

Optimal Credit Market Policy

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Optimal Credit Market policy

A frequently heard narrative:

- The Great Recession was caused by excessive lending and borrowing, especially in the housing market.
- Restraining borrowing and housing investment could have prevented the crisis, and could avoid a repeat of the crisis in the future.
- We should put in place macroprudential tools that prevent the buildup of financial imbalances.

What We Do

We analyze optimal credit market policy in a model with housing and financial frictions.

We show that such economy features too much or too little housing investment relative to socially optimal level over the business cycle

Savers and borrowers are explicitly modeled.

- Previous literature: Small-open economy models with international lenders, or models with a constant interest rate.
- This paper: An infinite-horizon model with borrowers and savers.

Preview of Results

- Optimal credit market policy leans against the wind
Ex-ante overborrowing is corrected with “macroprudential” taxes.
Ex-post underborrowing is corrected with credit market subsidies.
- A simple tax policy that responds to housing or credit gaps improves welfare.

$$\tau_t = \bar{\tau}_h + \phi_h (q_t h_t - \bar{q} \bar{h})$$

$$\tau_t = \bar{\tau}_b + \phi_b (b_t - \bar{b})$$

A 3-period Model with Frictions

- $t = 1, 2, 3$. Two goods: consumption c , housing h .
Total housing fixed ($h + h' = 2$).
Agents produce c goods using:

$$y_t = A_t h_{t-1}^\gamma$$

A_t stochastic in period 2 only (can be low or high)

- Two agents: utility functions are given by:

$$U^S(c'_t) = E_1 \sum_{t=1}^3 \log(c'_t), \quad U^B(c_t) = E_1 \sum_{t=1}^3 \log(c_t),$$

- Budget constraints, in each of three periods:

$$c_t + q_t h_t + R_{t-1} b_{t-1} = \omega_t + A_t h_{t-1}^\gamma + q_t h_{t-1} + b_t$$

ω_t a deterministic endowment.

- Borrowing subject to collateral constraint

$$b_t \leq m q_t h_t$$

Saver's Problem

Saver chooses $\{c'_t\}$, $\{b'_t\}$ and $\{h'_t\}$ to

$$\max E_1 \sum_{t=1}^3 \log(c'_t)$$

subject to:

$$c'_t + q_t h'_t + R_{t-1} b'_{t-1} = \omega'_t + A'_t h'^{\gamma}_{t-1} + q_t h'_{t-1} + b'_t \quad (1)$$

Optimality conditions given by:

$$1 = E_t \left(\frac{c'_t}{c'_{t+1}} \right) R_t \quad (2)$$

$$1 = E_t \left(\frac{c'_t}{c'_{t+1}} \frac{A_{t+1} F'(h'_t) + q_{t+1}}{q_t} \right) \quad (3)$$

plus budget constraint at equality. Saver equalizes discounted return on housing and saving.

Borrower's Problem

Borrower chooses $\{c_t\}$, $\{b_t\}$ and $\{h_t\}$ to:

$$\max E_1 \sum_{t=1}^3 \log(c_t)$$

subject to:

$$c_t + q_t h_t - b_t = \omega_t + A_t h_{t-1}^\gamma + q_t h_{t-1} - b_{t-1} R_{t-1} \quad (4)$$

$$b_t \leq m q_t h_t \quad (5)$$

Letting λ_t denote multiplier on constraint (5):

$$\frac{1}{c_t} = E_t \left(\frac{R_t}{c_{t+1}} \right) + \lambda_t \quad (6)$$

$$\frac{q_t}{c_t} = E_t \left(\frac{A_{t+1} F'(h_t) + q_{t+1}}{c_{t+1}} \right) + m \lambda_t q_t \quad (7)$$

together with complementary slackness condition on (5).

