Search and Credit Frictions in the Housing Market

Miroslav Gabrovski
U Hawaii Manoa

Victor Ortego-Marti
UC Riverside

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Motivation

- Housing market subject to search frictions
  - Takes time to find/sell house: ≈ 6 months to sell, US
  - Large fluctuations in time to buy/sell over the business cycle

- Housing market affected by credit frictions
  - Liquidity constraints: during 2016 88% of buyers use mortgage
  - Finding mortgage is costly and time consuming

This paper

- Model with search frictions on *both* housing and credit market
- Credit frictions $\Rightarrow$ multiple equilibria
  - Housing Entry: price and tightness negatively related
  - Price curve: downward sloping due to credit frictions
    - Buyer agreement point decreasing in time-to-buy
    - Tightness $\uparrow \Rightarrow$ time-to-buy $\uparrow \Rightarrow$ liquidity costs for financier $\uparrow$ $\Rightarrow$ financing fee $\uparrow \Rightarrow$ gains from trade b/w buyer and seller $\downarrow$ $\Rightarrow$ price $\downarrow$
- Quantitative importance of credit frictions channel
  - Low impact on prices
  - Matter more for housing liquidity and mortgage debt

Literature

- Search and housing market
  - Wheaton (1990 JPE), Arnott (1989 JREFE), Burnside et al (2016 JPE), Diaz Jerez (2013 IER), Head et al (2014/2016 AER), Ngai Tenreyro (2014 AER), Ngai Sheedy (2017), Novymarx (2009 REE), Piazzesi Schneider (2009 AERpp), Smith (2015), Gabrovski Ortego-Marti (2019, JET)

- Housing search + credit constraints
  - Guren McQuade (2018, WP), Hedlund (2016, JME), Head *et al.* (2016, WP)

- Credit market search
  - Wasmer Weil (2004, AER), Petrosky-Nadeau Wasmer (2018)

- Housing market, no search
  - Davis Heathcote (2005 IER), Piazzesi Schneider (2016 Handbook Macro)

Environment

- Continuous time, discount rate r
- Agents, risk neutral
  - Households: own house, search for credit/house, or idle
  - Realtor
  - Sellers: households, construction/new housing
  - Financiers: search for applicants, wait for buyers
- Houses identical
- Buyers need
  - Realtor to purchase home
  - Mortgage to finance purchase
- Sellers post vacancy, search for buyers

Environment

- Depreciation rate δ
- Exogenous separations s
- Search for houses/buyers $\rightarrow$ matching function, Pissarides
- b buyers, v vacancies, $\theta = b/v$ tightness
  - Matches: $M(b, v) = \mu b^{1-\alpha} v^{\alpha}$
  - House finding rate: $m(\theta) = \frac{M(b,v)}{b}$
  - House selling rate: $\theta m(\theta) = \frac{M(b,v)}{v}$

Environment

- Credit market frictions *a la* Wasmer Weil (2004, AER)
- $\mathfrak{a}$ applicants, $\mathfrak{f}$ financiers, $\phi = \mathfrak{a}/\mathfrak{f}$ tightness
  - Matches: $\mathcal{F}(\mathfrak{a}, \mathfrak{f}) = \mu_f \mathfrak{a}^{1-\alpha_f} \mathfrak{f}^{\alpha_f}$
  - Mortgage finding rate: $f(\phi) = \frac{\mathcal{F}(\mathfrak{a},\mathfrak{f})}{\mathfrak{a}}$
  - Applicant finding rate: $\phi f(\phi) = \frac{\mathcal{F}(\mathfrak{a},\mathfrak{f})}{\mathfrak{f}}$

Environment

Endogenous Entry

- Free entry of sellers: can build new houses at cost k
- Free entry of applicants at 0 cost
  - Realtor, cost of service: $\bar{c}b^{\gamma+1}/(\gamma+1)$ (Gabrovski Ortego-Marti 2019 JET; Sirmans Turnbull 1997 JUE)
  - Competitive market, charges buyers fee c^B
- Free entry of financiers at 0 cost
- Steady state: $\mathfrak{a}f(\phi) = bm(\theta)$

