# A STUDY OF THE BOOM AND BUST CYCLES OF THE UNITED STATES HOUSING MARKET FROM 2000 TO 2010

**Wei Liu**

**(6022001)**

**Major Paper Presented to the Department of Economics of the University of Ottawa in partial fulfillment of the requirements of the MA Degree**

**Supervisor: Prof. Gilles Grenier**

**Eco7997**

**Ottawa, Ontario**

**August 2011**

**Abstract**

This paper looks at the evolution of the housing market in the US from 2000 to 2010. This period is characterized by interesting and dramatic boom and bust cycles in the housing market. Data from the fifty states and the District of Columbia are used to study this phenomenon with panel data econometric methods. There is a significant structural change in most of the states during the years 2007, 2008, and 2009. After that, housing prices start to recover, but not strongly. This paper also looks at what causes the boom and bust of the cycle from the perspective of psychological factors. It is found that capital appreciation rate plays a role.

Keywords: bubbles, fundamentals, capital gains.

## 1. Introduction and Background

Housing prices have been up and down over the past decade in the US. In most states, they reached a peak during 2006 or at the beginning of 2007, and they then plummeted at the end of 2008. At the beginning of 2010, there was a sign of recovery in some states. This huge decline in housing prices was believed to be one of the factors that resulted in the subprime mortgage crisis which started just after the fall in the housing prices. Similarly to aggregate economies which have their business cycles, housing prices have their own cycles: in the long run, they rise in line with inflation and real fundamentals such as incomes; in the short run, they fluctuate around the fundamentals. Their volatility raises expectations that reflect how people or investors view the current housing market. When market prices are above fundamental prices, there can be housing bubbles, and vice-versa when the prices are below fundamental prices. When the housing bubbles burst, many people are trapped, particularly those who bought their house at the peak. This could affect the aggregate economy as well, for example by causing more people to be unemployed and by leading the economy into a recession.

In this paper, the focus will be firstly on how the cycle of housing prices developed over time for the period 2000 to 2010 for the fifty states and the District of Columbia. It is commonly accepted there were bubbles in the US housing market that burst in the years 2008 and 2009. However, there is little evidence on how the boom and bust cycle evolved for different states. The paper will then try to identify the causes of the bubbles. Theoretically, there are mainly three causes: 'real factors', monetary policy and psychological factors. The last factor will then be empirically tested against the data. The econometric methods used are pooled ordinary least squares estimators (OLS) and panel data fixed and random effects estimators.

The rest of this paper is organized as follows. Section 2 introduces various definitions of bubbles. Section 3 reviews the theoretical literature on bubbles and the empirical literature on housing prices. Section 4 presents the model, the data and the econometric methodology. Section 5 reports the empirical results for different specifications of the model. Section 6 analyzes the extent to which psychological factors play a role in the determination of housing prices. Finally, section 7 is the conclusion.

## 2. The Concept of Bubbles

Various definitions of bubbles have been proposed by different authors. Kindleberger (1978, p. 281) describes bubbles as follows: "a sharp rise in price of an asset or a range of assets in a continuous process, with the initial rise generating expectations of further rises and attracting new buyers—generally speculators interested in profits from trading rather than in its use or earning capacity. The rise is then followed by a reversal of expectations and a sharp decline in price, often resulting in severe financial crisis—in short, the bubble bursts." Kindleberger emphasizes the characteristic of a bubble as a fast rise in prices, and its profits generating. The intuition is that an increase in prices cannot be justified by its earning potential or price appreciation.

Garber (2000, p. 4) writes: "The definition of *bubble* most often used in economic research is that part of asset price movement that is unexplainable based on what we call fundamentals." The emphasis is that prices should follow the economic fundamentals (the long term momentum of the price fluctuations) and deviations are perceived as bubbles.

Rosser (2000, p. 107) provides the following definition: “A speculative bubble exists when the price of something does not equal its market fundamentals for some period of time for reasons other than random shocks. [Fundamental] is usually argued to be a long-run equilibrium consistent with a general equilibrium.” Rosser emphasizes the definition of a speculative bubble as any deviation away from economic fundamentals apart from the random shocks. The random shocks reflect on the short term price fluctuation, but in the long run, if there is no speculative bubble, actual prices should be equal to the fundamentals. Rosser (2000, p. 107) goes further and says that “the most fundamental [problem] is determining what is ‘fundamental’. The real question lies on the selection of the fundamentals, as an inappropriate selection may not capture the long run equilibrium.

Case and Shiller (2003, p. 321) characterize housing bubbles as follows: “a tendency to view housing as an investment is a defining characteristic of a ‘housing bubble.” Case and Shiller emphasize the purpose of buying the assets. Shiller (2005, p. 2) goes further to define a speculative bubble as follows: "Irrational exuberance is the psychological basis of a speculative bubble. I define a speculative bubble as a situation in which news of price increases spurs investor enthusiasm, which spreads by psychological contagion from person to person, in the process amplifying stories that might justify the price increases and bringing in a larger and larger class of investors, who, despite doubts about the real value of an investment, are drawn to it partly through envy of others' successes and partly through a gambler's excitement." Shiller looks at bubbles from a different perspective and defines them as a result of psychological contagion effects, as people bet prices will increase and this irrational behavior leads to increases in prices, rather than growth in prices being led by economic fundamentals

Krugman (2005) holds a similar view: "if people think prices will continue to rise, they become willing to spend even more, driving prices still higher, and so on...prices will keep rising rapidly, generating big capital gains. That's pretty much the definition of a bubble." Krugman believes that buying the assets or houses for the purpose of capital gains as a result of a psychological factor is a bubble.

All these authors try to identify what a bubble is from different perspectives. This can be summarized as profit generating, deviating from fundamentals, and irrational behavior. However, they have a common underlying character in that prices should follow a long run equilibrium based on fundamentals.

## 3. Survey of the literature

### 3.1. Literature on theory and causes of bubbles

There are three popular views about housing bubbles (Thornton, 2009, p. 238). One of them is the one of the supply-siders and the Chicago school economists. They do not believe that there are 'bubbles' in the housing market; what causes the 'bubbles' is in fact the result of changes in the fundamentals or real factors. This view is popular not just among some economists, but also in the general public in the belief that housing prices 'never go down'. This view seems to assume that people are rational and emphasizes that the so called 'bubbles' are corrections based on fundamentals.

The second popular view is from the Keynesians and the supporters of behavioral finance such as Robert Shiller. They believe in the existence of bubbles and that bubbles are driven by psychological factors. The housing market cycle reflects investors' confidence about the prospects of the market. The boom is formed when confidence is high and a bust is formed when investors' confidence is low. The expected increase in profits causes investors to take more risks based on speculative behavior rather than on 'real factors'. This leads to more people investing in the housing market; this is so called 'herding' behavior which worsens market conditions. The supporters of this view also recognize the role of the fundamentals that may play their parts in the bubbles, but they downgrade them. Shiller (2004) identifies three main psychological factors in recent history. The first of them is the burst of the 'dot-com bubble' and the attack of 9/11. This leads people to invest more in their homes and in the housing market. The second factor is the development of communications, driving people into urban areas. The third one is "the speculative contagion that underlies any bubble." He also believes that the first two factors will remain for a long period of time. However, the last factor will remain for a temporary period of time. When prices start to decline, the contagion effect goes in the opposite direction for years before it reverses back.

Finally, the third view about housing bubbles is from the Australian School of economics; they believe that bubbles are the results of changes in both 'real factors' and psychological factors. Changes in both 'real factors' and psychological factors in turn are caused by monetary policy. The argument is that monetary policy affects the changes in the business cycle (Thornton, 2009, p. 240). The boom and bust cycle in turn affect people's perceptions regarding the expected housing prices. People are more confident during times of economic boom and are more likely to take risks and bet that the prices will continue to go up. This perception and the boom build up each other and lead to 'speculative behaviours' instead of rational rules and behaviours. This will ultimately result in the formation of bubbles. On the other hand, as the boom starts to fade away, the economy enters the down slope cycle. The bad news and economic data start to come out and the prices start to crumble and fall. At the beginning, people think that this is just a temporary phenomenon and that the prices will soon recover. But as more bad news comes out, prices keep falling, resulting in housing construction being delayed and cancelled. This sequence of events will lead to pessimistic behaviours and people are now less willing to invest. Finally, the bubble bursts and the economy enters the recession. Similarly, the boom and bust cycle also affect the 'real factors'. This in turn causes the mispricing of houses. The change in 'real factors' will be reflected in housing prices. During the economic boom, the 'real factors' such as income tend to associate with higher housing prices.

3.2. Empirical literature on housing prices

There are mainly three standard approaches to empirically study housing markets (Cameron, Muellbauer and Murphy, 2006, p. 6). The first approach emphasizes the demand side of the market and is based on the economic fundamentals that determine price movements. However, Muellbauer and Murphy (1997, p. 1705) say that the majority of the variables that determine housing prices are from the demand side, but not all. Some supply side factors can also determine prices. A second approach emphasizes the supply side of the model and measures how new houses are produced. In other words, the purpose is to determine new housing supply. For example, in Mayer and Somerville (1996), the new housing supply is a function of housing prices, construction costs, and the real interest rate. Housing starts are normally used to measure new housing supply. Thirdly, the final model approach illustrates how changes in the stock of houses evolve as new houses are constructed. This is an economic model which shows that the prices are inversely related to the housing stock as the number of new houses rises and the stock of houses rises. If the demand is unchanged, the construction of new houses increases the stock of houses and prices fall as a result.

Among the three, the approach that emphasizes the demand side of the model is the most commonly used. It is also called an inverted demand function, because housing prices are the dependent variables and are a function of the economic fundamentals used to determine the demand. The specification of the fundamentals can vary with researchers, but it usually includes real income, real rental cost, and demographic factors (Cameron, Muellbauer and Murphy, 2006, p. 6). Hwang and Quigley (2006) use US metropolitan data from 1987 to 1999 to test how prices move. They find that changes in real housing prices are positively related to changes in prices from previous years and to housing permits, and negatively related to the change in house vacancy rates.

One way of finding a bubble is to define it as the 'wedge' between actual housing prices and housing prices determined by the economic fundamentals (Garino and Sarno, 2004, p. 784). If housing prices are above the prices determined by economic fundamentals, there are bubbles in the housing market and over time housing prices tend to correct themselves, and vice-versa. In terms of finding the bubbles, the specification of the fundamentals can vary and correctly finding the bubbles can be a challenge.

There are many models that have been specified to measure housing bubbles. For example, Case and Shiller (2003) carry out a study of the US housing market in 50 states and the District of Columbia between the first quarter of 1985 to the third quarter of 2002 with time series data. The study looks at the relationship between housing prices and income per capita and other fundamentals. The results show that the income per capita variable explains a large percentage of the variations in housing prices when the rest of the fundamentals are included in the regression. The authors find bubbles in some states such as California, New Hampshire, and a few others, using OLS. Although Case and Shiller do not explicitly define the 'wedge' as a bubble, they do not deny the hypothesis of a bubble's existence if the 'wedge' exists.

