Phasing out the GSEs

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Motivation

- Large government footprint in mortgage finance. GSE MBS account for
  - 60% of stock of mortgage debt
  - 80% of originations in last 5 years

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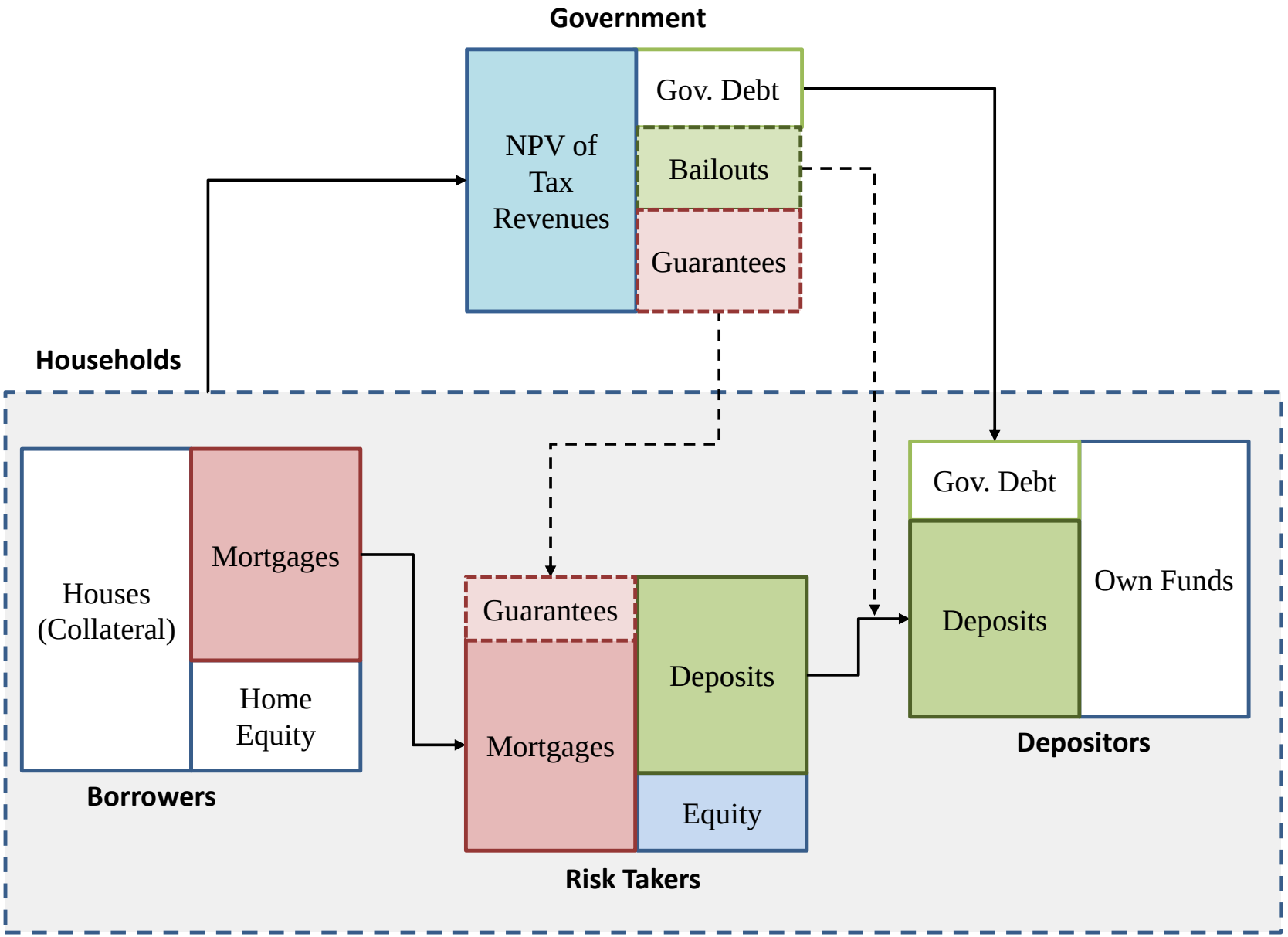
  - Ability of government to provide cushion in crises
- Welfare consequences of phase-out: "crowding in" the private sector
  - Opinions differ for effect on mortgage stability, house prices, etc. (Mortgage Bankers Association vs Congressional Budget Office)
  - Consensus around reform building (Johnson-Crapo bill)

Model Overview



Preview of Findings

1. Effect of guarantees
   - Cheap fixed-price guarantees distort mortgage pricing ...
     - ★ 16 % more mortgage debt
     - ★ 9% higher house prices
     - ★ 2.2 pp higher foreclosure rate
   - ... and increase financial fragility
     - ★ Risk takers have 10% higher leverage
     - ★ More frequent financial crises
   - Feedback: guarantees $\Rightarrow$ more bank leverage & mortgage debt $\Rightarrow$ more foreclosures $\Rightarrow$ more guarantees

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2. Welfare and Risk Sharing
   - Aggregate welfare gain of 5% from phase out
   - Depositors $>$ Risk takers $>$ Borrowers
   - Negative impact of guarantees due to
     - ★ less efficient allocation of risk
     - ★ foreclosure-induced DWL

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3. Interaction of asset and liability guarantees: deposit insurance amplifies effect of guarantees

Related Literature

- Quantitative models on causes and consequences of the housing boom:
  - Kiyotaki, Michaelides & Nikolov 2011, Favilukis, Ludvigson & Van Nieuwerburgh 2013, Landvoigt, Piazzesi & Schneider 2015, Chu 2014
  - Corbae & Quintin 2014, Garriga & Schlagenhauf 2009, Chetterjee & Eyigungor 2009, Jeske, Kruger, & Mittman 2013, Landvoigt 2013, Arslan, Guler, & Taskin 2013, Hedlund 2014

