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The asymmetric house price dynamics: Evidence from the California market

Yuming Li *

Department of Finance, California State University, Fullerton, CA 92834, USA

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ABSTRACT

This article studies asymmetric patterns in the serial correlation and mean reversion in house prices between periods of falling and rising prices in 26 metro areas in the state of California from 1979:Q1 to 2011:Q4. We document lower serial correlation (downward price rigidity) and greater mean reversion of house prices in periods of falling house prices. The asymmetric sensitivities of the serial correlation of house prices to income changes and population growth help explain the downward price rigidity. We document significant differences in the asymmetric patterns of house prices between the coastal and inland/valley regions of California and pervasive evidence on reduced serial correlation of house prices after the financial crisis.

1. Introduction

It has been well documented in the recent real estate and housing economics literature that the U.S. housing market, like other asset markets, exhibits both serial correlation and mean reversion. In particular, Case and Shiller (1989) find that the market for single-family homes does not appear efficient as changes in house prices tend to be serially correlated. Other researchers (e.g., Abraham and Hendershott, 1996; Malpezzi, 1999; Capozza et al., 2004; Gao et al., 2009) report that large swings of house prices are usually followed by reversals to the fundamental values. Costelloa et al. (2011) provide evidence of periods of sustained deviations of house prices from values warranted by income for all Australian state capitals with the greatest deviations arising in the New South Wales market and starting around 2000. Two of the most intriguing findings are that the house price dynamics vary across location and exhibit asymmetric patterns across time periods. For example, Capozza et al. (2004) document that the serial correlation of house price changes is higher in metro areas with higher real income and population growth but mean reversion is greater in large metro areas and faster growing cities. Gao et al. (2009) find that the serial correlation is much higher during periods of house price appreciation than during periods of declining house prices. As a result, housing markets tend to keep a fast pace during periods of growth but tend to "resist" price drops during declining periods, exhibiting evidence of downward rigidity.

In real estate markets, infrequent transactions and heterogeneous products are often considered as causes of high information costs and resulting informational inefficiencies and slow house price adjustments to new information (e.g., Case and Shiller, 1989; Clapp and Tirtiroglu, 1995; Capozza et al., 2004). In periods of declining house prices, transaction volume tends to be lower than normal (e.g., Akkoyun et al., 2013). This is because buyers, sellers, and lenders often behave differently across housing market cycles. For instance in weak periods of housing market buyers are sometimes reluctant to buy for fear of further price declines, sellers are often reluctant to sell their homes at a loss, and lenders tend to be reluctant to approve short sales for homes with negative equity and tighten lending standards for new home loans. As a result, during these periods changes in economic variables like income and population, which generate increased transaction volumes, should have greater impacts on information costs and the speed of house price adjustments. Therefore, we hypothesize that the sensitivities of the serial correlation and mean reversion to economic variables like population and income changes are likely to be asymmetric during different periods of housing market cycles, which may cause the asymmetric serial correlation of house prices between periods of rising and falling house prices.

To test our hypothesis, we first introduce a model of house price dynamics that can accommodate the asymmetric patterns in the serial correlation and mean reversion in house prices. In order to explain the

* Tel.: +1 657 278 3955; fax: +1 657 278 2216.
E-mail address: yli@fullerton.edu.

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asymmetric patterns in house prices, we propose an extended model of house prices in which the serial correlation and mean reversion can vary with lagged information about changes in the local economic variables and the relations are asymmetric between periods of falling and rising prices. We also propose an alternative model to accommodate the interaction of the serial correlation and mean reversion. We study the effects of the recent financial crisis on the serial correlation and mean reversion of house prices.

Similar to a recent study of house prices in the Southern California market (Gupta and Miller, 2012), our empirical analysis is specialized to the Freddie Mac house price indices from all of the 26 Metropolitan Statistical Areas (MSAs) in the state of California from 1979:Q1 to 2011:Q4.[1] The metro areas encompass one subsample of 12 coastal metro areas stretching from the Bay area in Northern California to San Diego in Southern California and the other subsample including 14 inland/valley metro areas located across the valley region in Northern California and the inland empire or desert region in Southern California. This sample including two subsamples is of particular interest since previous studies show that house prices tend to exhibit wilder swings and be more sensitive to local economic shocks in the coastal areas of the U.S. than inland areas like the Midwest and South regions. Our preliminary analysis reveals that the coastal areas of California are characterized by higher house prices and household income but the inland/valley region displays greater income growth and population growth. This indicates that the widespread practice in the real estate literature of treating all metro areas within a single state as homogeneous may be inappropriate. Our case study of a specialized sample of California metro areas should be more informative of the relationship between house price dynamics and location-specific economic fundamentals than that of previous studies that employ metro area data from various U.S. states.