Another way of finding a bubble is through cointegration tests. For example, Garino and Sarno (2004) use UK time series data from 1983 to 2002 to test if there is a bubble in the housing market using a Markov-Switching unit root test and a cointegration test. The results suggest that there is no cointegration or long run relationship between housing prices and economic fundamentals. This means that there were bubbles in the housing market and these results coincide with the findings of the Markov-Switching unit root test. However, this model may be underspecified because house prices only depend on income and interest rate. There are also other determinants from the demand side such as the unemployment rate, or from the supply side such as construction costs and housing permits, that can be considered as economic fundamentals (Case and Shiller 2003).

Hui and Yue (2006) test the existence of bubbles in 2003 in the Beijing and Shanghai housing markets respectively using time series data from 1990 to 2003. The econometric method used is cointegration testing with Granger causality tests and impulse response functions. The economic fundamentals used are stock of vacant new dwellings, disposable income of urban households, local GDP and Shanghai stock price index. The dependent variable is the housing price index. The results are that Shanghai seemed to have a bubble in the year 2003, but not Beijing.

A bubble can be measured through the past appreciation rate of prices and if there is a correlation between the housing prices and the past appreciation rate of prices, then there is a sign of a bubble. Abraham and Hendershott (1996) use data for 30 US cities from 1978 to 1992 to run two regressions to test bubbles. Firstly, they find the equilibrium prices by regressing prices over income growth, construction costs, employment growth, and after tax interest change, and they calculate the local price disequilibrium (actual price less than the equilibrium price). Secondly, they regress the real housing prices change on real income change, real construction costs, employment growth, after tax interest change, the lagged real prices appreciation rate and local price disequilibrium. They find strong evidence of bubbles among coastal cities; the coefficients on the last two variables (the appreciation rate and local price disequilibrium) are found to be 0.5 and 0.1 respectively, compared to the 0.2 and virtually zero in other regions. If the market is efficient, these two variables should not correlate with the price change. The higher the coefficients of the two variables, the higher the possibility of the existence of bubbles and of bubbles building up. The negative coefficients (the two variables) tend to associate with the bubble burst.

Similarly, Case and Shiller (1989) also includes the past appreciation rate as an explanatory variable as a proxy to test the market efficiency (bubbles). They use data from four US cities from 1970 to 1986 and regress the change in prices on the past appreciation rate. The results show that the coefficient is 0.3, which suggests that the existence of bubbles cannot be denied. This term (past appreciation rate) builds up as economic fundamentals increase. This is because this term is built on the formation of expectations and the expectation is built on the fundamentals.

In empirical studies of housing bubbles, the specification of the fundamentals can vary a lot. This depends on the researcher's beliefs and on country specific characteristics. The specification of the model in China, for example, may not be a good one for the US as the two countries have very different economic structures and characteristics. Therefore, a proper study of the US housing market requires a model that fits the US economic characteristics.

## 4. Model, data and econometric methodology

### 4.1 Model

This paper uses a similar model to the one specified by Case and Shiller (2003). It provides the inspiration for this research; however, different econometric techniques and more recent data are used. This model is chosen because it fits well the US economic structure. However, the model in this paper is a bit different from the one of Case and Shiller. Firstly, the model includes the unemployment rate instead of both the unemployment rate and the employment rate among the regressors. Secondly, the methodology is different. Instead of using time series OLS individually on the eight states with the most volatile prices, panel data methods are used to examine whether there were bubbles in the housing market from 2000 to 2010 in 50 states and the District of Columbia, and whether the bubbles vary across different states.

The housing price is determined by the interaction of housing demand and housing supply (Quigley, 1999). It can be expressed as follows.

$$MP= (INC, POP, UN, MR, HP,Y) \quad (1)$$

The variable MP is the median housing price. The number of houses demanded is a function of INC which is the income per capita, POP which is the population growth rate, UN which is the unemployment rate, MR which is the mortgage rate. Similarly, housing supply is a function mainly of the HP which is the number of housing permits. Y includes the other relevant variables such as location, weather and so on that affect demand and supply. The model is constructed by regressing housing prices on a list of fundamentals from both the demand side and the supply side.

4.2. Data

Housing prices are the median nominal prices of standard single family houses for each state and are available from the Federal Housing Agency directly. The data are available from 2000 to the second quarter of 2010. The first two quarters of 2010 are averaged out to proxy for the year of 2010. Income (INC) is the personal income at nominal prices by state and is obtained from the Bureau of Economic Analysis Regional Economic Accounts. The housing permits (HP) are the number of houses allowed to be built in that year by the local authority of each state and are obtained from the US Census Bureau. Population (POP) is obtained from the US Census Bureau and is converted to annual population changes in percentages. The unemployment rate (UR) by state level is obtained from the U.S. Bureau of Labor Statistics. The Mortgage rate (MR) is the 30 year fixed rate at the state level and is obtained from the historical data of HSH.com. All the data are annual and cover the period of 2000 to 2010. The variables in the equations below are converted to the log form such as logINC, except for the variable of population, as population change can be negative. The reason for choosing a log form is because this gives an interpretation in terms of percentages between the regressors and the regressand. This is consistent with the paper of Case and Shiller (2003).

4.3. Methodology

This paper uses panel data methods to analyze the US housing market. Panel data analysis explains variation of variables across time periods (t) within cross-sectional units (i). The advantage is that it gives more information, as compared to simple time series. Many empirical studies use time series along with cointegration methodology to test if there is a long run relationship in housing prices. However, this approach is appropriate for smaller countries, such as the UK and Korea, which do not have many variations among the different regions. In the US, however, the size of the country is very large and the variations across the different states can be quite large and can be exploited in empirical studies that use panel data, such as states data or metropolitan area data. In addition, the panel data compensate for the short period of data availability.

The pooled OLS model is:

$$y_{it} = x'_{it}\beta + \alpha + \varepsilon_{it} \qquad (2)$$

where y is the regressand and the x′ are the regressors (specified in the equation (1) and not including the constant); the subscript t is time and the subscript i is the cross-section of states. Finally, $\alpha$ and $\varepsilon$ are the constant and residual respectively. The pooled OLS has its downside, as it could suffer from the unobserved heterogeneity bias (Woodridge, 2002, p. 421).

The fixed effects model is:

$$y_{it} = x'_{it}\beta + \alpha_i + \varepsilon_{it} \quad (3)$$

The specification of the model is the same as before except for the term $\alpha_{i,}$ which is a time invariant variable related to each unit i which also affects y (in the case of housing prices, it represents factors that are specific to each state). The term $\alpha_i$ is allowed to be correlated with the regressors. This differs from the random effects model, which assumes that $\alpha_i$ is not correlated with the regressors. The fixed effects model has a key advantage over the pooled OLS, because it controls for unobserved heterogeneity (Woodridge, 2002, p. 441). This means that the estimator will not be otherwise inconsistent and biased from this perspective. If equation (3) is averaged out over time, then we have:

$$\bar{y}_i = \bar{x}'_i\beta + \alpha_i + \bar{\varepsilon}_i \quad (4)$$

Equation (3) minus (4) gives:

$$y_{it} - \bar{y}_i = (x_{it} - \bar{x}_i)'\beta + \varepsilon_{it} - \bar{\varepsilon}_i \quad (5)$$

Equation (5) shows the time-demeaned data derived from subtracting equation (3) from (4). This mechanism is the fixed effects and this equation shows how the unobserved heterogeity term has now dropped out of this equation. The fixed effects allow us to get rid of the heterogeity biases (Woodridge, 2002, p. 421).

There is another approach called the random effects model. This approach is based on an idea similarly to the fixed effects. They both control for the unobserved heterogeneity. However, the major difference between the two is the assumption about the correlation between the regressors and the unobserved heterogeneity (as mentioned earlier). The choice between the two approaches will depend on which assumption is true. Intuitively, the assumption of the fixed effects is more appropriate, because unobserved heterogeneity related to location could have an impact on housing prices and at the same time it could be correlated with regressors such as the unemployment rate. The median of housing prices in California could be higher than in Utah, for example, and at the same time California could have a lower unemployment rate than Utah, regardless of the other factors except location (the unemployment rate is a function of location). This idea is also supported by Woodridge (2002, p. 452): if the data come from states or provinces, the fixed effects tends to be a favoured tool. However, there is also drawback with the fixed effects model. Time invariant variables, such as dummies for major geographical regions or climate, cannot be included in the specification of the model. Instead these terms are assumed or controlled to be constant. In contrast, in the random effects model, these terms can be added into the model. The choice of the two models sometime lies on whether time invariant variables are the matter of interest.

## 5. Statistics and Results.

### 5.1. Descriptive statistics

Housing prices among different states can have large discrepancies. Those reflect the equilibrium prices resulting from the demand and supply of housing over time. In Table

1, price statistics for single family houses over the period of 2000 to 2010 are summarized by states. The statistics contain the lowest and the highest prices, the difference between the two (DF), the median and average prices, the standard deviation of the housing prices ($SD^1$) and the standard deviation of the ratio of the housing prices over personal incomes ($SD^2$). $SD^1$ and $SD^2$ are two ways to measure housing price volatility (Case and Shiller, 2003, p. 308). High values of $SD^2$ suggest inelastic housing prices and the possibility of a large amount of capital being allocated to the housing market for purposes other than living in a house, such as making capital gains (Angel and Mayo, 1996).

States in Table 1 are ranked in descending order of price volatility based on $SD^1$. The five states with the most volatile prices are Hawaii, California, the District of Columbia, Maryland and Nevada, and the five states with the least volatile prices are Nebraska,

Table 1. Descriptive statistics on single family housing prices, United States, 2000-2010.

