

# Are U.S. States Economic and Real Estate Cycles Related?

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## Abstract

Using Markov Switching estimation technique on U.S. state level coincident index and housing price index this paper calculates the turning points of the state as well as national business and real estate cycles. The analyses in this paper suggest that there are no distinct and persistent patterns between real estate cycles and state level economic fluctuations. However, based on the formation of the real estate cycles we divide U.S. states into four categories. We observe that real estate downturns are more persistent than economic recessions. Comparison of the national and state level business and real estate cycle patterns suggest that only two out of four recent NBER dated national recessions were accompanied by predominance of real estate downturns in most of the U.S. states. Our results also suggest that nearly forty five U.S. states as well as the U.S. on aggregate exhibited distinct downturn of the real estate cycle between the third quarter of 2006 and the third quarter of 2007. Severity of state level real estate fluctuations, measured in this paper as a difference between growth rates in expanding and declining phases, varied remarkably across states. We, however, observe relatively greater dispersion of the growth rates of the state housing index when the states economies are in recessionary phase of the business cycle. This suggests that the housing market across states converges during periods of expansions. Finally, we conclude that the magnitude and depth of real estate fluctuation is larger than economic fluctuation.

JEL Classification: E32, O51, R10 and R19

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## **1. Introduction**

For the last two decades the topic of the real estate cycle has gained a lot of attention not only in the fields of micro and macro economics, but also in the field of finance and investment. Recently real estate became a lucrative investment option for investors (Leonhardt, 2008; Dhar and Goetzmann, 2006). Securitization of the real estate market was one important trend that attracted many investors into this field. Further, now there are more investors who can participate in the global real estate market than a decade ago (Case, Goetzmann, and Rouwenhorst, 2000; and Chen and Hobbs, 2003). Nevertheless, in recent decades the world has experienced a couple of global real estate fluctuations including recent U.S. real estate crisis. This makes researchers and investors wonder about the structures of real estate cycles and how they are related to other economic activities in the nation as well as throughout the world.

Many studies show that the real estate cycle has a direct impact on the behavior of households, investors, banking systems, as well as on the national economy (Case, 2000; Wheelock, 2006; and, Barlevy, 2007). Very few studies, however, have compared and analyzed national and state level business cycles with the national and regional real estate cycles. This comparison is important for at least three reasons: first, the clear idea about the national and state level real estate cycle will help home owners and real estate investors minimize their losses. Second, it will help proper authorities (government, mortgage brokers, banks, etc.) to make effective decisions. Third, future researchers will have vivid understanding of states' economic structures and better understanding of the behavior of the real estate cycles. This paper strictly focuses on macroeconomic perspective of real estate

science and analyzes the patterns of real estate cycles. Thus, the study has three main objectives. First, using Markov-Switching estimation technique, this study compares the U.S. national and state level business cycles with the U.S. national and state level real estate cycles. Second, depending on the formation of the state level real estate cycles, this study categorizes different states, and finally it analyses the severity of the state level real estate cycles.

The rest of the paper is organized as follows. First, we discuss related literatures, second we explain the model, third we provide model and methods, fourth we give data description, fifth we state the results by presenting comparison of business cycles and real estate cycles, thus categorize states depending on the formation of real estate cycles. To give some idea how the U.S. states' real estate sector converges during the different phases of the real estate cycles, in section sixth we provide a convergence analysis and finally we conclude in the section seven.

## **2. Literature Review**

In the United States national business cycles are calculated and dated by the National Bureau of Economic Research (NBER). Hamilton (1989) used state space Markov Switching estimation technique on the U.S. GDP data to estimate business cycle turning points. Hamilton's estimated dates coincided with the dates provided by the NBER which confirms the validity of the Markov Switching estimation technique to measure business cycle turning points. Boldin (1994) compared five different business cycles turning point dating methods in the U.S. economy. He concluded that the Stock and Watson's (1989 and 1991) experimental business cycles indicators based on Kalman Filter algorithm and

Hamilton's Markov Switching (1989) estimation technique outperforms all other business cycles dating methods.

Crone (1998/1999 and 2004) used Kalman Filter estimation technique on the U.S. state level data and grouped U.S. into eight economic regions based on regional business cycles similarities. Using Hamilton's Markov Switching estimation technique on the state level coincident indexes<sup>2</sup> Owyang, Piger and Wall (2005) and later Mona and Giannikos (2005) dated the turning points of the U.S. state level business cycles. Both studies show that the U.S. state level business cycles do not necessarily coincide with the national business cycles. A recent study by Crone (2006) also estimates the U.S. state level business cycles using diffusion indexes. His study concludes that diffusion indexes are better data sets to track or to forecast regional business cycle turning points.

Exploring a threshold autoregressive (TAR) model Lizieri, Satchell, Worzala and Dacco (1998) found that regime switching model gives more accurate picture of real estate market performance than simple linear model. By using real interest rate<sup>3</sup> as a state variable, they compare the behavior of the U.S. and the U.K real estate market. To measure the U.S. real estate market performance the authors used monthly data of the Real Estate Investment Trust (REIT) from December 1972 to March 1995. The U.K. real estate performance was measured by the monthly data of International U.K. property Price index from January 1975 to August 1995. They found distinct real estate regimes in the U.S. and in the U.K. Thus they concluded that the real interest rate plays a significant role as an indicator of real estate performance in both countries, i.e., the property prices fall sharply

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<sup>2</sup> The state level coincident indices are provided by Crone 2000.

