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What factors drive the price–rent ratio for the housing market? A modified present-value analysis

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ABSTRACT

We consider which factors determined the price–rent ratio for the housing market in 18 U. S. metropolitan statistical areas (MSAs) and at the national level over the period of 1975–2014. Based on a present-value framework, our proposed empirical model separates the price–rent ratio for a given market into unobserved components related to the expected real rent growth and the expected housing return, but is modified from standard present-value analysis by also including a residual component that captures non-stationary deviations of the price–rent ratio from its present-value level. Estimates for the modified present-value model suggest that the present-value residual (PVR) component is always important and sometimes very large at the national and MSA levels, especially for MSAs that have experienced frequent booms and busts in the housing market. In further analysis, we find that house prices in MSAs that have larger PVR components are more sensitive to mortgage rate changes. These are also the MSAs with less elastic housing supply. Also, comparing our results with a recent statistical test for periodically-collapsing bubbles, we find that MSAs with large estimated PVR components are the same MSAs that test positively for explosive sub-periods in their price–rent ratios, especially during the 2005–2007 subsample. Our approach allows us to estimate the correlation between shocks to expected rent growth, the expected housing return, and the PVR component. We find that the expected housing return and movements in the PVR component are highly positively correlated implying an impact of the expected housing return on house prices that is amplified from what a standard present-value model would imply. Our results also show that most of the variation in the present-value component of the price–rent ratio arises due to the variation in the expected housing return.

1. Introduction

The financial crisis of 2008–2009 had its roots in the boom and the bust of the U.S. housing market. The collapse of house prices led to the overall decline in financial and macroeconomic stability, starting with a big decline in the stock market.[1] The sustained increase in house prices prior to 2007 attracted widespread attention from the empirical researchers. A big portion of the housing market literature has focused on the price–rent ratio as a metric to measure the extent of

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[1] It has been estimated that the net worth of the U.S. households declined by $13 trillion dollars between 2007 and 2009 (flow of funds data).

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overvaluation in the housing market. Most of these empirical studies have used some version of the present-value model of house prices to examine the sources of variation in the price–rent ratio and have found a mixture of results depending on which market is considered.[2]

The present-value model of house prices is based on Campbell and Shiller's (1988) model for asset prices, which has been applied extensively in the finance and exchange rate literature. The housing market version of this model implies that the current price–rent ratio reflects households' expectations about future rent growth and future housing returns. In particular, the price–rent ratio according to the conventional present-value model has the following representation:

$$p_t - r_t = \frac{\kappa}{1-\rho} + \sum_{j=1}^{\infty} \rho^{j-1} E_t(\Delta r_{t+j} - h_{t+j}) \tag{1}$$

where $p_t - r_t$ is the log of the price–rent ratio, Δr_t is the rent growth, h_t is the housing return, ρ is the discount factor and κ is a constant. The above model suggests that the log of the price–rent ratio can be expressed as the expected discounted sum of future rent growth minus future housing returns. If expected rent growth and the expected housing return are both stationary, then the price–rent ratio should also be stationary. Intuitively, this implies that if there is any deviation from the long-run equilibrium value, the price–rent ratio should self-correct. An upward surprise in the price–rent ratio today must correspond to news that future housing returns will be higher or to a downward revision in expected rent growth. The conventional analysis of the housing market takes this approach and assumes that the price–rent ratio is stationary.

The evidence, however, clearly suggests that the price–rent ratio is non-stationary. Table 1 shows results for unit root tests of the log of price–rent ratio for 18 U.S. metropolitan areas (MSAs) and the nation.[3] The results overwhelmingly support the presence of a unit root in the price–rent ratio, even when allowing for a structural break in the mean. This finding is not driven by the presence of a unit root in either rent growth or the housing return, as these fundamental variables are stationary. One explanation of the non-stationarity of the price–rent ratio is that there are some other factors that drive the variation in price–rent ratio and these factors are non-stationary. This is consistent with the nature of U.S. housing markets. Unlike stock markets, the functioning of the housing markets in the U.S. is characterized by illiquidity, high transaction costs, differential tax regimes, and zoning laws. To take into account these features of the housing market, we propose a modified present-value model that decomposes the price–rent ratio into the present-value of expected house price growth, the present-value of expected rent growth, and a present-value residual (PVR) component that captures non-stationary factors.

We take an unobserved component approach to estimate a modified present-value model for the U.S. and each of the 18 MSAs. Our framework explicitly takes into account the fact that the price–rent ratio may move due to changes in expected return to housing, expected rent growth variation, and a PVR component that cannot be accounted for by a conventional model.[4] We treat expected rent growth, expected housing return, and the PVR component as unobserved (to the econometrician) variables that follow exogenously specified time series processes. In particular, we assume a parsimonious AR(1) specification for both expected rent growth and expected housing return and a random walk specification for the PVR component. Because these latent variables are estimated using the Kalman filter, by construction we use information from the whole history of past realized rent growth, realized housing return, and the price–rent ratio when making inferences. We express realized variables as the sum of an expected component and an error term that is unforecastable.

Only a few other studies have used a present-value model to examine the determinants of the price–rent ratio for housing. Notably, Campbell et al. (2009) employ a reduced-form VAR approach to explain the movements in the price–rent ratio. They measure expectations by fixed coefficient VAR model. The VAR is used to directly compute expected future housing returns and then use an accounting identity to identify expected future rents as a residual given data on rent-price ratios. Recently, Fairchild et al. (2015) use a dynamic factor model in the present-value framework and estimate the relative share of national and local share in variation of the price–rent ratio. They also use data from the U.S. and 17 MSAs. They find that a large fraction of the variation is based on local factors. In their analysis, they allow for a pricing error in the present-value relationship, but their model also assumes that this pricing error is stationary in nature. In other related work, Ambrose et al. (2013) use 355 years of data for Amsterdam and find that deviations of house prices from their fundamentals are long-lasting and persistent.

Our approach has several advantages over more conventional analysis. First, we are not aware of any study that takes into account the non-stationarity of the price–rent ratio and modifies the present-value model accordingly. This also allows

[2] Using a present-value model, Case and Shiller (2003) argue that the U.S. housing market in 2004 was over-valued because the price–rent ratio was significantly above its historical average. However, Himmelberg et al. (2005) find no evidence of a bubble in 2004 in any of the regional markets. Using data from Northern California, Meese and Wallace (1994) reject both constant and time-varying discount rate versions of the housing price present-value relation in the short run. Long-run results are consistent with the housing price present-value relation when they adjust the discount factor for changes in both tax rates and borrowing costs for their 1970–1988 sample period.

[3] The 18 MSAs in our study are Atlanta, Boston, Chicago, Cleveland, Dallas, Denver, Houston, Los Angeles, Miami, Milwaukee, Minneapolis, New York, Philadelphia, Pittsburgh, Portland, San Francisco, Seattle and St. Louis. Our MSA sample is based on data availability for rent from the BLS for our sample period (1975–2014).

[4] Present-value models have also been studied extensively in finance and exchange rate literature to study the behavior of equity market and exchange rates. For example, Balke and Wohar (2002) apply a state-space/present-value model of stock prices to estimate what drives low-frequency movements in the price-dividend ratio. Binsbergen and Koijen (2010) follow a similar approach to estimate the expected stock returns, and apply it to predict stock returns. For application of present-value models to exchange rates, see Engel and West (2004, 2005) among others.