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Housing and business cycles in Korea: A multi-sector Bayesian DSGE approach☆

Junhee Lee [a], Joonhyuk Song [b,*]

[a] Yeungnam University, School of International Economics and Business, Republic of Korea
[b] Hankuk University of Foreign Studies, Department of Economics, Republic of Korea

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ABSTRACT

The Korean housing market showed booms in the early 2000s and sharp fluctuations after the U.S. financial crisis. The recent increase in volatility in the housing market has motivated greater attention to the relationship between the housing market and the Korean economy. This paper develops a dynamic stochastic general equilibrium (DSGE) model with the housing construction sector and analyzes the role of housing in the Korean business cycles. The results indicate that the model incorporating the collateral role of houses in conjunction with predetermined pricing in the housing construction sector provides a reasonably good fit to the data. In addition, the paper conducts policy simulations of a changing loan-to-value (LTV) ratio ceiling and finds its significant effects on financially constrained households' consumption.

1. Introduction

The role of housing in the business cycle has recently received greater attention (Davis and Heathcote, 2005; Iacoviello and Neri, 2010), reflecting the boom and burst of the U.S. housing market around the 2008–2009 U.S. financial crisis.

Housing has been a key economic issue in Korea because houses represent the principal form of personal wealth in the country and there have been sharp fluctuations in house prices during the last decade. Fig. 1 plots HP-filtered log real house prices (house prices compared to the CPI) and log residential investment since 2000 in Korea. House prices in Korea increase sharply around 2003 and 2007 and decline after the U.S. financial crisis. Residential investment shows higher volatility after the U.S. crisis. The recent decrease in house prices and increased volatility in residential investment raise some concerns over a possible collapse of the Korean housing market and its impacts on the Korean economy.

This paper builds a multi-sector dynamic stochastic general equilibrium (DSGE) model with the housing construction sector and estimates the model with Bayesian methods to analyze the role of housing in Korean business cycles. The results indicate that the model incorporating the collateral role of houses in conjunction with predetermined pricing in the housing construction sector provides a reasonably good fit to the data. In addition, the paper provides policy simulations with the estimated model and examines the effects of changes in the loan-to-value (LTV) ratio ceiling on the housing market and the economy.[1]

Previous studies of the relationship between housing and the Korean economy have generally focused on empirical VAR (vector autoregression) analyses, as in Song (2008), without fully specifying structural economic models. Some recent studies (e.g., Kang, 2006; Lee, 2011) have considered the role of housing by using structural DSGE models but focused only on the collateral role of housing, not fully incorporating residential investment. The present paper models housing construction as a separate production sector and provides an in-depth analysis of contributions of housing to economic fluctuations. The results show that the collateral role of houses and predetermined pricing in the housing construction sector are helpful for matching data. In addition, the paper provides policy simulations using the estimated model and examines the effects of changes in the LTV ratio ceiling on the housing market and the Korean economy.

The rest of this paper is organized as follows: Section 2 builds a multi-sector DSGE model with house construction. Section 3 estimates the model by using Bayesian methods and conducts policy simulations. Section 4 provides a summary of results and concludes.

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* Corresponding author.
E-mail addresses: lee1838@ynu.ac.kr (J. Lee), jhsong@hufs.ac.kr (J. Song).

[1] The LTV ratio ceiling is first regulated by financial authorities in 2002 to be 60% in terms of Korean commercial bank loans to households to suppress an excessive housing market boom. Since then, the ceiling is regulated to range from 40% to 70% depending on the housing market and the economic situation.

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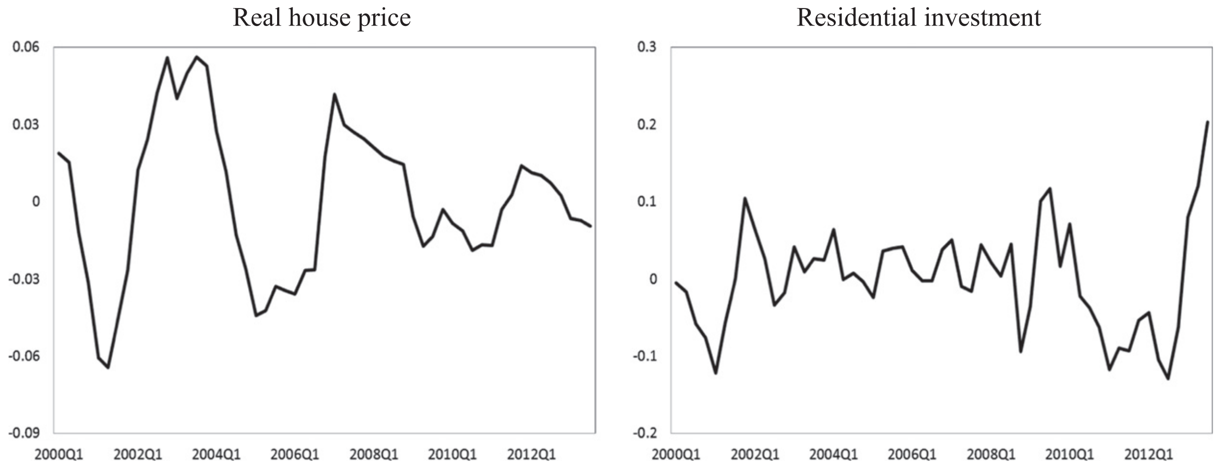

Fig. 1. Korean house prices and residential investment.

