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# What moves housing markets: A variance decomposition of the rent–price ratio ☆

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ABSTRACT

We apply the dynamic Gordon growth model to the housing market in 23 US metropolitan areas, the four Census regions, and the nation from 1975 to 2007. The model allows the rent–price ratio at each date to be split into the expected present discounted values of rent growth, real interest rates, and a housing premium over real rates. We show that housing premia are variable and forecastable and account for a significant fraction of rent–price ratio volatility at the national and local levels, and that covariances among the three components damp fluctuations in rent–price ratios. Thus, explanations of house-price dynamics that focus only on interest rate movements and ignore these covariances can be misleading. These results are similar to those found for stocks and bonds.



## 1. Introduction

The boom and bust to house prices and housing returns over the past 12 years is likely unprecedented in the United States. According to data from the Bureau of Economic Analysis and MacroMarkets LLC, real house prices in the United States increased by about 6-1/2% per year over the 1997–2006 period. To put this growth in context, over the decade spanning 1987–1996, the same data sources suggest that real house prices in the United States did not increase at all; and, the available evidence suggests that real house prices in the United States increased by less than 2% per year in real terms over the 1950–1996 period (Davis and Heathcote, 2007; Shiller, 2005).

From year-end 2006 through the first quarter of 2009, real house prices have fallen by 34%, and many expect house prices to continue to fall over the next few quarters. Extraordinary events in the financial sector and the macroeconomy as a whole have accompanied this decline of house prices. The fall in house prices triggered a wave of mortgage defaults and home foreclosures, perhaps because some borrowers did not fully understand the terms of their mortgage contract (Bucks and Pence, 2008) or perhaps because a significant portion of homeowners chose to strategically default once their mortgage was sufficiently under water (Haughwout et al., 2008; Foote et al., 2008). The increase in default rates on mortgages lead to a collapse in the price of mortgage-backed securities, which likely contributed to a run on the "shadow" banking system (Gorton, 2009) and sharp devaluation of stock prices. According to data from the *Flow of Funds Accounts of the United States*, the decline in house prices and stock prices reduced household net worth by 20% in nominal terms ($13 trillion) from mid-2007 through year-end 2008. The loss of wealth was associated with a sharp decline in consumer spending via standard "wealth-effect" arguments (Davis and Palumbo, 2001) leading to the contraction of real GDP and the current recession.

With this background in mind, the goal of this paper is to examine time-series fluctuations in house prices and the returns to housing using tools that have proved successful in characterizing the nature of returns in the stock and bond markets. Specifically, we start with the definition of the one-period return to housing. It can be shown that this definition implies that the ratio of housing rents to house prices, the "rent–price ratio," must be equal to the present discounted value of expected future housing service flows and the expected future returns to housing assets. The expected future returns to housing assets can further be split into the sum of expected future risk-free rates of interest and expected

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future premia paid to housing over the real risk-free rate. This model is known in the finance literature as the dynamic version of the Gordon growth model (Campbell and Shiller, 1988a,b). The approach is equivalent to assuming that house prices are the discounted sum of housing rents, where the growth rate of housing rents and required return to housing can vary over time. It is precisely this variation over time in expected required returns and expected growth rate of housing rents that yields changes in relative house prices, enabling us to study the factors responsible for time-series changes to housing valuations.

To put the dynamic Gordon growth model to practice, at each point in time we need to measure expectations of the expected present value of risk-free interest rates, housing premia, and rent growth. Our strategy, which is common in the finance literature, is to specify that households form expectations using a VAR with fixed coefficients. We use the VAR to directly compute expected future real risk-free rates and expected housing risk premia and then, given the accounting identity that we document, identify expected future rents as a residual given data on rent–price ratios. This approach accounts for all of the observed variation in rent–price ratios; it also facilitates comparisons of our results to results from other asset markets (Bernanke and Kuttner, 2005; Campbell, 1991; Campbell and Ammer, 1993; Shiller and Beltratti, 1992; Vuolteenaho, 2002). With time-series estimates of the expected real risk-free rate of interest, the expected risk premium to housing, and the expected growth rate of rents in hand, we use variance decompositions to detail how each of these three components contributed to the volatility of rent–price ratios over the 1975–2007 period.