| States | Median | $SD^1$ | Trough | Peak | Average | DF | $SD^2$ |
|---|---|---|---|---|---|---|---|
| Hawaii | 504249 | 127948 | 247729 | 583668 | 435184 | 335939 | 2.14 |
| California | 324934 | 99146 | 225519 | 520007 | 362158 | 294488 | 2.12 |
| District of Columbia | 335957 | 92915 | 167245 | 415047 | 311431 | 247802 | 0.83 |
| Maryland | 254571 | 64979 | 146895 | 333089 | 246403 | 186194 | 1.07 |
| Nevada | 180262 | 61285 | 141210 | 304822 | 205992 | 163612 | 1.32 |
| New Jersey | 287803 | 55201 | 181752 | 346816 | 277375 | 165064 | 0.88 |
| Rhode Island | 229067 | 50539 | 145714 | 298984 | 232693 | 153269 | 1.10 |
| Virginia | 224131 | 47913 | 136049 | 277870 | 213501 | 141821 | 0.80 |
| Washington | 245772 | 47757 | 165269 | 299678 | 230427 | 134409 | 0.72 |
| Florida | 149236 | 47031 | 107830 | 247458 | 168250 | 139628 | 1.02 |
| Massachusetts | 299669 | 46647 | 202695 | 345644 | 294190 | 142949 | 0.83 |
| New York | 242995 | 46321 | 146537 | 278811 | 226911 | 132274 | 0.68 |
| Arizona | 150934 | 44331 | 127290 | 252546 | 174308 | 125256 | 1.07 |
| Connecticut | 266083 | 44051 | 185473 | 315863 | 259584 | 130391 | 0.61 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Oregon | 203797 | 40326 | 140529 | 252321 | 194847 | 111793 | 0.77 |
| Delaware | 213902 | 40307 | 141120 | 255090 | 205153 | 113970 | 0.67 |
| New Hampshire | 219645 | 36989 | 145189 | 259409 | 214981 | 114220 | 0.72 |
| Wyoming | 154258 | 36823 | 98861 | 194925 | 151818 | 96065 | 0.25 |
| Utah | 170840 | 35432 | 135577 | 229420 | 175071 | 93843 | 0.62 |
| Alaska | 211431 | 34812 | 152455 | 238676 | 203445 | 86222 | 0.32 |
| Vermont | 203727 | 34403 | 127017 | 220628 | 184973 | 93611 | 0.52 |
| Montana | 154273 | 33696 | 100918 | 186543 | 149231 | 85625 | 0.45 |
| Maine | 173988 | 27923 | 109080 | 186910 | 160198 | 77829 | 0.50 |
| Idaho | 140625 | 27680 | 98575 | 175162 | 135179 | 76587 | 0.49 |
| New Mexico | 151606 | 26368 | 108801 | 178252 | 145616 | 69451 | 0.35 |
| West Virginia | 113722 | 23173 | 69582 | 129572 | 105560 | 59990 | 0.44 |
| South Dakota | 135023 | 23061 | 94820 | 156353 | 130604 | 61534 | 0.20 |
| Minnesota | 171936 | 21591 | 129943 | 199331 | 170007 | 69389 | 0.50 |
| Louisiana | 127618 | 21527 | 96658 | 151002 | 127069 | 54344 | 0.13 |
| Pennsylvania | 148407 | 21417 | 103280 | 161066 | 138159 | 57787 | 0.28 |
| North Dakota | 104211 | 21377 | 75585 | 134430 | 103898 | 58844 | 0.13 |
| Illinois | 156676 | 21028 | 128890 | 192310 | 161367 | 63420 | 0.47 |
| Michigan | 129938 | 17591 | 94839 | 143338 | 125099 | 48499 | 0.71 |
| Colorado | 212025 | 16973 | 171486 | 227429 | 207212 | 55943 | 0.29 |
| North Carolina | 148265 | 16907 | 116262 | 163917 | 142691 | 47655 | 0.18 |
| Wisconsin | 152033 | 16710 | 117671 | 166155 | 147745 | 48484 | 0.27 |
| Mississippi | 108279 | 16675 | 85293 | 126425 | 108559 | 41132 | 0.12 |
| Arkansas | 106853 | 14860 | 80058 | 118661 | 103063 | 38603 | 0.11 |
| Alabama | 122734 | 14658 | 96900 | 136009 | 118623 | 39109 | 0.13 |
| South Carolina | 133788 | 14570 | 109360 | 151808 | 130851 | 42448 | 0.23 |
| Tennessee | 116265 | 14527 | 90321 | 130189 | 111915 | 39868 | 0.16 |
| Oklahoma | 100186 | 13358 | 79879 | 116131 | 99365 | 36252 | 0.08 |
| Texas | 119486 | 12653 | 99078 | 133309 | 119454 | 34231 | 0.14 |
| Georgia | 140631 | 12497 | 123667 | 159663 | 141046 | 35996 | 0.40 |
| Missouri | 121060 | 11677 | 96749 | 132157 | 118130 | 35408 | 0.22 |
| Kentucky | 125013 | 11087 | 101176 | 131559 | 120154 | 30383 | 0.17 |
| Nebraska | 114277 | 8859 | 94344 | 118542 | 109868 | 24198 | 0.17 |
| Iowa | 109880 | 8821 | 91160 | 116265 | 106505 | 25105 | 0.18 |
| Kansas | 110633 | 8678 | 92894 | 117026 | 108185 | 24132 | 0.18 |
| Ohio | 115646 | 6710 | 108035 | 126314 | 116617 | 18279 | 0.35 |
| Indiana | 109780 | 4920 | 99625 | 114752 | 108793 | 15128 | 0.21 |
| Total | 148725 | 80524 | 69582 | 583668 | 173323 | 90058 | 1.65 |

Source: FHFA (http://www.fhfa.gov/Default.aspx?Page=87).

Iowa, Kansas, Ohio, and Indiana. If states are ranked by $SD^2$, Hawaii and California are still the top two, and Maryland and Nevada are still ranked among the top 5. Therefore, the two rankings do not differ much with respect to the most volatile states. The difference between the peak and trough prices over the 11 year period is as high as $335,939 in Hawaii, while for the state of Indiana, that difference is as low as $15,128. In total $SD^1$ is $80,524. Overall, this information demonstrates the high volatility of housing prices in the US, but there are a few states at the bottom of the table that have low volatility. Overall, the results offer a glimpse at the possibility of bubbles among some states with high volatility of prices.

5.2. Regression Results

The results of the model with the three methods presented above are shown in Table 2. Overall, the results appear to be quite robust and the signs are as expected for most variables; the results from the three methods do not differ much. In the method of pooled OLS, all the signs make economic sense. For example, if average income goes up by 1%, housing prices will go up by 1.59%. Similarly, if the growth rate of the population goes up by 1%, housing prices will go up by 2.67% (0.0267*100). This suggests that housing prices are responsive to population change and income. However, the coefficient of the mortgage rate variable is insignificant and has no explanatory power. Theoretically, the mortgage rate should have a negative relationship with housing prices, as the mortgage rate is a very important instrument that the central bank uses in its monetary policy. But empirically the results are mixed. In Case and Shiller (2003), only one out of 8 regressions has a significant negative relationship between mortgage rate and housing prices. In Malpezzi (1999), the coefficient of that variable is found to be negative when the dependent variable is the ratio of the housing prices over income instead of housing prices. Coming back to Table 1, the R square is about 60%, which means that the pooled OLS can explain 60% of housing price variations.

The results from the fixed effects model with the reference category of Alabama have a better fit as the R square is now 82%. This means that state fixed effects explain important variations in housing prices. In addition, all the regressors now have significant coefficients. A 1% increase in the mortgage rate corresponds to about a 0.22% decline in housing prices. However, the sign of the population growth rate becomes negative. Every 1% increase in the population growth rate corresponds to about a -2.29% decrease in

Table 2. Regression results with OLS, fixed effects and random effects.

| Methods / Variables | Pooled OLS | Fixed Effects | Random Effects |
|---|---|---|---|
| LogINC | 1.5903*** | 1.4054*** | 1.3855*** |
| LogMR | -0.1757 | -0.2216*** | -0.2511*** |
| LogHP | 0.0221*** | 0.1127*** | 0.0978*** |
| LogUR | -0.1300*** | -0.1761*** | -0.1977*** |
| POP | 0.0267*** | -0.0229*** | -0.0223*** |
| Constant | -4.3307*** | -3.0287*** | -2.5922*** |
| $R^2$ | 0.57 | 0.82 | 0.82 |
| Number of observations | 561 | 561 | 561 |

*****= Significant at 0.5%, **= Significant at 5%, *= Significant at 10%**

housing prices. This is against expectations; the reason for this result is not clear. One possibility is that the data from the fixed effects are now time-demeaned data and also time invariant variables are now controlled for. However, in the paper by Case and Shiller (2003), the results for population are also mixed. The results from the random effects model are similar to those from the fixed effects model. It also has a wrong sign for the population variable, but it has a good fit.

We know that the financial crisis started in the US in 2008 and it lasted until 2009. The economy started to recover in 2010. Dummies for the three years corresponding to the financial crisis are added into the model to see how housing prices were affected. The results in Table 3 show negative signs for all three years. This means that, irrespective of other factors, those three years correspond to negative housing price growth. From the pooled OLS regression, the results show that the years 2008, 2009 and 2010 correspond to a decrease of 40,530 dollars, 55,638 dollars, and 72,642 dollars respectively. The fixed effects model shows that the same years correspond to a decrease of 28,656 dollars, 22,038 dollars, 33,186 dollars respectively. The results of the random effects model are similar to those of the fixed effects model. Therefore, irrespective of other factors, the year 2010 corresponds to the highest decrease in prices. In fact, the years 2008 and 2009 have the highest decrease in prices, but this is because the economic fundamentals were also going down during those two years. The rest of the results in Table 3 are quite similar to those in Table 2.

Housing prices are related to the location of each state within the country. In some regions such as the state of Hawaii and California, housing prices tend to be higher than in the rest of the states. This could be due to many reasons, one of which being the attractiveness of the weather, which induces a higher demand as a result of migration. In Table 4, the states are grouped into four regions, the NE (Northeast), MW (Midwest), S (South) and W (West). The pooled OLS and random effects models are estimated to

Table 3. Regression results with the impact of the years 2008, 2009, and 2010, OLS, fixed effects and random effects.

| Methods / Variables | Pooled OLS | Fixed Effects | Random Effects |
|---|---|---|---|
| LogINC | 1.7131*** | 1.5136*** | 1.5292*** |
| LogMR | -0.6124*** | -0.3451*** | -0.3572*** |
| LogHP | -0.0012 | 0.0461*** | 0.0366*** |
| LogUR | -0.0396 | -0.1573*** | -0.1516*** |
| POP | 0.0503*** | -0.0123*** | -0.0101*** |
| Dummy 2008 | -0.2011***(-40530 dollars) | -0.1106***(-28656 dollars) | -0.1213***(-30144 dollars) |
| Dummy 2009 | -0.3007***(-55638 dollars) | -0.0885***(-22038 dollars) | -0.1049***(-25101 dollars) |
| Dummy 2010 | -0.4036***(-72642 dollars) | -0.1588***(-33186 dollars) | -0.1766***(-36345 dollars) |
| Constant | -4.8198*** | -3.3227*** | -3.3831*** |
| $R^2$ | 0.62 | 0.84 | 0.84 |
| Number of observations | 561 | 561 | 561 |

Table 4. Regression results with the impact of regional effects, OLS and random effects.

| Methods / Variables | Pooled OLS | Random Effects |
|---|---|---|
| LogINC | 1.5088*** | 1.3720*** |
| LogMR | -0.0361 | -0.2608*** |
| LogHP | -0.0226*** | 0.0925*** |
| LogUR | -0.1590*** | -0.2060*** |
| POP | -0.0264*** | -0.0234*** |
| DummyNE | 0.2279*** (36351 dollars) | 0.2563*** (43348 dollars) |
| DummyS | 0.1375***(32287dollars) | 0.1039 |
| DummyW | 0.4428***(92368 dollars) | 0.4256***(87723 dollars) |
| Constant | -3.8178*** | -2.5450*** |
| $R^2$ | 0.72 | 0.82 |
| Number of observations | 561 | 561 |

Note: **NE** includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, and New Jersey. **S** includes Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Mississippi, Alabama, Oklahoma, Texas, Arkansas and Louisiana. **W** includes Idaho, Montana, Wyoming, Nevada, Utah, Colorado, Arizona, New Mexico, Alaska, Washington, Oregon, California and Hawaii. **MW** includes Wisconsin, Michigan, Illinois, Indiana, Ohio Missouri, North Dakota, South Dakota, Nebraska, Kansas, Minnesota, and Iowa.

capture this effect, with the region of MW being left out as the reference category (the fixed effects model cannot be estimated because regional dummies are time constant variables). Overall, the results of the two methods do not differ too much. They show that the regions of the NE and W have relatively higher prices than the MW region. The price in NE is $36,351 (from pooled OLS) and $43,348 dollars (from random effects) higher than the MW region and the price in W is $92,368 dollars (from pooled OLS) and $87,723 dollars (from random effects) higher than MW region. This means that there is a relatively higher demand among the W and NE, which may follow from a tendency of the people to migrate from the MW to W (could be the weather factor) and NE (could be other factors). When it comes to the S region, the results are mixed. The pooled OLS model has a positive and significant coefficient for S, but it is insignificant in the random effects model. Overall, the results show that W corresponds to the highest prices among all regions. For example, the price in W is $56,017 (from pooled OLS 92368-36351=56017) higher than in NE. These results may not be surprising as the two states of California and Hawaii are in the W region. These two states tend to attract migrants. Hence, there seems to be a tendency for migration from MW to the rest of the regions and from MW, S and NE to W for the last 11 years.