Bellman Equations

- Financiers liquidity cost: c^F
  - Provide mortgage $\Rightarrow$ miss out on investing in illiquid assets
  - Cost of marketing, servicing applicants
- Financiers

$$rF_0 = -c^F + \phi f(\phi)(F_1 - F_0)$$

- Applicants

$$rB_0 = -c_0 + f(\phi)(B_1 - B_0)$$

Bellman Equations

- Realtor profit max $\Rightarrow c^B(b) = \bar{c}b^\gamma$
  - Includes realtor fee, related search costs (congestion externalities, etc.)
  - If constant or decreasing

    $\Rightarrow$ baseline model with no buyers entry (everyone buyer/applicant)

- Buyers

$$rB_1 = -c^B(b) + m(\theta)\left(H - B_1 - dp - \frac{\rho}{r+\delta}\right)$$

- Financiers (with matched buyer)

$$rF_1 = -c^F + m(\theta)\left(\frac{\rho}{r+\delta} - F_1 - p(1-d)\right)$$

Bellman Equations

- Utility flow of home ownership: ε
- Homeowners

$$rH = \varepsilon - s(H - V) - \delta H$$

- Vacancy

$$rV = -c^S + \theta m(\theta)(p - V) - \delta V$$

Bargaining

- Search frictions $\rightarrow$ surplus
- Credit Market
  - Applicant surplus $S^A = B_1 - B_0$
  - Financier surplus $S^F = F_1 - F_0$
- Housing Market
  - Buyer surplus $S^B = H - dp - \frac{\rho}{r+\delta} - B_1$
  - Seller surplus $S^V = p - V$

Bargaining

- Sequential Nash Bargaining
  - Applicant and financier bargain over repayment schedule $\rho(p)$
  - Buyer and seller take mortgage contract as given
- Credit market

$$\rho = \arg\max_{\rho} (S^F)^{\beta} (S^A)^{1-\beta}$$

$\Rightarrow \beta =$ bargaining strength of financier

- Housing market

$$p = \arg\max_{p} (S^S)^{\eta} (S^B)^{1-\eta}$$

$\Rightarrow \eta =$ bargaining strength of seller

Equilibrium

- Credit Entry condition

$$(\text{CE}): \qquad \phi = \frac{1-\beta}{\beta}\frac{c^F}{c_0}$$

- Repayment Equation

$$(\text{RE}): \qquad \underbrace{\frac{\rho}{r+\delta}}_{\text{Mortgage Size}} = \underbrace{p(1-d)}_{\text{Principal}} + \underbrace{\frac{r+m(\theta)+\phi f(\phi)}{m(\theta)\phi f(\phi)}c^F}_{\text{Financing Fee}}$$

- $\theta \uparrow \Rightarrow$ Financing Fee $\uparrow$
  - Low $m(\theta) \Rightarrow$ incur c^F for longer
  - Low $m(\theta) \Rightarrow$ receive ρ later

Equilibrium

- Buyer Entry condition

$$(\text{BE}): \qquad \frac{c^B(b)}{m(\theta)} + \frac{rc_0}{m(\theta)f(\phi)} = \frac{1-\eta}{\eta}(p-k)$$

- Housing Entry condition

$$(\text{HE}): \qquad p = k + \frac{(r+\delta)k + c^S}{\theta m(\theta)}$$

- (HE) downward sloping: $\theta \uparrow \Rightarrow$ search costs $\downarrow \Rightarrow p \downarrow$

