Managing a Housing Boom

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Disclaimer: Views presented are the authors’ and not necessarily those of the Bank of Canada.
Motivation

▶ Canada undergoing sustained housing boom, actively using macroprudential policy.

▶ Ex: 2016 policy tightened payment-to-income (PTI) limits by over 16%.

▶ Good laboratory for theory (Justiniano et al., 2015, Greenwald, 2018).
  - Implies tight PTI limits should be highly effective at dampening boom.
Main question: how can macroprudential policy be used effectively during a housing boom?

Approach: develop a GE model with main policy tools (LTV, PTI limits) and a key institutional feature: segmented submarkets.

- Government insured market: low down payments, tight PTI.
- Uninsured market: high down payments, loose PTI.
- Not specific to Canada (e.g., FHA vs. Fannie/Freddie in the US).

Main insights:

1. Multi-market structure allows larger housing booms.
2. Substitution between markets dampens effectiveness of PTI policy.
3. Effects of LTV (down payment) policy depend crucially on which submarket is targeted.
Model Overview

- **Borrowing**  $\Rightarrow$  impatient borrowers/patient savers.
  - Permanent types with fixed measure $\chi_j$ for $j \in \{b, s\}$.
  - Preferences:
    \[
    V_{j,t} = \log\left(\frac{c_{j,t}}{\chi_j}\right) + \xi \log\left(\frac{h_{j,t}}{\chi_j}\right) - \eta_j \frac{(n_{j,t}/\chi_j)^{1+\varphi}}{1 + \varphi} + \beta_j \mathbb{E}_t V_{j,t+1}
    \]

- **Mortgage debt**  $\Rightarrow$  durable housing.
  - Divisible, cannot change stock without prepaying mortgage.
  - Fixed housing stock, saver housing demand, no rental market.

- **Realistic mortgages**  $\Rightarrow$  long-term, fixed-rate, renew with prob. $\rho$.
  - At renewal, update balance and interest rate.

- **Endogenous interest rates, output, inflation**  $\Rightarrow$  labor supply, sticky prices, Taylor rule.
  - Intermediate production function: \( y_t(i) = a_t n_t(i) \).
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Credit Limits

- Two credit limits at origination only.

- Two sectors: government insured (I), and uninsured (U), indexed by j.

- Loan-to-value constraint $m_{i,t}^* \leq \theta_{j}^{LTV} p_t h_{i,t}^*$.
  - Looser in insured market: $\theta_{U}^{LTV} < \theta_{I}^{LTV}$
  - Credit limit: $\bar{m}_{i,j,t} \equiv \theta_{j}^{LTV} p_t h_{i,t}^*$.

- Payment-to-income constraint $(r_t^* + \nu + \alpha)m_{i,t}^* \leq (\theta_{j}^{PTI} - \omega) \cdot y_{i,t}$.
  - Tighter in insured market: $\theta_{U}^{PTI} > \theta_{I}^{PTI}$
  - Credit limit: $\bar{m}_{i,j,t}^{PTI} = (\theta_{j}^{PTI} - \omega) \cdot \text{income}_{i,t} / (r_t^* + \nu + \alpha)$. 
Constraint Structure by Submarket

Constraint space:
Constraint Structure by Submarket

- Data equivalent:

(a) Insured Sector

(b) Uninsured Sector
Credit Limits

- Overall credit limits:
  
  - Within sector $j$: $\bar{m}_i^j = \min \left( \bar{m}_i^{PTI}^j, \bar{m}_i^{LTV}^j \right)$
  
  - Across sectors: $\bar{m}_i = \max \left( \bar{m}_i^I, \bar{m}_i^U \right)$.

- Dispersion in house size/income ratio:
  
  $$y_{i,t} = w_t n_{b,t} e_{i,t}, \quad e_{i,t} \sim \Gamma_e$$

- Endog. fractions in each submarket, and limited by each constraint.
  
  - Borrowers choose submarket that gives larger loan.
  
  - Define $F_{j,t}^{LTV}$ to be fraction constrained by LTV in sector $j$. 
Representative Borrower’s Problem

- State variables: average principal balance $m_{t-1}$, mortgage payment $x_{t-1}$, housing stock $h_{b,t-1}$.

- Control variables: nondurable consumption $c_{b,t}$, labor supply $n_{b,t}$, prepayment rate, size of new houses $h^*_{b,t}$, size of new loans $m^*_t$.