Table 5 shows population changes by different regions for the years 2000 to 2009 according to the US Census Bureau. Population change in a region is the sum of natural

Table 5. Population change by regions from 2000 to 2009.

| Geographic Area | Total Population Change | Natural Increase | Vital Events | | Net Migration | | |
|---|---|---|---|---|---|---|---|
| | | | Births | Deaths | Total | International | Domestic |
| United States | 25581948 | 15875579 | 38358804 | 22483225 | 8944170 | 8944170 | |
| Northeast | 1688851 | 1877814 | 6269501 | 4391687 | -704140 | 1835442 | -2539582 |
| Midwest | 2441721 | 2969319 | 8268833 | 5299514 | -593753 | 1158438 | -1752191 |
| South | 13082047 | 5837372 | 14308185 | 8470813 | 6992907 | 3118775 | 3874132 |
| West | 8369329 | 5191074 | 9512285 | 4321211 | 3249156 | 2831515 | 417641 |

Source: US Census Bureau (http://www.census.gov/popest/states/NST-comp-chg.html) increase and net migration. Clearly, the table indicates that the largest increases in population numbers occur in S and W. The increases in the two regions are not solely due to natural increase. The total net migration in these two regions is much greater than in MW and NE. In particular, the domestic migration statistics show that there is a net increase of 3,874,132 in S and of 417,641 for W, and that there is a net decrease of 1,752,191 for MW and of 2,539,582 for NE. Hence, the price increase in W could be explained by the induced higher demand from people migration, but for the other regions, it is hard to explain it on the ground of migration.

5.3 Predicted versus actual prices

Many economists (for example: Greenspan, cited by Guha, 2007; Shiller, cited by *The News: International*, 2007) think that there were bubbles in the US housing market before the financial crisis. But the question is which states had bubbles, when the bubbles started and how the bubbles evolved. Figure A1 (derived from pooled OLS of Table 2), Figure A2 (derived from the fixed effects model of Table 2) and Figure A3 (derived from the random effects model of Table 2) of the Appendix illustrate for each state the actual housing prices and the predicted housing prices in log forms based on the economic fundamentals from the years of 2000 to 2010. Their difference can be interpreted as reflecting the bubbles and bursts. The solid lines represent the actual prices and the dotted lines represent the predicted prices. The overall graph patterns of Figure A1, Figure A2 and Figure A3 are quite similar. As shown by the actual prices which are above the predicted prices, there are obvious bubbles in states such as Hawaii, California, Nevada, Rhode Island, and New York. Most of the bubbles started in about the year 2005. Housing prices peaked in 2006 and 2007 and the bubbles burst in the years of 2008 and

2009. In 2010, the prices were sluggish and there were signs of price recovery. The results show that the prices in the states of Hawaii, California and a few others are still overvalued. On the other hand, there are states whose housing prices are still undervalued such as Indiana, Kansas, Nebraska, Texas and Wyoming. Housing prices in these states are associated with less volatility, even during the financial crisis as shown in the graph. There are also states whose housing prices follow quite closely the predicted prices such as Idaho, Kentucky, Mississippi, South Carolina and West Virginia. This means that the prices are neither overvalued nor undervalued and prices are closely following economic fundamentals. In total, there seem to be about 23 out of the 51 prices that were overvalued from the fixed effects model of Figure A2.

5.4. Closer examination for some selected states

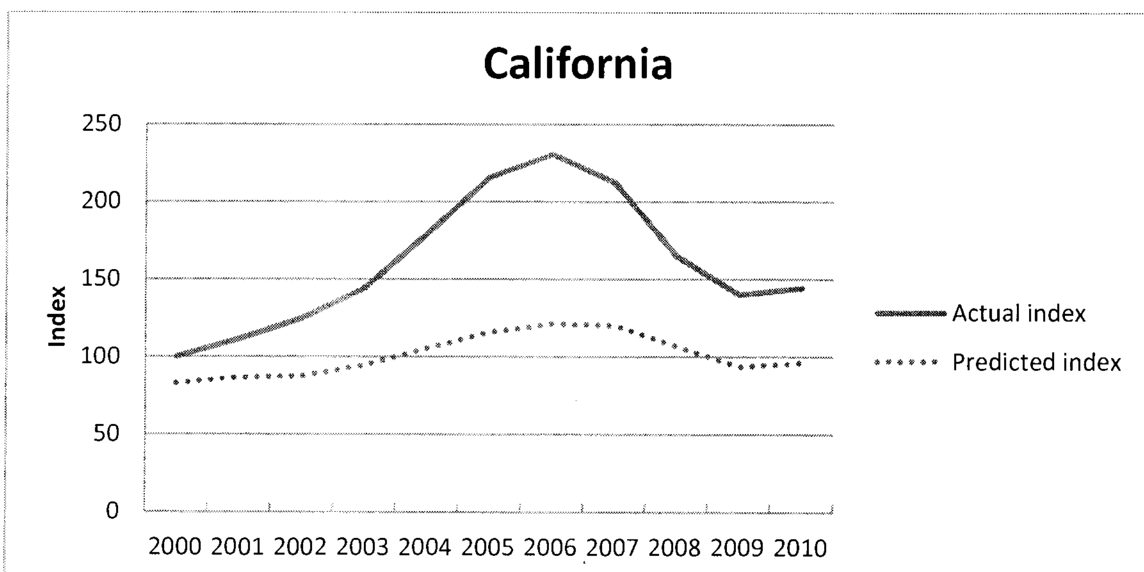
The results obtained from Table 2 show that the fixed and random effect models explain more variations than the pooled OLS. Therefore, it would be more sensible to choose fixed and random effects over the pooled OLS to show the predicted values versus the actual values. Since the explanatory powers of the fixed effects and the random effects are similar, it would not make much difference to present either result. But since state data tend to associate with the fixed effects model according to Woodridge (2002, p. 452), this model is chosen for the results illustrations below.

A few states are chosen for closer examination, based on the volatility of prices shown in Table 1. They include some of the most volatile states, some of the moderately volatile states, and some of the least volatile states. The figures below show the actual and predicted price indices, calculated from the fixed effect model, to reflect the importance of potential bubbles.

*5.4.1. The most volatile states: California and Nevada*

California is one of the states with the most volatile prices for the entire 11 years. The actual index in Figure 1 illustrates the fact that the prices peaked in 2006, and then there was a sharp fall. This index also shows that prices actually doubled in just four and a half years, from 2000 to the second half of 2004. The dotted line or predicted index has a similar pattern but are less volatile. There is strong evidence that prices were overvalued as the predicted index was below the actual index, especially around 2006. The prices were then followed by a sharp correction. However, the bubbles did not seem to burst totally as in the year of 2010 as the actual index was still above the predicted index. This could mean that California has relatively higher prices over time than the predicted index,

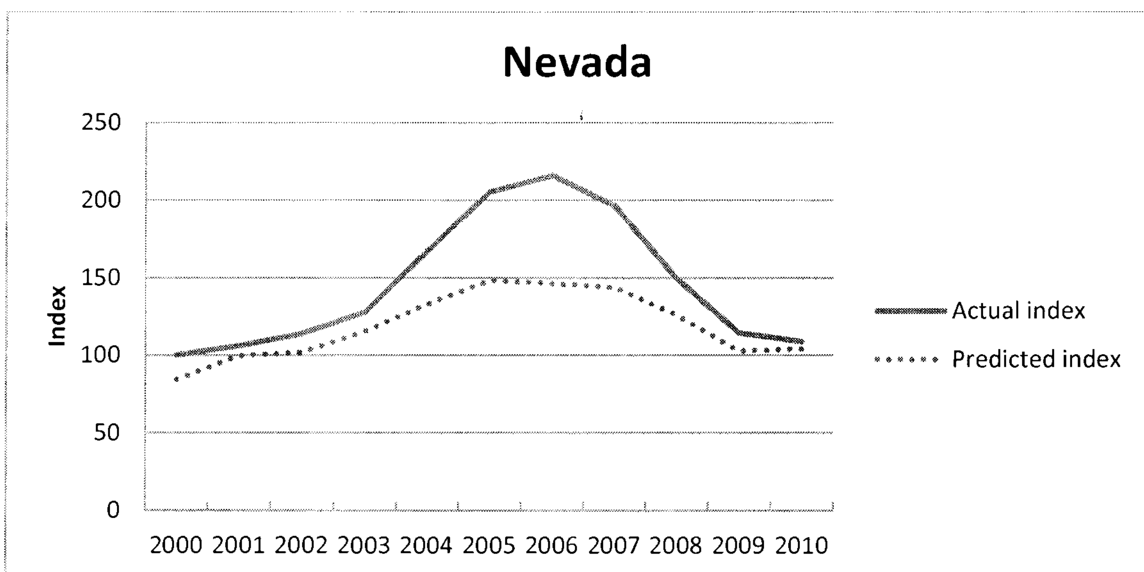
Figure 1. Actual price index versus predicted price index in California.



because of its popularity as a migrant destination. In 2010, the prices index shows that there was a sign recovery, but it is very weak.

Nevada is also one of the states with the most volatile prices. In comparison with California, Figure 2 shows that prices in Nevada were relatively less volatile. Prices also peaked around 2006 and there were a steep rise from 2003 to 2006. There was evidence of bubbles particular for the years 2003 to 2008, and in 2006 prices seemed to be overvalued by 26%; after that year, prices went for a sharp correction. However, unlike California, from the comparison of the gaps of Figure 1 and Figure 2, the bubble in Nevada seemed to be relatively smaller and it almost completely burst in 2010.

Figure 2. Actual price index versus predicted price index in Nevada.

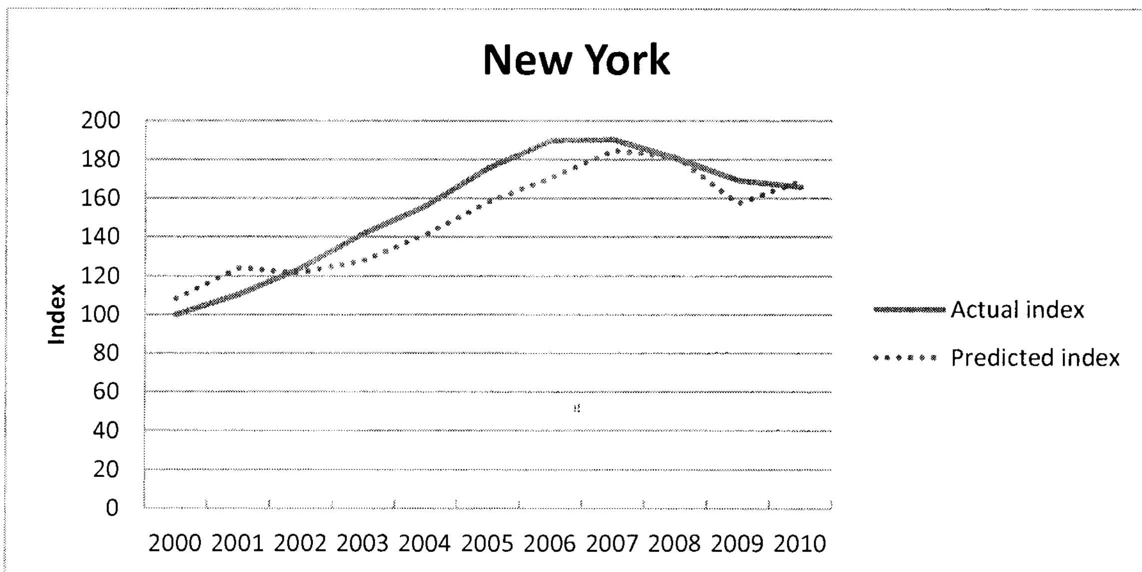



*5.4.2. Moderately volatile states: New York and West Virginia*

New York has relatively little volatility in prices compared to the states just discussed. Prices peaked in 2006 and then went down gradually, as shown in Figure 3.