- Financial intermediaries and crises:
  Brunnermeier & Sannikov 2012, He & Krishnamurthy 2013, Gârleanu & Pedersen 2011, Adrian & Boyarchenko 2012 Drechsler, Savov, & Schnabl 2014

Households and Goods

- Households are three types, $j = B, D, R$:
  borrowers, depositors and risk-takers
- 2 goods: housing consumption, nonhousing consumption (numeraire)
- Aggregate endowment of numeraire consumption,
  grows with stochastic trend
- Housing tree pays housing services as dividends
- Households have preferences over both goods
  - Consumption bundle: Cobb-Douglas aggregator
  - Epstein-Zin over consumption bundle
    with intertemporal elasticity of one, risk aversion σ_j, discount factor β_j
- Households get share of income,
  initial endowment K^j of shares in housing tree

Borrowers

- Large family of households who choose consumption, houses, mortgage debt, opt. default threshold
- Mortgages are (i) long-term
- (ii) defaultable,
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  - Face value of debt at beginning of period

$$\text{debt}_{t-1} = \frac{\alpha}{1-\delta} \times \#\text{ of bonds} \equiv F \times A^B_{t-1}$$

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  - Each period, borrower i receives idiosyncratic house valuation shock ω_i
  - Value of house after shock $\omega_i p_t K^B_{t-1}$
  - Borrowers optimally choose owners of houses who default $\Rightarrow$ threshold ω^*_t s.t. default for all $\omega_i < \omega^*_t$
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  - Option to prepay amount R^B_t of outstanding debt at face value F for convex cost $\Psi(R^B_t / A^B_{t-1})$

Borrowers (contd.)

- Housing shock distribution $G(\omega)$ with $\mathrm{E}(\omega_i) = \mu_\omega = 1-$depreciation
  - Default rate $Z_A(\omega_t^*) = G(\omega_t^*)$
  - $1-$ Recovery rate of lender $= Z_K(\omega_t^*) = \int_{\omega > \omega_t^*} \omega \, dG(\omega)$
- Variance $\sigma^2_{\omega,t}$ determines aggregate credit risk of borrower debt
- $A_t^B = \delta(1 - Z_A(\omega_t^*))A_{t-1}^B - R_t^B +$ new borrowing
- Budget constraint

$$(1-\tau)\mathrm{Y} + q^m A_t^B + Z_K(\omega^*)\, pK_{t-1}^B =$$

$$\mathrm{C} + (1 - Z(\omega^*))(1-\delta)q^m A_{t-1}^B + FR_t^B + \Psi\left(\frac{R_t^B}{A_{t-1}^B}\right) + pK_t^B$$

- Borrowing constraint: $F\, A_t^B \leq \phi p K_t^B$

▸ Complete Problem

Risk Takers

- Risk takers are households that arise as intermediaries between borrowers and depositors
- Timing of risk taker decisions
  1. Bankruptcy choice
  2. Consumption and portfolio choice
- Risk taker bankruptcy
  - leads to liquidation of assets and liabilities
  - and RTs incur (stochastic) utility penalty
  - Government covers shortfall if assets $-$ liabilities < 0
- Effectively limited liability and deposit insurance

Risk Takers (contd.)

- Portfolio choice of
  - private mortgage bond A_P^R with payoff M_P and price q^m

$$M_P = 1 - Z(\omega^*) + \frac{(1-\zeta)(\mu_\omega - Z_K(\omega^*))pK^B}{A^B}$$

  - guaranteed bond A_G^R with payoff M_G and price $q^m + \gamma$

$$M_G = 1 + \delta Z(\omega^*)F$$

  - Risk free one-period bond B^R with price q
- No short-sales for both mortgage bonds and leverage constraint

$$-B^R \leq q^m(\xi_P A_P + \xi_G A_G)$$

- Beginning-of-period risk taker wealth

$$\begin{aligned} W_t^R =& [M_{P,t} + \delta(1 - Z(\omega_t^*)) - Z_t^R(q_t^m - F)]A_{P,t-1}^R \\ &+ [M_{G,t} + \delta(1 - Z(\omega_t^*)) - Z_t^R(q_t^m - F)]A_{G,t-1}^R \\ &+ B_{t-1}^R \end{aligned}$$

▸ Complete Problem

Depositors and Government

- Depositors are very risk averse
  and only invest in risk free bonds, B^D

- Government follows passive tax and spending rule
  - Revenues

$$T_t = \tau_t^B Y_t^B + \tau_t^S (Y_t^R + Y_t^D) - \tau_t^m Z_A(\omega_t^*) A_t^B + \gamma A_{t,G}^R$$

  - Expenditures

$$G_t = (M_{G,t} - M_{P,t}) A_{G,t}^R - I_{\{\text{R bankruptcy}\},t} W_t^R + G_t^T$$

  - Budget constraint

$$B_{t-1}^G + G_t = q_t B_t^G + T_t$$

  - Transversality condition to ensure B^G stays bounded

Competitive Equilibrium

Given realizations $\{Y_t, \sigma_{\omega,t}\}$, sequence of choices

$\{C_t^B, K_t^B, A_t^B, R_t^B, \omega_t^*\}$ for borrower households

$\{D_t, C_t^R, A_{P,t}^R, A_{G,t}^R, B_t^R\}$ for risk-taker households

$\{C_t^D, B_t^D\}$ for depositor households

and prices $\{q_t^m, q_t, p_t\}$ such that all agents optimize and all asset markets clear

$$B_t^G = B_t^R + B_t^D$$
$$A_t^B = A_{P,t}^R + A_{G,t}^R$$
$$K_t^B = \bar{K} - K^D - K^R$$

Goods market

$$C_t^B + C_t^R + C_t^D + \text{Housing maint.} + \text{Prepaym. cost} = Y_t - \text{Forecl. losses}$$

