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Do house prices reflect fundamentals? Aggregate and panel data evidence

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ABSTRACT

We investigate whether recently high and consequently rapidly decreasing U.S. house prices have been justified by fundamental factors such as personal income, population, house rent, stock market wealth, building costs, and mortgage rate. We first conduct the standard unit root and cointegration tests with aggregate data. Nationwide analysis potentially suffers from problems of the low power of stationarity tests and the ignorance of dependence among regional house markets. Therefore, we also employ *panel data* stationarity tests which are robust to cross-sectional dependence. Contrary to previous panel studies of the U.S. housing market, we consider several, not just one, fundamental factors. Our results confirm that panel data unit root tests have greater power as compared with univariate tests. However, the overall conclusions are the same for both methodologies. The house price does not align with the fundamentals in sub-samples prior to 1996 and from 1997 to 2006. It appears that the real estate prices take long swings from their fundamental value and it can take decades before they revert to it. The most recent correction (a collapsed bubble) occurred around 2006.

1. Introduction

Prior to 2006, the possibility of a house price bubble in the U.S. housing market was an active topic of discussion in both the popular press and academic journals. This issue was of interest because a bursting bubble in a housing market could lead to a decrease in the value of household wealth. According to the 2004 Survey of Consumer Finances, primary and other residential property constituted almost 39% of the total assets in the portfolios of U.S. families (see Bucks et al., 2006). Therefore, a drop in house prices could result in a severe negative impact on consumption and GDP. Recent developments in the housing markets have confirmed that these worries had been justified.

Theoretical background for the use of various determinants of house prices can be found in Gallin (2006), Timmermann (1995), and Poterba (1984). We build on these studies, derive the housing price as a function of the underlying economic factors in both the present value and structural housing models, and explicitly illustrate the link between them. A house price bubble is then defined as a situation when a growth of the price is not supported by changes in its fundamentals (Stiglitz, 1990). There were two categories of papers which considered breaks in the relationship between house price and fundamentals. Papers in the first category argued about this issue using aggregate data. For example, McCarthy and Peach (2004) suggested that there was no bubble in the U.S. housing market and that changes in house prices reflected movements in personal income and nominal mortgage rates. Another example of this approach is Shiller (2005) or Gallin (2006) who used aggregate data on home prices, personal income, building costs, population, user costs of housing and interest rates. They showed that changes in fundamentals did not explain the rapid growth of U.S. house prices after 2000.

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The present paper confirms the discrepancy between house prices and their determinants using similar data prior to 2006 and standard univariate unit root and cointegration tests. Adding two years of data with collapsing housing prices implies reversion to the fundamental factors. Our findings correspond to occurrence of three housing price peaks in 1979, 1989, and 2006, which have been aligned with fundamental factors' behavior only after the third price correction. Construction costs and income appear to be the driving forces of the real estate prices. Below we check whether panel data stationarity tests, which have greater power, are in line with these results.

The second stream of this literature relied on regional or micro data in order to get more insights into the behavior of the housing market. For example, Himmelberg et al. (2005) used their own calculations of owning costs of housing for 46 Metropolitan Statistical Areas (MSA) to argue that the high price-to-income and price-to-rent ratios observed in recent years were explained by shifts in real long-term interest rates and therefore there was no bubble in the U.S. housing market. Smith and Smith (2006) suggested that house prices were below their fundamental value derived from house rents where prices and rents were taken from a sample of matched single-family homes. Case and Shiller (2003) were more in favor of the existence of a speculative bubble in some regional U.S. housing markets based on the results of a survey of consumers' attitudes toward housing.

Finally, Gallin (2006) and Mikhed and Zemčík (2007) employed panel data for the U.S. MSA to analyze house prices. The former study used income and the latter rent as the only fundamental factor. Both studies employed panel data stationarity tests to find that house price dynamics could not be explained by either of the two variables. The omission of other potential demand and supply shifters on the housing market could be a reason for the lack of the relationship between the price and fundamentals at the regional level. We construct a panel with other fundamental variables to investigate this possibility. Our dataset contains series for house prices, rents, construction costs, income, population, stock index and mortgage rates. Real variables are calculated using a regional Consumer Price Index (CPI).