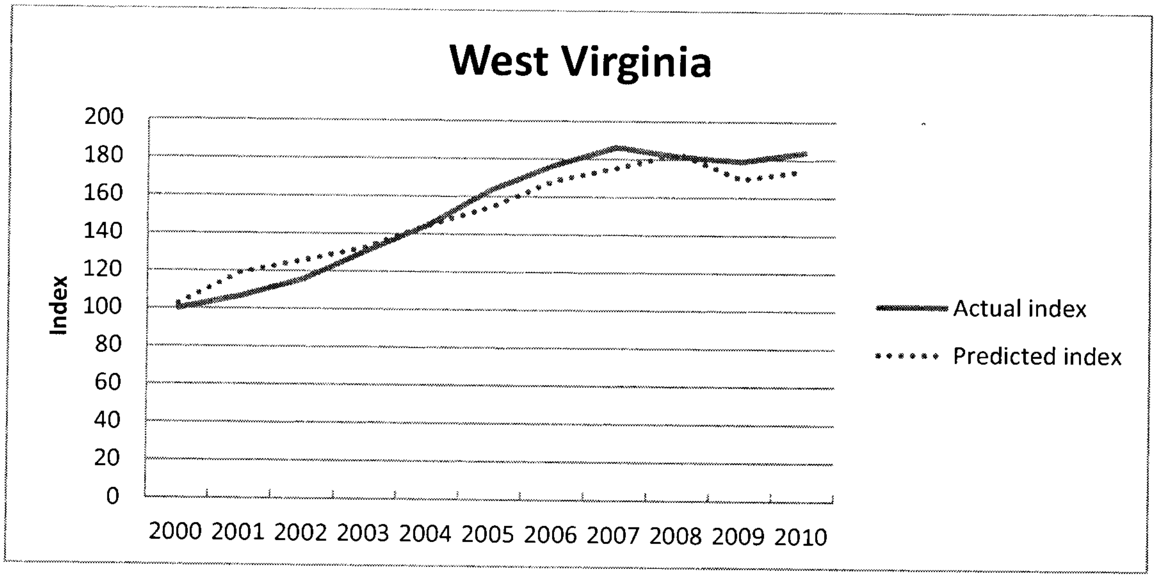
There was evidence of a bubble from 2002 to 2007, but the bubble was much smaller than in California and prices fell much more slowly than in California. The statistics show that in 2006 prices were overvalued by about 11%. Prices in 2010 reached their long run equilibrium. Another interesting result is that prices in 2000 and 2001 seemed to be undervalued, and they overtook the predicted prices in 2002. There is then a strong momentum of price increase from 2002 until 2006. This is similar to California and Nevada. The difference is that the bigger the bubble, the faster and sharper the price decline.

Figure 3. Actual price index versus predicted price index in New York.




The state of West Virginia is ranked in the middle among the states in terms of volatility. The graph is shown in Figure 4. Prices in West Virginia peaked in 2007, then fell slightly, and in 2010 started to recover. Similarly to the state of New York, at the beginning, there seemed to be a sign of prices undervaluation and there was no bubble until 2005. However, the bubble was relatively small: even at its peak, the overvaluation was only 6%.

Figure 4. Actual price index versus predicted price index in West Virginia.




*5.4.3. The least volatile states: Kentucky and Indiana*

Kentucky is one of the states with the least volatile prices. Actual prices peaked in 2007, which was an increase of about 30% from year 2000, as shown in Figure 5. Prices then fell slightly and levelled off. There was a sign of bubbles particularly in 2004 and prices fell by about 1.5% in 2008 and 1% in 2009; in 2010 there was a sign of recovery, but it was not strong.

Indiana is the state with the least volatile prices according to Table 1. The actual and predicted indexes are graphed in Figure 6. The graph is more extreme than the others and looks like the opposite of the graph of California. The predicted index is always much higher than the actual index, suggesting that houses are significantly undervalued. The actual price index is quite stable and there was barely any increase over the 11 year period. Like other states, there was a slight peak around 2006 and 2007 and then prices fell slightly. The predicted prices, on the other hand, are more volatile. The actual price

Figure 5. Actual price index versus predicted price index in Kentucky prices.

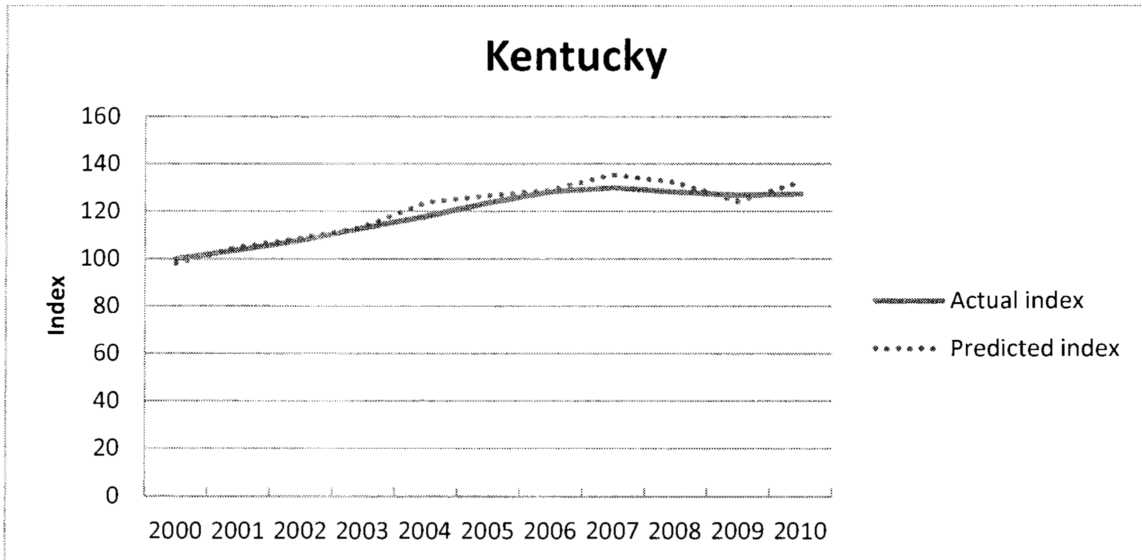
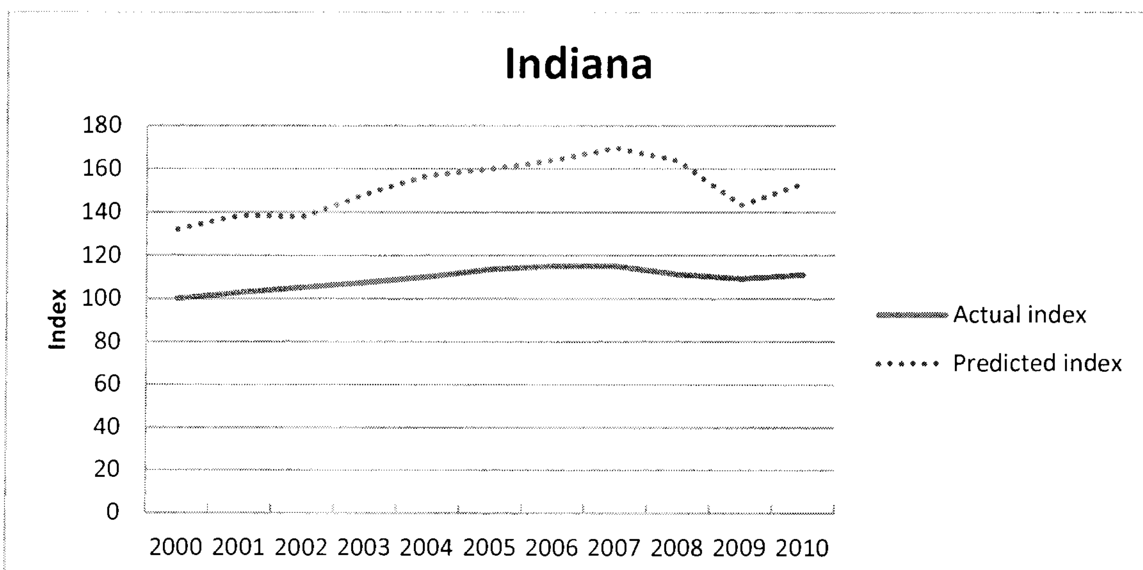



Figure 6. Actual price index versus predicted price index in Indiana.



index does not follow the predicted index.

Overall, the results have the similar features of prices peaking around 2006 or 2007. Prices then fell afterwards. However, the size of the decrease in prices differs and the more volatile states tend to be associated with larger bubbles. The prices then in turn fall largely when bubbles burst. On the other hand, the less volatile prices tend to be associated with smaller bubbles or price undervaluation; the prices in turn barely fall when the bubbles in other states burst. The states with moderately volatile prices tend to follow the economic fundamentals with some moderate deviations. It can be inferred from Figure A2 in the Appendix and from Figures 1 to 6 that the bubbles were local phenomena, but that the price depreciations were a national phenomenon.

## 6. The Psychological Factor of Capital Gains as the Cause of Bubbles

Krugman (2005) represents the view of the Keynesian economists and believes that the cause of bubbles is psychological. From the citation of Krugman (presented in section 2), it can be inferred that bubbles are built on the expectation of housing price appreciation. This idea is also supported by Harris (1989), who calls this appreciation an adaptive appreciation. The market forms expectations based on the past appreciations of housing prices. For example, Grebler and Mittelbach (1979) use a simple model in which they regress housing prices over a lag of five quarters and seasonal dummies and empirically find a statistically significant explanatory power of the lagged regressors. Harris (1989) uses an econometric model where real housing prices are regressed over economic fundamentals and the past appreciation rate of housing prices. The results show a positive but insignificant relationship between prices and the appreciation rate.

Similarly, Mayer and Sinai (2007) use US metropolitan data from 1984 to 2006 to test if there is any psychological relationship between the share of subprime mortgage lending and the appreciation rate of housing prices at a one year and a five year lag respectively. It is found that the five year lag is significantly positively correlated with the share, but that the one year lag is not. The results suggest that the increase in the share of banks lending respond to a five year lag of the appreciation rate.

