</td>
<td>-4.52</td>
<td>-4.39</td>
<td>-39.05</td>
<td>-25.70</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>2.24</td>
<td>2.73</td>
<td>1.90</td>
<td>1.73</td>
<td>1.72</td>
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Notes: The table lists the sample mean, median, maximum, minimum, standard deviation, skewness, kurtosis, and the Jarque-Bera (JB) statistics, sums of squared deviations for the quarterly housing price returns at the MSA levels, REIT(FTSE NAREIT US Real Estate Index Series) and stock price(S&P 500) returns. The sampling period runs from 1976Q1 to 2010Q4.
Table 3 – Estimation of the unobserved components model

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Notes: The study applies the asymmetric correlated unobserved components model in Morley et al. (2003). The model is: $y_t = \tau_t + c_t; \tau_t = \mu + \tau_{\tau, t} + \theta_t$; $c_t = \phi_{1c_{t-1}} + \phi_{2c_{t-2}} + \gamma S_t + \varepsilon_t; Pr(S_t = 1 | S_{t-1} = 1) = p; Pr(S_t = 0 | S_{t-1} = 0) = q; S_t = \begin{cases} 0 & \text{if } S_t^* < 0 \\ 1 & \text{if } S_t^* \geq 0 \end{cases}; S_t^* = a_0 + a_1S_{t-1} + \omega_t; \left[ \begin{array}{c} \omega_t \\ \theta_t \end{array} \right] \sim N(0, \Sigma_t), \Sigma_t = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \sigma^2_{\theta} & \sigma_{\theta} \\ 0 & \sigma_{\theta} & \sigma^2_{\theta} \end{bmatrix}$. The t-statistics of the parameters are reported in parentheses, and the superscripts *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.
Figures

Figure 1 – The trends toward housing, REITs, and stock from 1976:Q1 to 2010:Q4

Notes: The figure shows the US housing index, REIT price index, and S&P 500 stock index from 1976:Q1 to 2010:Q4. REIT and stock indexes refer to the left axis, and housing price index refers to the right axis. The shaded areas represent the NBER-dated recessions.
Figure 2 – Probabilities of Low-growth Regimes due to Exogenous Asymmetric Shocks

Panel 1 - Probability of New York (NY)

Panel 2 - Probability of Los Angeles (LA)

Panel 3 - Probability of Chicago (CH)
Panel 4 - Probability of Dallas ($DA$)

Panel 5 - Probability of Phoenix ($PH$)
Panel 6 - Probability of Houston (HO)

Panel 7 - Probability of Miami (MI)
Panel 8 - Probability of Washington, D.C. (WA)

Panel 9 - Probability of Atlanta (AT)
Panel 10 - Probability of Boston (BO)

Panel 11 - Probability of REITs
Panel 12 - Probability of STOCK

Note: Shading areas are the NBER-dated recessions, and the solid lines show the occurrence probabilities of exogenous asymmetric shocks to the asset markets, representing the low-growth regimes of the asset price returns.