Equilibrium

- Use (RE) $\Rightarrow$

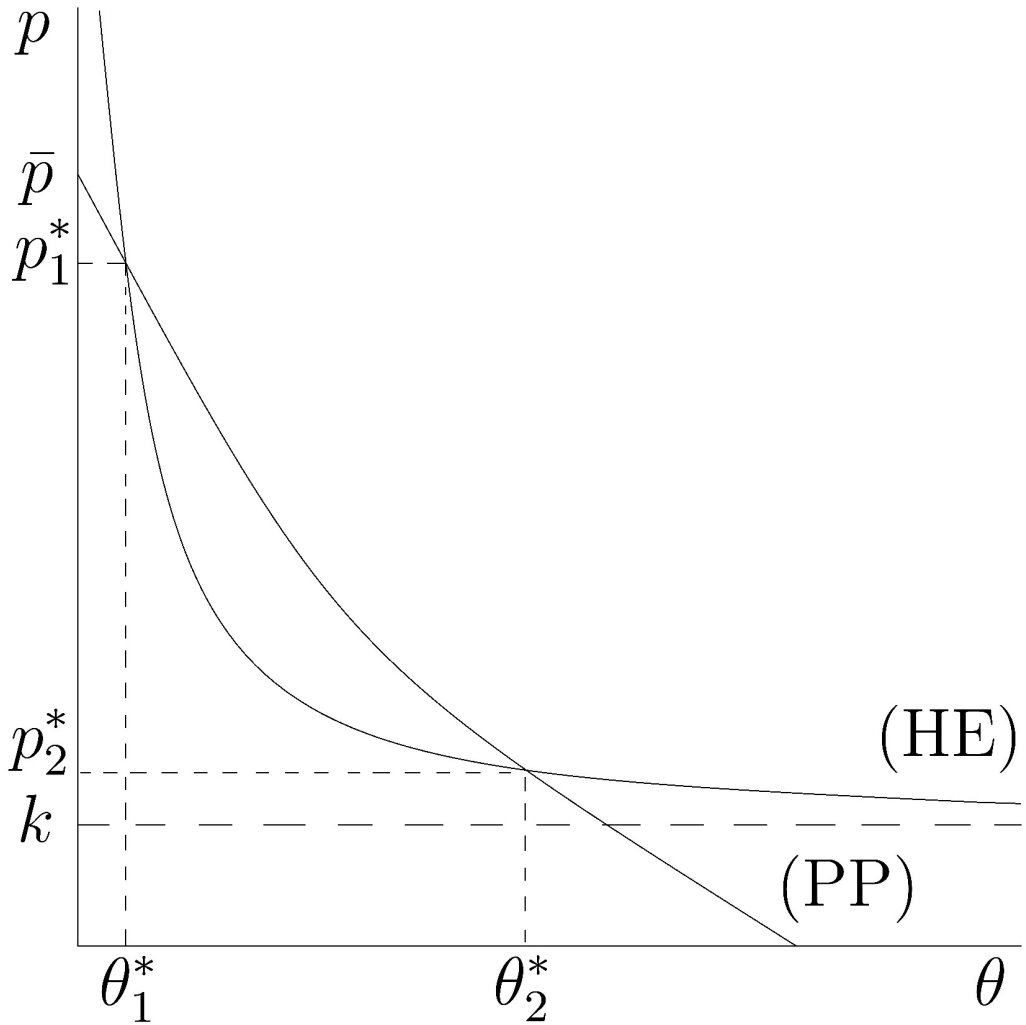
$$S^B = \overbrace{\left[H - p - \underbrace{\frac{r + m(\theta) + \phi f(\phi)}{m(\theta)\phi f(\phi)} c^F}_{\text{Financing Fee}}\right]}^{\text{Agreement Point}} - B_1$$

