The Housing Risk Premium in A Production Economy

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Abstract
This article studies how the housing risk premium is determined in a simple real business cycle model. We present a consumption-based asset pricing model for the housing risk premium and evaluate whether the model is able to explain the observed housing risk premium. Our findings show that a real business cycle model with generalized recursive preferences is able to match the observed housing risk premium. We also find that the volatility of the housing demand shock plays a crucial role in determining the risk–return relationship for housing.
Keywords
Housing risk premium, house price, recursive preferences, production economy

I. Introduction
Housing accounts for half of the median-wealth household portfolio (Eiling et al. 2019). However, it has received much less attention than stocks in the finance literature. The objective of this article is to investigate the risk–return relationship on housing in a production economy. In particular, we evaluate the ability of a simple real business cycle model to replicate the observed housing risk premium. We present a consumption-based asset pricing model for the housing risk premium as a reward for risk. It shows that the housing risk premium is determined by (1) the covariance between the stochastic discount factor and the capital gain on housing and (2) the covariance between the stochastic discount factor and the marginal rate of substitution between housing consumption and nonhousing consumption.¹

Our findings are fourfold. First, the real business cycle model with recursive preferences is able to account for the observed housing risk premium. Second, the volatility of housing prices and the housing risk premium are best explained when the model incorporates technology and housing demand shocks. Third, the positive risk–return relationship can be weakened due to the hedging role of home ownership against future housing consumption risk (also known as rent risk) as the volatility of the housing demand shock increases. In this respect, the housing demand shock has a different implication from the technology shock. Finally, a high-risk aversion is needed to match the observed housing risk premium. This issue is also found in the literature investigating the equity premium and the bond premium (e.g. Tallarini 2000; Rudebusch and Swanson 2012).²

Home ownership subjects households to house price risk, but provides a hedge against future housing consumption risk. Han (2013) provides empirical evidence that the return on housing increases with house price risk, but that the hedging role of home ownership requires a lower return to compensate for the risk.³ Case, Cotter, and Gabriel (2011) and Eiling et al. (2019) also investigate which factors explain the return on housing using an empirical multi-factor model. Our article differs from these papers in that we focus on the evaluation of a simple macroeconomic model with respect to its ability to replicate the observed housing risk premium. We also study how the increased volatility of the housing demand shock affects the risk–return relationship for housing.

Our findings show that the importance of the hedging role of home ownership for future housing consumption risk rises with the increased volatility of the shock, leading to a lower excess return on housing. Jaccard (2011) also studies the risk–return relationship for housing in a production economy and finds that habit in consumption and inelastic housing supply are key ingredients that generate the housing risk premium.⁴ This article differs from Jaccard (2011) in that households own houses, and generalized recursive preferences in our model, instead of habit formation in consumption, play a crucial role in generating the housing risk premium.⁵ Only technology shocks are considered in the work by Jaccard (2011). We consider housing demand shocks along with technology shocks. As Iacoviello and Neri (2010) point out, housing demand shocks make a substantial contribution to house price fluctuations.⁶ Our findings show that the volatility of the housing demand shock plays an important role in determining the risk–return relationship for housing.

The organization of the article is as follows. Section II describes a production economy. Section III presents a consumption-based asset pricing model for the housing risk premium and investigates whether the model is able to match the observed housing risk premium. Section IV concludes.
II. The basic neoclassical model with housing

Our model has a household who owns house and generalized recursive preferences. This section describes the household’s problem. In each period, the household chooses consumption, $c_t$, its housing stock, $h_t$, its quantity of real risk-free bonds, $b_t$, and labour, $l_t$. The flow budget constraint of the household is given by

$$ b_t = (1 + r_t) b_{t-1} + w_t l_t + d_t - c_t - q^h_t (h_t - h_{t-1}), $$

(1)

where $r_t$ is the real risk-free rate, $w_t$ is the real wage, $q^h_t$ is the real house price, and $d_t$ is net transfer payments.