2. The model economy

The model economy consists of the standard household, the impatient household, the standard production sector, the housing construction sector, and the monetary policy authority. The standard household is a net lender, and the impatient household is a net borrower. The impatient household is subject to collateral constraints on borrowing. Standard goods are used for consumption and capital investment and produced in the standard production sector, and new houses are produced in the housing construction sector. The monetary authority manages monetary policy according to a Taylor-type rule. The model is similar to that in Iacoviello and Neri (2010) and incorporates household collateral constraints dependent on the value of houses. The main difference of the model from that in Iacoviello and Neri (2010) is predetermined pricing in the housing construction sector, which is helpful for matching data.

2.1. The standard household

There are two types of households indexed by $j = 1, 2$ with the subjective discount rate β_j. Assume that $\beta_1 > \beta_2$ and that households with β_1 are more patient, that is, the standard patient household. The standard household is denoted by the subscript 1. The i-th standard household maximizes

$$E_t\left[\sum_{\tau=0}^{\infty}\beta_1^{\tau}U\left(c_{1,i,t+\tau}-bc_{1,i,t+\tau-1},\,h_{1,i,t+\tau},\,l_{1,i,t+\tau}\right)\right] \tag{1}$$

subject to the budget constraint

$$\begin{aligned}&c_{1,i,t}+\frac{P_{h,t}}{P_{s,t}}\left(h_{1,i,t}-(1-\delta_h)h_{1,i,t-1}\right)+\frac{B_{1,i,t}}{P_{s,t}}+\frac{P_{n,t}}{P_{s,t}}n_{1,i,t}\le\\&\frac{W_{1,i,t}l_{1,i,t}}{P_{s,t}}+\frac{R_{t-1}B_{1,i,t-1}}{P_{s,t}}+\frac{R_{n,t}}{P_{s,t}}n_{1,i,t}+\frac{P_{n,t}}{P_{s,t}}n_{1,i,t-1}+\frac{T_{1,i,t}}{P_{s,t}}\end{aligned} \tag{2}$$

where $c_{1,i,t}$ is consumption; $h_{1,i,t}$, the housing stock; $l_{1,i,t}$, the labor hour; $B_{1,i,t}$, the nominal bond holding; $n_{1,i,t}$, the supply of land; $T_{1,i,t}$, the transfer from the production sectors; $P_{s,t}$, the price of standard goods; $P_{h,t}$, the house price; $P_{n,t}$, the land price; $W_{1,i,t}$, the nominal wage rate; R_t, the nominal interest rate; $R_{n,t}$, the land rental rate; and δ_h, the housing stock depreciation rate. The standard household owns land and provides it to the housing construction sector. The subscript i is dropped by assuming the symmetric equilibrium below.

The household utility function is

$$\begin{aligned}U(c_t-bc_{t-1},h_t,l_t)=&\exp\left(\zeta_{c,t}\right)\\&\times\left(\ln(c_t-bc_{t-1})+\exp\left(\zeta_{h,t}\right)\chi_h\ln(h_t)-\chi_l l_t^2\right)\end{aligned} \tag{3}$$

where $\zeta_{c,t}$ and $\zeta_{h,t}$ are consumer preferences and housing demand shocks, respectively; b is the consumption habit formation parameter; and χ_h and χ_l are housing and labor weights, respectively, in the utility function.

Nominal wage stickiness is introduced using the Calvo mechanism, and the standard household adjusts its wage rate each period with probability $1 - \theta_w$ or updates the wage rate just as much as the trend inflation rate Π. The log-linearizing standard household-wage-setting condition, the so-called new Keynesian wage Phillips curve, is obtained as follows:

$$\hat{\pi}^w_{1,t}=\beta_1E_t\hat{\pi}^w_{1,t+1}+\frac{(1-\theta_w)(1-\beta_1\theta_w)}{\theta_w(1+\phi_l/(\phi_l-1))}\left(\hat{l}_{1,t}-\hat{\lambda}^b_{1,t}-\hat{w}_{1,t}+\zeta_{c,t}\right) \tag{4}$$

where $\pi^w_{1,t}$ is wage rate inflation ($W_{1,t}/W_{1,t-1}$); $w_{1,t}$ is the real wage rate ($W_{1,t}/P_{s,t}$); $\lambda^b_{1,t}$ is the Lagrange multiplier associated with the budget constraint; and ϕ_l is the wage markup parameter. Variables with a hat are log-linearized versions of variables without a hat. First-order conditions, except for the wage-setting condition, are omitted for expositional simplicity.

2.2. The impatient household

An impatient household is a household with a subjective discount rate β_2 lower than β_1. The impatient household borrows from the standard household because of the difference in the subjective discount rate. The impatient household is denoted by subscript 2 below. Unlike standard patient households, impatient households do not own land and hold no shares in production firms.

The i-th impatient household maximizes

$$E_t\left[\sum_{\tau=0}^{\infty}\beta_2^{\tau}U\left(c_{2,t+\tau}-bc_{2,t+\tau-1},\,h_{2,t+\tau},\,l_{2,t+\tau}\right)\right] \tag{5}$$

subject to the budget constraint

$$c_{2,t}+\frac{P_{h,t}}{P_{s,t}}\left(h_{2,t}-(1-\delta_h)h_{2,t-1}\right)+\frac{B_{2,t}}{P_{s,t}}\le\frac{W_{2,t}l_{2,t}}{P_{s,t}}+\frac{R_{t-1}B_{2,t-1}}{P_{s,t}}+\frac{T_{2,t}}{P_{s,t}}. \tag{6}$$

Impatient households borrow from standard households and are subject to a borrowing constraint dependent on the collateral value of