State Variables and Solution Method

- Exogenous states
  - Persistent growth rate of income
  - Mortgage credit risk $\sigma_{\omega,t}$
- Endogenous states: wealth distribution matters for asset prices due to differences in preferences
  - Total mortgage debt (borrower wealth)
  - Risk-taker wealth
  - Depositor wealth
  - Government debt
- Nonlinear global solution method (policy time iteration)
  - Wealth distribution between risk-taker and depositor depends on differences in risk aversion
  - Collateral constraints not always binding
  - Bankruptcy choice

Equilibrium Characterization

- Borrowers' optimal default threshold

$$\omega_t^* = \frac{(1 - \tau^m - \psi' + \delta q_t^m) A_t^B}{p_t K_{t-1}^B}$$

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- Risk takers' demand for private mortgage bonds ...

$$q_t^m (1 - \xi_P \lambda_t^R) = \mathrm{E}_t \left[\tilde{\mathcal{M}}_{t,t+1}^R \left(M_{P,t+1} + \delta (1 - Z(\omega_{t+1}^*)) q_{t+1}^m - Z_{t+1}^R (q_{t+1}^m - F) \right) \right]$$

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- ... and mortgage default insurance (guaranteed bonds)

$$\gamma = \mathsf{E}_t \left[\tilde{\mathcal{M}}_{t,t+1}^R \left(M_{G,t+1} - M_{P,t+1} \right) \right] + \lambda_t^R q_t^m \left(\xi_G - \xi_P \right)$$

Calibration: Mortgage Risk

1. Jointly estimate mortgage duration δ and face value $F = \frac{\alpha}{1-\delta}$ from Barclays MBS index using prepayment model ▸ Model
   - Auxiliary pricing model to back out duration of data mortgage pool
   - Match geometric bond's price-rate relationship to auxiliary model: $\delta = 0.95$, $\alpha = 0.52$

2. Two states of mortgage risk $[\sigma_{\omega,lo}, \sigma_{\omega,hi}]$ with transition matrix P^{ω}
   - to match average loss rates on mortgages
   - and frequency and length of mortgage crises (Jorda, Shularick, and Taylor (2014))

3. Set borrower leverage ϕ to match mortgage debt/income of "borrower" households in SCF

Calibration: Overview

Parameter & Description	Value	Target
Exogenous Shocks		
$\bar{g}$ mean income growth	1.9%	Mean rpc GDP gr 1929-2013
σ_g volatility income growth	3.9%	Vol rpc GDP gr 1929-2013
ρ_g persistence income growth	0.41	AC(1) rpc GDP gr 1929-2013
μ_ω mean idiosync. house value shock	2.5%	Housing depreciation Census
Population, Income, and Housing Shares		
ℓ^i, $i \in \{B, D, R\}$ population shares	{47,51,2}%	Population shares SCF 1995-2013
Y^i, $i \in \{B, D, R\}$ income shares	{38,52,10}%	Income shares SCF 1995-2013
K^i, $i \in \{B, D, R\}$ housing shares	{39,49,12}%	Housing wealth shares SCF 1995-2013
Preferences		
σ^B risk aversion borrower	8	Vol household mortgage debt to GDP 1985-2014
β^B time discount factor borrower	0.88	Mean housing wealth to GDP 1985-2014
θ^B housing expenditure share	0.20	Housing expenditure share NIPA
σ^D risk aversion depositor	20	Volatility risk-free interest rate 1985-2014
$\beta^D = \beta^R$ time discount factor savers	0.975	Mean risk-free interest rate 1985-2014
σ^R risk aversion risk taker	4	Financial sector leverage Flow of Funds 1985-2014
ν intertemp. elasticity of subst.	1	
Government Policy		
$\tau^S = \tau^B$ income tax rate	19.83%	BEA govmt revenues to trend GDP 1929-2013
G^o exogenous govmt spending	15.8%	BEA govmt spending to trend GDP 1929-2013
G^T govmt transfer to HH	3.41%	BEA govmt net transfers to trend GDP 1929-2013
τ^m mortgage interest rate deductibility	0.48 τ^B	See text
ϕ collateral constr	0.65%	Mean borrowers' mortgage debt-to-income SCF 1995-2013
ξ_G margin guaranteed MBS	1.6%	Basel 2/3 regulatory capital charge agency MBS
ξ_P margin private MBS	8%	Basel 2/3 regulatory capital charge non-agency mortgages

Model Simulation: Different G-fees

▸ G-fees

	20 bp g-fee		25 bp g-fee		65 bp g-fee	
	mean	stdev	mean	stdev	mean	stdev
			Prices			
Risk free rate	-0.001	0.018	0.023	0.031	0.032	0.035
Mortgage rate	0.035	0.003	0.039	0.003	0.042	0.003
House price	2.121	0.138	2.041	0.100	1.934	0.100
			Risk-Taker			
Market value of bank assets	0.603	0.027	0.550	0.020	0.507	0.021
Market value of private bonds	0.213	0.240	0.494	0.166	0.507	0.021
Market value of guaranteed bonds	0.390	0.243	0.056	0.162	0.000	0.000
Risk taker leverage	0.955	0.034	0.866	0.048	0.849	0.055
Fraction $\lambda^R > 0$	0.922	0.269	0.205	0.404	0.154	0.361
Bankruptcy frequency	0.186	0.389	0.002	0.039	0.000	0.014
Return on RT wealth (excld. bankr.)	0.131	0.730	0.041	0.226	0.033	0.217
			Borrower			
Market value of debt LTV	0.760	0.072	0.724	0.057	0.706	0.058
Default rate	0.046	0.102	0.022	0.051	0.018	0.046
Rate-induced prepayment rate	0.087	0.025	0.048	0.026	0.029	0.026
Loss rate private	0.023	0.054	0.011	0.027	0.009	0.024
Loss rate guaranteed (prepaym.)	0.006	0.012	0.002	0.004	0.001	0.003
			Government			
Government debt / GDP	0.195	0.179	0.051	0.059	0.021	0.005