Each household is assumed to have multiplier preferences following Hansen and Sargent (2001) and Swanson (2016). Multiplier preferences are a special version of conventional generalized recursive preferences and very convenient as neither $u \geq 0$ nor $u \leq 0$ are required. The household’s value function is given by

$$ V(b_{t-1}, h_{t-1}; \Theta_t) = \max_{c_t, h_t, l_t \in \Gamma} (1 - \beta) u(c_t, h_{t-1}, l_t) - \beta \frac{1}{\alpha} \log[E_t \exp(-\alpha V(b_t, h_t; \Theta_{t+1}))]. $$

(2)

In Equation (2), $\Gamma$ is the choice set for $c_t$, $h_t$, and $l_t$. $u$ is the period utility function, $\beta \in (0,1)$ is the discount factor, $\alpha$ measures the additional curvature of multiplier preferences, and the state of the aggregate economy, $\Theta_t$, controls the processes for $w_t$, $r_t$, $q^h_t$, and $d_t$. We assume that housing stock $h_{t-1}$ is purchased at the end of period $t-1$ and that it delivers utility in period $t$ so that households derive utility from $h_{t-1}$ in period $t$.

There is a unit continuum of identical households. Each household chooses consumption, housing, labour, and real risk-free bond to maximize (2) subject to the budget constraint (1), with period utility given by

$$ u(c_t, h_{t-1}, l_t) \equiv \log c_t + j \log h_{t-1} - \chi_0 \frac{l_t^{1+\chi}}{1 + \chi}, $$

(3)

where $\chi_0 > 0$ is the relative weight on labour, $\chi > 0$ denotes the inverse Frisch elasticity of the labour supply, and $j > 0$ denotes the relative weight on housing.

The first-order necessary conditions for the bond, $b_t$, housing, $h_t$, and labour, $l_t$, choice are given by

$$ 1 = E_t m_{t,t+1} (1 + r_{t+1}), $$

(4)

$$ q^h_t = E_t m_{t,t+1} \left( \frac{u_h(c_{t+1}, h_t, l_{t+1})}{u_c(c_{t+1}, h_t, l_{t+1})} + q^h_{t+1} \right), $$

(5)

$$ \chi_0 l_t^{\chi} = \frac{1}{c_t} w_t, $$

where $m_{t,t+1}$ is the marginal utility of consumption.
where $E_t$ is the conditional expectation on the state of the economy at time $t$, and $m_{t,t+1} = \frac{\beta c_t \exp(-\alpha V(b_t,h;\Theta_{t+1}))}{E_t \exp(-\alpha V(b_t,h;\Theta_{t+1}))}$ denotes the stochastic discount factor for the household. $u_h$ and $u_c$ are the marginal utility of housing consumption and the marginal utility of nonhousing consumption, respectively. Equation (5) shows that the house price is determined by the discounted one-period ahead house price and the marginal rate of substitution between housing and nonhousing consumption, $\frac{u_h(c_{t+1},l_{t+1})}{u_c(c_{t+1},l_{t+1})}$, which is equal to $\frac{j_{t+1}}{h_t}$. The marginal rate of substitution can be interpreted as the rent savings from owning one unit of housing. Therefore, we define rent at time $t + 1$ as $rent_{t+1} = \frac{u_h(c_{t+1},l_{t+1})}{u_c(c_{t+1},l_{t+1})}$. Notice that assuming the household rents house services yields the budget constraint given by $b_t = (1 + r_t)b_{t-1} + w_t l_t + d_t - c_t - rent_t h_{t-1}$. The optimal condition for housing yields $rent_{t+1} = \frac{u_h(c_{t+1},l_{t+1})}{u_c(c_{t+1},l_{t+1})}$. Rent fluctuates with the marginal utility of housing consumption.

There is a unit continuum of perfectly competitive firms producing goods using physical capital, labour, and housing as inputs. The production function is given by

$$y_t = A_t \left( k_t^{1-\phi} h_{f,t-1}^{\phi} \right)^{1-\eta} l_t^\eta,$$

(7)

where $h_{f,t}$ denotes the housing held by each producer. The technology shock $A_t$ follows an AR(1) process

$$\log A_t = \rho \log A_{t-1} + \epsilon_t^A,$$

(8)

where $\rho \in (0,1]$ is a parameter capturing the persistence of technology, and $\epsilon_t^A$ is an i.i.d., white noise process with mean zero and variance $\sigma_A^2$. The firm chooses capital, $k_{t+1}$, housing, $h_{f,t}$, and labour, $l_t$, to maximize the discounted sum of current and future profits given by

$$\max_{k_{t+1}, h_{f,t}, l_t} \sum_{i=0}^{\infty} E_t \left( m_{t+i} (y_{t+i} - w_{t+i} l_{t+i} - i_{t+i} - \frac{h_t}{d_{t+i}} (h_{f,t+i} - h_{f,t+i-1})) \right).$$

(9)

The discount factor $m_{t,t+i}$ is defined as $\Pi_{k=1}^{i} m_{t+k-1,t+k}$ for $i > 0$ and $1$ for $i = 0$.

