Returns to Housing with Financial Frictions

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Introduction

- In this paper, we study the interaction of monetary policy and financial frictions on returns to housing.
- We consider two types of financial frictions: loan-to-value (LTV) and payment-to-income (PTI) limits. Example
- We also fit a vector autoregression (SVAR) to Canadian macro data and examine the impact of monetary policy shocks on returns to housing.

Literature

Contribution

- **The Model:**
- **A. Benchmark model with LTV frictions only:**
  - A New Keynesian dynamic stochastic general equilibrium (DSGE) model with collateral constraints in each period.
- **B. Extend DSGE model with LTV and PTI constraints:**
  - The benchmark model extended with LTV and PTI financial frictions.
  - In both models, we derive the expected excess return to housing analytically and show that the excess return depends on both monetary and macroprudential policy parameters.
  - Financial frictions tend to increase the excess return to housing.

The Model

- The economy is composed of an ω measure of borrowers and $1-\omega$ measure of savers with heterogenous preferences in $[0, 1]$.

- Two sectors and each populated by a large number of monopolistic competitive firms.

- Households derive utility from consumption of nonhousing final goods and services of final housing goods.

- Debt accumulation reflects intertemporal trading between the borrowers and savers.

- In addition to budget constraints borrowers are subject to LTV and PTI constraints. Constraints

The Model

Borrowers Maximization Problem

- In our setting credit frictions consist of random combinations of LTV and PTI constraints: If the borrowers random income is above a threshold, the LTV constraint binds and if it is below, the threshold the PTI constraint binds.

- An increase in the interest rate tightens borrowing via the PTI constraint, which could be relaxed by working more but the decreased opportunity cost of leisure due to the higher interest rate reduces the borrowers' labor supply.

- An additional unit of housing relaxes the LTV constraint and allows the borrower to accumulate more debt but the PTI constraint limits this and reduces the debt level.

The Model

Expected Excess return on Housing With LTV and PTI

- Borrowers choose $\{C_t, N_t, H_t, b_t\}$ to maximize expected lifetime utility based on informations available at time 0 subject to: budget constraint and the combined debt constraint.

- Expected excess return to housing defined as $\mathbb{E}[R^h_{t+1}] - R_t = \frac{q_{t+1}}{q_t} - R_t$ depends on the monetary and macroprudential policy variables including shadow value of borrowing, user cost of housing, and, LTV and PTI limits.

▸ Cons. Index ▸ FOCs ▸ Excess return

The Model

Expected Excess Return on Housing with LTV and PTI Frictions

- The debt constraint has **direct** and **indirect** effects on excess return to housing:

  - **Direct effect:** binding debt constraint $\psi_t > 0 \implies$ marginal utility of nonhousing goods current period is higher than the expected marginal utility next period $\implies$ relative demand of housing $\downarrow \implies$ current price of housing $\downarrow \implies$ expected excess return $\uparrow$.

  - **Indirect effect:** covariance between the marginal utility of consumption next period and R^d_{t+1} is likely to be more negative because of a binding borrowing constraint. This reduces the ability of the household to smooth consumption, resulting in higher consumption variability, precautionary saving and a lower covariance between future consumption and housing returns. The hld will require a higher housing premium in order to invest in housing.

The Model / Equilibrium

- The savers optimization problem is same as the optimization problem without financial frictions. In terms of notation, ˜ over the variables pertain to the savers.
  Savers optimization problem

- There are intermediate and final goods producers in both the housing and nonhousing sectors. Firms optimization problem

- **The equilibrium:**
  - Given prices $\{P_{c,t}, P_{h,t}\}$, and wages, $\{C_t, H_t, b_t, N_t\}$ solve borrowers' problem.
  - Given prices and wages, $\{\tilde{C}_t, \tilde{H}_t, \tilde{b}_t, \tilde{N}_t\}$ solve savers' problem.
  - Given inflation, R_t satisfies the monetary policy rule.
  - The goods, labor, and credit market clear.

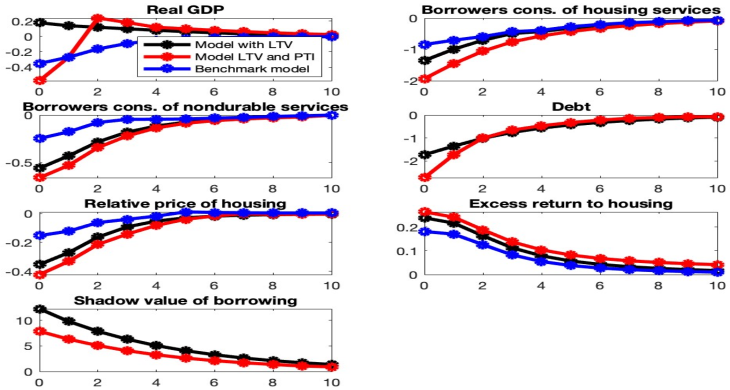
Calibration

- The steady state real rate of interest is pinned down to 4% by the savers discount factor $\gamma = 0.99$ and borrowers discount factor 0.98.
- The LTV limit is assumed to be 80% and PTI limit to be 30%.
- All other parameters are from the literature and presented in the following table:

