# Managing a Housing Boom

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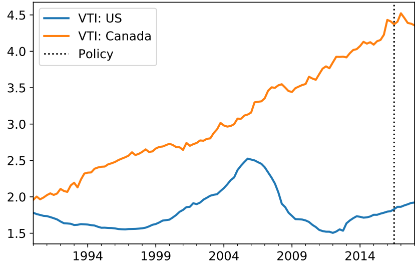
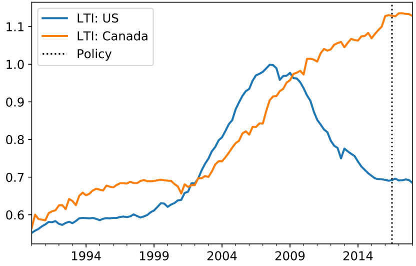
**Disclaimer:** Views presented are the authors' and not necessarily those of the Bank of Canada.

# 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.




(a) Aggregate Value-to-Income




(b) Aggregate Loan-to-Income

# This Paper

- **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 $\Longrightarrow$ impatient borrowers/patient savers.
  - Permanent types with fixed measure $\chi_j$ for $j \in \{b, s\}$.
  - Preferences:

$$V_{j,t} = \log(c_{j,t}/\chi_j) + \xi \log(h_{j,t}/\chi_j) - \eta_j \frac{(n_{j,t}/\chi_j)^{1+\varphi}}{1+\varphi} + \beta_j \mathbb{E}_t V_{j,t+1}$$

- Mortgage debt $\Longrightarrow$ durable housing.
  - Divisible, cannot change stock without prepaying mortgage.
  - Fixed housing stock, saver housing demand, no rental market.
- Realistic mortgages $\Longrightarrow$ long-term, fixed-rate, renew with prob. $\rho$.
  - At renewal, update balance and interest rate.
- Endogenous interest rates, output, inflation $\Longrightarrow$ labor supply, sticky prices, Taylor rule.
  - Intermediate production function: $y_t(i) = a_t n_t(i)$.

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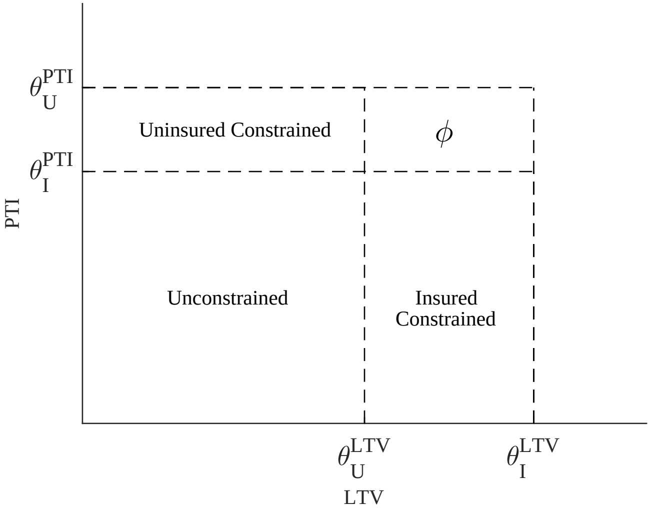
# Credit Limits

- Two credit limits **at origination only**.
- Two sectors: government insured $(I)$, and uninsured $(U)$, indexed by $j$.
- **Loan-to-value** constraint $m^*_{i,t} \leq \theta^{LTV}_j p^h_t h^*_{i,t}$.
  - Looser in insured market: $\theta^{LTV}_U < \theta^{LTV}_I$
  - Credit limit: $\bar{m}_{i,j,t} \equiv \theta^{LTV}_j p^h_t h^*_{i,t}$.
- **Payment-to-income** constraint $(r^*_t + \nu + \alpha) m^*_{i,t} \leq (\theta^{PTI}_j - \omega) \cdot y_{i,t}$.
  - Tighter in insured market: $\theta^{PTI}_U > \theta^{PTI}_I$
  - Credit limit: $\bar{m}^{PTI}_{i,j,t} = (\theta^{PTI}_j - \omega) \cdot \text{income}_{i,t} / (r^*_t + \nu + \alpha)$.