<sup>3</sup> UK's real interest rate data was based on current inflation and short-term interest rates. Where inflation was measured by the changes in Retail Price Index (RPI).

during the high interest rate regimes and the reverse happens during the lower interest rate regimes. Similarly, Carlino and DeFina (1996, 1998, 1999a,b) showed that changes in interest rate by the monetary authorities has differential effect on regions throughout the United State. The regions specialized in construction, housing, or real estate based industries get affected differently compared to manufacturing or service based industry regions.

Proposing a simple model of lagged supply response to price changes and speculation in housing market Malpezzi and Wachter (2005) generated real estate cycles. They found that demand condition and speculation play major role in housing market and real estate cycles. Further, they showed that the price elasticity of supply is the dominant component of speculation. The largest effects of speculation were observed when supply is inelastic.

### 3. Model and Estimation Method:

Following is the Hamilton's Markov-switching model (1989) to estimate business cycle turning points. In his model, he assumes the phases of business cycle shifts with the mean growth rate of a parametric time-series model for economic output:

$$(\Delta y_t - \mu_{S_t}) = \varphi_1 (\Delta y_{t-1} - \mu_{S_{t-1}}) + \varphi_2 (\Delta y_{t-2} - \mu_{S_{t-2}}) + \dots + \varphi_4 (\Delta y_{t-4} - \mu_{S_{t-4}}) + e_t$$

where  $e_t \sim N(0, \sigma_{S_t}^2)$  and  $\mu_{S_t^*}$  indicates  $\mu_1$  when  $S_t^* = 1$ , and indicates  $\mu_2$  when  $S_t^* = 2$ , where  $S_t$  is an unobserved variable and represents the different states of the economy. For this paper, we use a simple version of the Hamilton (1989) model that can be written as:

$$y_t = \beta_0 + \beta_{S_t} + e_t, \quad t = 1, 2, \dots, T, \quad (1)$$

$$e_t \sim N(0, \sigma^2) \quad (2)$$

where  $S_t$  represents different regimes of business cycles,  $S_t = 0, \text{ or } 1$ .  $y_t$  is the growth rate of GDP or some measure of economic activities,  $\beta_0$  is an initial growth rate and  $\beta_{st}$  is the mean growth rate which can switch between regimes to indicate expansionary or recessionary phases.  $e$  is an iid a stochastic disturbance of the process.

The model can be rewrite as:

$$y_t = \mu_0 + e_t, \text{ when } S_t = 0 \text{ (recession); Thus: } \mu_0 = \beta_0 + \beta_0 \quad (3)$$

$$y_t = \mu_1 + e_t, \text{ when } S_t = 1 \text{ (expansion); Thus: } \mu_1 = \beta_0 + \beta_1 \quad (4)$$

However,  $S_t, t = 1, 2, \dots, T$ , is not observed. Thus we consider the joint density of  $y_t$  and the unobserved  $S_t$  variable and rewrite the log likelihood function of  $f(y_t | \Psi_{t-1})$  as:

$$\begin{aligned} \ln L = \sum_{t=1}^T \ln(f(y_t | \Psi_{t-1})) &= \sum_{t=1}^T \ln\left(\frac{1}{\sqrt{2\pi\sigma_0^2}} \exp\left(-\frac{\{y_t - \beta_0\}^2}{2\sigma_0^2}\right) \times \Pr[S_t = 0 | \Psi_{t-1}] \right. \\ &\quad \left. + \frac{1}{\sqrt{2\pi\sigma_1^2}} \exp\left(-\frac{\{y_t - \beta_0 - \beta_1\}^2}{2\sigma_1^2}\right) \times \Pr[S_t = 1 | \Psi_{t-1}] \right) \end{aligned}$$

The series of probabilities  $\Pr[S_t = 0 | \Psi_{t-1}]$  and  $\Pr[S_t = 1 | \Psi_{t-1}]$   $t = 1, 2, \dots, T$  are not known, therefore, following Hamilton (1989), we assume that the regime that governs the system follows a two-state Markov process with the following probabilities:

$$\Pr[S_t = 0 | S_{t-1} = 0] = p \quad (5)$$

$$\Pr[S_t = 1 | S_{t-1} = 0] = 1 - p \quad (6)$$

$$\Pr[S_t = 1 | S_{t-1} = 1] = q \quad (7)$$

$$\Pr[S_t = 0 | S_{t-1} = 1] = 1 - q \quad (8)$$

where  $p$  and  $q$  are coefficients estimated by MLE along with other coefficients.

Then we used the Kim's Smoothing Algorithm<sup>4</sup> which was first suggested by Cosslett and Lee (1985). Instead of using only the previous information, it is possible to obtain the probability of the economy being in either recession or expansion  $\Pr[S_t = j | \Psi_T]$ , using the full set of information  $\Psi_T$ .

#### 4. Data Descriptions:

Three different data sets are used in this study: 1) the U.S. fifty states coincident indexes; 2) the housing price indexes for the fifty U.S. states and the nation; and 3) national business cycle turning dates. Following are the descriptions of the data sets we used for this study.

The U.S. fifty states' monthly coincident indexes are provided by the Federal Reserve Bank of Philadelphia dating from 1979:IQ – 2007:IIIQ. This data set is developed by Crone (2002) estimating four latent dynamic factors of each state. The four variables are: the total number of jobs in nonagricultural establishments, average weekly hours in manufacturing, the unemployment rate, and the real wage and salary disbursements. This is

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<sup>4</sup> See "State-Space Models With Regime Switching" by Kim and Nelson.

one of the most comprehensive monthly data set available for state level economic analysis. The reason for using state level coincident indexes for this study is that there is no monthly Gross State Product (GSP) data available for the U.S. states. GSP data are in the annual basis, but state level recession or expansion can begin and end within a year.

