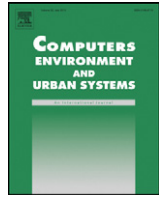




ELSEVIER

Contents lists available at ScienceDirect

## Computers, Environment and Urban Systems

journal homepage: [www.elsevier.com/locate/ceus](http://www.elsevier.com/locate/ceus)

# Endogenous rise and collapse of housing price<sup>☆</sup> An agent-based model of the housing market



Jiaqi Ge

The James Hutton Institute, Craigiebuckler, Aberdeen, UK

## ARTICLE INFO

## Article history:

Received 27 May 2015

Received in revised form 10 November 2016

Accepted 12 November 2016

Available online xxx

## Keywords:

Agent-based model

Housing market

Housing bubble

Lenient lending

Speculation

## ABSTRACT

On the basis of interviews with local real estate agents, this study develops an agent-based model of housing market to determine the cause of rise and collapse of US housing price during the years immediately preceding the US financial crisis (2007–2009). We study the key factors affecting housing price volatility, such as lenient financing and speculation. The dynamic simulation findings in the study show in concrete terms how lenient lending practices combined with speculation can lead to increased volatility in housing price, including sharp rises immediately followed by collapses. The exploratory work in this study will contribute to the understanding of the causes of housing bubbles and inform policy decisions.

© 2016 Elsevier Ltd. All rights reserved.

## 1. Introduction

The US housing bubble started in about 2000. Average housing price almost doubled in just a few years before it immediately collapsed at the end of 2006. The housing market crash triggered the global financial and economic crises, and eventually led to the disappearance of approximately US \$11 trillion in household wealth. Similarly, when Japan's housing bubble crashed in the early 1990s, it caused tremendous loss and an economic slowdown that lasted for many years. Housing bubbles have taken place all over the world, in both developed countries, such as Australia, France, Spain, Ireland, and the United Kingdom (Fig. 1), and emerging economies, such as South Korea, Russia, China, and India, causing economic turmoil every time. Kindleberger (1987) defined a bubble as:

“A bubble is a sharp rise in asset price in a continuous process, with the initial rise generating expectations of further rises and attracting new buyers – generally speculators interested in profit from trading in the asset rather than its use or earning capacity. The rise is then followed by a reversal of expectations and a sharp

decline in price, often resulting in severe financial crisis in short, the bubble bursts.”

The definition captures the two distinguishing characteristics of a bubble: (1) it features a continuous steep rise of asset price followed by a sudden steep fall in asset price and (2) it involves speculation behavior that causes a disconnection between change in asset price during a bubble and change in fundamentals. The recent US housing bubble fits both characteristics.

The housing market differs from other commodity markets in many ways. First, it is highly leveraged: most houses are purchased with borrowed money. Property purchased with mortgage loans are then used as the collateral for the loan, which creates a close link between the housing and the financial market. Second, properties provide both services and investment values. A typical housing market is made up of both investor and non-investor buyers. Third, the housing market is a “thin market,” meaning the number of transactions in a given period can be low, and buyers and sellers often have to wait on the market to secure a deal. Moreover, they often engage in negotiations and other strategic interactions (Merlo & Ortalo-Magn, 2004). As a result, the initial listed price is rarely the final price. Finally, the housing market is made up of multiple submarkets or neighborhoods, and price across neighborhoods can vary enormously within the same metropolitan area (Goodman, 1978; Palm, 1978). Neighborhoods also interact with each other through relocation of residents (Rosenthal, 2008), shared public services (Glaeser, Kahn, & Rappaport, 2008) and environment (Ellen, Schill, Susin, & Schwartz, 2002). These characteristics have made

<sup>☆</sup> I would like to give special thanks to Prof. Leigh Tesfatsion at Iowa State University for her advice and support throughout the writing of the paper. I would like to thank Prof. Steve Kautz at Iowa State University for his generous help. I would like to thank Prof. Catherine Kling, Prof. Joseph Herrige and Prof. John Schroeter at Iowa State University for their comments and suggestions. Finally, I would like to thank two anonymous reviewers for their helpful and constructive feedback.

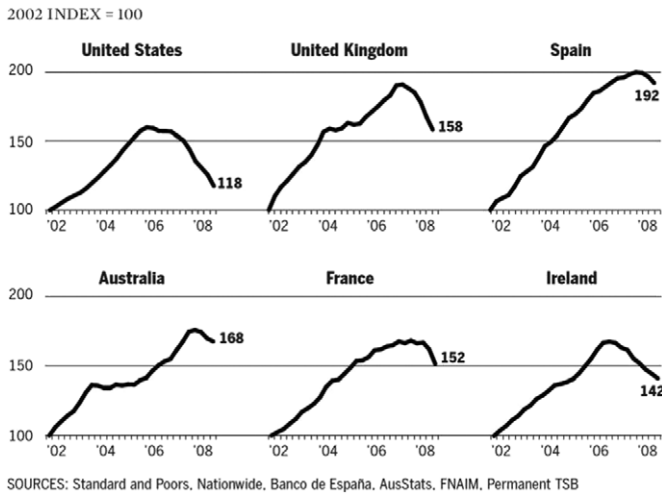


Fig. 1. Housing bubble in selected countries. Source: Graph source: Commission et al. (2011)

the housing market highly complex, which may render conventional approaches inadequate in dealing with it.