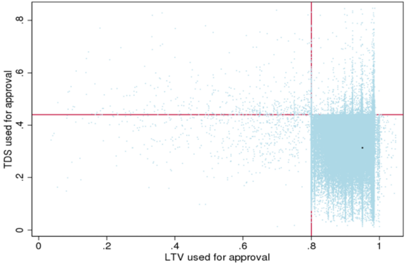
# Constraint Structure by Submarket

- Constraint space:

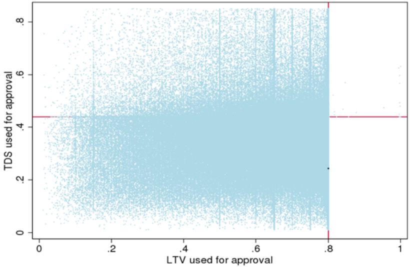


# Constraint Structure by Submarket

- Data equivalent:




(a) Insured Sector




(b) Uninsured Sector

# Credit Limits

- Overall credit limits:
  - Within sector $j$: $\bar{m}^{j}_{i,t} = \min\left(\bar{m}^{PTI}_{i,j,t}, \bar{m}^{LTV}_{i,j,t}\right)$
  - Across sectors: $\bar{m}_{i,t} = \max\left(\bar{m}^{I}_{i,t}, \bar{m}^{U}_{i,t}\right)$.
- Dispersion in house size/income ratio:

$$y_{i,t} = w_t n_{b,t} e_{i,t}, \quad e_{i,t} \overset{iid}{\sim} \Gamma_e$$

- Endog. fractions in each submarket, and limited by each constraint.
  - Borrowers choose submarket that gives larger loan.
  - Define $F^{LTV}_{j,t}$ 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:

$$
\begin{aligned}
c_{b,t} \leq\ & \underbrace{(1-\tau_y)w_t n_{b,t}}_{\text{labor income}} - \underbrace{\pi_t^{-1}(1-\tau_y)x_{t-1}}_{\text{interest payment}} - \underbrace{\pi_t^{-1}\nu_j m_{t-1}}_{\text{principal payment}} \\
& + \underbrace{\rho\left(m^*_t - (1-\nu)\rho\pi_t^{-1}m_{t-1}\right)}_{\text{net new debt issuance}} - \underbrace{\rho p^h_t\left(h^*_{b,t} - h_{b,t-1}\right)}_{\text{housing purchases}} \\
& - \underbrace{\delta p^h_t h_{b,t-1}}_{\text{maintenance}} + \underbrace{T_{b,t}}_{\text{transfers}}
\end{aligned}
$$

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

# House Prices

- Representative borrower housing optimality condition:

$$p_t^h = \frac{u_{b,t}^h / u_{b,t}^c + \mathbb{E}_t \left\{ \Lambda_{b,t+1} p_{t+1}^h \left[ 1 - \delta - (1 - \rho) \mathcal{C}_{t+1} \right] \right\}}{1 - \mathcal{C}_t}$$

- $\mathcal{C}_t$ is marginal collateral value of housing.
  - Unconstrained borrowers: $\mathcal{C}_t = 0$, $p_t^h$ = PV of rents
  - Single market, LTV constraint: $\mathcal{C}_t = \mu_t \theta^{LTV}$
  - Single market, LTV and PTI constraints: $\mathcal{C}_t = \mu_t F_t^{LTV} \theta^{LTV}$
  - Dual market, LTV and PTI constraints: $\mathcal{C}_t = \mu_t \left( F_{U,t}^{LTV} \theta_U^{LTV} + F_{I,t}^{LTV} \theta_I^{LTV} \right)$