The Housing Price Index (HPI) data used in this study is published by the Office of Federal Housing Enterprise Oversight (OFHEO).<sup>5</sup> The HPI is a broad measure of the movement of single-family house prices,<sup>6</sup> which measures weighted average changes in repeat sales, mortgage defaults, prepayments, refinancings, and housing affordability in specific geographic areas. The primary housing data are collected and provided by Fannie Mae and Freddie Mac to the OFHEO. The OFHEO generates HPI by using a modified version of the Case-Shiller geometric weighted repeat-sales procedure (Calhoun, 1996). The HPI by OFHEO is more accurate and complete measure of housing price change compare to S&P/ Case-Shiller indexes<sup>7</sup> or Constant Quality Housing Price Index (CQHPI)<sup>8</sup>. The HPI covers more transactions and geographic areas compared to other two data sets. We used quarterly HPI for fifty U.S. states from 1979:IQ to 2007:IIIQ.

For the national real estate cycle analysis, we also used quarterly HPI data for the U.S. provided by the OFHEO. National business cycles and its turning points dates are listed by the NBER from 1979:IQ to 2004:IQ.

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<sup>5</sup> The Office of Federal Housing Enterprise Oversight (OFHEO) was established as an independent entity within the Department of Housing and Urban Development by the Federal Housing Enterprises Financial Safety and Soundness Act of 1992 (Title 13 of P.L. 102-550).

<sup>6</sup> HIP does not cover condominiums, cooperatives, multi-unit properties, and planned unit developments.

<sup>7</sup> S&P/ Case-Shiller indexes is available for only 38 states.

<sup>8</sup> Constant Quality Housing Price Index (CQHPI) is published by the Department of Commerce. The CQHPI covers sales of new homes and homes for sales. CQHPI is based on sample size of 14,000 annual house transactions. The HPI by OFHEO's covers repeated transaction of more than 32.4 millions houses over 32 years.

## 5. Result:

First, we compare the national business cycle with the national real estate cycle. We use business cycle phases (e.g., recession and expansion) for our comparison. In the following figures, vertical lines represent national recessions dated by the NBER. Recessionary states are measured in 0 to 1 scale, where 0 represents zero probability of recession, and 1 represents full probability of recession. Therefore if the cycles are under 0.5 probability scale we called these the state expansion; those above 0.5 probability scale we called the state recession. According to the following figures, the U.S. experienced four major national recessions<sup>9</sup> during 1979:IQ to 2007:IIIQ time periods. Two recessions were at the beginning of the 1980s, the third one was at the beginning of the 1990s, and the last one was at the beginning of the 2000<sup>10</sup>.

Real estate recessions are marked by the solid (curve) lines in Figure 1. According to the Figure 1, the U.S. has experienced two major real estate recessions during 1979:IQ to 2006:IQ period. One started at 1981:IIQ and ended at 1985:IQ, and the second one started at 1989:IVQ and sustained until 1999:IIIQ. For both cases, the real estate recessions started before the national recessions, and continued several periods after the national recession ended.

The result indicates that even though the real estate is one of the biggest industries in the United States, not all national recessions are due to the real estate sector fluctuation. In many cases real estate fluctuations may play an important role in some national recessions.

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<sup>9</sup> Confirmed by NBER announced date

<sup>10</sup> Recession time periods: 1980:IQ – 1980:IIIQ; 1981:IIIQ – 1982:IVQ; 1990:IIIQ – 1991:IQ; and 2001:IQ – 2001:IVQ.

Nevertheless, just from the Figure 1 alone, we cannot confirm that real estate was the sole reason of two national recessions of the 1980s and the 1990s.

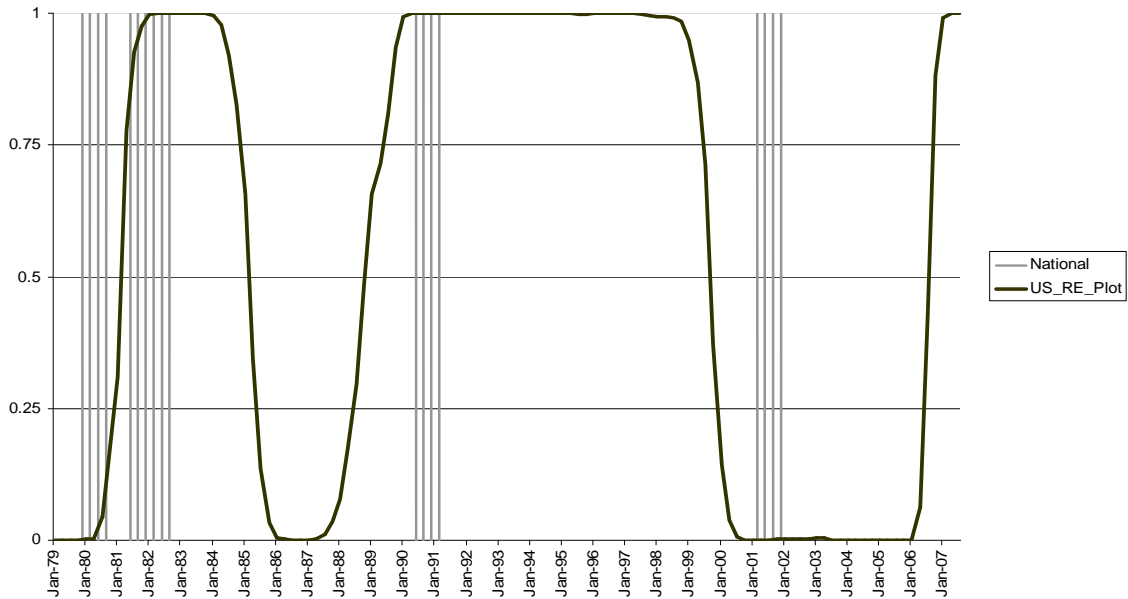


Figure: 1 The U.S. Business and Real Estate Cycles

Analyzing Figure 1, we also observe that in the recent years, starting from 2006:IIQ, the probability of another nation wide real estate recession is very high. A downturn in real estate in 2007:IIIQ occurred on the national level and on the state level in about forty five out of fifty U.S. states (Appendix 1). However, so far only nineteen states tend to have high probability of entering into state level economic recession, but there is no indication of national economic recession.