The first two papers above show the likelihood of psychological factors being important determinants of housing prices. Housing prices are determined by the fundamentals, but at the same time they can also be influenced by psychological factors. The part that is unexplained by the fundamentals and explained by psychological factors is the bubble. The bubbles as defined by Garber (2000, citation presented in section 2) are the differences between actual prices and predicted prices. If bubbles are built on capital gains as suggested by Krugman (2005), there must be a link between the two. The way to test the link is to regress directly the bubbles on the past appreciation rates of housing prices. The number of lags used, one and five years, is the same as in the paper by Mayer and Sinai (2007) described earlier.

In Table 6, the residuals saved from Table 2 for the pooled OLS and fixed effects model are regressed on the rate of price appreciation lagged 1 and 5 years respectively (the variables Lag1 and Lag5). Because of the presence of the lagged variables, this procedure results in a loss of observations compared to the original sample. The random effects results are not shown in the table because they are similar to those of the fixed effects model. The purpose is to see if there is any relationship between price deviations and past growth rates in housing prices. The results from OLS show that there is a positive relationship between the price deviations and the past growth rates. The pooled OLS show that a 1% increase in the one year lag leads to an increase in the deviation of prices by about 0.89 %( 100*0.0089), and that a 1% increase in the five year lag leads to an increase in the deviation of prices of about 2.68% (100*0.0268) in the regression that includes only this lag and 1.54% (0.0154*100) and 3.86% (100*0.0386) respectively in the regression that includes both lags. The results show that lag 5 has more explanatory power than lag 1 in both the separate regressions and the one that includes both lags. This suggests that people are more responsive to the growth rate five years earlier than to the growth rate one year earlier. Since the values of the deviations can be positive or negative, the interpretation includes both positive and negative relationships. When the deviation is positive, it means that the expected capital gain depends on the growth rate of prices lagged 1 and 5 years; when it is negative, it means that the expected loss also depends on the presumably smaller or negative growth rates of Lag1 and Lag5. The higher returns can be associated with even higher capital gains 1 or 5 years later; and likewise, the lower returns can be associated with even higher capital losses 1 or 5 years later, as the bubbles burst. The R square of the pooled OLS shows that the model explains about 33% of the variation in the deviations in column (3). However, the fixed effects model shows that Lag1 and Lag5 have no explanatory power in the two separate regressions of columns (4) and (5), but that they have explanatory power in the regression of column (6). The coefficients in column (6) are smaller than the ones in column (3) and the R square is also lower. The pooled OLS has stronger results than the fixed effects. Overall, the results seem to support the idea that prices today can be affected by the capital returns in the past because of psychological factors.

Table 6. Impact of capital gains on the residuals of the housing prices regressions.

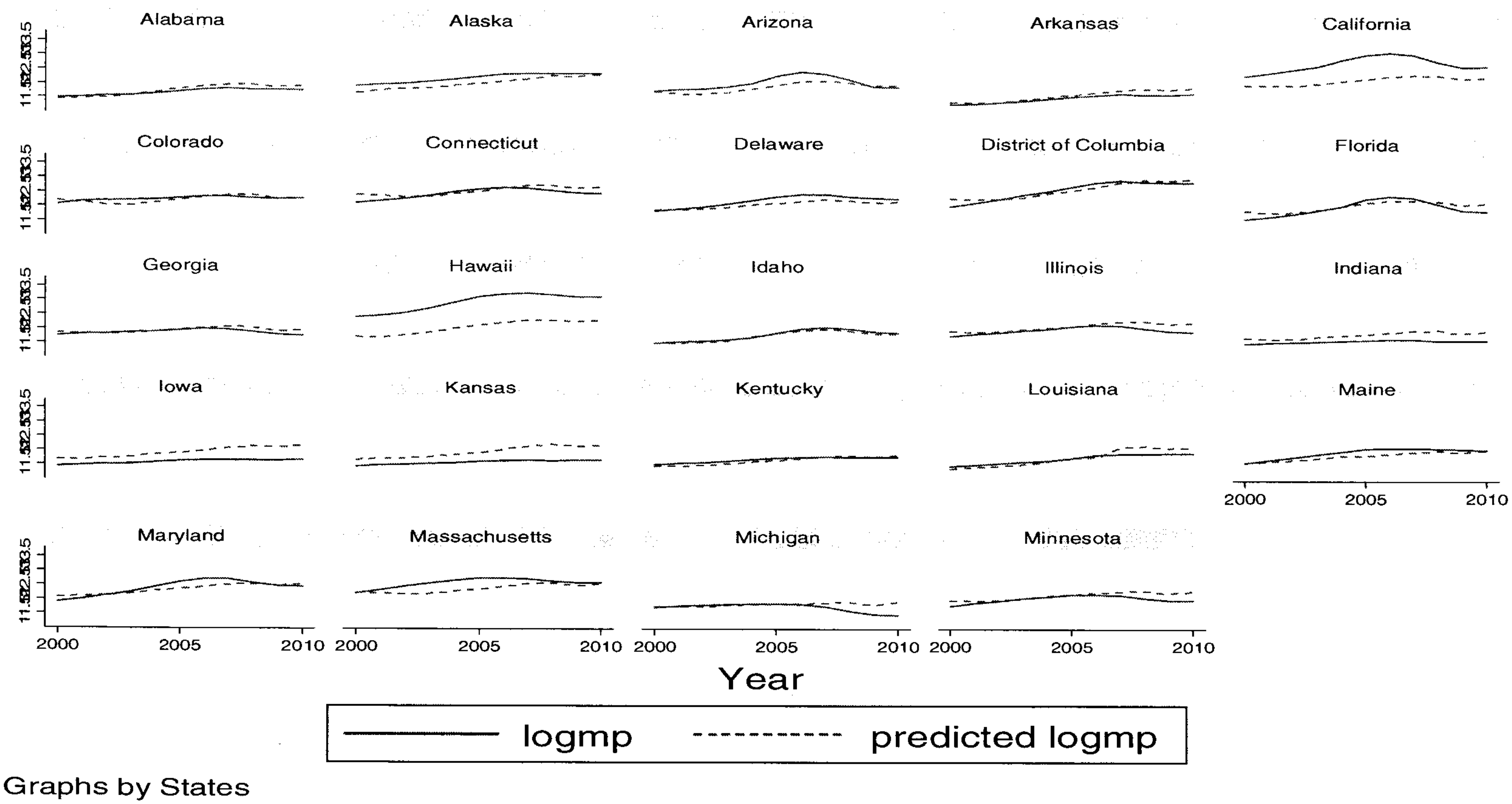
| Methods / Regressors | Pooled OLS (1) | Pooled OLS (2) | Pooled OLS (3) | Fixed Effects (4) | Fixed effects (5) | Fixed effects (6) |
|---|---|---|---|---|---|---|
| Lag1 | 0.0089*** | | 0.0154*** | 0.0005 | | 0.0048*** |
| Lag5 | | 0.0268*** | 0.0386*** | | 0.0007 | 0.0079*** |
| Constant | -0.0247*** | -0.2271*** | -0.3331*** | -0.0024 | 0.0018 | -0.0585*** |
| $R^2$ | 0.06 | 0.18 | 0.33 | 0.003 | 0.001 | 0.22 |
| Number of observations | 510 | 306 | 306 | 510 | 306 | 306 |

## 7. Conclusion

This paper examines the last 11 years of the US housing market. This period has very interesting characteristics in terms of booms and busts of the housing market. Pooled data on the 50 states and the District of Cumbria are used to test this phenomenon. The results show that 23 out of 51 states during the period had bubbles and that the bubbles peaked in 2006 and 2007. Prices then fell and some of the bubbles burst, such as Arizona and Maryland, while some of the bubbles partially burst, such as California and Hawaii. In particular, in the state of California, there is still a bubble in the housing market and the bubble does not seem to burst. On the other hand, there are states such as Indiana in which the prices were undervalued during the entire sample period. Overall, there is a sign of a recovery among some states such as California and West Virginia, but it is not strong. Housing prices have undergone quite a dramatic correction since 2006 and 2007. It seems that housing prices have reached their bottom, but the evidence is not strong to support that view. It will be interesting to observe how housing prices will develop over the coming years; they are likely to go back to an upward cycle again.

## Appendix. Predicted and Actual Prices for All States.

Figure A1. Predicted Versus Actual Prices in Log (*Pooled OLS*)