Implications of Collateral Constraint

- Binding collateral constraint, $\lambda_t > 0$, prevents borrower from undertaking investment even if marginal benefit of such investment is greater than marginal cost of funds:

$$E_t \left(\frac{c_t}{c_{t+1}} \frac{A_{t+1} F'(h_t) + q_{t+1}}{q_t} \right) > E_t \left(\frac{c'_t}{c'_{t+1}} R_t \right).$$

- Collateral constraint prevents beneficial trade between borrowers and savers.
- Welfare analysis below will explore different ways in which a planner, although forced to respect constraint and to operate through same markets as private agents, can reduce the extent of such unexploited trade opportunities.

Optimal Policy

- Two sources of inefficiency in this model:
 - ▶ Collateral constraint
 - ▶ Market incompleteness
- Planner is allowed decide borrower's portfolio but must respect:
 - ▶ Saver's optimality conditions for h and b
 - ▶ Agents' budget constraints
 - ▶ Collateral constraint

Planner's Problem (Commitment)

Choose $\{c_t\}$, $\{c'_t\}$, $\{h_t\}$, $\{h'_t\}$, $\{b_t\}$ and prices $\{R_t\}$, $\{q_t\}$ to solve

$$\max E_1 \sum_{t=1}^3 \log(c_t) \quad (8)$$

subject to:

$$c_t + q_t h_t - b_t = \omega_t + A_t h_{t-1}^\gamma + q_t h_{t-1} - b_{t-1} R_{t-1} \quad (9)$$

$$b_t \leq m q_t h_t \quad (10)$$

$$c'_t + q_t h'_t + b'_t = \omega'_t + A_t h'_{t-1}^\gamma + q_t h'_{t-1} - b'_{t-1} R_{t-1} \quad (11)$$

$$1 = E_t (c'_t / c'_{t+1}) R_t \quad (12)$$

$$1 = E_t \left(\frac{c'_t}{c'_{t+1}} \frac{A_{t+1} F'(h'_t) + q_{t+1}}{q_t} \right) \quad (13)$$

$$E_1 \sum_{t=1}^3 \log(c'_t) \geq v'(h_{-1}, b_{-1} R_{-1}) \quad (14)$$

v' : indirect utility function of saver in competitive equilibrium.

Remarks on Planner's Problem

- Chosen allocation satisfies the notion of constrained efficiency
- Allocation differs from competitive equilibrium because of pecuniary externalities.
- Allocation internalizes effect of borrower's choices on prices
- If planner could set arbitrary prices (savers FOCs taken out), then the solution would be the unconstrained first-best.
- If planner did not internalize effects on prices, then the solution would be the competitive equilibrium.

Implementing the Constrained-Efficient Allocation

Planner can implement different allocations by choosing taxes to achieve desired levels of $\{c_t\}$, $\{c'_t\}$, $\{h_t\}$, $\{h'_t\}$, $\{b_t\}$ and prices $\{R_t\}$, $\{q_t\}$, that is, choose τ_h and τ_b to solve

$$\max E_1 \sum_{t=1}^3 \log(c_t) \quad (15)$$

subject to all constraints as before, as well as

$$\frac{1 - \tau_{b,t}}{c_t} = E_t \left(\frac{R_t}{c_{t+1}} \right) + \lambda_t \quad (16)$$

$$\frac{q_t (1 + \tau_{h,t})}{c_t} = E_t \left(\frac{A_{t+1} F'(h_t) + q_{t+1}}{c_{t+1}} \right) + m \lambda_t q_t \quad (17)$$

Taxes are rebated lump-sum to borrowers

Parameter Values

- $y = Ah_{-1}^{0.5}$.
- $A = 1$ in t_1 and t_3 .
- In t_2 :
 - ▶ $A = 1$ (no-uncertainty), or
 - ▶ $A = (1 + \sigma, 1 - \sigma)$ wp 1/2 (uncertainty).
- $\omega_2 = \omega'_2 = \omega_3 = \omega'_3 = 0$. $\omega_1 + \omega'_1 = 2$, $h_0 + h'_0 = 2$.
- Focus on implementation through **housing taxes** only.
(achieves half of maximum welfare gains, but gets intuition across)
- Study how allocations and welfare of borrowers vary with σ , holding savers' welfare at competitive equilibrium level.