This paper also found that twenty two<sup>11</sup> states have state level real estate cycle patterns similar to the national. In other words, these twenty two states experienced two real estate recessions as the nation during the 1980s and the 1990s; the span of recession, however, varied throughout the states. Nevertheless, the pattern of the cycle is not a

<sup>11</sup> AL, CA, CT, DE, FL, IL, KS, ME, MD, MI, MN, MO, NE, NH, NJ, NY, NC, PA, RI, TN, VA, WA

sufficient condition for explaining the reasons behind similar real estate fluctuations. A study by Grobar (1996) showed that two regions might experience similar business cycle phases for two different reasons.

Depending on the pattern of the state level real estate cycles formation, we sort states into four categories. The first group is the leading group, where the real estate cycle begins. In other words, this is the group of states where the real estate cycles start before those states' own business cycles, as well as the national real estate and business cycles. In total

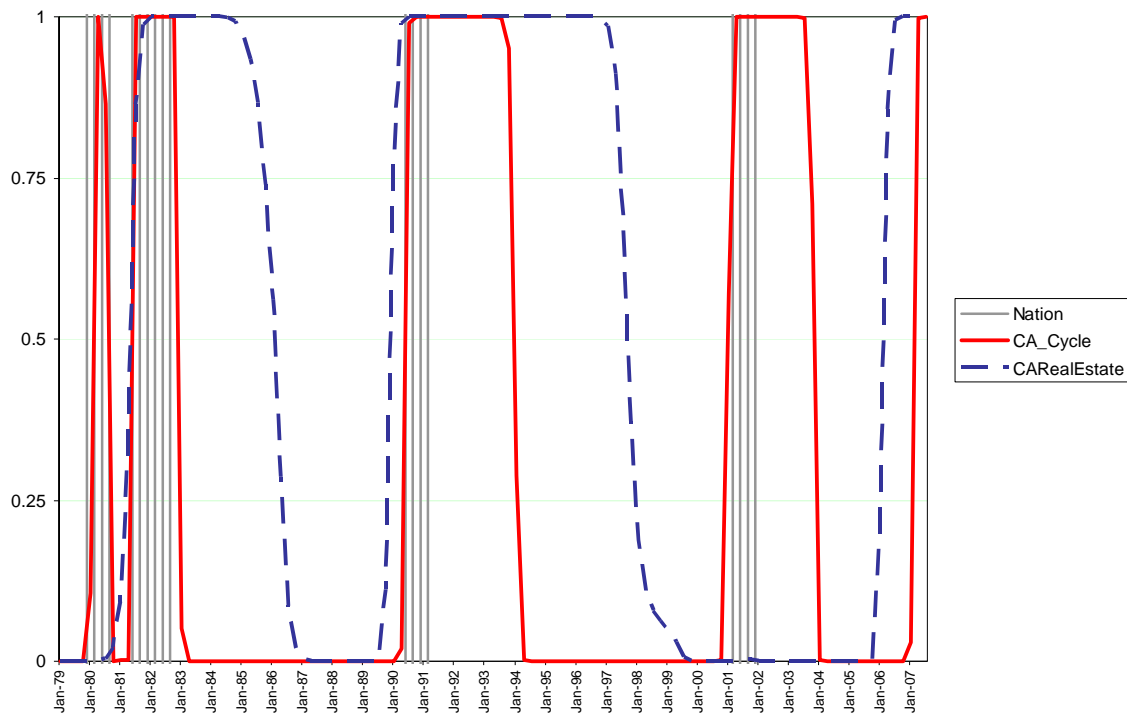


Figure 2: California

eighteen U.S. states<sup>12</sup> fall into the first category of states, where the state level real estate cycle started before the state level business cycles during the two national real estate fluctuations. Figure 2: California represents one of the eighteen leading states. In Figure 2, we observe both state level real estate fluctuations (1981 and 1990), started right before the

<sup>12</sup> CA, CO, CT, IL, MA, MI, MN, MT, NV, NH, NJ, NY, NC, OH, OR, PA, TN, VA

national real estate fluctuations, which were later followed by the state level business cycle fluctuations. We observe a similar pattern at the beginning of 2006 and 2007 in California when the state entered into economic recession in 2007:IIQ following it's real estate recession of 2006:IIIQ. This result of leading states' real estate fluctuation may indicate that the probability that the nation will enter into economic fluctuation in 2008 is very high.

The second group contains states where the real estate cycles follow those states' state level business cycles. In other words, for this group of states, state level business



Figure 3: Maryland

cycles were formed first and then followed by the state level real estate cycles. Thus, the second group of states is the lagging states. For this group of states, some state level variables, other than real estates, are more responsible for the formation of the state level business cycle, which might eventually affect those states' real estate sectors. In total, six

states - Alabama, Delaware, Maryland, New Mexico, Texas, and Washington - fall into this category of states. In Figure 3: Maryland, we observe how the 1981s, the 1990s and the 2007s Maryland's real estate cycles not only followed the state's state level business cycle patterns with lags, but it also followed the pattern of the national real estate cycle with lags. In Figure 3 the state level business cycle is marked by the solid red line<sup>13</sup> (curve). In all three cases, the solid red line is followed by the national and state level real estate cycles which are marked by the dotted green and blue lines<sup>14</sup> respectively.