▸ Parameters

Calibration/Results

- Impulse responses to 25 bps increase in the nominal interest rate in the model with and without financial frictions:



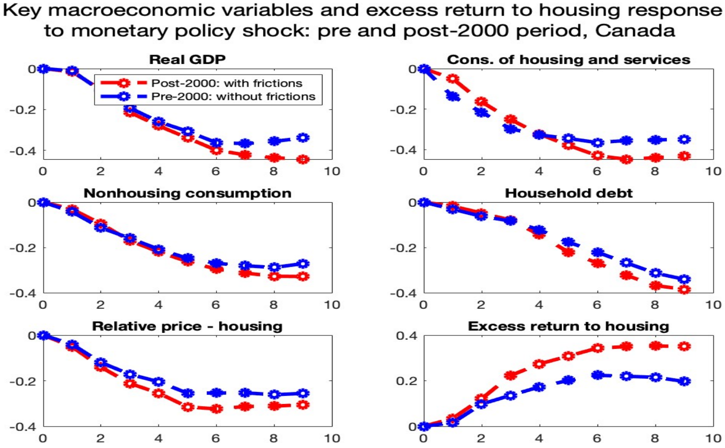
Contribution

- **Empirical Evidence:**
  A structural VAR was estimated with Canadian quarterly data for pre-2000 (1979Q1 - 1999/Q4) and post-2000 (2000Q1 - 2022Q4) periods. The variables in the dataset are: real GDP, housing consumption, nonhousing consumption, household debt, GDP deflator, excess return to housing, LTV and PTI limits, and nominal interest rate.
  SVAR
- **Results:**
  - The result shows higher excess return to housing in the post-2000 period than the pre-2000 period in response to the monetary policy shock. Pre and post-2000 IRFs
  - In the post-2000 period financial frictions were more binding in Canada.
  - Furthermore, the excess return to housing increases, household debt decreases and there is a negligible effect on real GDP in response to the LTV and PTI shocks.

Conclusions

- The model with both LTV and PTI constraints fits the data better. Further, these constraints have direct and indirect effects on excess returns to housing.
- Excess returns to housing increase in the model with both income and collateral constraints relative to the model with one or no financial constraints.
- LTV and PTI limits of 78% and 30% with 4% real rate of interest ensures the excess return of housing 5.87% which is closer to the empirical evidence of 6.91% return per year in post 2000 period. Steady state

- Empirical IRFs to overnight rate shocks: pre and post 2000 period.



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The Model

Borrowers Maximization Problem With LTV and PTI

- Then, the optimality conditions w.r.t. $\{C_t, N_t, H_t, b_t\}$ are:

$$\frac{-U_{n,t}}{U_{c,t}} = \frac{W_t}{P_{c,t}} \left[1 + \psi_t \frac{(1-\kappa^{pti})}{(R_t - 1 + \tau)} G(\bar{e}_t) \right] \tag{1}$$

$$U_{c,t} = \lambda_t \tag{2}$$

$$U_{c,t} q_t = U_{h,t} + \beta(1-\delta)\mathbb{E}_t[q_{t+1} U_{c,t+1}] + \left(1 - \kappa^{ltv}\right)(1-\delta) U_{c,t} \psi_t q_t \mathbb{E}_t(\pi_{h,t+1}) \frac{(1 - F_e(\bar{e}_t))}{R_t} \tag{3}$$

$$R_t \psi_t = 1 - \beta \mathbb{E}_t \left[\frac{U_{c,t+1}}{U_{c,t}} \frac{R_t}{\pi_{c,t+1}} \right] \tag{4}$$

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- Expected excess return to housing:

$$\mathbb{E}[R^h_{t+1}] - R_t = \frac{1 - \frac{1}{q_t} Z_t - \beta Cov\left(R^h_{t+1}, \lambda_{t+1}\right)}{\beta \mathbb{E}\left(\frac{\lambda_{t+1}}{\lambda_t}\right)} + \frac{\kappa^{ltv}(1-\delta)\psi_t \mathbb{E}_t(\pi_{h,t+1})}{\beta \mathbb{E}\left(\frac{\lambda_{t+1}}{\lambda_t}\right)(1 - G(\bar{e}_t))} - \frac{1}{\psi_t + \beta \mathbb{E}_t\left\{\frac{\lambda_{t+1}}{\lambda_t}\frac{1}{\pi_{c,t+1}}\right\}} \quad (5)$$

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- Excess return to housing in the model with LTV and PTI limit is 0.0587 which is close to the empirical result of 0.0691 year over year for last 22 years in Canada.