Individual time series in our panel are likely to be mutually correlated because close regional house markets tend to be synchronized to some extent. We confirm that cross-sectional dependence is present in our data using a test from Pesaran (2004). Then we test for unit roots in all of the involved series. Im et al. (2003) develop a panel unit root test based on an average of t-statistics for autoregressive coefficients in individual Dickey–Fuller regressions. We use an updated version of this test constructed in Pesaran (2007), which is robust to cross-sectional dependence. If house price dynamics reflects fundamentals, non-stationary house prices should be cointegrated with other variables. We implement the Pedroni (1999, 2004) statistic to test for panel data cointegration. We account for regional interdependence by bootstrapping critical values.

Using the panel data, we find that the house price series contains a unit root only prior to 2006. This finding is in contrast with the aggregate data unit root tests since these cannot reject the unit root in any sub-sample. It provides additional evidence that panel data unit root tests have greater power as compared with univariate methodology. Our results also show that house price is not cointegrated with any variables of the same order of integration. We observe the same pattern if we split the sample to the periods before and after 1996. The first subsample includes price peaks in 1979, and 1989 and the second sub-sample the recent rally (and fall) of the real estate prices. Therefore, there is a discrepancy between house prices and fundamentals before 2006 and the overall outcome of our panel data tests is consistent with findings using the aggregate data. The natural conclusion of our paper is that house prices swing away from fundamentals for extended periods of time. The most recent such period ended in 2006.

2. Structural model of the housing market

The present-value model may be a simple way to connect house prices to rents. Basically, this model implies that under rational expectations the price of an asset is equal to the discounted stream of expected future dividends. According to Gallin (2006), if one ignores taxes, maintenance costs, and risk premium associated with housing, the house price may be written as follows:

$$P_t = R_t + E_t\left[\frac{P_{t+1}(1-\delta)}{1+i_{t+1}}\right] \tag{1}$$

where P_t is the price of housing at time t, E_t is the expectation operator conditional on information available at date t, R_t is housing rent at time t, δ is a constant rate of depreciation, and i_{t+1} is time-variant rate of discounting.

Substituting the corresponding expressions for P_{t+1}, P_{t+2}, and so on into Eq. (1) and using the law of iterated expectations, it is possible to derive the following result:

$$P_t = E_t\left[R_t + \frac{R_{t+1}(1-\delta)}{1+i_{t+1}} + \frac{R_{t+2}(1-\delta)^2}{(1+i_{t+1})(1+i_{t+2})} + \dots + \frac{R_{t+k}(1-\delta)^k}{\prod_{j=1}^{k}(1+i_{t+j})} + \frac{P_{t+k+1}(1-\delta)^{k+1}}{\prod_{j=1}^{k+1}(1+i_{t+j})}\right] \tag{2}$$

Imposing a boundary condition

$$\lim_{k\to\infty}\frac{P_{t+k}(1-\delta)^k}{\prod_{j=1}^{k}(1+i_{t+j})} = 0 \tag{3}$$

we derive

$$P_t = E_t\left[R_t + \sum_{k=1}^{\infty}\frac{R_{t+k}(1-\delta)^k}{\prod_{j=1}^{k}(1+i_{t+j})}\right] \tag{4}$$

In the way similar to Timmermann (1995), this last equation may be transformed into

$$P_t = R_t(1+i_t)\left[\frac{1}{1+i_t} + E_t\sum_{k=1}^{\infty}\beta_t\prod_{j=1}^{k}\rho_{t+j}\beta_{t+j}\right] \tag{5}$$

where $\rho_{t+j} = (1-\delta)R_{t+k}/R_{t+k-1}$ and $\beta_{t+k} = 1/(1+i_{t+k})$. If we denote $\left[\frac{1}{1+i_t} + E_t\sum_{k=1}^{\infty}\beta_t\prod_{j=1}^{k}\rho_{t+j}\beta_{t+j}\right]$ as a_t then