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Bankruptcy frequency	0.186	0.389	0.002	0.039	0.000	0.014
Return on RT wealth (excld. bankr.)	0.131	0.730	0.041	0.226	0.033	0.217
			Borrower			
Market value of debt LTV	0.760	0.072	0.724	0.057	0.706	0.058
Default rate	0.046	0.102	0.022	0.051	0.018	0.046
Rate-induced prepayment rate	0.087	0.025	0.048	0.026	0.029	0.026
Loss rate private	0.023	0.054	0.011	0.027	0.009	0.024
Loss rate guaranteed (prepaym.)	0.006	0.012	0.002	0.004	0.001	0.003
			Government			
Government debt / GDP	0.195	0.179	0.051	0.059	0.021	0.005

Model Simulation: Different G-fees

	20 bp g-fee		25 bp g-fee		65 bp g-fee	
	mean	stdev	mean	stdev	mean	stdev
			Prices			
Risk free rate	-0.001	0.018	0.023	0.031	0.032	0.035
Mortgage rate	0.035	0.003	0.039	0.003	0.042	0.003
House price	2.121	0.138	2.041	0.100	1.934	0.100
			Risk-Taker			
Market value of bank assets	0.603	0.027	0.550	0.020	0.507	0.021
Market value of private bonds	0.213	0.240	0.494	0.166	0.507	0.021
Market value of guaranteed bonds	0.390	0.243	0.056	0.162	0.000	0.000
Risk taker leverage	0.955	0.034	0.866	0.048	0.849	0.055
Fraction $\lambda^R > 0$	0.922	0.269	0.205	0.404	0.154	0.361
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Sources of Welfare Differences

Welfare is lower in low g-fee economy due to

- less efficient allocation of risk
  - Effect on volatility of consumption through worse insurance
  - Effect on mean of consumption through lower interest rates
  - Can gauge these effects by looking at ratios of marginal utilities (complete markets = ratios are constant)
- larger deadweight losses from foreclosure: effect on mean of consumption

	20 bp g-fee		**25 bp g-fee**		**65 bp g-fee**	
	mean	stdev	mean	stdev	mean	stdev
Aggregate Welfare	0.309	0.008	0.313	0.008	0.324	0.009
Consumption borrower	0.300	0.040	0.296	0.031	0.295	0.030
Consumption depositor	0.393	0.018	0.413	0.012	0.420	0.009
Consumption risk taker	0.077	0.011	0.075	0.005	0.073	0.004
log(MU ratio) borrower/risk taker	-0.766	0.226	-0.774	0.139	-0.852	0.116
log(MU ratio) risk taker/depositor	1.109	0.154	1.146	0.082	1.174	0.051

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Role of Limited Liability and Capital Requirements

	Benchmark 20 bp		High μ_ρ		$\xi_G = 92\%$	
	mean	stdev	mean	stdev	mean	stdev
			Prices			
Risk free rate	-0.001	0.018	0.020	0.032	0.017	0.029
Mortgage rate	0.035	0.003	0.039	0.003	0.038	0.003
House price	2.121	0.138	2.099	0.101	2.063	0.106
			Risk Taker			
Market value of bank assets	0.603	0.027	0.572	0.020	0.563	0.019
Market value of private bonds	0.213	0.240	0.512	0.175	0.504	0.171
Market value of guaranteed bonds	0.390	0.243	0.060	0.172	0.059	0.169
Risk taker leverage	0.955	0.034	0.865	0.048	0.869	0.044
Fraction $\lambda^R > 0$	0.922	0.269	0.216	0.411	0.243	0.429
Bankruptcy frequency	0.186	0.389	0.000	0.000	0.001	0.033
Return on RT wealth (excld. bankr.)	0.131	0.730	0.040	0.225	0.055	0.239
			Borrower			
Market value of debt LTV	0.760	0.073	0.731	0.058	0.732	0.059
Default rate	0.046	0.105	0.024	0.054	0.025	0.057
Loss rate private	0.023	0.054	0.012	0.028	0.013	0.030
Loss rate guaranteed	0.006	0.012	0.002	0.005	0.002	0.006
			Government			
Government debt / GDP	0.195	0.179	0.082	0.092	0.064	0.072
			Welfare			
Aggregate Welfare	0.309	0.008	0.318	0.009	0.320	0.009