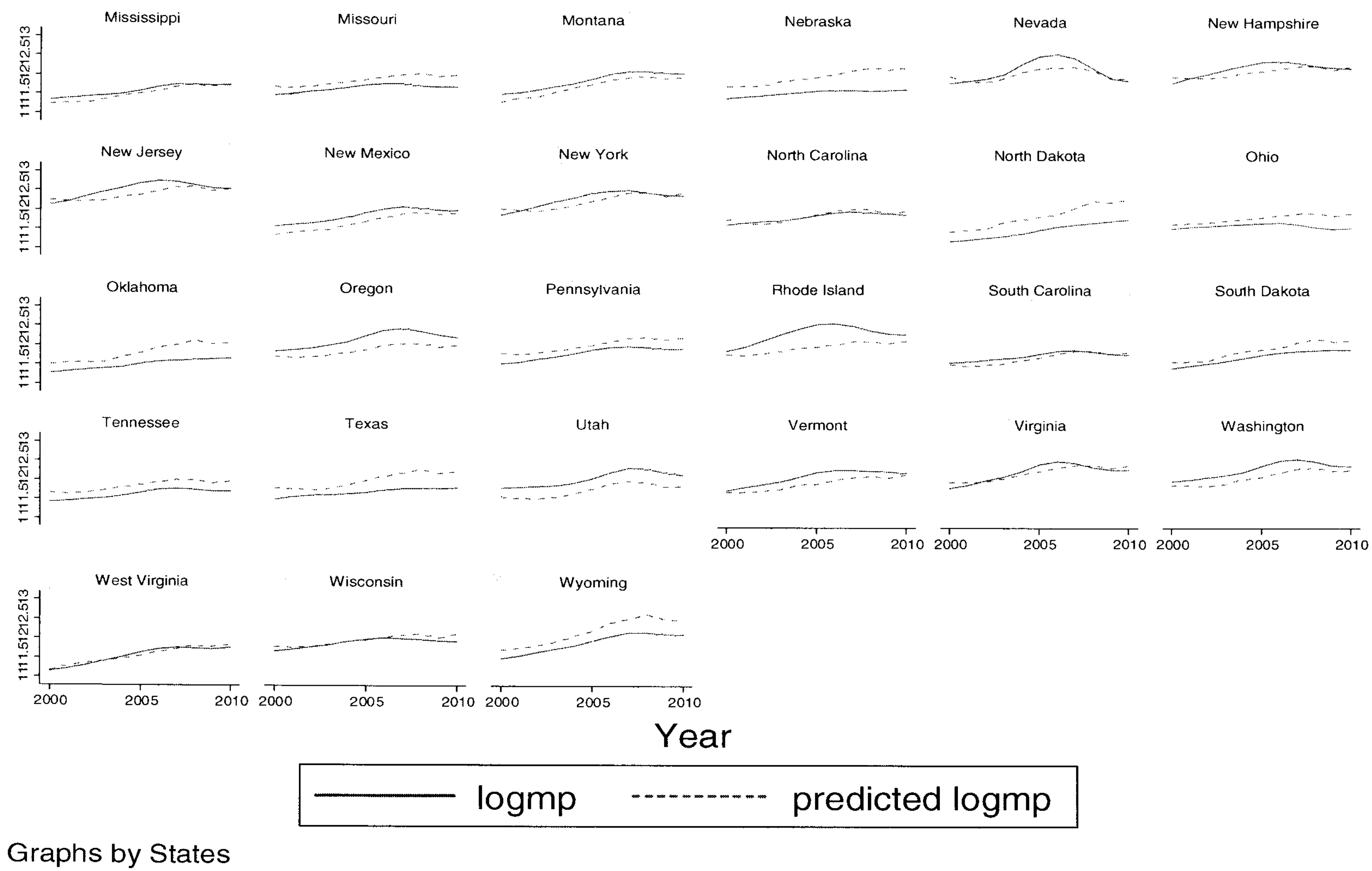
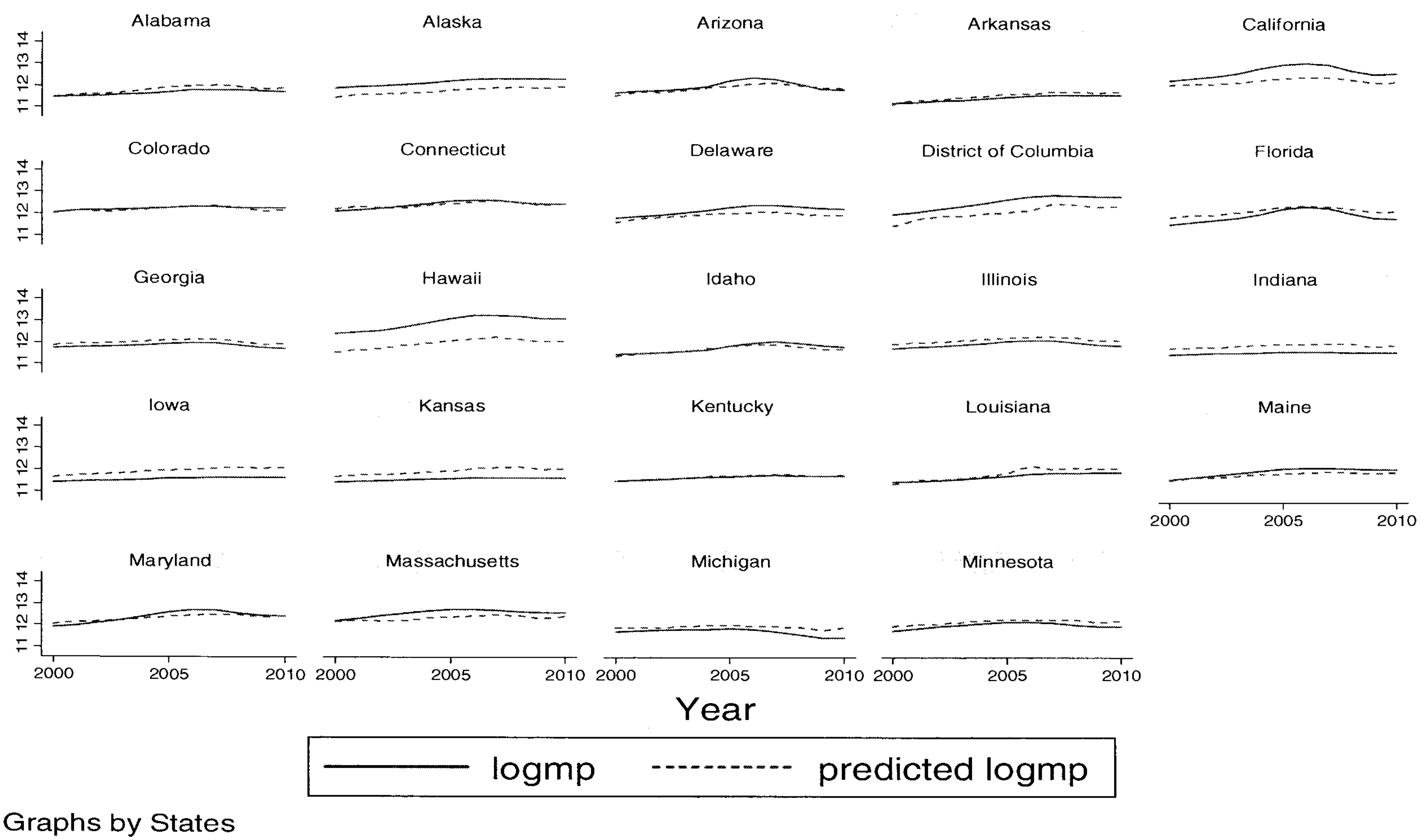

Mississippi
Missouri
Montana
Nebraska
Nevada
New Hampshire
New Jersey
New Mexico
New York
North Carolina
North Dakota
Ohio
Oklahoma
Oregon
Pennsylvania
Rhode Island
South Carolina
South Dakota
Tennessee
Texas
Utah
Vermont
Virginia
Washington
West Virginia
Wisconsin
Wyoming
11 11.5 12 12.5 13
2000 2005 2010
Year
logmp
predicted logmp
Graphs by States

Figure A2. Predicted Versus Actual Prices in Log (*Fixed effects*)



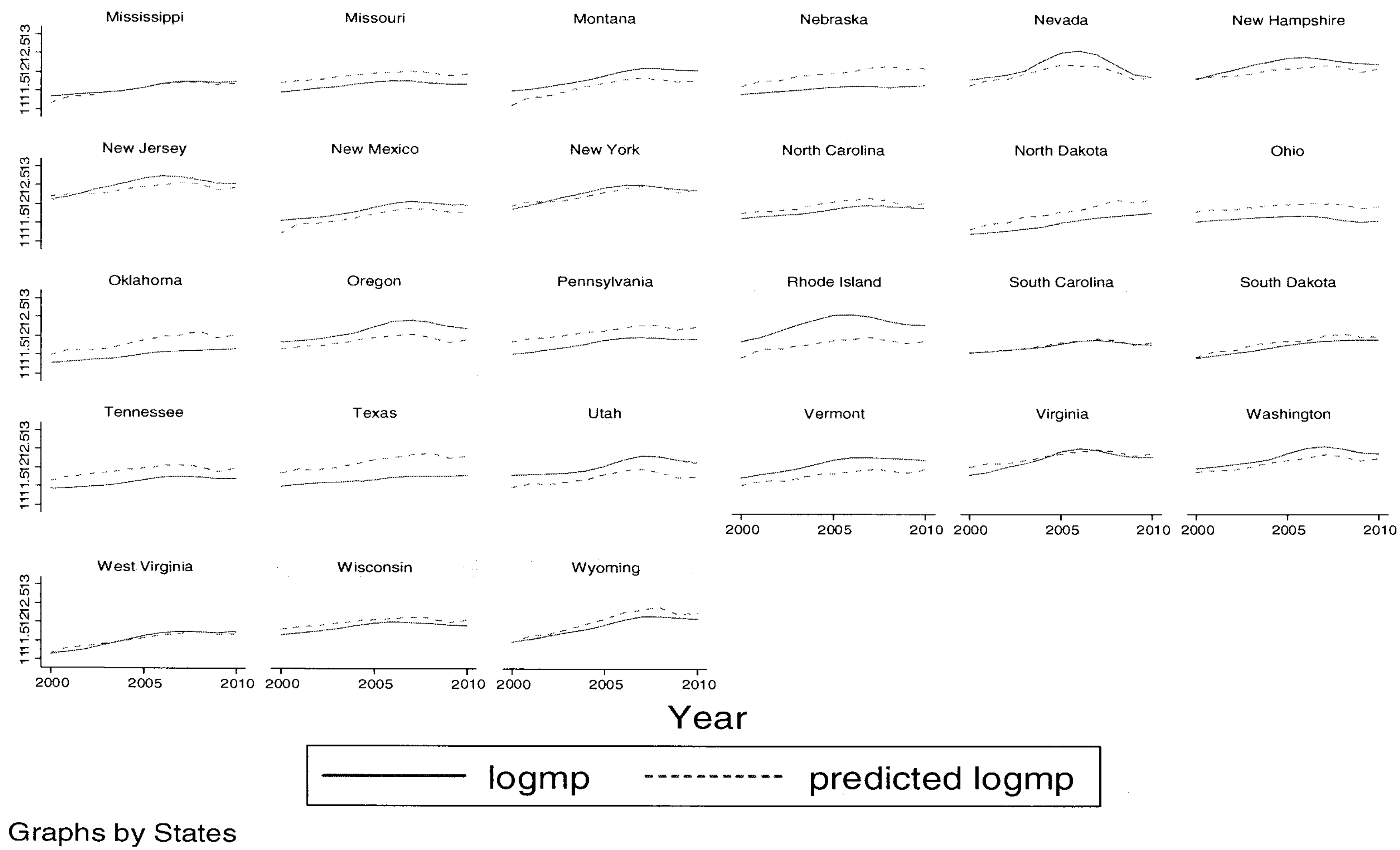
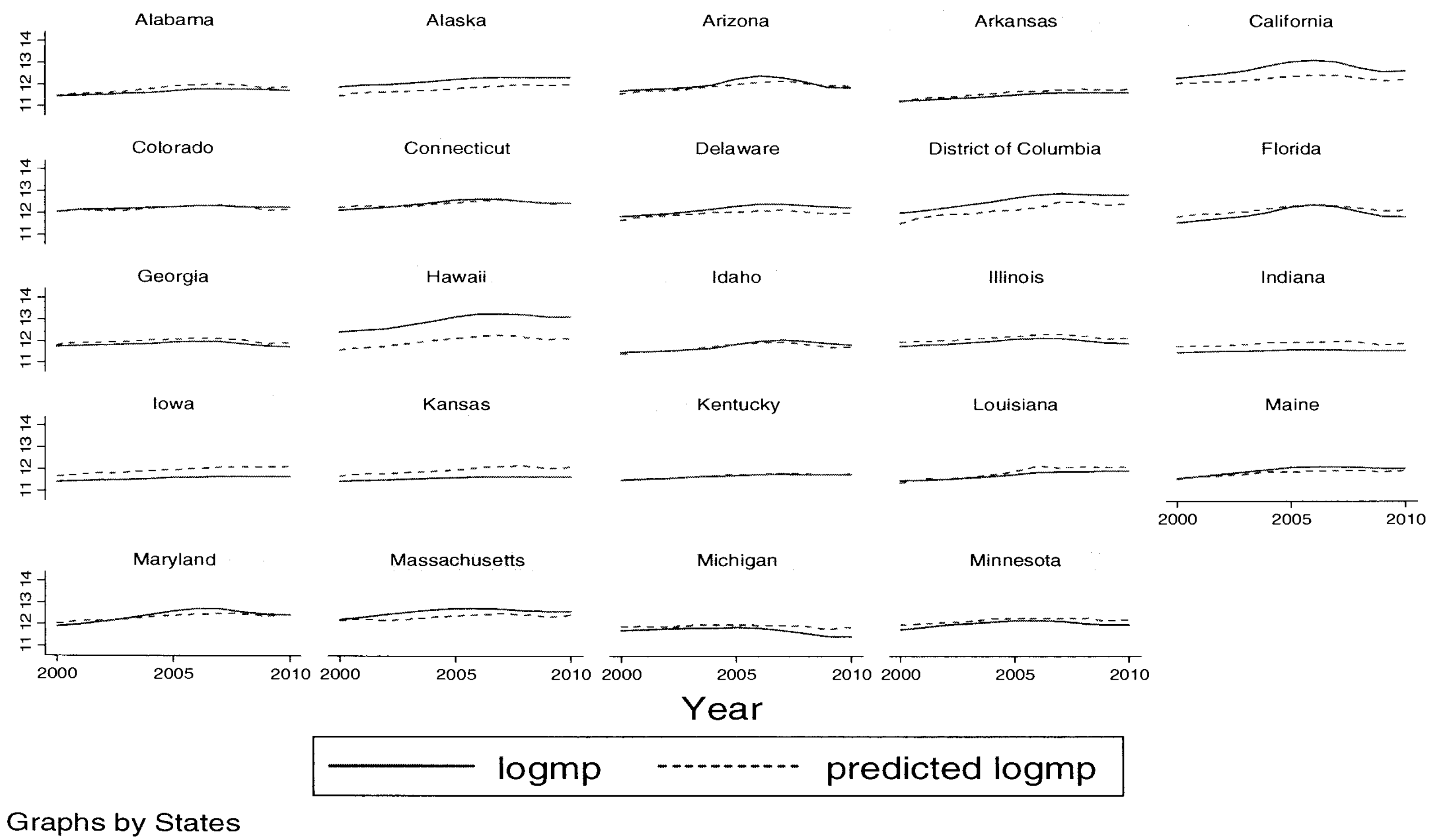
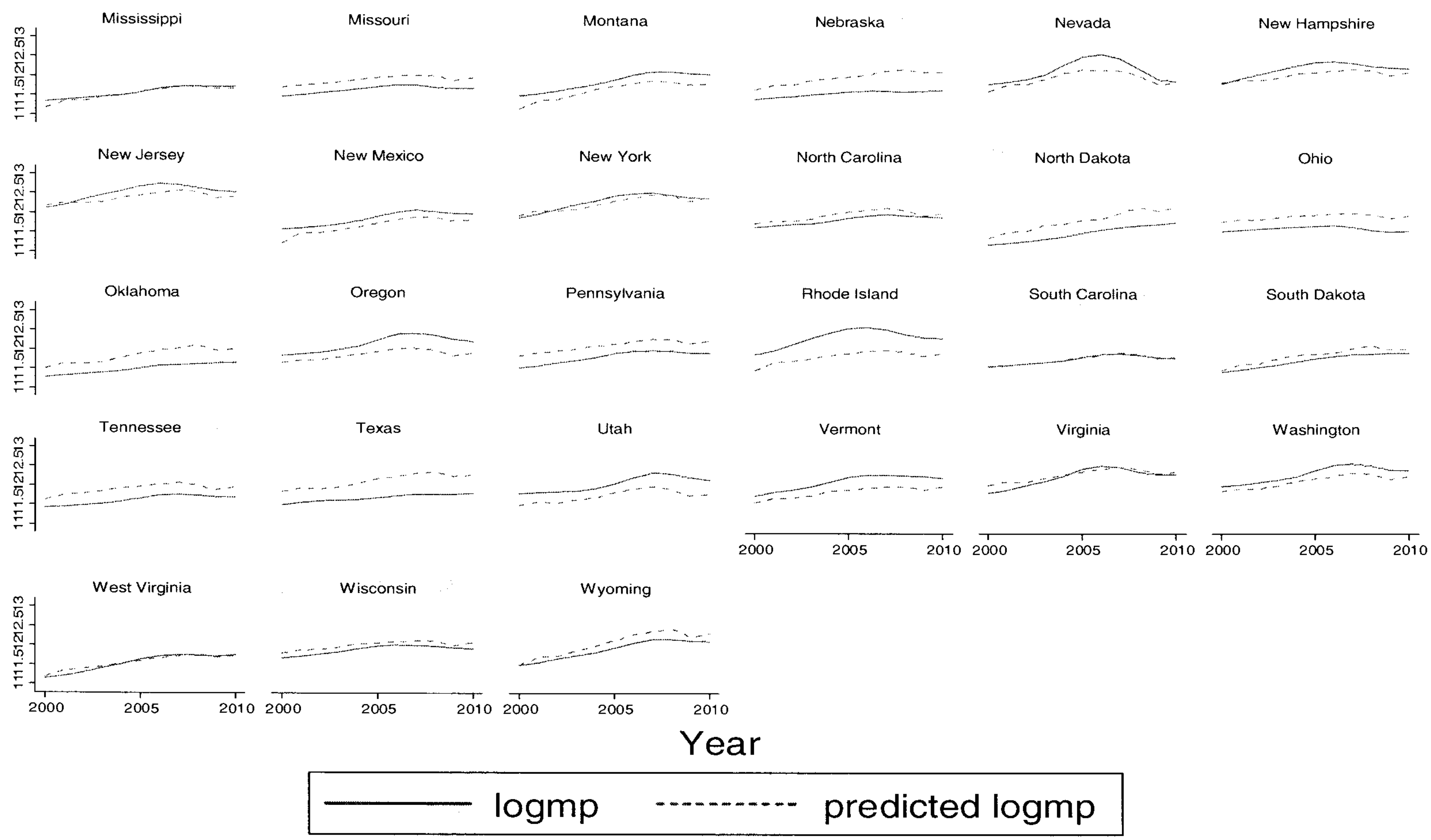