Table 1.2: Steady states

Variable	Description	Values	
		LTV	LTV and PTI
$4(R-1)$	Annual real interest rate	0.04	0.04
C/Y	Nonhousing consumption share to GDP	0.5312	0.5141
D/Y	Housing and services consumption share to GDP	0.3428	0.3136
b/Y	Debt to GDP	0.6123	0.5837
$\bar{H}$	Excess return to housing	0.0365	0.0587

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Table 1: Parameter Values

Parameter	Description	Values	
ϕ	Inverse elasticity of labor supply	1.000	Monachelli(2009)
ρ	Persistence of monetary shock	0.500	Monachelli(2009)
δ	Depreciation rate of housings	0.010	Monachelli(2009)
ϵ_j	Elasticity of substitution between varieties	6.000	Monachelli(2009)
η	Elast. of subst. between housing and nonhousing	1.167	Monachelli(2009)
ϕ_{pi}	Coefficient of inflation in Taylor rule	1.500	Monachelli(2009)
ω	Fraction of borrowers	0.540	Monachelli(2009)
μ	Share of housing consumption	0.200	Monachelli(2009)
τ	Debt related expenses parameter	0.0028	Greenwald(2018)
σ_e	Income dispersion	0.411	Greenwald(2018)

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Related Literature

- Presnt paper is closely related to the literature on Tommaso Monacelli (2009), Greenwald (2018) and Iacoviello and Neri (2010)

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The Model

Borrowers Maximization Problem

- Define an index of consumption:

$$X_t \equiv \left[(1-\mu)^{\frac{1}{\eta}}(C_t)^{\frac{\eta-1}{\eta}} + \mu^{\frac{1}{\eta}}(H_t)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}, \tag{6}$$

  where, C_t, H_t : nonhousing, housing final goods, at the end of period t, $\mu > 0$, share of housing, $\eta \geq 0$ the elasticity of substitution.

- The borrower maximizes utility, :

$$\sum_{t=0}^{\infty} \beta^t \left(log(X_t) - \frac{\nu N_t^{1+\phi}}{1+\phi} \right) \tag{7}$$

  subject to budget, LTV and PTI constraints. Here ϕ is the inverse elasticity of labor supply.

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- The average budget constraint (BC):

$$P_{c,t}C_t + P_{h,t}(H_t - (1-\delta)H_{t-1}) + R_{t-1}B_{t-1} = B_t + W_tN_t + T_t \quad (8)$$

where, B_t : the nominal debt, T_t : the government lump-sum transfer, W_t : the nominal wage common across sectors, N_t : total labor supply.

- Borrower $i's$ debt $B_{i,t}$ must satisfy both LTV and PTI constraints:

$$R_t B_{i,t}{}^{ltv} \leq \left(1 - \kappa^{ltv}\right)(1-\delta)\mathbb{E}_t\{H_{i,t}P_{h,t+1}\} \quad (9)$$

$$(R_t - 1 + \tau)\, B_{i,t}{}^{pti} \leq \left(1 - \kappa^{pti}\right) W_t N_{i,t} e_{i,t} \quad (10)$$

where, τ : taxes, insurance, and other borrowing costs associated with debt issuance and payment; $e_{i,t}$: a random shock to the borrower's labor income Back

- Infinitely lived representative saver chooses $\{\tilde{N}_t, \tilde{C}_t, \tilde{b}_t, \tilde{H}_t\}$ to maximize:

$$\mathbb{E}_0\{\sum_{t=0}^{\infty}\gamma^t(log(\tilde{X}_t) - \frac{\nu\tilde{N}_t^{1+\phi}}{1+\phi})\} \tag{11}$$

subject to,

$$\bar{C}_t + q_t\tilde{I}_t + R_{t-1}\frac{\tilde{b}_{t-1}}{\pi_{c,t}} = \tilde{b}_t + \frac{\tilde{W}_t}{p_{c,t}}\tilde{N}_t + \frac{\tilde{T}_t}{p_{c,t}} + \frac{\tilde{\Gamma}_{c,t}}{1-\omega} + \frac{q_t\tilde{\Gamma}_{h,t}}{1-\omega} \tag{12}$$

where, γ the savers discount factor, $\tilde{b}_t$ is end of period t real debt, and $\tilde{\Gamma}_{j,t}$ the aggregate nominal profits from the monopolistic competitive firms. Back

Completing the Model: Firms Maximization Problem

- Each producer in sector j operates the production function:

$$Y_{j,t} \equiv \left(\int_0^1 Y_{j,t}(i)^{\frac{\epsilon_j - 1}{\epsilon_j}} di\right)^{\frac{\epsilon_j}{\epsilon_j - 1}}, \ \epsilon_j > 1, j = c, h \qquad (13)$$

  where, $Y_{j,t}(i)$ is the intermediate good produced by firm $i \in [0, 1]$ demanded to produce final good j, ϵ_j, the elasticity of substitution between differentiated varieties in sector j.

- The firm i that produces intermediate goods j, choose the sequence of employment and prices $\{N_{j,t}(i), P_{j,t}(i)\}$ to maximize profit with linear production function $Y_{j,t}(i) = N_{j,t}(i) - F_j$, for firm i where, $F_j \geq 0$ a fixed cost.

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- $$Y_t = \sum_{j=1}^{L} A_j Y_{t-j} + B\epsilon_t \tag{14}$$

  where,
- A_j the $(L \times L)$ coefficient matrices.
- L is the number of variables considered in the model.
- Y_t is a vector consisting of endogenous variables in the framework.
- ϵ_t is a vector of contemporaneous disturbances.
- B is a matrix of structural coefficients that relate the endogenous variables to the structural shocks.

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