- Agreement Point of buyer decreasing in θ
- Price Equation

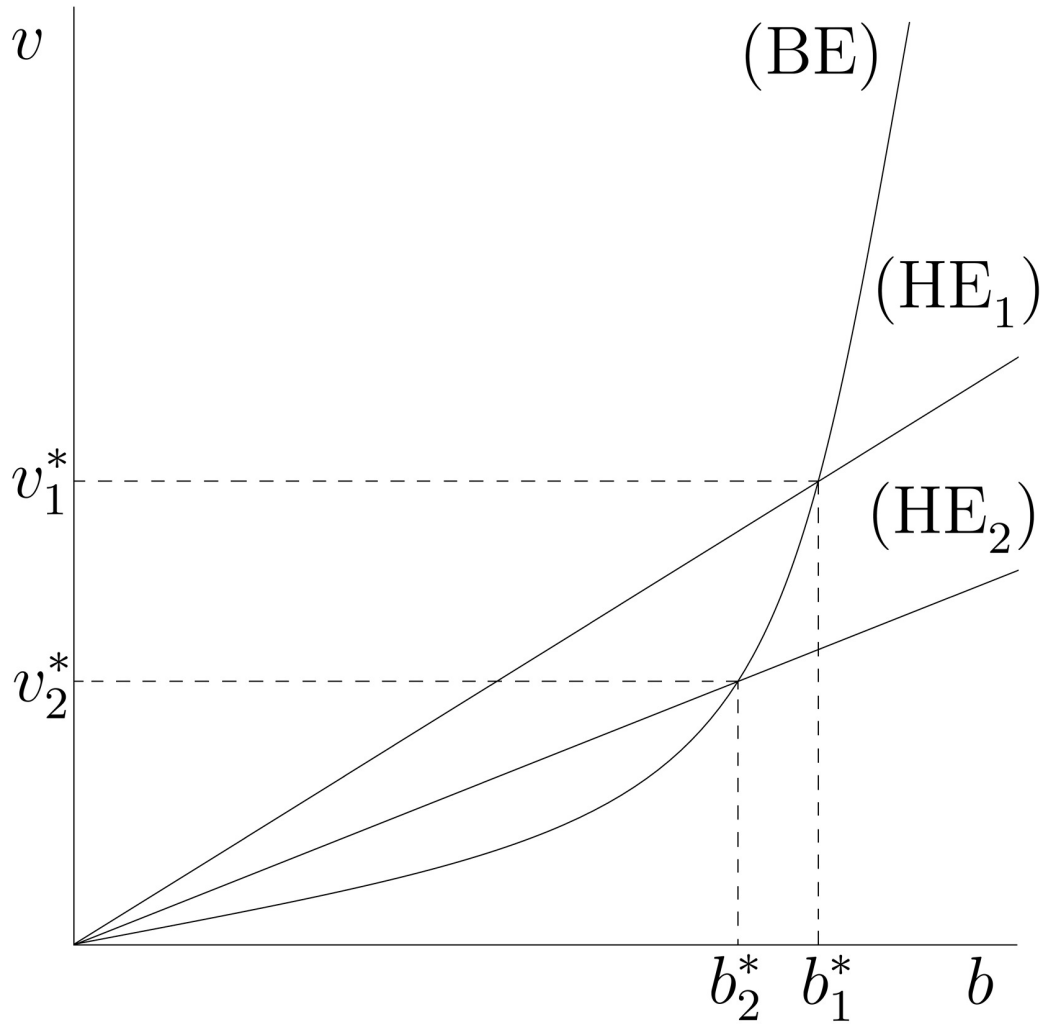
$$\text{(PP)}: \quad p = k + \eta \left[\frac{\varepsilon + sk}{r + s + \delta} - \frac{c_0}{f(\phi)} - \frac{r + m(\theta) + \phi f(\phi)}{m(\theta)\phi f(\phi)} c^F - k\right]$$

- (PP) downward sloping: $\theta \uparrow \Rightarrow$ Fin Fee $\uparrow \Rightarrow S^B \downarrow \Rightarrow p \downarrow$