Consider various parameter configurations depending on initial wealth distribution ω_1 and h_0

1. No Credit Constraints

- ▶ $\omega'_1 = 1, h_0 = 1$, no borrowing/lending in equilibrium
- ▶ $\omega'_1 \rightarrow 1, h_0 \rightarrow 1$, borrowing/lending without binding borrowing constraints

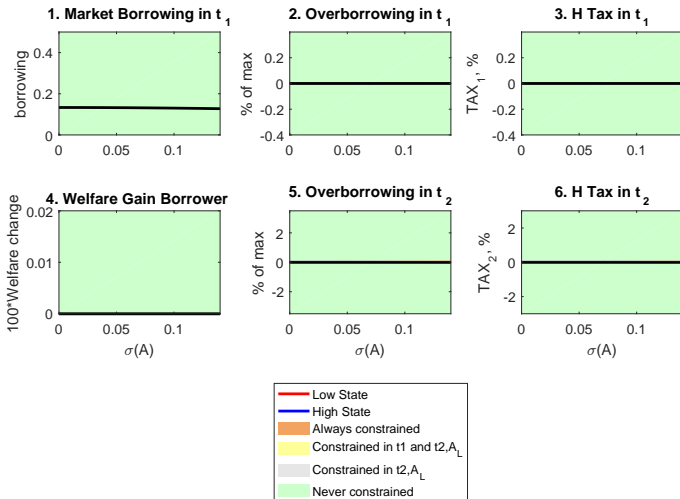
2. Always Binding Constraints

- ▶ $\omega'_1 \rightarrow 0, h_0 \rightarrow 0$, borrowing and lending with binding borrowing constraint

3. Occasionally Binding Constraints: Intermediate between 1 and 2

- Taxes active only when shocks hit, and fully anticipated by agents

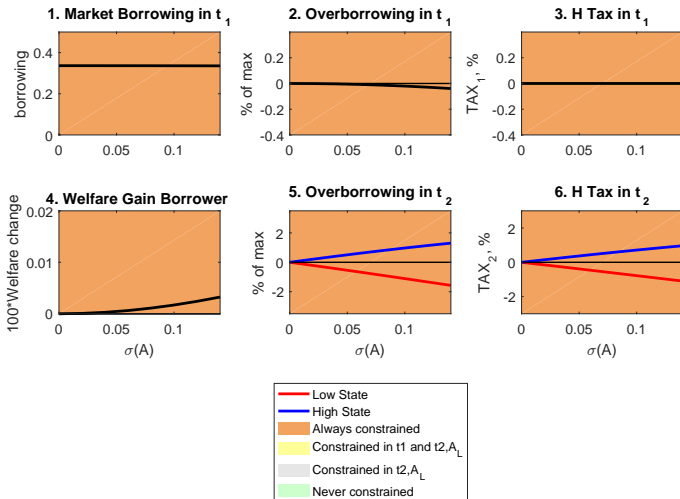
Case 1: No Credit Constraints



Case 1: No Credit Constraints

- Scope for credit market intervention is (almost) non-existent.
- Planner can undo a bit of market incompleteness with state-contingent taxes, but welfare gains are tiny.