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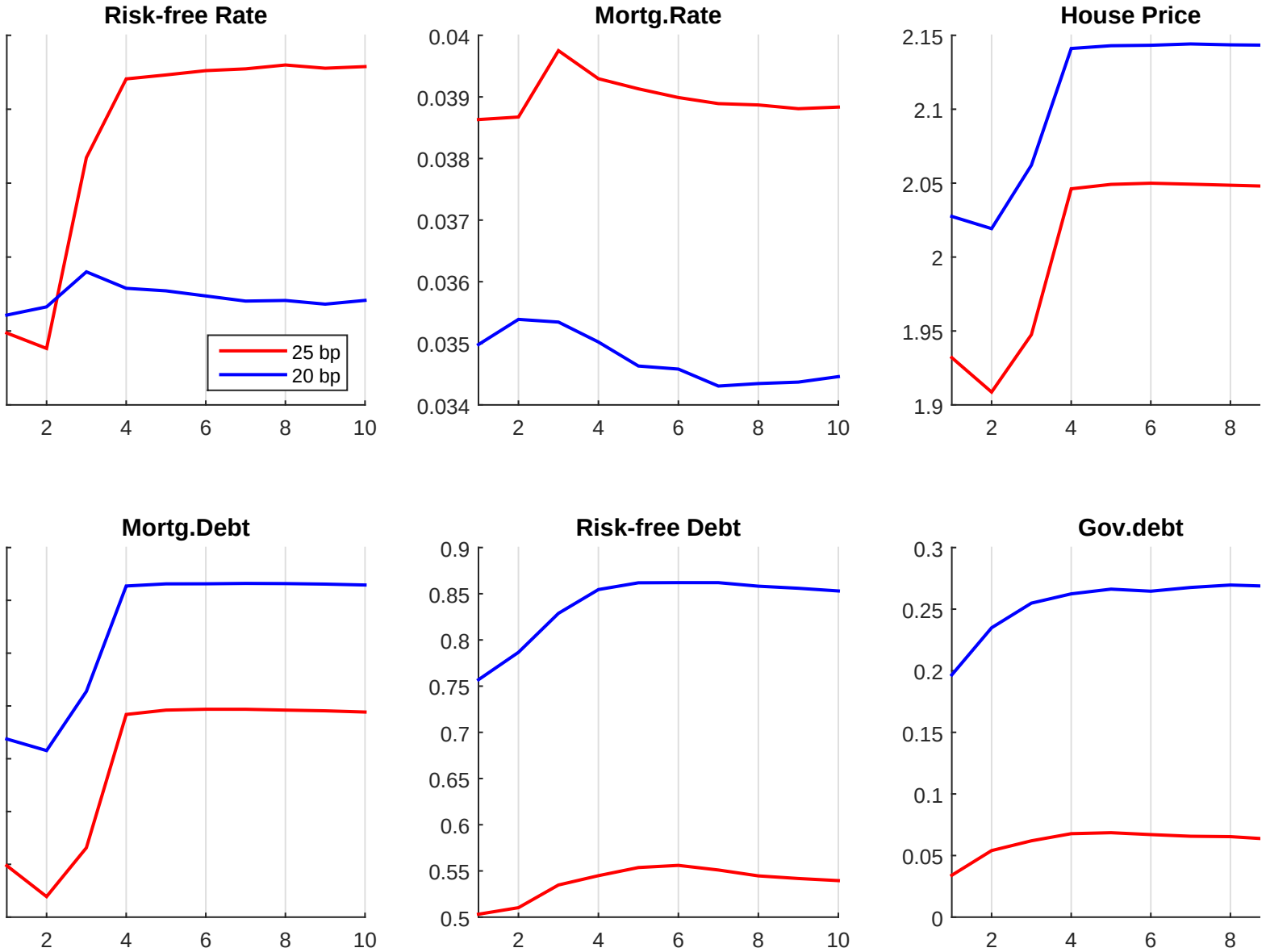
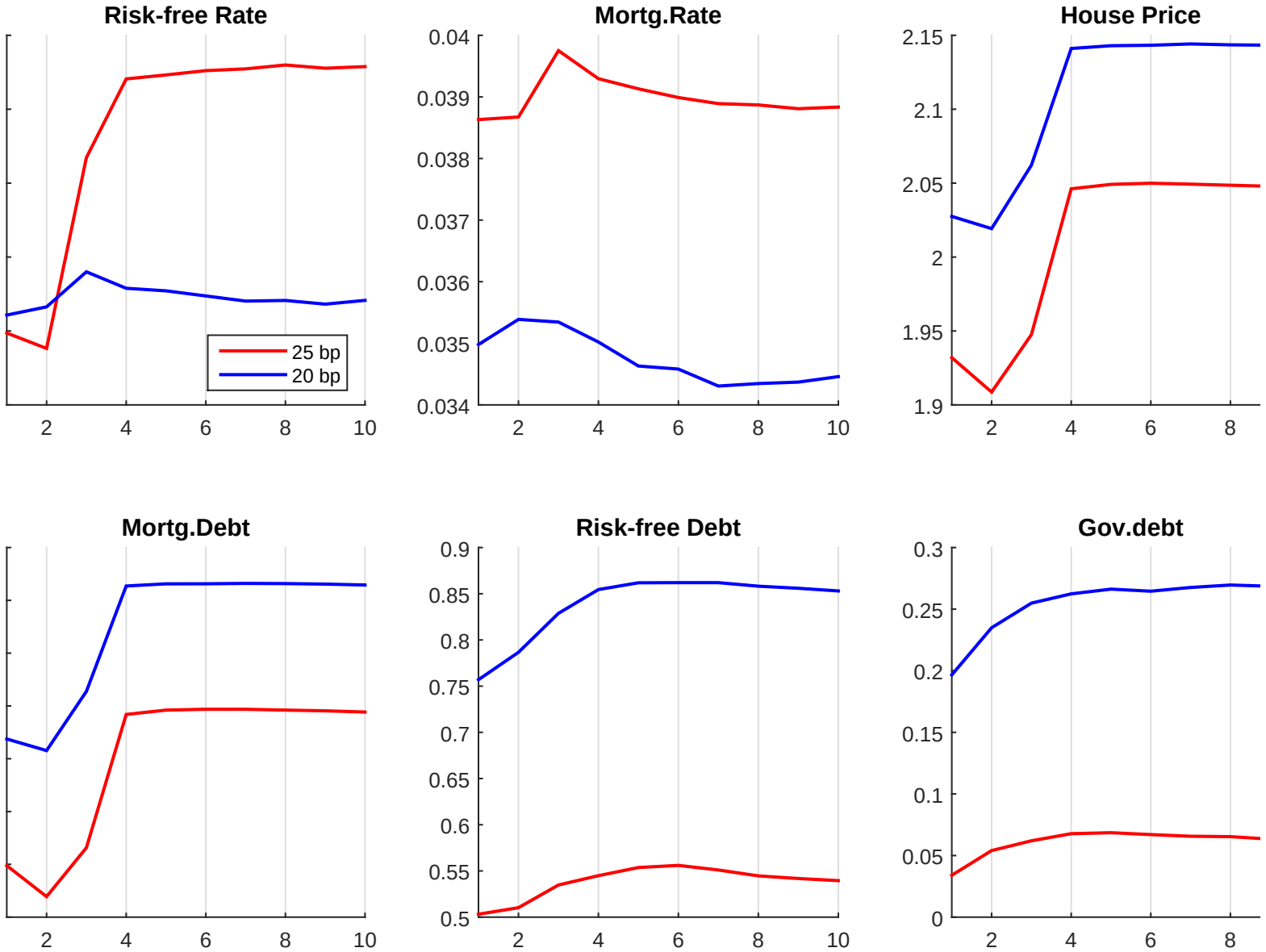
Dynamics During Mortgage Crisis