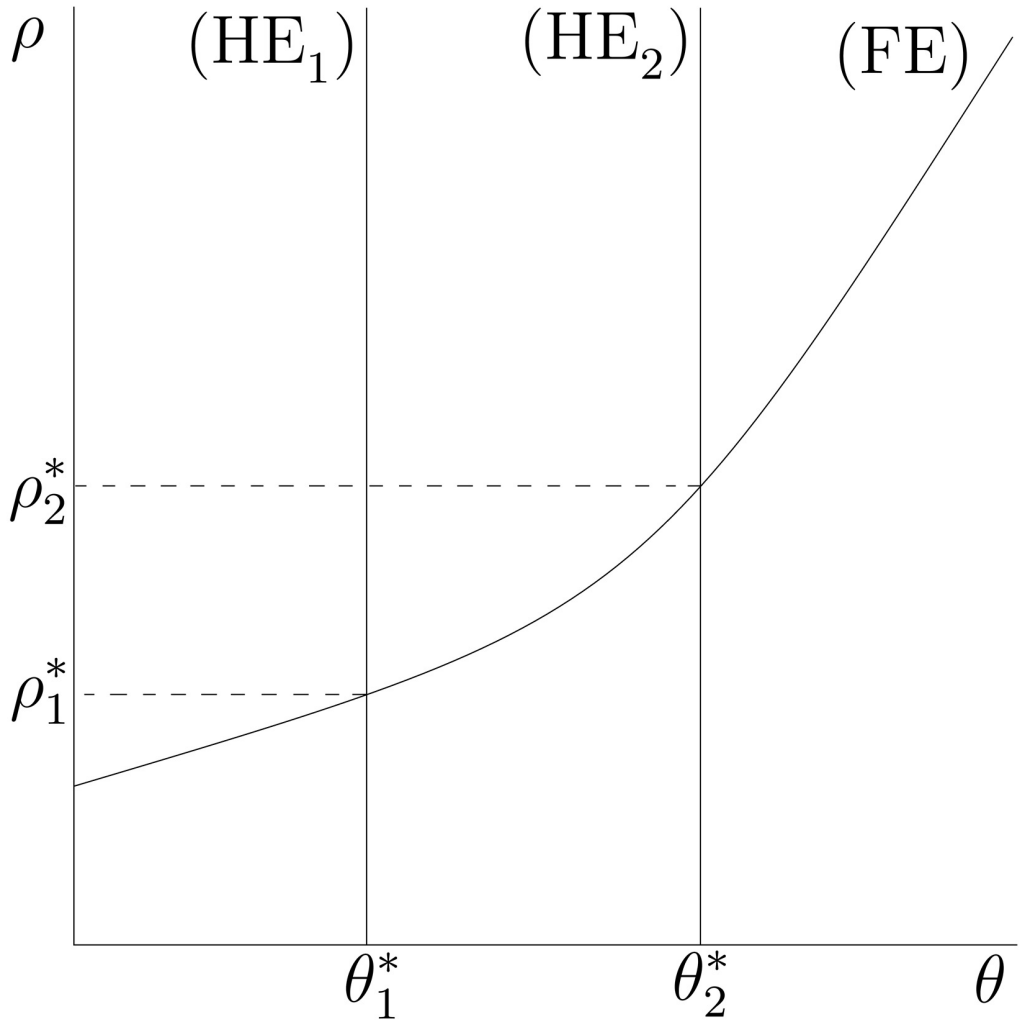
Equilibrium price p^*, tightness θ^*



Equilibrium buyers b^*, vacancies v^*

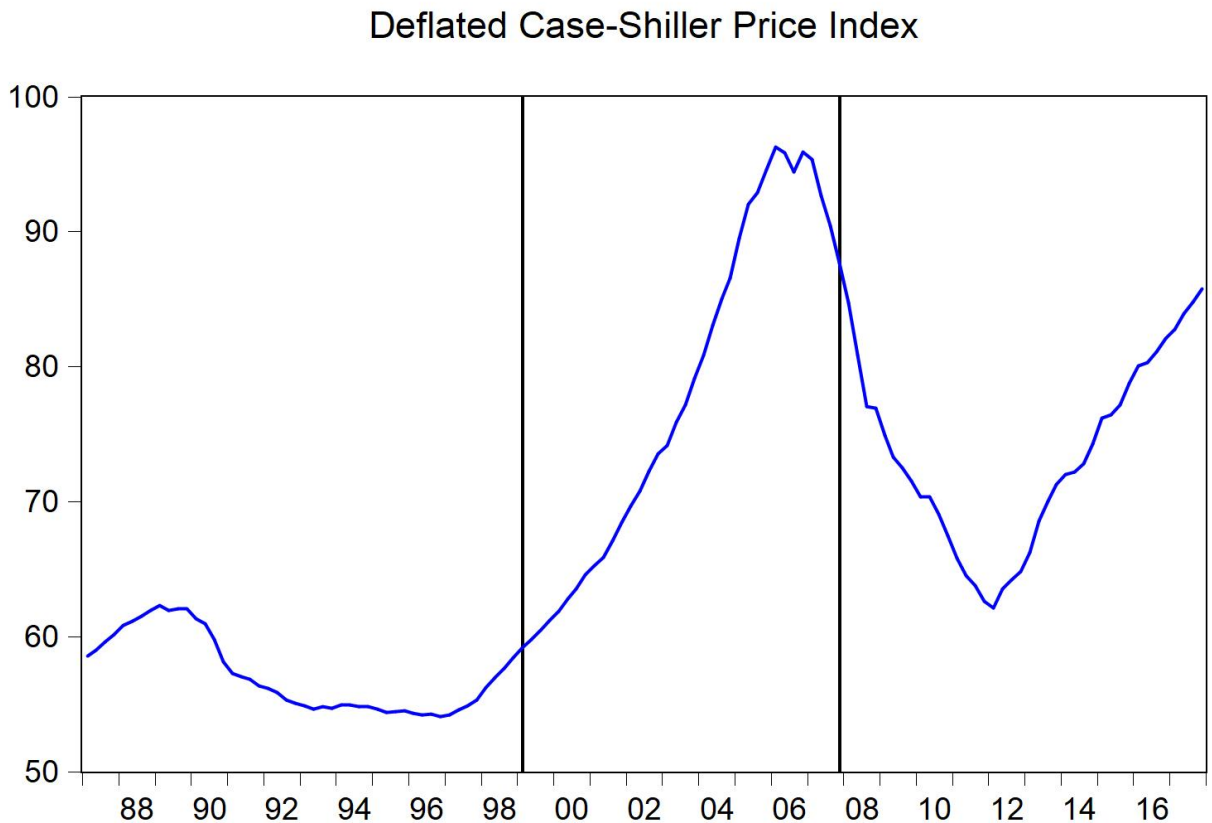


Equilibrium tightness θ^*, repayment ρ^*



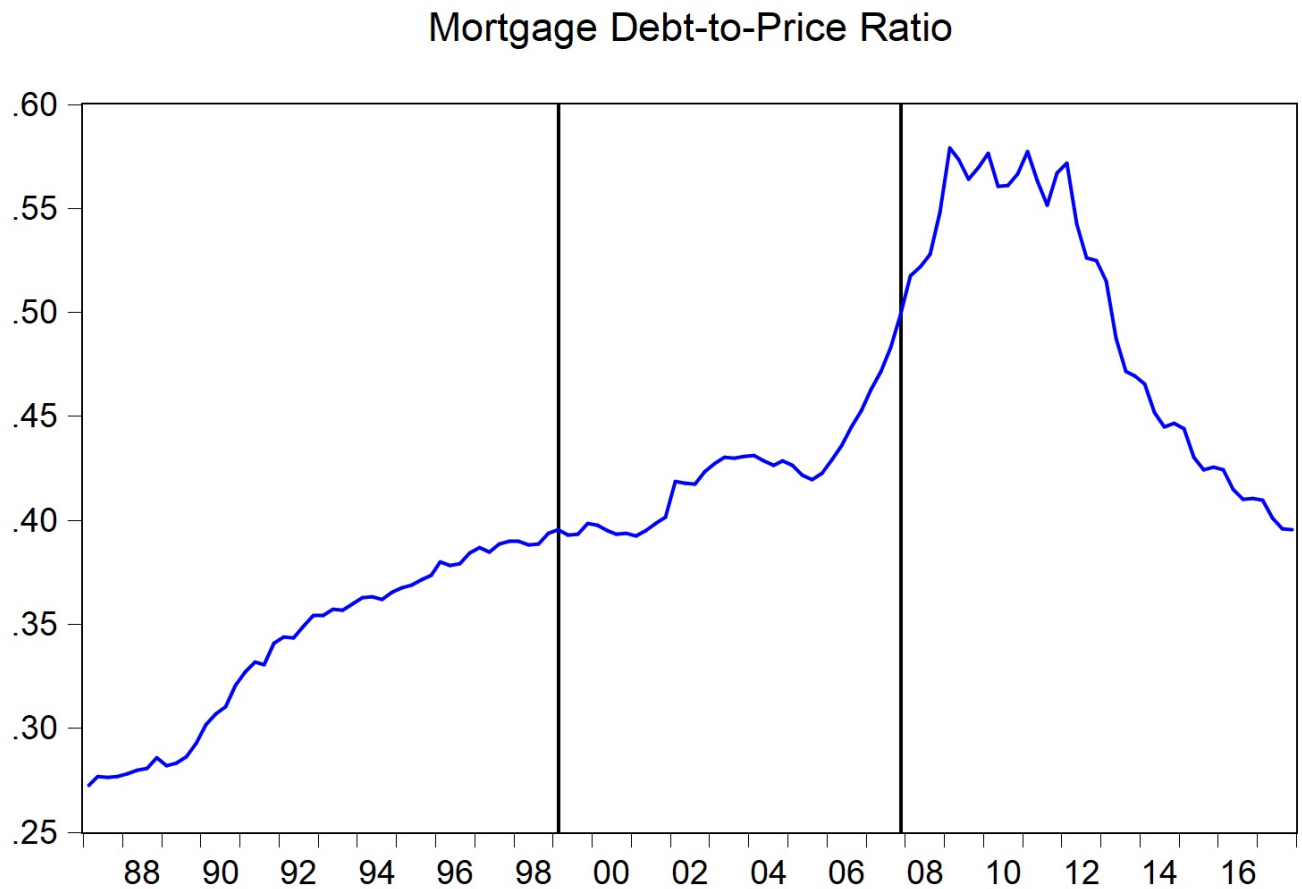
Numerical Exercise

- Prior to 2007 housing market crash:
  - Increase in prices



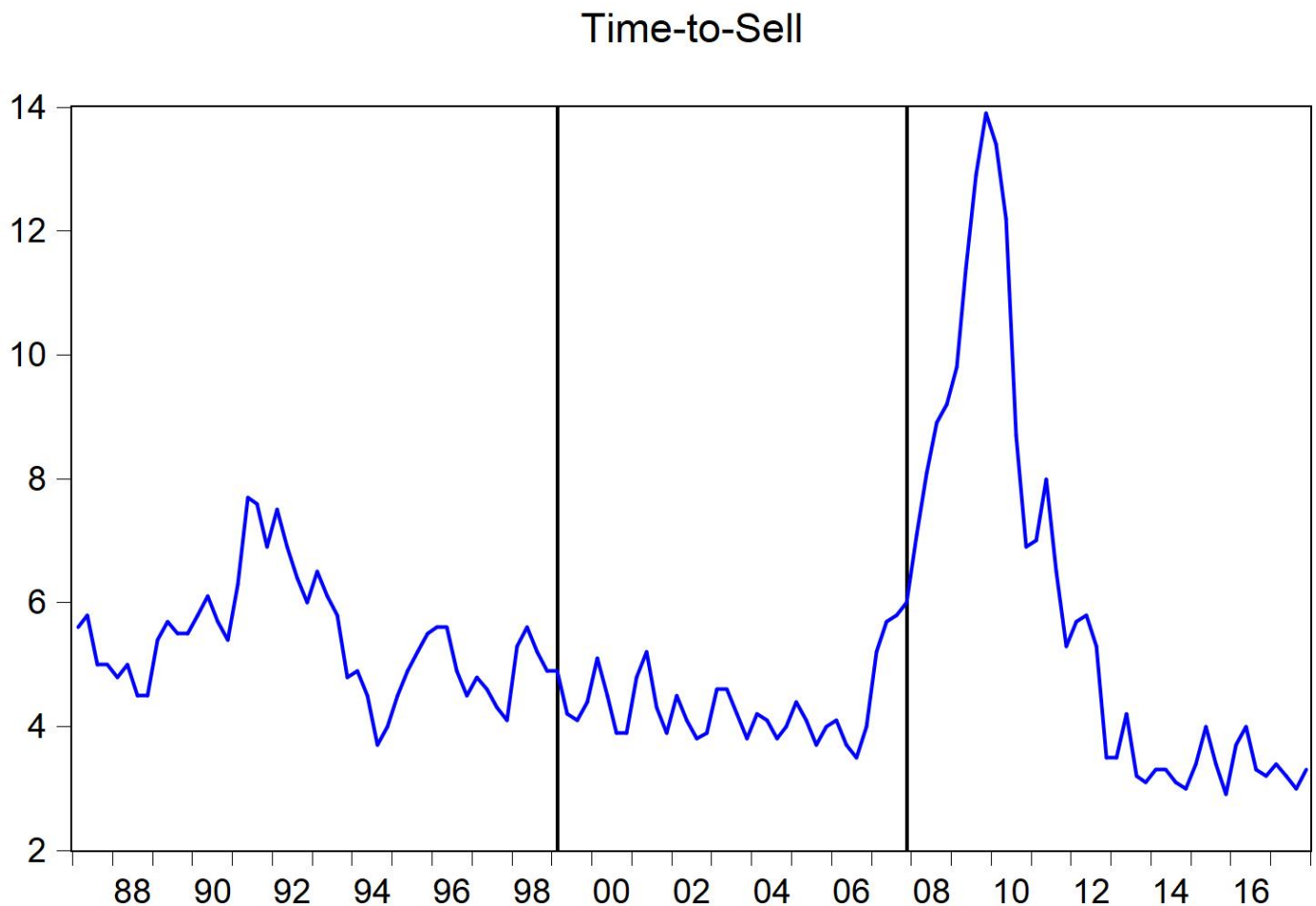
Numerical Exercise

- Prior to 2007 housing market crash:
  - Increase in Mortgage Debt-to-Price



Numerical Exercise

- Prior to 2007 housing market crash:
  - No trend in Time-to-Sell



Numerical Exercise