Our empirical findings are summarized as follows. First, consistent with the existing literature on the house price dynamics based on metro area data from coast to coast, house prices exhibit significant serial correlation and mean reversion in our full sample of 26 metro areas in California and two subsamples of metro areas for the coastal and inland/valley regions. Second, we not only find evidence on the reduced serial correlation of house price changes in periods of falling house prices, which is also consistent with the existing literature on the downward price rigidity, but we also document greater mean reversion of house prices during these periods. Third, we find evidence of asymmetric sensitivities of the serial correlation and mean reversion to income changes and more importantly population growth. Fourth, we find that the coastal areas contribute to statistically significant downward price rigidity, but the inland/valley region contributes to greater mean reversion in the periods of falling house prices. The asymmetric sensitivities of the serial correlation to income changes and population growth explain the downward price rigidity in the coastal region. The asymmetric mean reversion disappears after controlling for the interaction between the serial correlation and mean reversion. Finally, we find evidence of the reduced serial correlation of house prices in each region after the recent financial crisis. The effect of the financial crisis is pervasive after controlling for asymmetric sensitivities of the serial correlation and mean reversion to local economic variables.

The contributions of the paper are straightforward. First, we introduce models of house prices with asymmetric patterns of serial correlation and mean reversion and more importantly asymmetric sensitivities of the serial correlation and mean reversion to economic fundamentals between periods of falling and rising prices. Second, we provide empirical evidence that the asymmetric sensitivities explain the asymmetric serial correlation in house prices found in the data for California's metro areas. Third, we document significant differences in the asymmetric patterns of house prices between the coastal and inland/valley regions of California and significant differences in the serial correlation between periods before and after the recent financial crisis.

In the next section, we introduce the asymmetric house price models. The third section describes the panel data set that we use for our estimates and the summary statistics. The fourth section discusses the empirical results. The final section concludes with comments.

[1] For other studies on the house prices across contiguous geographic regions, see the analysis of Tirtiroglu (1992) and Clapp et al. (1994) for the Hartford MSA.

2. A model of asymmetric house price dynamics

The observed house prices in each metro area can move persistently in the short run. However, if house prices exhibit mean reversion, there must be a fundamental house value for each metro area at any point of time. At equilibrium, house prices are equal to their fundamental or equilibrium values but the observed house prices tend to deviate from and adjust toward their fundamental values. The fundamental values are assumed to be functions of a set of exogenous economic variables. Let X_{it} denote a (column) vector of metro-level local economic variables and let Y_t denote a nationwide economic variable. Also let I_i^c denote a coast dummy (indicator) variable that takes the value of unity if the metro area i lies in the coastal region and zero otherwise. We use the coast dummy variable to capture the location-specific differences in house prices that are not explained by our choice of economic variables to be described below and to allow for the sensitivities of house prices to economic variables to vary between the coastal and inland regions. Following the literature (e.g., Capozza and Helsley (1989); Abraham and Hendershott (1996); Capozza et al. (2004); Gao et al. (2009)), we assume that the log house price, P_{it}, and log value, P_{it}^*, for metro area i at time t are given by the following pricing model:

$$P_{it} = P_{it}^* + e_{it} = \left(a + a^c I_i^c\right) + \left(b_X + b_X^c I_i^c\right) X_{it} + b_Y Y_t + e_{it}, \tag{1}$$

where a, a^c and b_Y are constant scalars, while b_X and b_X^c are (row) vectors of constant parameters. More specifically, a is the intercept for the inland/valley region and each element of b_X is the elasticity of house prices to a metro-level economic variable in the inland region. The parameter a^c is the incremental intercept for the coastal areas. The vector b_X^c measures the incremental elasticity of local economic variables on the house prices for metro areas in the coastal region. In the rest of the article, we include income and population as local economic variables, $X = (INC, POP)'$, and the real mortgage payment as a measure of the borrowing cost, Y, as a nationwide variable. We expect each element of b_X and $b_X + b_X^c$ to be positive and the coefficient b_Y to be negative since higher income or population should stimulate demand for houses while higher borrowing cost should dampen demand.

It is documented that the short-run serial correlation and long-run mean reversion can both induce predictable changes in house prices. First consider the following baseline error-correction model which accommodates both the serial correlation and mean-reversion terms:

$$\Delta P_{i,t+1} = \alpha + \beta \Delta P_{it} + \gamma\left(P_{it} - P_{it}^*\right) + \varepsilon_{i,t+1}. \tag{2}$$

On the left hand side of Eq. (2), $\Delta P_{i,t+1}$ represents the one-period-ahead change in the log real house price in metro area i and period $t+1$. On the right hand side of Eq. (2), ΔP_{it} is the (lagged) price change in period t, $P_{it} - P_{it}^*$ the (lagged) difference of the house price from the fundamental value, which measures the extent of overvaluation or undervaluation of the housing market, α, β and γ are constant scalars, and finally the error term, $\varepsilon_{i,t+1}$, represents the unexpected change in the house price in period $t+1$. If price changes exhibit a positive serial correlation, we expect the serial correlation coefficient to be positive, $\beta > 0$. Similarly, if house prices have the tendency to revert to the long term trends, we expect the mean reversion coefficient to be negative, $\gamma < 0$.

It is well known to both researchers and practitioners that housing markets often differ in many aspects during periods of declining prices from periods of price appreciations. First, in weak markets sellers are