The law of motion for capital given by

$$k_{t+1} = (1 - \delta) k_t + i_t,$$

(10)

where $\delta$ denotes the capital depreciation rate and $i_t$ is investment in new physical capital. Solving the profit maximization problem yields the first-order necessary conditions for capital, housing, and labour:
\[ 1 = E_t m_{t,t+1} \left( (1 - \phi)(1 - \eta) \frac{y_{t+1}}{k_{t+1}} + (1 - \delta) \right), \]

(11)

\[ q_t^h = E_t m_{t,t+1} \left( \phi(1 - \eta) \frac{y_{t+1}}{h_{f,t}} + q_{t+1}^h \right), \]

(12)

\[ w_t = \eta \frac{y_t}{l_t}. \]

(13)

In a competitive equilibrium, all markets clear. The goods market clearing condition is

\[ y_t = c_t + i_t. \]

(14)

The housing market clearing condition is

\[ h_t + h_{f,t} = H, \]

(15)

where \( H \) denotes the total supply of housing, which is normalized to unity as it is typical in the literature (Iacoviello 2005; Liu, Wang, and Zha 2013). Finally, the labour market clears so that labour supply equals labour demand.

III. The housing risk premium

As shown in Equation (5), a key determinant of the house price is the marginal rate of substitution between nonhousing consumption and housing consumption. The marginal rate of substitution interpreted as rent plays the same role in determining house prices as the dividend does in pricing stocks. Equation (5) can be written as

\[ E_t m_{t,t+1} (1 + r_{t+1}^h) = 1, \]

(16)

when the return on housing is defined as \( r_{t+1}^h \equiv \frac{q_{t+1}^h + rent_{t+1}}{q_t^h} - 1 \). Using Equation (4) and \( Cov_t \left( m_{t,t+1}, 1 + r_{t+1}^h \right) = E_t m_{t,t+1} (1 + r_{t+1}^h) - 1 \), Equation (16) can be expressed as

\[ E_t \left( r_{t+1}^h - r_{t+1} \right) = -(1 + r_{t+1}) Cov_t (m_{t,t+1}, r_{t+1}^h). \]

(17)
The housing risk premium, \( \psi_t^h \equiv r_{t+1}^h - r_{t+1} \), depends on the covariance between the stochastic discount factor and the return on housing. When the capital gain on housing is defined as \( r_{t+1}^q \equiv \frac{q_{t+1}^h}{q_t^h} - 1 \), the housing risk premium can be decomposed as

\[
E_t(r_{t+1}^h - r_{t+1}) = -(1 + r_{t+1}) \text{Cov}_t(m_{t,t+1}, r_{t+1}^q) - (1 + r_{t+1}) \text{Cov}_t(m_{t,t+1}, \frac{\text{rent}_{t+1}}{q_t^h}).
\]

(18)

Rearranging Equation (18) yields

\[
E_t(r_{t+1}^h - r_{t+1}) = -\lambda_t \beta_t^q - \lambda_t \beta_t^\text{rent},
\]

(19)

where \( \beta_t^q \equiv \frac{\text{Cov}_t(m_{t,t+1}, r_{t+1}^q)}{\text{Var}_t(m_{t,t+1})} \) and \( \beta_t^\text{rent} \equiv \frac{\text{Cov}_t(m_{t,t+1}, \text{rent}_{t+1})}{\text{Var}_t(m_{t,t+1})} \). Our model predicts the \( \beta_t^q \) is negative since the stochastic discount factor is countercyclical and the capital gain on housing is cyclical. The \( \beta_t^\text{rent} \) is predicted to be positive due to the cyclical property of the price–rent ratio. 10 The \( \beta_t^\text{rent} \) is associated with rent risk since the price of housing is known at time \( t \). The signs of the \( \beta_t^q \) and \( \beta_t^\text{rent} \) imply that the risk associated with house price fluctuations is rewarded, while home ownership works as an insurance on the rent risk since homeowners are able to protect themselves from the rent risk. This issue is also discussed using a reduced form approach in the work by Han (2013). 11

Calibration

We now calibrate our model to replicate the observed housing risk premium. Table 1 reports the benchmark calibration for the model.