We do not analyze data on the experience of individual housing units. Rather, we perform our analysis on averages for owner-occupied housing in each of 28 housing markets – 23 metropolitan, 4 regional, 1 national – at the semi-annual frequency from 1975 to 2007. As such, our unit of analysis can be thought of as "portfolios" of individual houses. As we show, rent–price ratios were roughly stable in most markets from 1975 to 1996, but declined precipitously after 1997 in almost all of the markets we examine. Shiller (2005) argues that the behavior of house prices since 1997 has no precedent in the twentieth century. With this in mind, we conduct separate variance decompositions of the 1975–1996, or "pre-boom," period, and the 1997–2007, or "boom," period to ensure that our conclusions are not driven exclusively by recent experience.

We have two main findings that are largely robust to time period. First, we find that changes in expected future housing premia are an important source of volatility in rent–price ratios. For example, at the national level, variation in housing premia is the dominant source of variation in rent–price ratios during the 1975–1996 period and an important source of variation during the 1997–2007 period. More generally, we find that time-varying premia are an important feature of housing markets at the national, regional, and metropolitan levels. Second, we find that the covariances between the three components dampen total volatility of rent–price ratios. In particular, we find that expected future premia and rent growth tend to be positively correlated and expected future real risk-free rates and premia tend to be negatively correlated. The latter implies that, historically speaking, house prices have not fully capitalized changes to expected future real risk-free rates.

While many features of housing markets seem to be fundamentally different than those of stock and bond markets – for example, search frictions may play an important role in the liquidity of any given house (Wheaton, 1990) – we find important similarities between returns to housing markets and returns to financial assets that have not been previously recognized. To start, housing returns and returns to financial assets exhibit substantial variation in premia over real rates. In terms of volatility, housing premia contribute to housing valuations in much the same way as stock and bond premia contribute to stock and bond valuations. Further, our finding that expected future rent growth and premia tend to be positively correlated is also consistent with Vuolteenaho's (2002) finding that expected future dividends and premia tend to be positively correlated at the firm-level.

To put our paper in context, we are the first to use the dynamic Gordon growth model to study valuations of owner-occupied real estate across a large number of geographic markets, and the first to document the similarities of valuations in housing markets and those of stock and bond markets. Previous authors (Himmelberg et al., 2005) have used the static version of the Gordon growth model to study rent–price ratios in housing markets. Recently, the dynamic version of the Gordon growth model has been applied to study valuations in commercial real estate (Plazzi et al., 2006) and to examine the linkages of money illusion and house-price inflation in national rent–price ratios (Brunnermeier and Julliard, 2008).

Our results and analysis have some important implications for current analysis and policy. For example, many housing-market analysts have argued that the run-up of house prices from 2002 to 2006 was the result of an unexpectedly low Federal Funds rate (Taylor, 2007) or (related) a sharp decline in mortgage rates in the early 2000s (Himmelberg et al., 2005). Additionally, some have proposed reducing the rate of interest on a 30-year fixed rate mortgage for the purposes of stabilizing the level of house prices (Hubbard and Mayer, 2008). Our finding that the expected net present value of the risk premium for housing and the risk-free rate of interest are negatively correlated implies that the link between the level of house prices and real interest rates is more complex than these interpretations of history suggest. Indeed, our results provide evidence that changes in risk-free interest rates may not have done much to change housing valuations over the 1975–2007 period.

Recently, the Federal Open Market Committee (FOMC) announced in a press release dated March 18, 2009 that it will purchase up to $1.25 trillion in mortgage backed securities in 2009 to "Provide greater support to mortgage lending and housing markets".[1] While this policy will likely improve the availability of credit to home buyers, our results suggest that the effect of this policy on the level of house prices is less clear.

The rest of this paper proceeds as follows. Section 2 describes our implementation of the dynamic Gordon growth model and Section 3 discusses the data. In Section 4, we outline the VAR model and report estimation results. Section 5 details the results of all of our variance decompositions. In Section 6 we conclude and discuss directions for future research.

## 2. The Campbell–Shiller decomposition

Consider the one-period gross real return to housing

$$\frac{P_{t+1}+R_{t+1}}{P_t}, \tag{1}$$

where $P$ is the real price of housing and $R$ is housing rents. We can use the method of Campbell and Shiller (1988a,b) to rewrite this gross return using a log-linear approximation that sets the log of the rent–price ratio at date $t$, $\log(R_t/P_t) \equiv r_t - p_t$, equal to the expected net present value of all future (date $t+1+j$ for $j = 0, \ldots, \infty$) real rates of return to housing and real growth in housing rents,

[1] See the press release dated March 18, 2009 at the Federal Reserve Board web site, available at http://www.federalreserve.gov/newsevents/press/monetary/20090318a.htm.