Dynamics During Mortgage Crisis



Conclusion and Outlook

- Underpriced government guarantee leads to pecuniary externality
  - Intermediaries stop pricing credit risk in mortgage rates
  - More debt and foreclosures
- Limited liability and low capital charges of intermediaries greatly amplify effect
- Welfare higher in economy without guarantees
  - Intermediaries are constrained less often
  - Better allocation among households with different risk preferences
- Next steps
  - Allow depositors to hold guaranteed bonds (mutual funds)
  - Evaluate policy proposal from Corker-Warner
  - Production economy: effect of mortgage guarantees on other productive lending opportunities in economy

Borrowers: Complete Problem

Back

$$V^B(K^B_{t-1}, A^B_t, \mathcal{S}^B_t) = \max_{\{C^B_t, K^B_t, \omega^*_t, R^B_t, B^B_t\}} \left\{ (1-\beta_B) \left[\left(C^B_t\right)^{1-\theta} \left(A_K K^B_{t-1}\right)^{\theta} \right]^{1-1/\nu} + \right.$$

$$\left. + \beta_B \mathsf{E}_t \left[\left(e^{g_{t+1}} \tilde{V}^B(K^B_t, A^B_{t+1}, \mathcal{S}^B_{t+1}) \right)^{1-\sigma_B} \right]^{\frac{1-1/\nu}{1-\sigma_B}} \right\}^{\frac{1}{1-1/\nu}}$$

subject to

$$\begin{aligned}
C^B_t &= (1-\tau^B_t) Y^B_t + G^{T,B}_t + Z_K(\omega^*_t) p_t K^B_{t-1} + q^m_t B^B_t \\
&\quad - (1-\tau^m_t) Z_A(\omega^*_t) A^B_t - p_t K^B_t - F R^B_t - \Psi(R^B_t, A^B_t) \\
A^B_{t+1} &= e^{-g_{t+1}} \left[\delta Z_A(\omega^*_t) A^B_t - R^B_t + B^B_t \right] \\
\phi p_t K^B_t &\geq F \left[\delta Z_A(\omega^*_t) A^B_t - R^B_t + B^B_t \right] \\
0 &\leq R^B_t \leq \delta Z_A(\omega^*_t) A^B_t \\
\mathcal{S}^B_{t+1} &= h(\mathcal{S}^B_t)
\end{aligned}$$

Risk Takers: Complete Problem

Back

$$V^R(\tilde{W}_t^R, \tilde{\rho}_t, \mathcal{S}_t^R) = \max_{C_t^R, A_{t+1,P}^R, A_{t+1,P}^R, B_t^R} \left\{ (1-\beta_R) \left[\frac{(C_t^R)^{1-\theta}(K_{t-1}^R)^{\theta}}{e^{\tilde{\rho}_t}} \right]^{1-1/\nu} \right.$$
$$\left. + \beta_R \mathrm{E}_t \left[\left(e^{g_{t+1}} \tilde{V}^R \left(W_{t+1}^R, \mathcal{S}_{t+1}^R \right) \right)^{1-\sigma_R} \right]^{\frac{1-1/\nu}{1-\sigma_R}} \right\}^{\frac{1}{1-1/\nu}}$$

subject to:

$$(1-\tau^S) Y_t^R + \tilde{W}_t^R + G_t^{T,R} = C_t^R + (1-\mu_\omega) p_t K_{t-1}^R + q_t^m A_{t+1,P}^R + (q_t^m + \gamma_t) A_{t+1,G}^R + q_t^f B_t^R,$$

$$W_{t+1}^R = e^{-g_{t+1}} \left[(M_{t+1,P} + \delta Z_A(\omega_{t+1}^*) q_{t+1}^m) A_{t+1,P}^R + (M_{t+1,G} + \delta Z_A(\omega_{t+1}^*) q_{t+1}^m) A_{t+1,G}^R + B_t^R \right],$$