Table 1. Benchmark calibration

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Descriptions</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Households preferences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \beta )</td>
<td>Discount rate</td>
<td>0.9925</td>
</tr>
<tr>
<td>( j )</td>
<td>Relative utility weight of housing</td>
<td>0.045</td>
</tr>
<tr>
<td>( \chi_0 )</td>
<td>Relative utility weight of labour</td>
<td>0.87</td>
</tr>
<tr>
<td>( \chi )</td>
<td>Inverse Frisch elasticity of labour supply</td>
<td>3</td>
</tr>
<tr>
<td>Firms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \eta )</td>
<td>Elasticity of output to labour</td>
<td>0.666</td>
</tr>
<tr>
<td>( \phi )</td>
<td>Elasticity of output to housing</td>
<td>0.07</td>
</tr>
<tr>
<td>( \delta )</td>
<td>Depreciation rate</td>
<td>0.025</td>
</tr>
<tr>
<td>Shock process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \rho_A )</td>
<td>Persistence of technology</td>
<td>1</td>
</tr>
<tr>
<td>( \sigma_A )</td>
<td>SD of technology shock</td>
<td>0.005</td>
</tr>
</tbody>
</table>

The parameter values are standard in the literature. Following Iacoviello and Neri (2010), we set the household’s discount factor, \( \beta \), to 0.9925, implying that the real interest rate is 3% at the nonstochastic steady state. The relative utility weight of housing is set to 0.045, which is in line with the empirical estimates of Liu, Wang, and
Zha (2013). The calibrated value of the relative utility weight of labour, $\chi_0$, is set to 0.87 to imply the unity labour at the nonstochastic steady state. The inverse Frisch elasticity of labour supply, $\chi$, is set to 3 as in the work by Del Negro, Giannoni, and Schorfheide (2015).

Turning to the production sector, we calibrate the elasticity of output to labour, $\eta$, to 0.666, which is consistent with the US. data. The parameter determining the elasticity of output to housing, $\phi$, is set to 0.07, which is in line with Liu, Wang, and Zha (2013). The depreciation rate of capital, $\delta$, is set to 0.025 as in the work by King and Rebelo (1999). We set the persistence of technology to unity as in the work by Tallarini (2000) and Swanson (2016). Finally, the SD of the technology shock is set to 0.5% which is in line with estimates from Liu, Wang, and Zha (2013).

Implications of the housing risk premium
This section considers whether the real business cycle model is able to replicate the observed housing risk premium. We present the housing risk premium, $\psi_t^h$, along with the second moments of the variables of interest, the covariance between the return on housing, $r^h_{t+1}$, and the stochastic discount factor, and the correlation between output growth and the return on housing. All are reported in Table 2. The observed housing risk premium is taken from Eiling et al. (2019), who estimate it using US. housing data from the period April 1996 to December 2016. 12
Table 2. Moments of aggregate variables and the housing risk premium