- Decompose observed changes in data into 5 shocks
  - Housing market shocks
    - Demand: ε
    - Supply: k
  - Credit market shocks
    - Liquidity costs: c^F
    - Matching efficiency: μ_f
    - Bargaining strength: β
- Study contribution of credit channel in counter-factual exercises

Numerical Exercise: Shock Decomposition

Table: Shocks

Shock		Data Target	
Variable	% Change	Variable	% Change
ε	82.22%	Price	51.71%
k	53.71%	Time-to-Sell	8.74%
c^F	−12.66%	Aaa bond yield relative to 10-y c.m. Treasury bond	−42.58%
μ_f	−67.40%	Mortgage Originations to Applications Ratio	−3.97%
β	60.14%	Mortgage Debt to Price Ratio	16.46%

Counter-Factual Scenarios

Table: Impact of Credit Shocks

No Change in Credit Market Shoks c^F, μ_f, β			
Variable	Price	Time-to-Sell	Debt-to-Price
Counter-factual Change	64.91%	165.31%	−1.99%

Counter-Factual Scenarios

Table: Impact of Credit Shocks

No Change in Liquidity Costs, c^F			
Variable	Price	Time-to-Sell	Debt-to-Price
Counter-factual Change	50.45%	−6.11%	18.24%

Counter-Factual Scenarios

Table: Impact of Credit Shocks

No Change in Matching Efficiency, μ_f			
Variable	Price	Time-to-Sell	Debt-to-Price
Counter-factual Change	62.91%	141.51%	1.84%

Counter-Factual Scenarios

Table: Impact of Credit Shocks

No Change in Bargaining Strength, β			
Variable	Price	Time-to-Sell	Debt-to-Price
Counter-factual Change	58.74%	92.10%	2.78%

Conclusion

- Model with search frictions in *both* housing and credit market
- Credit friction channel $\rightarrow$ multiple equilibria
  - Tightness $\uparrow \Rightarrow$ Fin. Fee $\uparrow \Rightarrow$ Buyer's agreement point $\downarrow$
    $\Rightarrow$ Price Curve downward sloping
- Numerical example: Credit shocks have sizable effect on housing market
  - Low impact on prices
  - Matter more for time-to-sell and mortgage debt