$$B_t^R \geq -q_t^m (\xi_P A_{t+1,P}^R + \xi_G A_{t+1,G}^R),$$

$$A_{t+1,G}^R \geq 0,$$

$$A_{t+1,P}^R \geq 0,$$

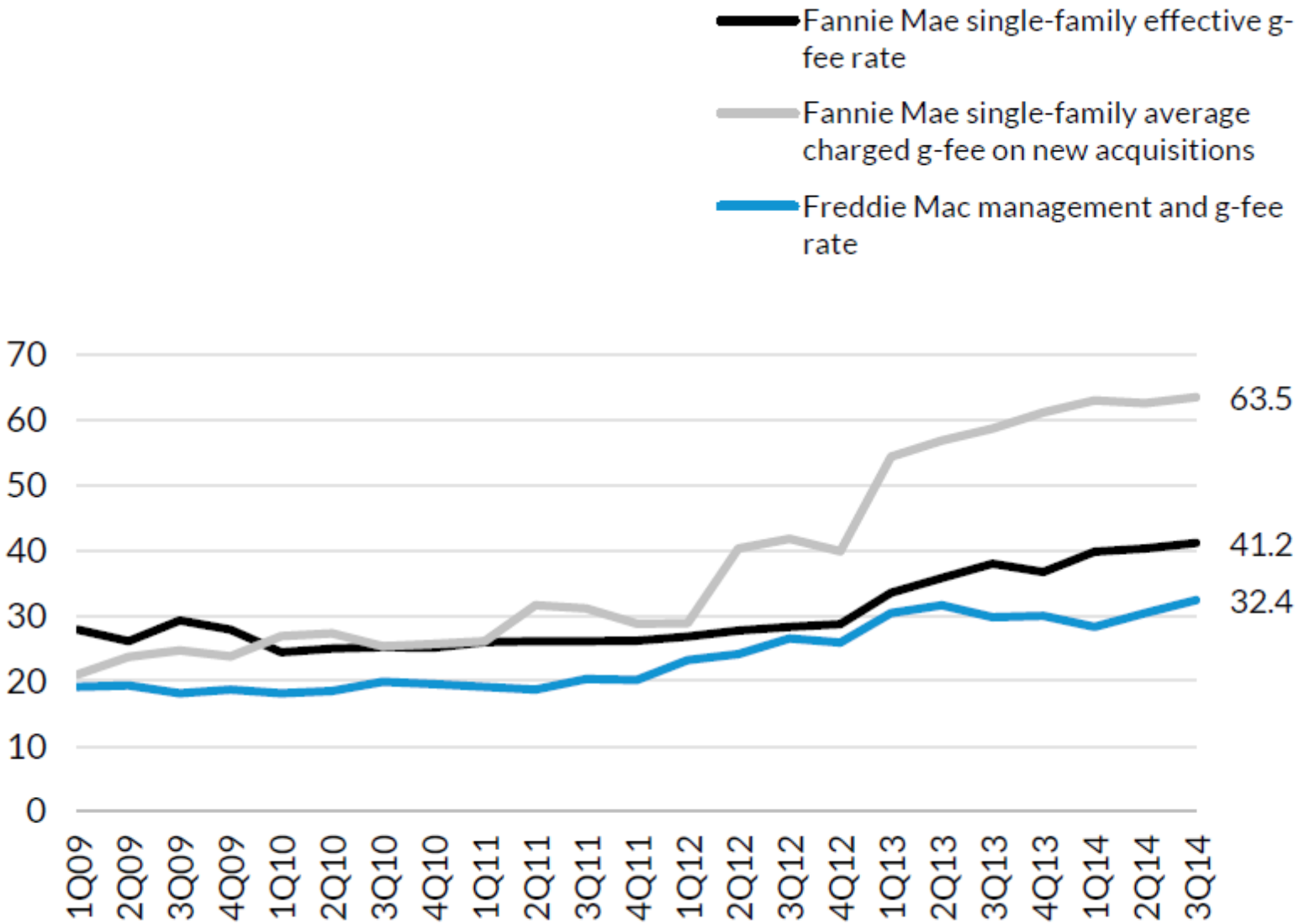
$$\mathcal{S}_{t+1}^R = h(\mathcal{S}_t^R)$$

with continuation value

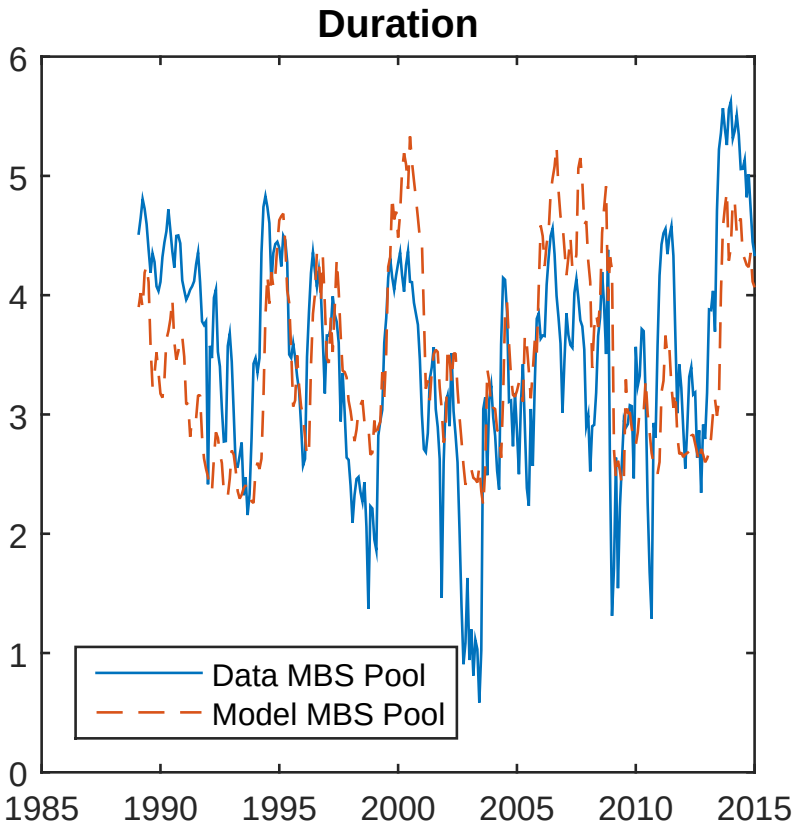
$$\tilde{V}^R(W_t^R, \mathcal{S}_t^R) = \max_{D(\rho)} \mathrm{E}_\rho \left[D(\rho) V^R(0, \rho, \mathcal{S}_t^R) + (1 - D(\rho)) V^R(W_t^R, 0, \mathcal{S}_t^R) \right]$$