<table>
<thead>
<tr>
<th></th>
<th>$\sigma(\Delta y)$</th>
<th>$\sigma(\Delta c)$</th>
<th>$\sigma(\Delta i)$</th>
<th>$\sigma(\Delta q^h)$</th>
<th>$\sigma(r)$</th>
<th>$\psi^h_t$</th>
<th>$\sigma_t(\psi^h_t)$</th>
<th>$\text{Cov}(m, r^h)$</th>
<th>$\text{Corr}(\Delta y, r^h)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel I: Data</td>
<td>0.54</td>
<td>0.37</td>
<td>2.91</td>
<td>6.76</td>
<td>2.10</td>
<td>1.07</td>
<td>5.39</td>
<td>–</td>
<td>0.23</td>
</tr>
<tr>
<td>Panel II: RBC model with the technology shock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha = 65$</td>
<td>0.54</td>
<td>0.33</td>
<td>1.20</td>
<td>1.37</td>
<td>0.23</td>
<td>0.58</td>
<td>1.35</td>
<td>-60.44</td>
<td>0.99</td>
</tr>
<tr>
<td>$\alpha = 110$</td>
<td>0.54</td>
<td>0.33</td>
<td>1.20</td>
<td>1.37</td>
<td>0.23</td>
<td>0.98</td>
<td>1.33</td>
<td>-101.95</td>
<td>0.99</td>
</tr>
<tr>
<td>$\alpha = 155$</td>
<td>0.54</td>
<td>0.33</td>
<td>1.20</td>
<td>1.37</td>
<td>0.23</td>
<td>1.38</td>
<td>1.32</td>
<td>-143.46</td>
<td>0.99</td>
</tr>
<tr>
<td>Panel III: RBC model with the technology and housing demand shock</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha = 65$</td>
<td>0.57</td>
<td>0.33</td>
<td>1.42</td>
<td>4.83</td>
<td>0.24</td>
<td>0.44</td>
<td>6.42</td>
<td>-51.82</td>
<td>0.31</td>
</tr>
<tr>
<td>$\alpha = 110$</td>
<td>0.57</td>
<td>0.33</td>
<td>1.42</td>
<td>4.83</td>
<td>0.24</td>
<td>0.74</td>
<td>6.57</td>
<td>-87.45</td>
<td>0.31</td>
</tr>
<tr>
<td>$\alpha = 155$</td>
<td>0.57</td>
<td>0.33</td>
<td>1.42</td>
<td>4.83</td>
<td>0.24</td>
<td>1.05</td>
<td>6.71</td>
<td>-123.08</td>
<td>0.31</td>
</tr>
<tr>
<td>Panel IV: RBC model without housing in production</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha = 65$</td>
<td>0.54</td>
<td>0.33</td>
<td>1.16</td>
<td>8.08</td>
<td>0.24</td>
<td>0.56</td>
<td>9.22</td>
<td>-69.93</td>
<td>0.18</td>
</tr>
<tr>
<td>$\alpha = 110$</td>
<td>0.54</td>
<td>0.33</td>
<td>1.16</td>
<td>8.08</td>
<td>0.24</td>
<td>0.94</td>
<td>9.21</td>
<td>-117.99</td>
<td>0.18</td>
</tr>
<tr>
<td>$\alpha = 155$</td>
<td>0.54</td>
<td>0.33</td>
<td>1.16</td>
<td>8.08</td>
<td>0.24</td>
<td>1.33</td>
<td>9.19</td>
<td>-166.05</td>
<td>0.18</td>
</tr>
</tbody>
</table>

SDs for macroeconomic variables are computed over 1996:Q2 to 2016:Q4. The housing risk premium is taken from the estimates of Eiling et al. (2019) over the period of April 1996–December 2016.
As shown in Table 2, the real business cycle model performs well in matching the SDs of output and consumption growth. However, it underpredicts the volatility of investment growth and the risk-free real interest rate. Panel I shows that the observed housing risk premium is 1.07 for the US housing price index. Panel II shows that the model with only the technology shock is able to explain the observed housing risk premium when the parameter $\alpha$ is set sufficiently high. As shown by Tallarini (2000), Rudebusch and Swanson (2012), and Li and Palomino (2014), a large risk aversion parameter is also necessary to explain the bond premium and the equity premium in a production economy. The volatility of the housing risk premium is underpredicted when the model economy includes only one type of shock. Iacoviello and Neri (2010) point out that housing demand shocks contribute substantially to house price fluctuations so that we incorporate housing demand shocks into the utility function as follows:

$$u(c_t, h_{t-1}, l_t) \equiv \log c_t + j_t \log h_{t-1} - \lambda_0 \frac{l_t^{1+\chi}}{1+\chi^\chi}.$$ 

The variable $j_t$ affects housing demand following an autoregressive process given by $j_t = (1 - \rho_H) j_{t-1} + \rho_H j_t + \epsilon_t^H$, where the shock $\epsilon_t^H$ is an i.i.d. white noise process with mean zero and variance $\sigma_H^2$. The terms $\rho_H$ and $\sigma_H$ are set to 0.99 and 0.0462, which are consistent with the estimates of Liu, Wang, and Zha (2013). With both technology and housing demand shocks, as revealed in Panel III, the volatility of the housing risk premium increases by more than 5% regardless of the value of $\alpha$. The model does the best in accounting for both the observed housing risk premium and its SD. The volatility of housing price growth and the correlation between output growth and the housing return can be better matched with their observed counterparts. The model’s performance is the best when $\alpha = 155$. Finally, turning to the last panel, we find that the standard real business cycle model with housing abstracted from the production function of firms also performs well in accounting for the observed housing risk premium, but overpredicts the volatility of the premium as well as the volatility of housing price growth. Once firms do not purchase housing, the aggregate housing stock held by households is fixed, making the housing price more volatile.