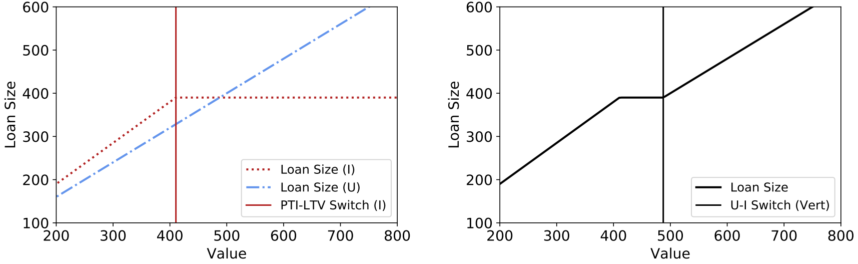
- Uninsured conditionally more likely to be LTV constrained
  - Increase in uninsured share can boost house prices.

# Calibration and Solution Technique

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

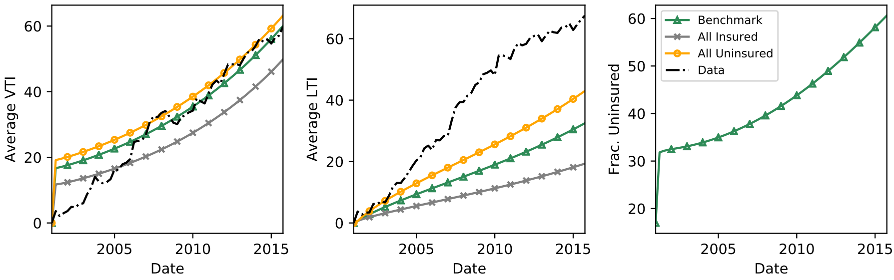
- Sample debt limit functions for household with income \$100k.
    - Increasing regions: LTV-constrained (high collateral value).
    - Flat regions: PTI-constrained (low collateral value).
    - Marginal collateral value jumps discontinuously at switch points.
- Aggregate housing demand related to average steepness of curve.




(a) By Market (b) Overall

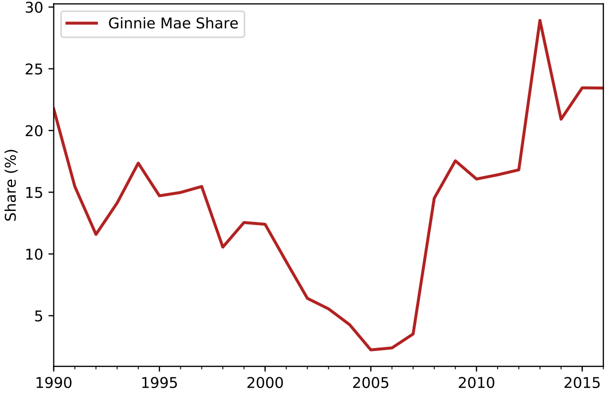
# Experiment: Housing Boom

- 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.



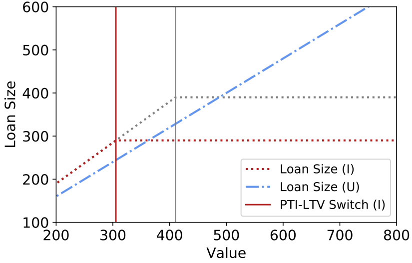
# Aside: Parallel with US Boom/Bust

- 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.

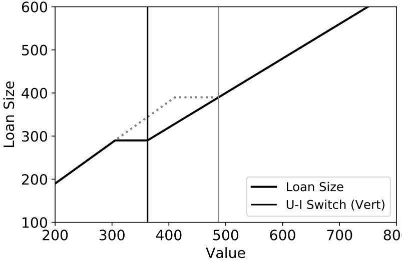


# Intuition: Shock to PTI Limit

- 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.