Mississippi
Missouri
Montana
Nebraska
Nevada
New Hampshire
New Jersey
New Mexico
New York
North Carolina
North Dakota
Ohio
Oklahoma
Oregon
Pennsylvania
Rhode Island
South Carolina
South Dakota
Tennessee
Texas
Utah
Vermont
Virginia
Washington
West Virginia
Wisconsin
Wyoming
11 11.5 12 12.5 13
2000 2005 2010
Year
logmp
predicted logmp
Graphs by States

Figure A3. Predicted Versus Actual Prices in Log (*Random effects*)






Graphs by States

## References

**Abraham, Jesse M., and Patrick H. Hendershott.** 1996. "Bubbles in Metropolitan Housing Markets." *Journal of Housing Research,* 7(2): 191-207.

**Angel, Shlomo, and Stephen K. Mayo.** 1996. "Enabling Policies and Their Effects on Housing Sector Performance: A Global Comparison." Paper presented to the Habitat II Conference, Istanbul, Turkey.

**Cameron, Gavin, John Muellbauer, and Anthony Murphy**. 2006. "Was there a British House Price Bubble? Evidence from a Regional Panel." *CEPR Discussion Paper*: No. 5619.

**Case, Karl E., and Robert J. Shiller.** 1989. "The Efficiency of the Market for Single-Family Homes." *American Economic Review,* 79(1):125-37.

**Case, Karl E., and Robert J. Shiller.** 2003. "Is There a Bubble in the Housing Market?" *Brookings Papers on Economic Activity*, 34(2): 299-362.

**Garber, Peter M.** 2000. *Famous First Bubbles.* London: The MIT Press.

**Garino, Gaia, and Lucio Sarno.** 2004. "Speculative Bubbles in UK. House Prices: Some New Evidence." *Southern Economic Journal,* 70(4): 777-795.

**Grebler, Leo, and Frank G. Mittelbach.** 1979. *The Inflation of House Prices, its Extent, Causes, and Consequences.* Lexington, Mass: Lexington Books.

**Guha, Krishna.** 2007. "Greenspan Alert on US House Prices." *FT.* http://www.ft.com/cms/s/0/31207860-647f-11dc-90ea0000779fd2ac.html#axzz1SfqOm6X5 (accessed June 19, 2011).

**Harris, Jack C.** 1989. "The Effect of Real Rates of Interest on Housing Prices." *Journal of Real Estate Finance and Economics,* 2(1): 47-60.

**Hui, Eddie, and Shen Yue.** 2006. "Housing Price Bubbles in Hong Kong, Beijing and Shanghai: A Comparative Study." *Journal of Real Estate Finance and Economics,* 33(4): 299-32.

**Hwang, Min, and John M. Quigley.** 2006. "Economic Fundamentals in Local Housing Markets: Evidence from U.S." *Journal of Regional Science,* 46(3):425-453.

**Kindleberger, Charles P.** 1978. *Manias, Panics, and Crashes: A History of Financial Crises.* New York: Wiley Investment Classics.

**Krugman, P.** 2005. "That Hissing Sound". *New York Times.* http://www.nytimes.com/2005/08/08/opinion/08krugman.html?pagewanted=print

(accessed July 19, 2011)

**Malpezzi, Stephen.** 1999. "A Simple Error Correction Model of House Prices." *Journal of Housing Economics.* 8(1): 27-62.

**Mayer, Christopher J., and Craig T. Somerville.** 1996. "Unifying Empirical and Theoretical Models of Housing Supply." *Working Papers 96-12, Federal Reserve Bank of Boston.*

**Mayer, Christopher J., and Todd Sinai.** 2007. "Housing and Behavioral Finance" *Paper presented at the Federal Reserve Bank of Boston Conference on Behavioral Economics.*

**Muellbauer, John, and Anthony Murphy.** 1997. "Booms and Busts in the UK Housing Market." *The Economic Journal,* 107(445):1701-1727.

**Quigley, John M.** 1999. "Real Estate Prices and Economic Cycles." *International Real Estate Review,* 2(1):1-20.

**Rosser, John B.** 2000. *From Catastrophe to Chaos: A General Theory of Economic Discontinuities.* Norwell, Massachusetts: Kluwer Academic Publishers.

**Shiller, Robert J.** 2004. "Are Housing Prices a House of Cards?" *Project-Syndicate.org.* http://www.project-syndicate.org/commentary/shiller17/English (accessed July 19, 2011).

**Shiller, Robert J.** 2005. *Irrational Exuberance.* New York: Princeton University Press.

***The News: International.*** 2007. "Two top US economists present scary scenarios for US economy" http://www.finfacts.com/irelandbusinessnews/publish/article_1011005.shtml (accessed June 19, 2011).

**Thornton, M.** 2009. The Economics of Housing Bubbles. In: **Holcombe, Randall G., and Benjamin Powell.** *Housing America: Building Out of a Crisis.* California: The Independent Institute.

**Wooldridge, Jeffrey.** 2002. *Introductory Econometrics: A Modern Approach.* Mason, OH: South-Western College Pub.

**DATA Sources:**

**Bureau of Economic Analysis Regional Economic Accounts.** 2000-2010. "State Quarterly Personal Income" http://www.bea.gov/regional/sqpi/ (accessed June 8, 2011).

**Federal Housing Finance Agency.** 2000-2010. "Quarterly Average and Median Prices for States and U.S.: 2000Q1-2010Q2" http://www.fhfa.gov/Default.aspx?Page=87 (accessed June 8, 2011).

**HSH.** 2000-2010. "Mortgage Rates in United States" http://www.hsh.com/mortgage-rates/ (accessed June 8, 2011).

**U.S. Bureau of Labour Statistics.** 2000-2010. "Local Area Unemployment Statistics" http://www.bls.gov/lau/ (accessed June 8, 2011).

**US Census Bureau.** 2000-2009. "National and State Population Estimates Components of Population Change" http://www.census.gov/popest/states/NST-comp-chg.html (accessed July 9, 2011).

**US Census Bureau.** 2000-2010. "Population Estimates" http://www.census.gov/popest/estimates.html (accessed June 8, 2011).

**US Census Bureau.** 2000-2010. "Housing Permits" http://www.census.gov/const/www/permitsi ndex.html (accessed June 8, 2011).