This study develops an agent-based model of the housing market that is able to account for the aforementioned unique characteristics and complex nature. In addition to the agents typical in an agent-based housing model, such as households and developers, we also include speculators and a lending agent, which enables us to study the role of speculation and leverage in the rise of a housing bubble. We attempt to answer the following research questions: can housing price rise and collapse endogenously without external shocks? If so, what is the mechanism that causes the endogenous rise and collapse of housing price? We find in the simulation results that housing prices will rise and collapse endogenously without external shocks, and the two necessary conditions for the rise of a housing bubble are lenient lending and speculation.

The paper is organized as follows. Section 2 reviews various approaches to the housing market in the existing literature. Section 3 describes the agent-based housing market model. Section 4 discusses treatment factors of the model and the experimental design. Section 5 shows the model results. Finally, Section 6 concludes the study.

## 2. Approaches to the housing market

In the economic literature, classic frameworks such as asset-pricing theory, trade theory, hedonic price model, prospect theory, life cycle model, and business cycle model have been applied to the housing market. For example, Poterba (1984) applied an asset-pricing model to derive equilibrium housing price based on rent and maintenance cost. Stein (1995) used a trade model to explain price volatility and trading volume in the housing market. Can (1992) reviewed various types of hedonic price models, which decompose housing price as the sum of the values provided by the house's various attributes. Genesove, Mayer, et al. (2001) used prospect theory in behavioral economics to explain seller behavior in the housing market. Ortalo-Magne and Rady (2006) developed a life cycle model with credit constraint for first-time buyers to explain housing price volatility. Finally, Silos (2007) and Sommervoll, Borgersen, and Wennemo (2010) developed business cycle models to study the effect of wealth distribution, portfolio composition, heterogeneous expectations, and other factors on the acquisition of housing.

More recently, equilibrium sorting models have been developed to study heterogeneous location preferences under market

equilibrium condition (Banzhaf & Walsh, 2008; Bayer, Ferreira, & McMillan, 2007; Calabrese, Epple, Romer, & Sieg, 2006; Kuminoff, Smith, & Timmins, 2013). Equilibrium sorting models study the process that households sort themselves into different neighborhoods according to their heterogeneous preferences and household characteristics. Similar to equilibrium sorting models, agent-based housing models also consider heterogeneity and study the dynamic process that individual households sort themselves into neighborhoods based on their preferences and socio-demographic characteristics. However, unlike equilibrium sorting models, agent-based models do not impose market equilibrium conditions to settle the sorting process. Rather, sorting emerges because of interactions between all types of market participants in agent-based models.

Researchers have been developing agent-based models to study emergent spatial phenomena, such as segregation (Crooks, 2010; Feitosa, Le, & Vlek, 2011; Fossett, Dietrich, et al., 2009), urban sprawl (Brown & Robinson, 2006) and gentrification (Torrens & Nara, 2007). So far, fewer studies have focused on housing price and housing bubble per se. One exception is the study by Geanakoplos et al. (2012), who studied systemic risk using an agent-based model of the housing market. Another exception is the study by Gilbert, Hawkworth, and Swinney (2009), which proposed an agent-based model of the English housing market. Some models have adopted a highly simplified market representation. In fact, after reviewing 51 agent-based models of urban residential choice, Huang, Parker, Filatova, and Sun (2014) found that only 11 have represented the market price formation process using some form of competitive bidding, meaning agents make a bid for the ideal property that maximizes their objectives, and the highest bid is accepted. An increasing number of researchers have been arguing for better representation of the market process in agent-based land use and housing models (Filatova, Parker, & Van der Veen, 2009; Parker et al., 2012; Polhill, Parker, & Gots, 2007). In particular, Parker and Filatova (2008) argued that, in order to properly model land and housing market, agent-based models need to represent price formation in a more realistic way.

A number of agent-based models have used competitive bidding as a price settling mechanism, in which buyers search for a housing good that maximizes their objectives, and then trade with sellers via bilateral bidding and negotiation. The implementation of competitive bidding differs in the number of actors included, the level of empiricism, and expectation formation. For example, in Filatova (2014), agents derive their price expectation from an empirical hedonic price model. In Magliocca, Safirova, McConnell, and Walls (2011), the bilateral bidding takes place between both households and developers, and developers and land owners. In Ettema (2011), buyers and sellers update market perceptions using a Bayesian update rules. Finally, in Chen, Irwin, Jayaprakash, et al. (2011), households derive their optimal bid using an auction model.

Regarding agent heterogeneity, households can be heterogeneous in budget (almost all do), preference (Filatova, Parker, & Van der Veen, 2009; Gaube & Remesch, 2013; Haase, Lautenbach, & Seppelt, 2010; Wu, Birkin, & Rees, 2008), and risk attitudes (Filatova, 2014; Ligmann-Zielinska, 2009). In terms of land heterogeneity, land can be heterogeneous in location, such as distance to central business district (Brown & Robinson, 2006; Filatova, Van Der Veen, & Parker, 2009), flood risks (Filatova, Van Der Veen, & Parker, 2009), and access to green space (Filatova, Parker, & Van der Veen, 2009). It can also have heterogeneous land quality (Augustijn-Beckers, Flacke, & Retsios, 2011).

One contribution of this study is that we include the lending agent (bank) in the model, which enables us to study the role of leverage and lenient lending in the rise of housing bubbles. Leverage is central in the housing crises in the 2000s: after examining the historical relationship between interest rate and housing price, Dokko et al. (2011) concluded that it is credit regulation and leverage, not low interest rate, that is behind the recent housing boom and crash in the

Download English Version:

<https://daneshyari.com/en/article/4965226>

Download Persian Version:

<https://daneshyari.com/article/4965226>

[Daneshyari.com](https://daneshyari.com)