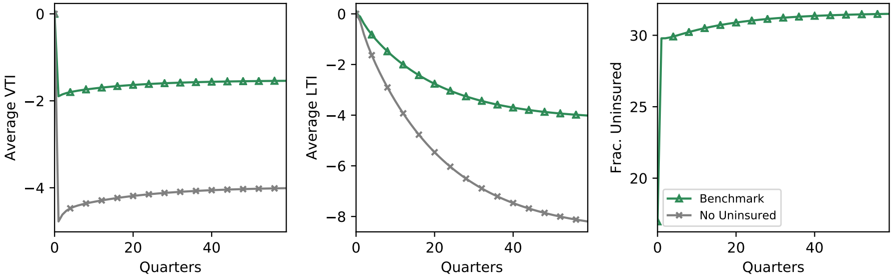

(a) By Market ($\theta_I^{PTI} \downarrow$)




(b) Overall ($\theta_I^{PTI} \downarrow$)

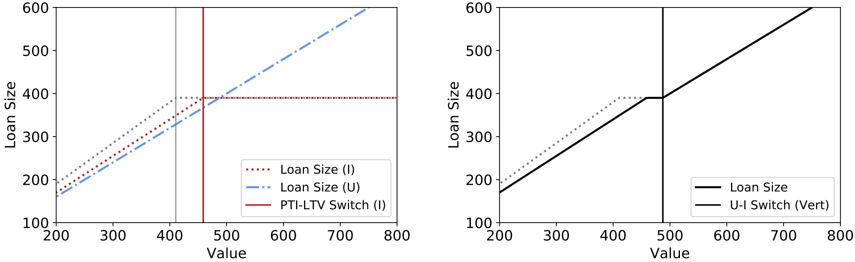
# Experiment: Shock to PTI Limits

- October 2016: new rule that PTI ratios must be evaluated at "posted" rate ($\sim$ 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.



# Intuition: Shock to LTV Limits

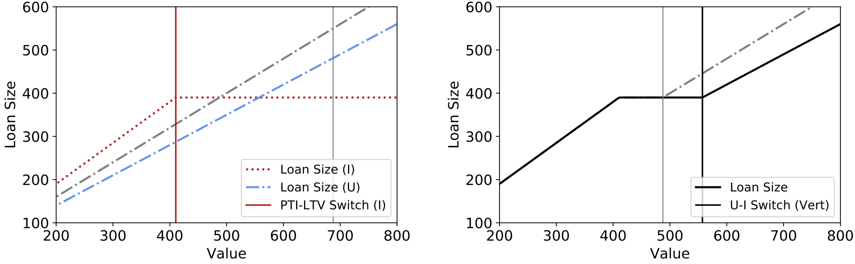
- Tight $\theta_I^{LTV}$ reduces debt limits, but has no direct effect on switching.
- Slightly increases fraction LTV constrained, collateral demand.




(a) By Market ($\theta_I^{LTV} \downarrow$)  (b) Overall ($\theta_I^{LTV} \downarrow$)

# Intuition: Shock to LTV Limits

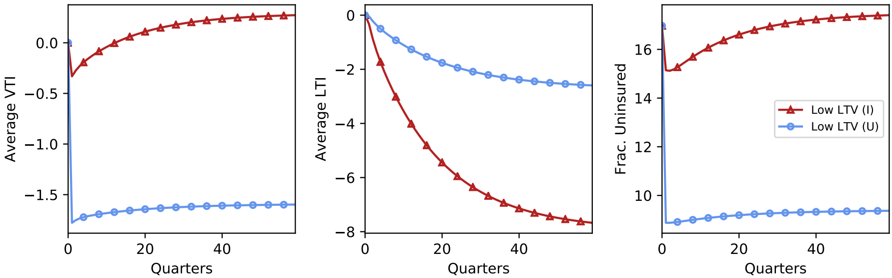
- Tight $\theta_U^{LTV}$ induces switching to insured market.
- Flattens curve and reduces collateral demand, prices.
- But switching dampens effect on debt.




(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.