Case 2: Always Binding Constraints



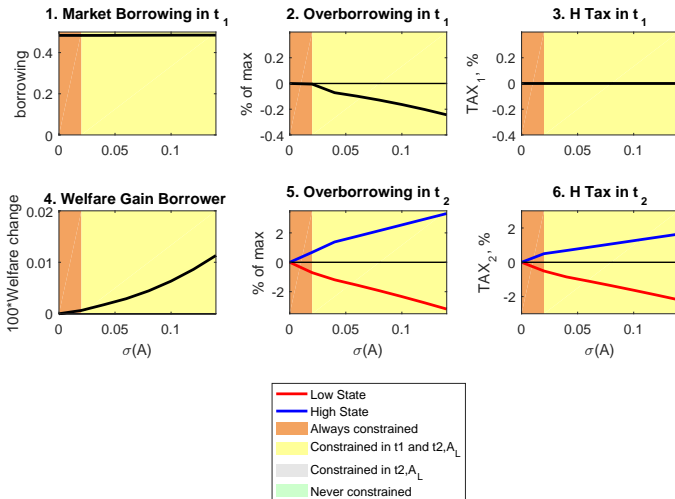
Case 2: Always Binding Constraints

- Without uncertainty, if planner can only set taxes in period 2, no credit market intervention can improve welfare of both agents
If planner helps borrower, it hurts saver
- With uncertainty, optimal credit policy is prudential, and countercyclical

$$\tau_t = \phi_y (y_t - y)$$

- Planner improves welfare by giving higher weight to pecuniary externalities in bad states than in good states.

Case 3: Constraint Binds Only in Bad State

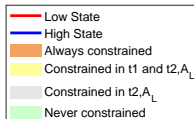
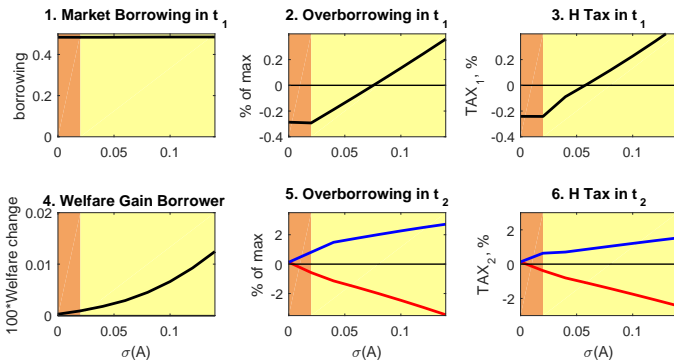


Case 3: Constraint Binds Only in Bad State

- Optimal credit policy leans against wind (tax in good state, subsidy in bad) as before.
- Distortion created by tax in good state is small
- Welfare gains afforded by subsidy in bad state are larger
- Overall welfare gains are larger than before

Case 4: Constraint Binds Only in Bad State

Taxes Can Be Set in Period 1 Too



Case 4: Constraint Binds Only in Bad State Taxes Can Be Set in Period 1 Too

- Optimal credit policy in period 2 looks similar.
- In period 1, if uncertainty is small, planner corrects externalities on time 1 with subsidies that relax constraints today – underborrowing ex ante
- In period 1, if uncertainty is large, planner has a stronger macroprudential motive and taxes housing demand today to prevent drop in asset prices tomorrow – overborrowing ex ante –

Case 4 and the Housing Crisis

Case 4 captures some elements and discussions on the housing crisis

- Before the crisis (t_1 , low σ), perception that risk was low \rightarrow subsidize housing (panel 3, low σ).
- During the crisis (t_2 , low state): Immediate action is to subsidize housing (mortgage relief, support house prices).
- After the crisis (t_1 , high σ), discussion of new policy framework, perception that risks are not so low after all.
- Policies discussed: macro-prudential policies, taxing housing.
- Policy trade-offs in a crisis with high σ :
subsidize (mitigate current crisis) vs. tax (mitigate future crisis).

Infinite Horizon Model

Do these results carry over to more standard macro models? Yes

- Set up infinite-horizon version of the model with uncertainty, evaluate welfare
- Economy similar to three-period version, except
 - ▶ Add variable capital for additional realism
 - ▶ Technology A follow an AR(1) process:

$$\ln A_t = 0.95 \ln A_{t-1} + 0.0125 \varepsilon_t, \quad \varepsilon \sim N(0, 1)$$

- Create motive for borrowing through different discount factors. Two groups of borrowers and savers of equal size.