The third group is a mixture of the leading and the lagging states. This set of states sometimes faces the leading real estate cycles, and sometimes faces the lagging real estate cycle compared to these states business cycles. Nine U.S. states<sup>15</sup> fall into this category. In Figure 4: Maine, we observe that during the 1980s' and the 2000s', economic and real estate fluctuations, the real estate cycle followed the state level business cycle with four and twenty quarters lags respectively. The 1980s the real estate recession in Maine persisted for maximum six quarters where the state level economic recession persisted for twenty quarters. In other words in Maine during the 1980s the state level economic recession continued longer than the state level real estate recession. During the 2000s recession we observe that Maine first entered into economic recession in 2000:IIQ, and then went into real estate recession around 2005:IIIQ, which still persists to this date. Similar pattern we observe for other eight states in this group where the states' economic cycles acted as a leading indicator of the real estate recession of the 1980s and of the 2000s.

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<sup>13</sup> The red line is only visible in the colored version. In the black and white version it is just a solid line.

<sup>14</sup> Blue and green color is only visible in colored version of the paper. In black and white version of the paper, blue color is represented by the darker dotted lines and green color is represented by the lighter dotted lines.

<sup>15</sup> AK, FL, HI, ME, NE, RD, SC, UT, VT

On the other hand, the order of the economic and the real estate cycles were reversed during the 1990s for this third group of states, where the state level business cycles followed

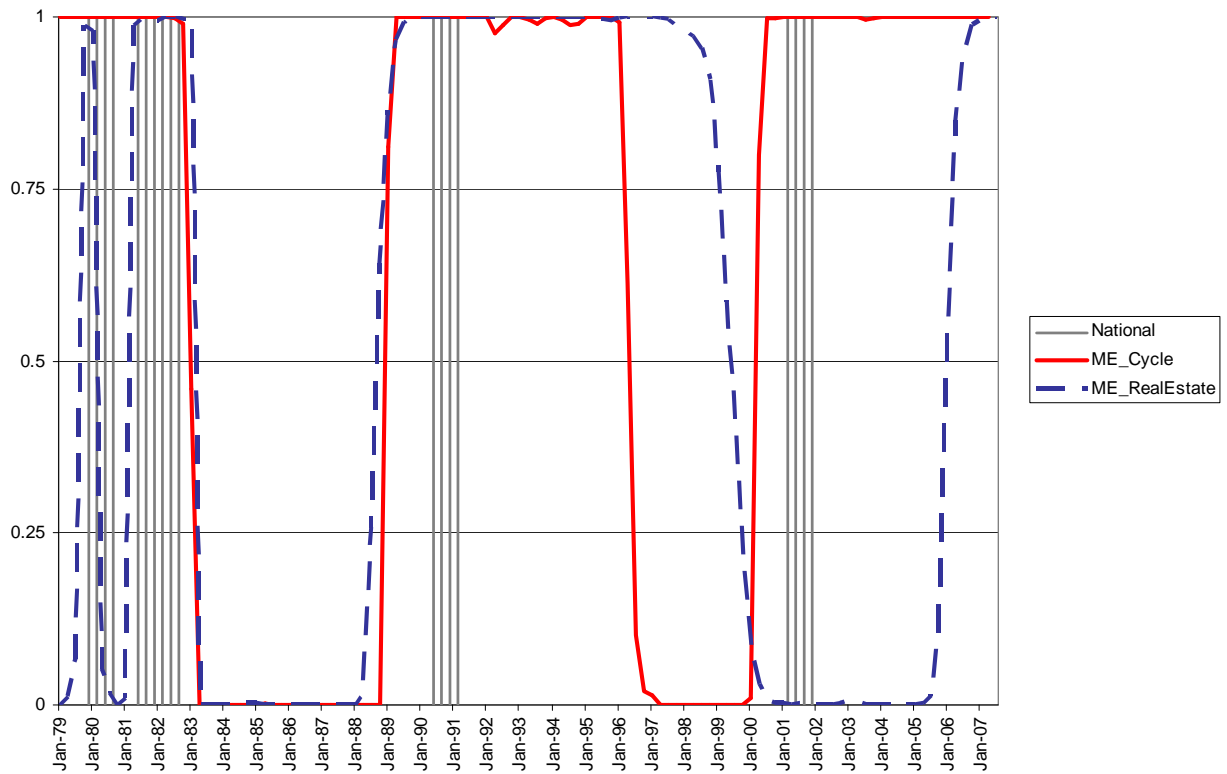


Figure 4: Maine

the real estate cycles. In Figure 4: Maine, we observe that the real estate recession started at 1988:IVQ, and followed by the economic recession after a quarter in 1989:IQ. Thus, we can assume that in these nine states the 1990s recession was mostly due to the real estate recession.

The fourth category contains states where the state level business cycles are not related to the state level real estate cycles. In this category of states, the real estate cycles have comparatively insignificant effect on the state level economic conditions. However, most of these states' state level business cycles are related to the national business cycles.

