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Speculative bubbles or market fundamentals? An investigation of US regional housing markets☆

Shuping Shi[a,b,⁎]

[a] Department of Economics, Macquarie University, Australia
[b] Centre for Applied Macroeconomic Analysis, Australia

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A B S T R A C T

This paper investigates the existence of speculative bubbles in the US national and 21 regional housing markets over three decades (1978–2015). A new method for real-time monitoring exuberance in housing markets is proposed. By taking changes in the macroeconomic conditions (such as interest rate, per-capita income, employment, and population growth) into consideration, the new method provides better control for housing market fundamentals and thereby it is expected to significantly reduce the chance of false positive identification. Compared with the method of Phillips et al. (2015a, 2015b), the new approach finds a dramatic reduction in the number of speculative housing markets and shorter bubble episodes in the US. It locates only one bubble episode in the early-to-mid 2000s over the whole sample period in the national housing market. At the regional level, it identifies two periods of speculation: late 1980s and early-to-mid 2000s. The early-to-mid 2000s bubble episode lasts longer and involves 16 metropolitan statistical areas.

"*Although the house price bubble appears obvious in retrospect–all bubbles appear obvious in retrospect–in its earlier stages, economists differed considerably about whether the increase in house prices was sustainable; or, if it was a bubble, whether the bubble was national or confined to a few local markets.*" Bernanke (2010)

1. Introduction

Following the 2008 subprime mortgage crisis there has been widespread recognition of the harm that speculative housing bubbles can inflict on the aggregate economies. The bursting of housing bubbles or a severe decline in house prices could lead to an extensive reduction in household consumption (Case et al., 2005; Skinner, 1996; Case, 1992) and may result in more foreclosures and unanticipated losses for lenders (see Case et al. (2000) among others), exacerbating the development of a negative economic shock and leading to a greater general economic decline.[1]

In the aftermath of the crisis, policy-makers have been urged to *deepen their understanding about how to combat speculative bubbles*.[2] One major challenge to policy-making is identifying the presence of speculative behaviour in housing markets as quoted above. Measures commonly used to gauge deviations from fundamentals are the affordability ratios, including price-to-rent ratio and price-to-income ratio. These measures also form the basis for several popular bubble detection techniques. These include the recursive window bubble tests of Phillips et al. (2011, 2015a, 2015b), the CUSUM test of Homm and Breitung (2012), and the Markov-switching bubble tests (Hall et al., 1999; Shi, 2013; Shi and Song, 2016).

Those techniques, especially the recursive window bubble test, have been applied to a wide range of markets (including energy, real estate, commodities, and financial assets)[3] and have attracted attention from policy-makers and fiscal regulators. For example, the Federal Reserve Bank of Dallas is now publishing a quarterly *exuberance indicator*, calculated from the bubble test of Phillips et al. (2015a, 2015b, PSY hereafter), for 23 international housing markets.[4] The PSY procedure has been shown superior to the bubble detection methods of Phillips

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⁎ Correspondence address: Department of Economics, Macquarie University, Australia.
E-mail address: shuping.shi@mq.edu.au.

[1] See McCarthy and Peach (2004) for a detailed review.

[2] By the former Federal Reserve Board vice chairman Donald Kohn (March 24, 2010).

[3] See Phillips and Yu, 2011; Das et al., 2011; Homm and Breitung, 2012; Phillips and Yu, 2013; Narayan et al., 2013; Etienne et al., 2014; Pavlidis et al., 2015; Greenaway-McGrevy and Phillips, 2016; Narayan et al., 2016, and Deng et al., forthcoming, among others.

[4] http://www.dallasfed.org/institute/houseprice/.

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et al. (2011) and Homm and Breitung (2012). In particular, the strategy can consistently estimate the origination and termination dates of bubbles even when there are multiple bubble episodes within the sample period (Phillips et al., 2015b). It also has the advantage of being computational efficient relative to the Markov switching methods.

The common ground for these approaches is the following two equations. Let p_t be the log real price of housing and r_t be the log real housing rent. The price-to-rent ratio consists of a market fundamental (F_t) and a bubble component (B_t) such that

$$p_t - r_t = F_t + B_t.$$

The bubble component B_t satisfies the submartingale property (Diba and Grossman, 1988)

$$E_t(B_{t+1}) = \frac{1}{\rho} B_t \text{ with } \frac{1}{\rho} > 1. \tag{1}$$

In the presence of speculative bubbles, the price-to-rent ratio defined as the sum of the market fundamental and the bubble components follows an explosive process. The key task of these techniques is to detect the existence of explosive dynamics in asset prices or the price-to-rent ratio. It is a convention in the empirical literature that bubble detection techniques are applied separately to the log real housing price index and the log real rent index, or to the price-to-rent ratio.[5,6] The rent index serves as a proxy for the housing market fundamental.

Despite the econometric competency of these approaches, an inference of bubble existences based simply on affordability measures can be misleading. This is because the important impact of the aggregate economy on housing markets, such as changes in interest rates influencing home ownership affordability and economic and population growth reflecting the demand for housing is ignored.

