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Imperfect information and the house price in a general-equilibrium model

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ABSTRACT

House prices have inertia, which may be because housing-market participants need time to recognize long booms and recessions. Within a dynamic stochastic general-equilibrium model with an endogenous market for housing, I consider the case of rational expectations subject to imperfect information about the persistence of exogenous shocks. I evaluate the performance of the model against the last 40 years of key U.S. macroeconomic data. Bayesian comparison strongly favors the model over the baseline case with perfect information. Under imperfect information, agents rely on learning to form expectations, which improves the ability of the model to generate realistic low-frequency house-price dynamics. However, as long as the agents form expectations rationally, the improvement is limited. Furthermore, to confine price inertia within the housing market is a challenge for the general-equilibrium approach.

1. Introduction

Long upturns and downturns are a particularly puzzling feature of the U.S. housing market. As Fig. 1 shows, the house price index declined steadily for five years upon the onset of the financial crisis of 2007–2009.[2] For comparison, the S&P500 Index shows that the corresponding downward price adjustment in the market for capital lasted only six quarters. The fact that the house price evolves slowly is well-known in the literature. Case and Shiller (1989) have noted that house prices possess momentum, or high auto-correlation in their growth. A number of more recent studies confirm for the U.S. and other countries that house prices exhibit long duration of upturns and downturns, and generally estimate each of them between 4.5 and 6.5 years on average (Agnello and Schuknecht, 2011; Bracke, 2013; Ceron and Suarez, 2006; Cunningham and Kolet, 2011). However, a general-equilibrium model typically predicts that market prices should immediately reflect all the news about the current and future state of the economy. It has been a challenge to create a dynamic stochastic general-equilibrium model that can explain the observed house-price momentum.

A potential explanation of this dynamic property of the housing market is that its participants lack information about the persistence of business-cycle fluctuations. In case of the Great Recession, economic agents observed the deteriorating economy, but did not expect the downturn to be so long. They were initially over-optimistic. Eventually, they understood

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[2] House prices briefly increased around the end of 2008 after the Federal Reserve announced its large-scale MBS purchase program. Fuster and Willen (2010) study the effects of the program.

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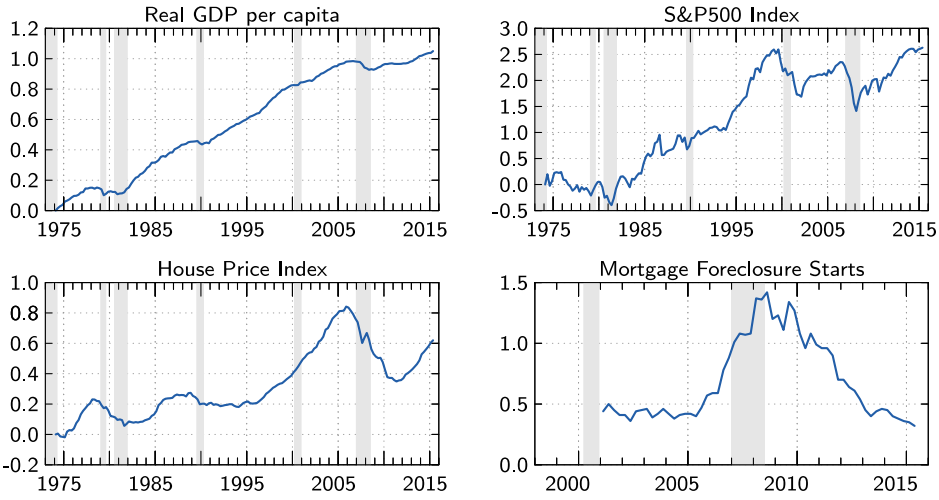

Fig. 1. U.S. economy and housing market, 1975–2015. All the series are adjusted by inflation and seasonally, and cast in logs with base 2. Foreclosure starts are yearly percentage rates. Shades indicate NBER-dated recessions. *Source*: BEA, BLS, S&P Dow Jones Indices, FHFA, MBA, FRED, NBER.

the length of the economic downturn as it continued. Such gradual learning about a persistent recession could potentially account for the slow adjustment of the house price, as well as other housing-market variables. For example, as long as economic agents kept updating their beliefs towards a longer recession, they saw unexpected house-price declines, which in turn stimulated mortgage foreclosures.[3] Fig. 1 shows that during the recent crisis, the rate of mortgage-foreclosure starts was hovering for over three years above the one-percent mark, more than double its average value for 2002–2006.

The goal of this paper is to study imperfect information and learning about the persistence of exogenous shocks to economy as an explanation for the house-price momentum. I take four steps towards this goal. First, I build a dynamic stochastic general-equilibrium model with an endogenous market for housing that is driven by exogenous shock processes with transitory and persistent components. Second, I consider the case of imperfect information when economic agents are rational but unable to observe the individual shock components. The agents would observe a shock process and apply the Kalman filter to learn about its components. Third, I evaluate the ability of the models with perfect and imperfect information about shocks to explain the last 40 years of key U.S. data on housing and the aggregate economy. To that end, Bayesian methods help compare the two models. Numerical simulations reveal posterior odds that are strongly in favor of the model with imperfect information and learning, as well as a significantly better ability of the latter to simulate low-frequency dynamics of the house price. Finally, for the model with imperfect information, I demonstrate the mechanism that adds momentum to the house price and expose its limitations.

A couple arguments help motivate the assumption of imperfect information. First, in models with rational expectations and complete information, market prices immediately react to exogenous shocks. Without additional assumptions, gradual house-price adjustments in such models would have to come from sequences of small shocks, which are incompatible with the assumption that the shocks are serially independent. Second, there is literature that supports the assumption of imperfect information. For example, Edge et al. (2007) find that the projections for long-run productivity growth by economists and professional forecasters adjust gradually to incoming data, in a manner that resembles a constant-gain Kalman filter. Another example is an empirical study by Foote et al. (2012) who argue that at the beginning of the 2007–2009 financial crisis, mortgage-market participants did not know the state of economy; they acted rationally subject to beliefs that were ex-post over-optimistic.

One benefit of the chosen DSGE approach is its straightforward application to data for the purposes of estimation, forecasting, and model comparison. Another benefit is the possibility to study linkages between the housing market and the rest of the economy. For example, an important question is how imperfect information and learning can account for the different dynamics of the house price and the equity price. The DSGE approach allows to expose the puzzling difference between the cyclical features of the two prices that is observed in the data and that is difficult to explain theoretically. To construct the model, I draw from several key sources. Iacoviello and Neri (2010) study the impact of the housing market on the aggregate economy. They introduce a rich technology structure that accounts for long-run growth and a portion of short-run fluctuations in the house price and other variables. I use a similar structure but expand it to incorporate persistent and transitory shock components. To implement imperfect information, I follow Gilchrist and Saito (2006), who augment the financial-frictions model of Bernanke et al. (1999) to study the implications of imperfect information for monetary policy.

The events that surrounded the crisis of 2007–2009 have made it difficult to talk about the housing market without mentioning the financial side of it. The growing literature on housing has established that financial frictions amplify the

[3] Gerardi et al. (2008) find that unexpected house-price changes drive mortgage foreclosures.