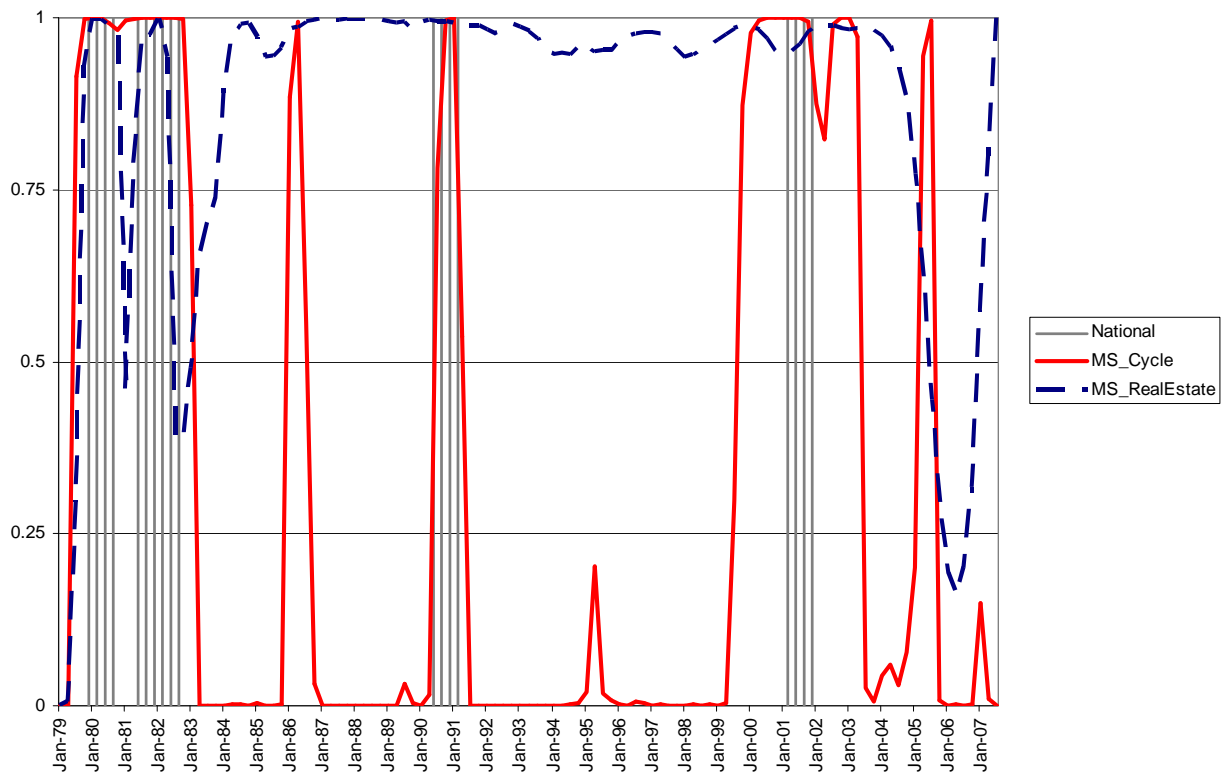


Figure 5: Mississippi

The sixteen U.S. states<sup>16</sup> fall into this category of states. It might be possible that this category of states economic and real estate sectors are affected by some out-of-state variables.

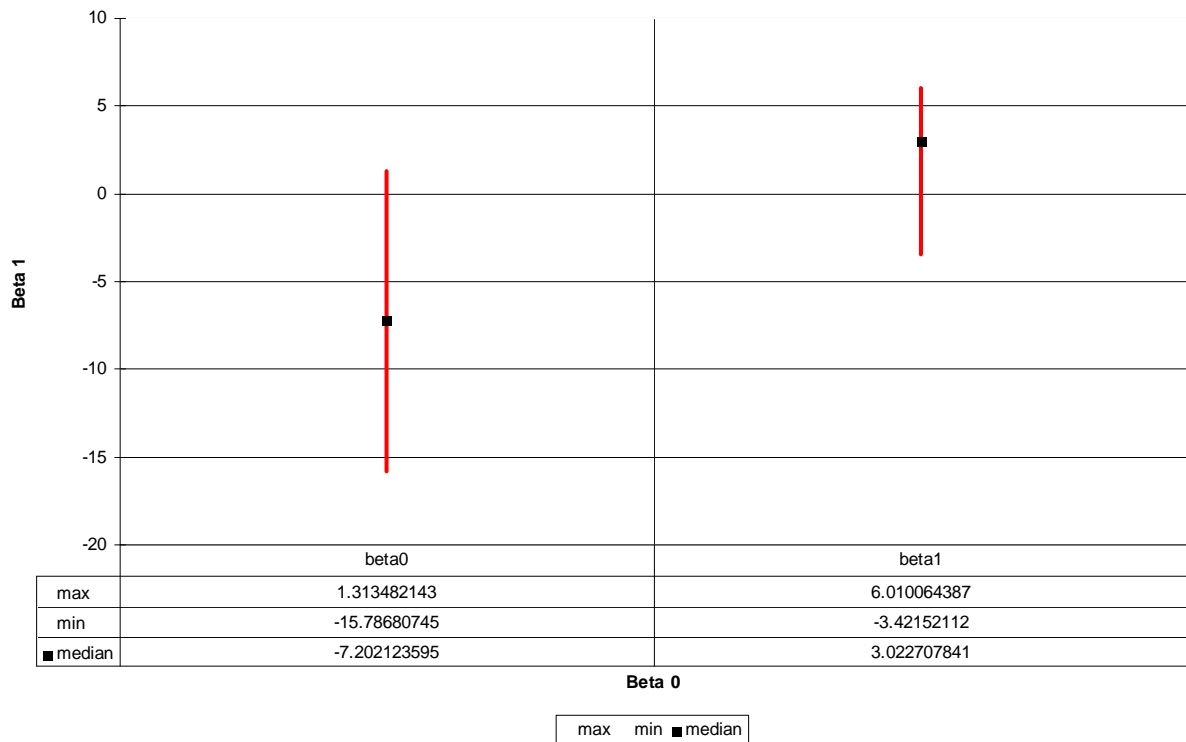
Our analysis shows that most of the states in this category faced the real estate recession eighty percent of time during 1979:IQ to 2007:IIIQ time period. While the state economies experience various phases of the business cycles during the same time period. In Figure 5: Mississippi represents this group of states where we observe quite persistent and erratic real estate recession compare to its economic recession.