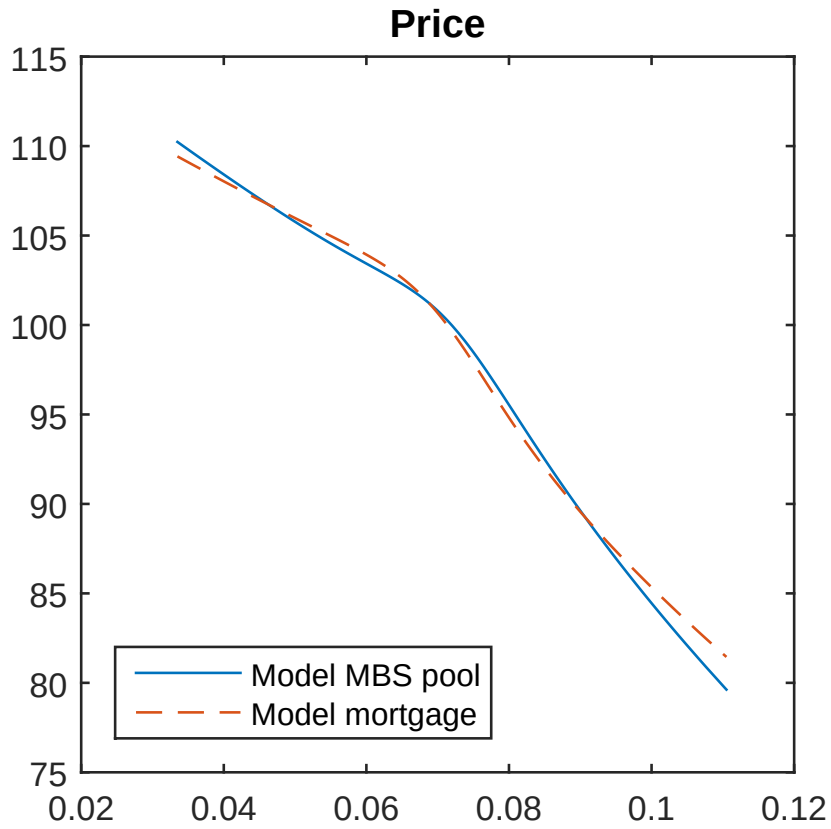
G-fees Over Time

Back



Prepayment Model: Fit





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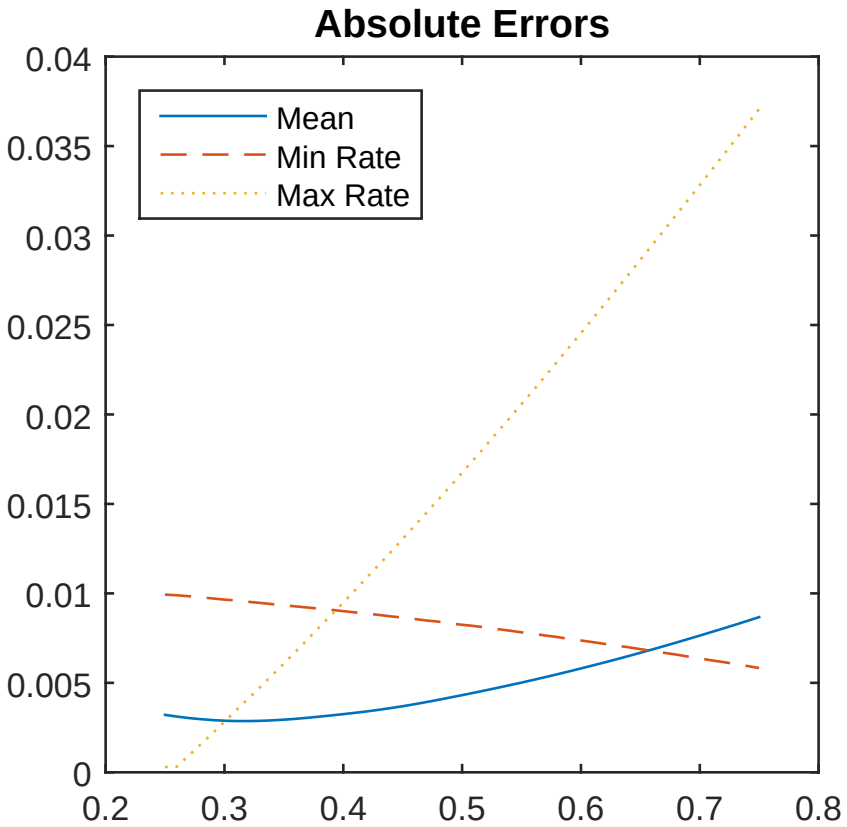
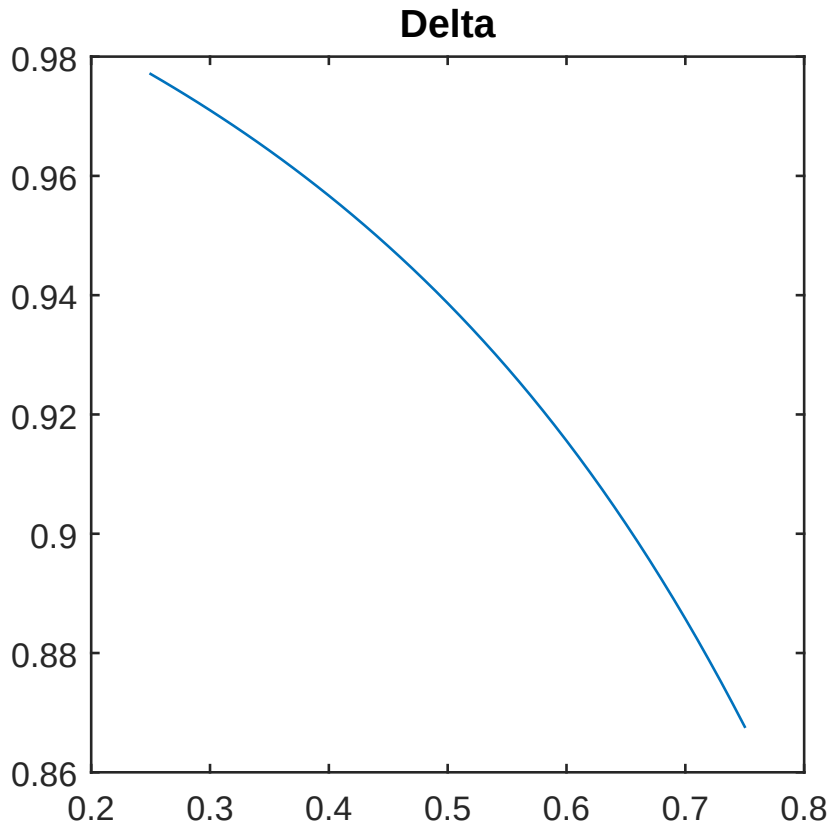
Prepayment Model: Error for Different α





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