Han (2013) provides empirical evidence on the puzzling negative risk–return relationship for housing in some markets. He points out that the positive risk–return relationship predicted by standard theory can be weakened when (1) housing supply is inelastic, (2) population grows, and when (3) hedging incentives for the rent risk are sufficiently strong. In markets with such properties, households face high housing consumption risk (or rent risk), leading to an increase in housing demand that makes housing demand more volatile. In this regard, it is worth investigating how hedging incentives for future housing consumption risk lowers the housing risk premium using a real business cycle model. Our interest is in how an increase in the SD of the housing demand shock that makes the housing consumption risk larger weakens the positive risk–return relationship.

Table 3 shows how the model-implied housing risk premium varies with the SD of the housing demand shock, $\sigma_H$. An increase in $\sigma_H$ causes the housing risk premium to fall despite an increase in the volatility of the housing price. The increased volatility of the housing demand shock gives rise to a rise in rent risk, since rent is a function of the marginal utility of housing consumption. Home ownership provides a hedge against rent risk, so that households accept a lower return on housing. Thus, the positive risk–return relationship can be weakened with an increase in rent risk. In particular, a negative risk–return relationship for housing is possible when rent risk is high. As shown in Table 3, setting $\sigma_H$ to 0.10 yields a negative housing risk premium. It shows the hedging role of home ownership against rent risk plays a crucial role in accounting for the housing risk premium. The results based on the real business cycle model are consistent with the empirical findings of Han (2013). For comparison, the impact of the technology shock on the model-implied housing risk premium is reported in Table 4. The table illustrates that a rise in the volatility of the technology shock generates the positive risk–return
relationship for housing. In sum, our findings show that the implication of the housing demand shock on the risk–return relationship for housing is different from that of the technology shock.

Table 3. Housing demand shocks and the housing risk premium

<table>
<thead>
<tr>
<th>$\sigma_H$</th>
<th>0.01</th>
<th>0.02</th>
<th>0.03</th>
<th>0.04</th>
<th>0.05</th>
<th>0.06</th>
<th>0.07</th>
<th>0.08</th>
<th>0.09</th>
<th>0.10</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\psi_t^h$</td>
<td>1.36</td>
<td>1.32</td>
<td>1.24</td>
<td>1.13</td>
<td>0.99</td>
<td>0.81</td>
<td>0.61</td>
<td>0.38</td>
<td>0.11</td>
<td>−0.19</td>
</tr>
<tr>
<td>$\sigma_t(\psi_t^h)$</td>
<td>2.28</td>
<td>3.31</td>
<td>4.47</td>
<td>5.79</td>
<td>7.33</td>
<td>9.13</td>
<td>11.25</td>
<td>13.73</td>
<td>16.62</td>
<td>19.98</td>
</tr>
<tr>
<td>$\sigma(\Delta q^h)$</td>
<td>1.70</td>
<td>2.43</td>
<td>3.30</td>
<td>4.23</td>
<td>5.19</td>
<td>6.16</td>
<td>7.14</td>
<td>8.13</td>
<td>9.12</td>
<td>10.11</td>
</tr>
</tbody>
</table>

Table 4. Technology shocks and the housing risk premium

<table>
<thead>
<tr>
<th>$\sigma_A$</th>
<th>0.0001</th>
<th>0.0002</th>
<th>0.0003</th>
<th>0.0004</th>
<th>0.0005</th>
<th>0.0006</th>
<th>0.0007</th>
<th>0.0008</th>
<th>0.0009</th>
<th>0.0010</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\psi_t^h$</td>
<td>−0.28</td>
<td>−0.11</td>
<td>0.16</td>
<td>0.55</td>
<td>1.05</td>
<td>1.65</td>
<td>2.37</td>
<td>3.19</td>
<td>4.13</td>
<td>5.18</td>
</tr>
<tr>
<td>$\sigma_t(\psi_t^h)$</td>
<td>5.78</td>
<td>6.05</td>
<td>6.30</td>
<td>6.52</td>
<td>6.71</td>
<td>6.87</td>
<td>7.00</td>
<td>7.08</td>
<td>7.13</td>
<td>7.14</td>
</tr>
<tr>
<td>$\sigma(\Delta q^h)$</td>
<td>4.64</td>
<td>4.66</td>
<td>4.70</td>
<td>4.76</td>
<td>4.83</td>
<td>4.91</td>
<td>5.01</td>
<td>5.12</td>
<td>5.24</td>
<td>5.38</td>
</tr>
</tbody>
</table>