- Budget constraint:

  $$c_{b,t} \leq \left(1 - \tau_y\right)w_t n_{b,t} - \pi^{-1}_t (1 - \tau_y) x_{t-1} - \pi^{-1}_t \nu j m_{t-1} + \rho \left( m^*_t - (1 - \nu) \rho \pi^{-1}_t m_{t-1} \right) - \rho p^h_t (h^*_t - h_{b,t-1}) + \delta p^h_t h_{b,t-1} + T_{b,t}$$

- Debt limit: $m^*_t \leq \int \max \left\{ \min \left( \bar{m}_{i,L,t}^{LTV}, \bar{m}_{i,L,t}^{PTI}, \bar{m}_{i,U,t}^{LTV}, \bar{m}_{i,U,t}^{PTI} \right), \min \left( \bar{m}_{i,L,t}^{LTV}, \bar{m}_{i,U,t}^{PTI} \right) \right\} d\Gamma_e(e_i)$
House Prices

- Representative borrower housing optimality condition:

\[
p^h_t = \frac{u^h_{b,t} / u^c_{b,t} + \mathbb{E}_t \left\{ \Lambda_{b,t+1} p^h_{t+1} \left[ 1 - \delta - (1 - \rho) C_{t+1} \right] \right\}}{1 - C_t}
\]

- \(C_t\) is marginal collateral value of housing.
  - Unconstrained borrowers: \(C_t = 0, \ p^h_t = \text{PV of rents}\)
  - Single market, LTV constraint: \(C_t = \mu_t \theta^{LTV}\)
  - Single market, LTV and PTI constraints: \(C_t = \mu_t F_{LTV}^{U} \theta^{LTV}\)
  - Dual market, LTV and PTI constraints: \(C_t = \mu_t \left( F_{LTV}^{U} \theta^{LTV}_U + F_{LTV}^{I} \theta^{LTV}_I \right)\)

- Uninsured conditionally more likely to be LTV constrained
  - Increase in uninsured share can boost house prices.
Calibration and Solution Technique

- Credit limits: taken directly from regulation.
  - Insured market: $\theta_I^{LTV} = 95\%, \theta_I^{PTI} = 44\%$.
  - Uninsured market: $\theta_U^{LTV} = 80\%, \theta_I^{PTI} = 70\% (\sim \infty)$.

- Preference and technology parameters: match key moments.
  - Ratio of house value to income among borrowers.
  - Typical mortgage rate.
  - Average time between renewals.

- Solution technique: nonlinear perfect foresight paths.
Intuition: Debt Limits

- Sample debt limit functions for household with income $100k.
  - Increasing regions: LTV-constrained (high collateral value).
  - Flat regions: PTI-constrained (low collateral value).
  - Marginal collateral value jumps discontinuously at switch points.

- Aggregate housing demand related to average steepness of curve.

(a) By Market

(b) Overall
Experiment: Housing Boom

- Generate boom using anticipated increase in housing utility.
  - Compare Benchmark to economies with only insured or uninsured sectors.

- As house prices rise, LTV limits loosen (collateral ↑) but PTI limits don’t.

- With two markets, substitution allows for much more credit growth.
  - Closer to all uninsured than all insured.
Aside: Parallel with US Boom/Bust

- Below: share of loans securitized by Ginnie Mae (FHA + VA).
  - Like insured sector. Low down payments (3.5%) + strict income reqs.

- Huge substitution out of insured sector during boom.
Intuition: Shock to PTI Limit

- Direct effect on insured market: reduce collateral demand (flatten curve), sharply tighten debt limits.

- Substitution into uninsured market largely undoes both effects.
  - Access to uninsured market mostly replaces lost borrowing.
  - Switch from PTI-constrained in insured to LTV-constrained in uninsured increases collateral demand.

(a) By Market ($\theta^{PTI}_I \downarrow$)

(b) Overall ($\theta^{PTI}_I \downarrow$)
Experiment: Shock to PTI Limits

- October 2016: new rule that PTI ratios must be evaluated at “posted” rate (~ 200bp higher than contract rate) in insured market only.
  - Effectively 16.5% tightening of PTI limit.
- Compare benchmark to economy with single (insured) market.
- Including uninsured submarket cuts effect of policy by more than half.
  - Large substitution out of insured market.

![Graphs showing the effect of the PTI shock](image)
Intuition: Shock to LTV Limits

- Tight $\theta_{I}^{LTV}$ reduces debt limits, but has no direct effect on switching.
- Slightly increases fraction LTV constrained, collateral demand.

(a) By Market ($\theta_{I}^{LTV} \downarrow$)

(b) Overall ($\theta_{I}^{LTV} \downarrow$)
Intuition: Shock to LTV Limits

- Tight $\theta_U^{LTV}$ induces switching to insured market.
- Flattens curve and reduces collateral demand, prices.
- But switching dampens effect on debt.

(a) By Market ($\theta_U^{LTV} \downarrow$)

(b) Overall ($\theta_U^{LTV} \downarrow$)
Experiment: Shock to LTV Limits

▶ Experiments reducing each LTV limit by 10ppt (Insured: 95% → 85%, Uninsured: 80% → 70%).

▶ Tightening in insured space has much bigger effect on debt (~4x) but almost no impact on house prices.

▶ Tightening in uninsured space substantially dampens prices by driving borrowers out of uninsured market, pushing down collateral demand.
Conclusion

- GE model with key macroprudential tools and segmented submarkets.
- Substitution allows larger booms, dampens effectiveness of PTI policy.
- Effects of LTV tightening depend on targeted submarket:
  - **Insured market**: large reduction in debt, little effect on house prices.
  - **Uninsured market**: smaller decline in debt, large fall in house prices.
- Next steps:
  - Directly compare theoretical and observed impact of policies.
  - Split between booming and flat regions.
  - Examine influence of mortgage market structure on monetary policy.
  - Analyze impact of policies in case of house price decline.