Infinite Horizon Model: Equations

Borrower's problem

$$\max E_0 \sum_{t=0}^{\infty} \beta^t (\log c_t)$$

$$\text{s.t } c_t + q_t h_t + R_{t-1} b_{t-1} = A_t h_{t-1}^{\gamma} + q_t h_{t-1} + b_t$$

$$\text{and to } b_t \leq m_h q_t h_t$$

Saver's problem

$$\max E_0 \sum_{t=0}^{\infty} \beta'^t (\log c'_t)$$

$$\text{s.t } c'_t + k'_t + q_t h'_t + R_t b'_{t-1} = A_t k'_{t-1}{}^{\alpha'} h'_{t-1}{}^{\gamma'} + q_t h'_{t-1} + b'_t + (1 - \delta) k'_{t-1}$$

Market clearing

$$b_t + b'_t = 0 \text{ and } h_t + h'_t = 1$$

Infinite Horizon Model: Taxes

Borrower's problem (tax on housing holdings, rebated lump-sum)

$$\text{s.t. } c_t + q_t(1 + \tau_t)h_t + R_{t-1}b_{t-1} = A_t h_{t-1}^\gamma + q_t h_{t-1} + b_t + T_t$$

where

$$\tau_t = \varepsilon \ln A_t$$

$$T_t = \tau_t q_t h_t$$

Tax is levied on the borrower only.

Tax only changes the borrower's housing accumulation equation.

Model Equilibrium Conditions

$$\frac{1}{c_t} = \beta R_t \frac{1}{c_{t+1}} + \lambda_t \quad (1)$$

$$\lambda_t (b_t - m q_t h_t) = 0 \quad (2)$$

$$\frac{q_t (1 + \tau_t)}{c_t} = \beta \frac{1}{c_{t+1}} \left(q_{t+1} + \gamma \frac{y_{t+1}}{h_t} \right) + \lambda_t m h_t q_t \quad (3)$$

$$\frac{1}{c'_t} = \beta' R_t \frac{1}{c'_{t+1}} \quad (4)$$

$$\frac{q_t}{c'_t} = \beta' \frac{1}{c'_{t+1}} \left(q_{t+1} + \gamma \frac{y'_{t+1}}{h'_t} \right) \quad (5)$$

$$\frac{1}{c'_t} = \beta' \left(\alpha \frac{y'_{t+1}}{k'_t} + 1 - \delta \right) \frac{1}{c'_{t+1}} \quad (6)$$

$$b_t = c_t + q_t h_t + R_{t-1} b_{t-1} - y_t + q_t h_{t-1} \quad (7)$$

$$c_t + c'_t + k'_t = y_t + y'_t + (1 - \delta) k'_{t-1} \quad (8)$$

Calibration

Parameter	Value
β	0.9865
β'	0.99
γ	0.3
γ'	0.1
α	0.2
δ	0.025
m	0.8

Annual Target	Value
Wealth/GDP	3
Debt/GDP	2
Stdev log GDP	4.5 percent
Stdev C borrowers	6.7 percent
Stdev C savers	2.8 percent
Frequency of binding constraint	55 percent