<sup>16</sup> AZ, AR, GA, ID, IN, KS, KY, LA, MO, MS, ND, OK, SD, WV, WI, and WY.

## 6. Convergence Analysis:

Convergence analysis measures the convergence and divergence in the state level growth rate of the real estate sector during the various phases of a business cycle in the United States. “Beta 0” and “Beta 1” in Figure 6: Convergence Analysis, represent the

Figure 6: Convergence Analysis

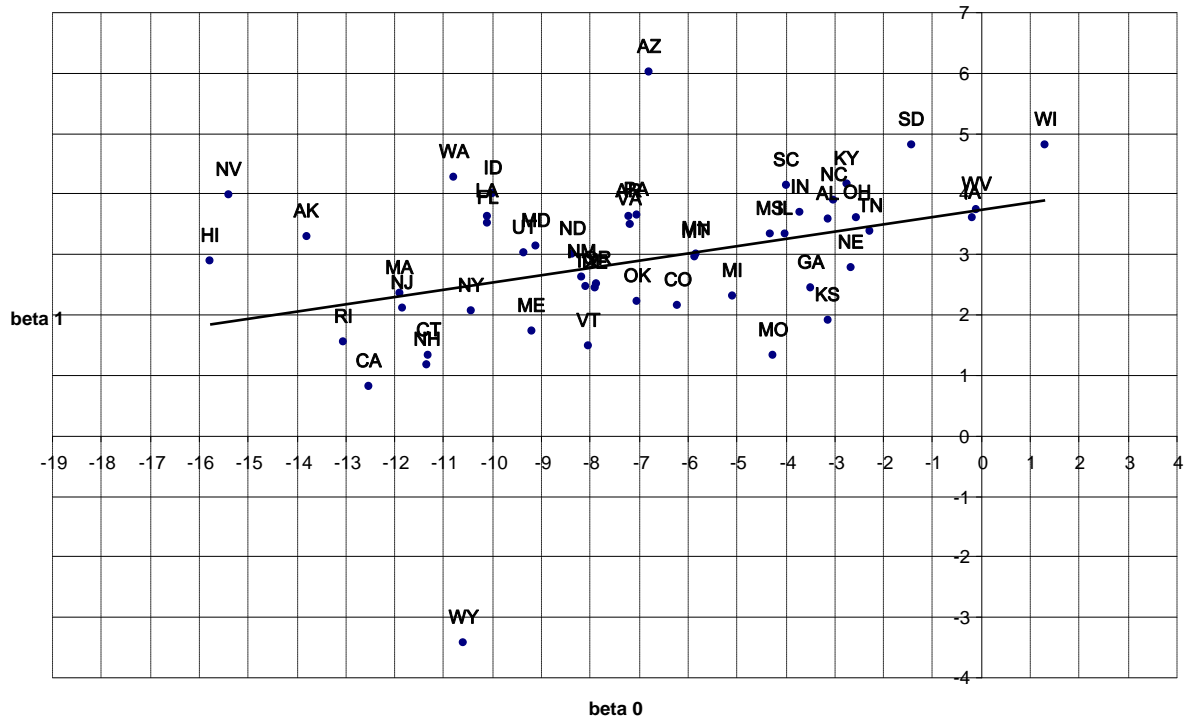


average real estate growth during the state level recession and expansion respectively.

Where “max” represents the average maximum state level real estate growth rate and “min” represents the average minimum state level real estate growth rate during the two phases of a business cycle. Our analysis shows that the median growth rate during the recession is (-15.7868) percent and during the expansion is about three percent. According to the Figure 6, the statewide average real estate growth rate diverges more during the recession compared to the expansionary period average growth rate. Thus, the convergence analysis shows that

the gap in real estate growth rate decreases or converges during the boom and diverges during the recession across the states.