This paper proposes a new real-time bubble detection method for the housing market, with an emphasis on distinguishing between a rapid rise in home prices induced by changes in fundamentals and a housing price bubble. Unlike existing bubble detection techniques, the new method explores information beyond housing markets and takes the impact of the aggregate economy conditions into consideration. As in Campbell et al. (2009), we assume that macroeconomic factors affect housing market fundamentals through rent and interest rates. Thereby, variables reflecting the aggregate economic conditions such as interest rates, per capita GDP, population and employment growth rates are included in a VAR model to forecast future streams of rent and interest rates. These two streams are subsequently used to obtain estimates of the fundamental. The recursive bubble detection method of PSY is then applied to the non-fundamental component to identify the start and end dates of bubble episodes. This is in sharp contrast to the existing bubble detection techniques where the methods are applied directly to the price-to-rent ratio. In other words, with the existing methods, the only proxy used for capturing housing market fundamentals is the historical and current rent.

There are papers in the literature that attempt to control for the impact of real interest rates on housing markets fundamentals. Kivedal (2013) incorporates interest rate dynamics into the calculation of imputed rents and uses imputed rates for the analysis of bubble existence. The imputed rates are, however, calculated in an ad hoc way using a formula of $R_t/(1 + i_t)$, where R_t is the actual rental price and i_t is the 10-year government bond rate. Caspi (2016) suggests that, like the rent index, one should also conduct explosiveness tests on the real interest rate. Inference of bubble existence is affirmative if there is an explosive dynamic in the log price-to-rent ratio but not in either the log real rent or log real interest rate. Unfortunately, this extension is immaterial as in reality we do not observe explosive rates of interest, not withstanding that interest rates become explosive simultaneously with the price-to-rent ratio. It is more often the case that a prolonged period of low interest rates stimulates housing demand and hence leads to a rapid increase in housing prices. Therefore, the real interest rate is not appropriate as a direct proxy for housing fundamentals.

The new approach is a novel development with wide-ranging policy implications. We apply the new method to the US national and to 21 metropolitan statistical areas (MSA) from 1978 to 2015. As quoted above, the question of whether the bubble was national or confined to a few local markets is of critical importance to policy-making. By controlling for the impact of macroeconomic factors on housing markets, the new method leads to distinct conclusions of bubble existence from the standard PSY method. With the new method, we observe significant reductions in the numbers of MSAs experiencing speculative housing bubbles and shorter speculative episodes. In particular, the number of speculative MSA housing markets reduces from 20 to 12 in the first half of 2005. At the national level, the duration of the identified bubble episode reduces from nine to 1.5 years.

The rest of the paper is organized as follows. Section 2 introduces the market (non-)fundamental decomposition method and the PSY procedure for bubble detection. Section 3 describes the data used in this paper. In Section 4, we conduct model comparison and lag order selection using an out-of-sample forecasting criteria, presents the estimated non-fundamental components and the bubble detection results for the 21 metropolitan statistical areas and the nation. Section 5 concludes.

2. Econometric methods

Consider the one-period gross return to housing

$$V_{t+1} = \frac{P_{t+1} + R_{t+1}}{P_t}$$

where P is the real price of housing and R is the real housing rent. The first order Taylor series expansion gives the following expression of the log housing price

$$p_t = \kappa + \rho p_{t+1} + (1 - \rho) r_{t+1} - v_{t+1}. \tag{2}$$

where $v_{t+1} = \log V_{t+1}$, $p_{t+1} = \log P_{t+1}$, $r_{t+1} = \log R_{t+1}$, $\rho = e^{\overline{p}}/(e^{\overline{p}} + e^{\overline{r}})$, and $\kappa = -\log(\rho) + (1 - \rho)(\overline{p} - \overline{r})$ with $\overline{p}$ and $\overline{r}$ being the sample means of p_t and r_t.

Iterating (2) forward, we can obtain

$$p_t = \frac{\kappa}{1 - \rho} + (1 - \rho) \sum_{j=0}^{\infty} \rho^j r_{t+1+j} - \sum_{j=0}^{\infty} \rho^j v_{t+1+j} + B_t \tag{3}$$

$$B_t \equiv \lim_{j\to\infty} \rho^j p_{t+j} = \frac{1}{\rho} B_{t-1}, \tag{4}$$

The bubble component B_t satisfies Eq. (1). It follows immediately from (3) that

$$p_t - r_t = F_t + B_t \text{ with } F_t \equiv \frac{\kappa}{1 - \rho} + \sum_{k=0}^{\infty} \rho^k (\Delta r_{t+1+k} - v_{t+1+k}). \tag{5}$$

It is commonly assumed in the literature[7] that the log gross return to housing is the sum of the real risk-free rate (i_{t+1}) and a time-varying risk premium (φ_{t+1}). We further assume that $\varphi_{t+1} = \varphi + \varepsilon_{t+1}$, where φ is the expected (long-term) risk premium and ε_{t+1} is a zero mean disturbance. The log gross return becomes $v_{t+1} = \varphi + i_{t+1} + \varepsilon_{t+1}$ and future log gross return to housing $\{\hat{v}_{t+j}\}_{j=1}^{\infty}$ can be estimated as

$$\hat{v}_{t+j} = \hat{\varphi} + \hat{\imath}_{t+j},$$

[5] The price-to-rent ratio is often replaced by the price-to-income ratio when the rent index is not available.

[6] See, for example, Caspi (2016); Pavlidis et al. (2015); Kishor and Morley (2015), and Greenaway-McGrevy and Phillips (2016).

[7] See Campbell et al. (2009) and Sun and Tsang (2013), for example.