Impulse Responses

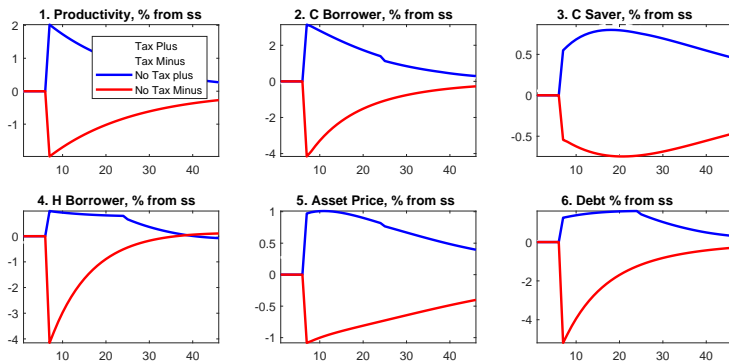


Figure: Responses in deviation from stochastic steady state of no tax economy

Policy Functions

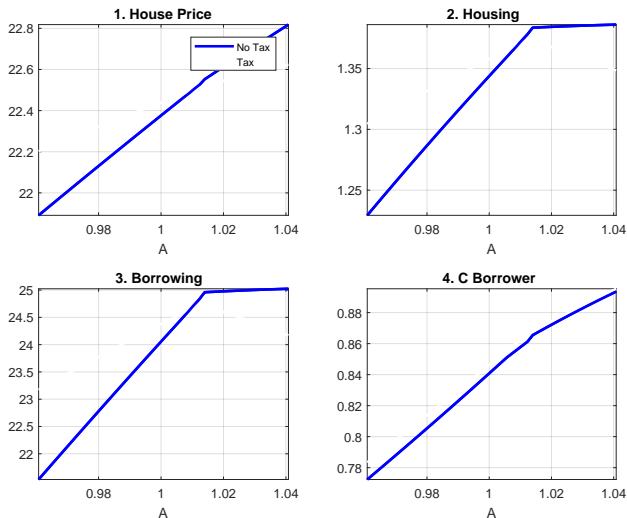


Figure: Optimal Choices as a function of A

Pareto-Improving Housing Tax

We evaluate how welfare of savers and borrowers varies for different values of the elasticity ϵ of tax rate to the aggregate state.

Can we find a Pareto-improving tax? Yes!

A tax with an elasticity of 0.02 to aggregate productivity yields welfare gains 0.1 percent of lifetime consumption for the borrower, holding savers welfare unchanged.

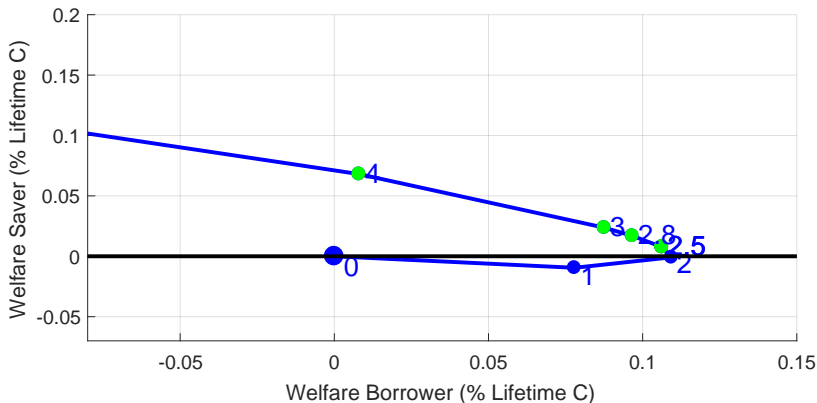
Formally, letting Z_t being the state:

$$Z_t = \{R_{t-1}b_{t-1}, k_{t-1}, h_{t-1}, A_t\}$$

welfare of borrowers and savers is:

$$W = W(Z_t; \epsilon), \text{ and } W' = W'(Z_t; \epsilon)$$

How Welfare Varies with the Tax



Impulse Responses with Tax

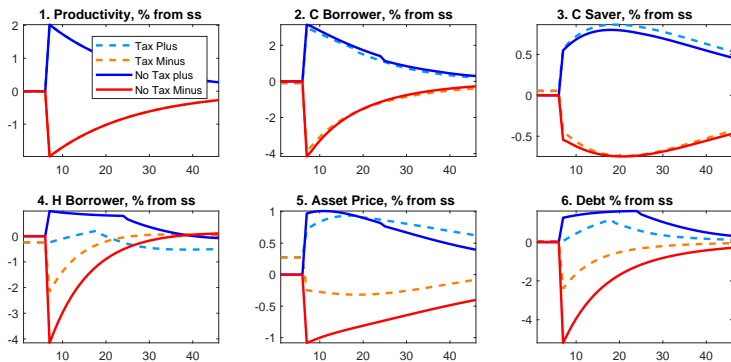


Figure: Responses in deviation from stochastic steady state of no tax economy

Policy Functions with Tax

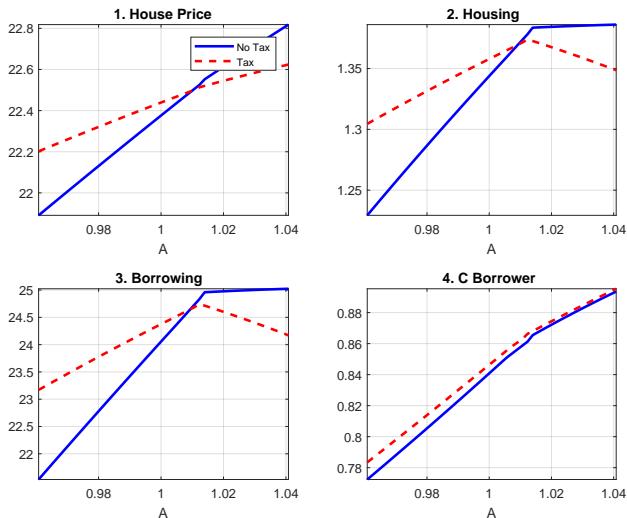


Figure: Optimal Choices as a function of A

Properties of The Pareto-Improving Tax

Reduces the covariance of consumption and asset prices in a recession, thus increasing asset prices on average

Subsidizes borrowers in a recession, but taxes them in a boom

The Pareto-Improving Tax

“Property” Tax is levied as a % of the value of borrowers’ housing.

From the borrower’s budget constraint,

$$c_t + (1 + \tau_t) q_t h_t = \text{income},$$

a tax τ_t raises the holding cost of housing by $100 \times \tau_t$ percent.

An x percent negative productivity shock thus calls for a reduction in the holding cost of housing of $100 \times \varepsilon \times x$ percent.

With $\varepsilon = 0.02$ and $x = 0.03$, the reduction in the housing holding cost is thus $100 \cdot 0.02 \cdot 0.03 = 0.06\%$.

For a house of \$300,000, this corresponds to a subsidy of about $180 \cdot 4 = \$720$ per year in a typical recession.

Pareto Frontiers in Booms and Recessions

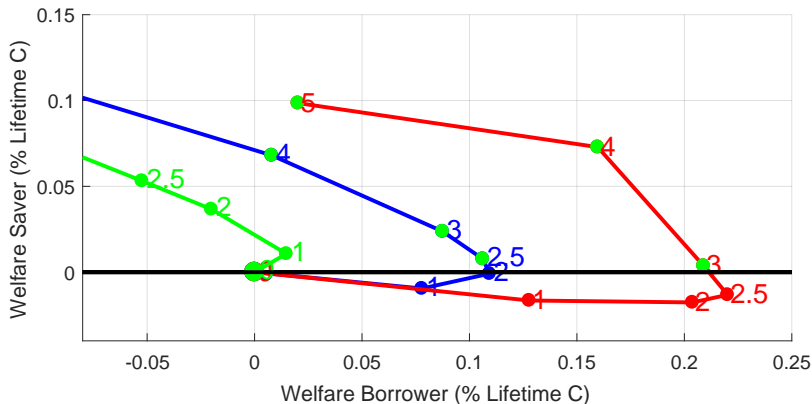


Figure: Frontier starting from different state: boom, normal times, recession

Conclusions

- Optimal Credit Policy leans against the wind:
Ex post pecuniary externalities are corrected with credit market subsidies.
Ex ante pecuniary externalities are corrected with “macroprudential” taxes.
- Economies with credit frictions feature underborrowing or overborrowing depending on the severity of financing constraints.
- A simple countercyclical housing tax can improve social welfare.