Figure 7: Real Estate Fluctuations and Severity Analysis

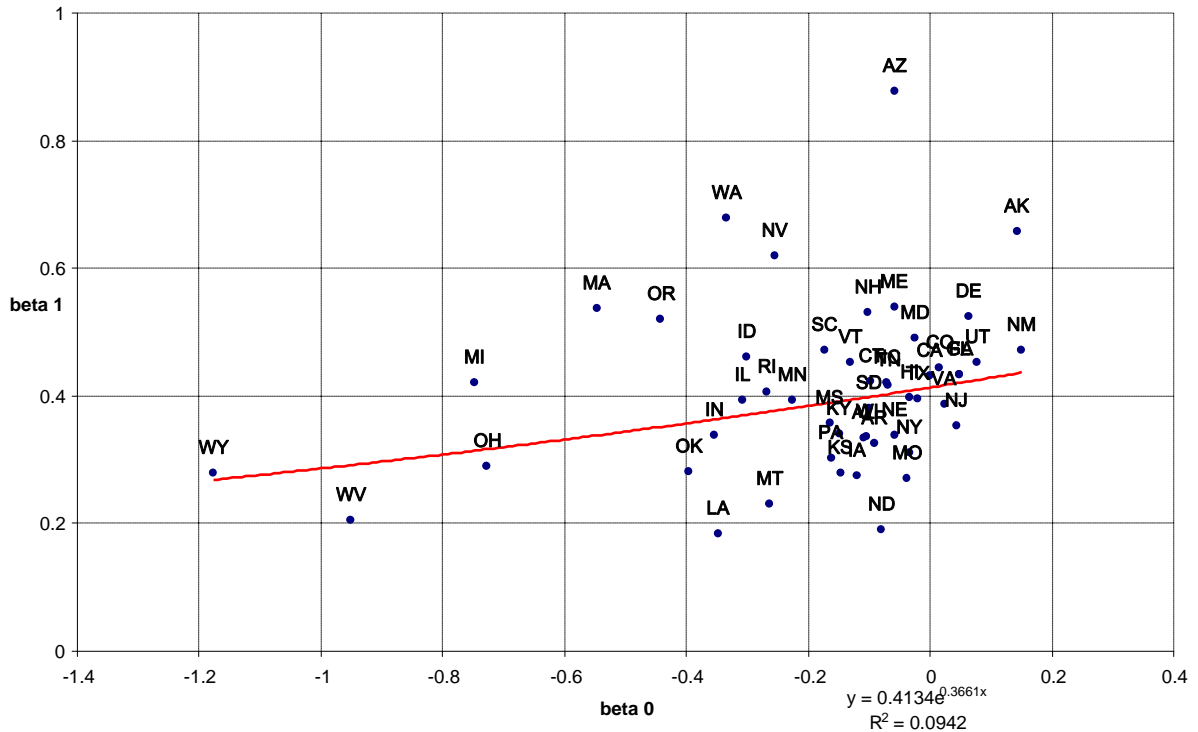


The second part of the convergence analysis is used to calculate the severity of state level real estate recessions. In the Figure 7: Severity Analysis, the  $x$  – axis represents “Beta 0”, the growth rate of the real estate market during recessions, and the  $y$  – axis represents “Beta 1”, the growth rate of the real estate market during expansion. The upward sloping trend line reconfirms that the gap between average growth rates of the real estate market throughout the United States increase during the real estate recession. In other words, the average states level real estate growth rate diverges more during the period of real estate recessions.

In the Figure 7: Severity Analysis, we observe that the severity of the real estate recessions vary across the states. On the one hand, the severity of the real estate recession in

some states, e.g., West Virginia, Iowa, and South Dakota, is less than some other states. In these states, the average real estate sector growth rate during expansion is higher than the negative growth rate during recession. On the other hand, there are states where the

Figure 8: Economic Fluctuations and Severity Analysis



negative recessionary growth rate exceeds the positive expansionary growth rate. For example, Rhode Island, California, New Hampshire, and Connecticut represent states, where the average recessionary growth rate is negative twelve percent while the average expansionary growth rate is less than positive two percent. There are two anomalies in our study: 1) Wisconsin, in Figure 7: we observe Wisconsin faces positive real estate growth rate during both expansionary and recessionary states; 2) Wyoming, where the state, faces negative growth rate throughout the business cycle.

We present Figure 8: Economic Fluctuation and Severity Analysis, to compare the state level economic severity<sup>17</sup> with the state level real estate severity in Figure 7. We observe that the magnitude and depth of the real estate fluctuation is greater than the magnitude of the state level economic fluctuation. Additionally, on average the severity of the state level real estate recession is much higher than the severity of the economic recession. For some state results are relatively consistent. For example, the average expansionary growth rate is the highest in Arizona during the economic and real estate expansionary phases. While the state of Wyoming faces the worst outcomes for both fluctuations.

However, for other states the severity of the state level economic recession differs from the severity of the state level real estate recession. For example, in Figure 7, West Virginia, and Ohio faced comparatively moderate real estate recession during 1979:IQ – 2007:IIIQ period. When we compare Figure 7 with Figure 8, we observe that both West Virginia and Ohio faced very severe economic recession during the same period. The opposite result we observe for New York, New Jersey, and California: these states experienced extreme real estate recession and comparatively reasonable economic recession.

## **7. Conclusion**

Using Markov Switching estimation technique, this paper estimates the turning points of the national and the state level business cycles as well as the real estate cycles. We show that the national business cycle is different from the national real estate cycle. Among four national recessions between 1979:IQ and 2006:IQ, only two were followed by the real

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<sup>17</sup> For the elaborate computation see Mona and Giannikos (2005).

estate recessions. This suggests that not all national recessions are due to the real estate fluctuation. However, the persistence of the real estate recession is longer compare to the persistence of the economic recession for both national and state level. We also found that the state level real estate cycles are different from the state level business cycles. Despite the dissimilarity of the state level real estate and business cycles, depending on the formation of the state level real estate cycles, we divided U.S. states into four categories: e.g., 1) Leading states, where the real estate cycles develop first and followed by those states business cycles; 2) lagging states where the real estate cycles follow the state level business cycles; 3) mixtures of leading and lagging states; and 4) where state level business cycles do not coincide with those states real estate cycles. This result and the division of the states based on the formation of the state level real estate and the business cycles are important for both state and national policy makers.

Further our analysis show that between 2006:IIQ and 2007:IIIQ the probability of the nation and the forty five U.S. states entering into real estate recession (Appendix 1) is very high. However, so far only nineteen states tend to have high probability of entering into economic recession, but there is no indication of national economic recession.

The convergence analysis of this paper suggests that the average growth rate of the state level real estate market diverges during the recession across the United States. A similar result we observed for the state level economic growth rate by Mona and Giannikos (2005). The second part of the convergence analysis shows that the magnitude, depth, and severity of the real estate recessions are higher than the economic recession.

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