IV. Conclusion

This article examines the housing risk premium using a housing asset pricing model and investigates whether the real business cycle model is able to replicate the observed housing risk premium. Our findings reveal that the model can reasonably match the data. However, unrealistically high-risk aversion is required to explain the housing risk premium. Our findings also reveal that the volatility of the housing demand shock plays a crucial role in determining the risk–return relationship for housing. Requiring high-risk aversion may arise from the fact that risks related to high transaction costs, illiquidity of housing, and model uncertainty are abstracted from the model. Therefore, there is a need for future research on the risk–return relationship using a more realistic model for housing.

Acknowledgments

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1 The model suggests that owning a house eliminates the risk associated with future housing consumption, while subjecting homeowners to the risk related to house price fluctuations. The former reduces the housing risk premium, but the latter increases the housing risk premium.

2 The reason for this is that the model economy is short of uncertainty unlike the real economy. See Barillas, Hansen, and Sargent (2009) for a detailed discussion.

3 Sinai and Souleles (2005) find that the probability of home ownership is affected by future housing consumption risk.

4 Favilukis, Ludvigson, and van Nieuwerburgh (2017) find that the housing risk premium plays a crucial role in accounting for the house price boom in the early and mid-2010s.
5 Jaccard (2011) assumes that firms produce housing and rent it to households so that households take future housing consumption risk, but avoid house price risk.

6 Davis and Heathcote (2007) find empirical evidence that most of the house price dynamics are driven by the fluctuations of the land price rather than by the value of structures, and the land price is greatly affected by factors related to housing demand.

7 See Hansen and Sargent (2001) and Swanson (2016) for more detail.

8 The expectation operator is ‘twisted’ by the factor $-\alpha$ and exponential function and ‘untwisted’ by the factor $-\alpha^{-1}$ and the natural logarithm function.

9 See Han (2013) for a detailed discussion on this interpretation.

10 The cyclicity of this ratio is reported by Piazzesi and Schneider (2016).

11 The covariance terms do not appear in the work by Han (2013) due to certain simplifying assumptions.

12 Eiling et al. (2019) collected monthly zip code-level house prices from Zillow.

13 There are many ways to alleviate this problem. For example, including investment-specific shocks or markup shocks can increase volatility of investment without distorting the model’s performance. This issue is also noted in the literature studying the bond premium (e.g. Li and Palomino 2014).

14 Using zip-code level data from Zillow, the housing risk premium is computed to be 0.84 by Eiling et al. (2019).

15 The coefficient of risk aversion is closely related with the Epstein-Zin parameter $\alpha$. The coefficient of risk aversion can be expressed as $R^c = \left( \frac{1}{1+\frac{\alpha}{X}+j} + \alpha \right) \frac{c+q^h}{c}$ in the model.

16 We also compute the model-implied equity premium to be 6.83 for the model with technology and housing demand shocks, while its observed counterpart reported by Eiling et al. (2019) is 7.95. Following Abel (1999), Gourio (2012), Campbell, Pflueger, and Viceira (2014), and Swanson (2016), we define the equity premium as the difference between stock returns and the risk-free rate: $\psi^e_t \equiv \frac{E_s(C^v_{t+1}+p^f_{t+1})}{p^f_t} - (1 + r_{t+1})$. Stocks are considered as levered claims on aggregate consumption. In every period, equity pays a dividend equal to $C^v_t$. As pointed out by Swanson (2016), the parameter $v$ can be interpreted as capturing broad leverage in the economy, including operational and financial leverage. Operational leverage arises from the fixed production costs of firms (Gourio 2012; Campbell, Pflueger, and Viceira 2014). We set the degree of leverage at $\psi = 3$ to match the empirical estimates of dividend growth’s volatility as in the work by Abel (1999) and Bansal and Yaron (2004).

References


