Optimal Credit Market Policy

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Optimal Credit Market Policy: Motivation

- The Great Recession was caused by sharp housing price declines exacerbated by collateral constraints.

- Policies were insufficient to:
  - prevent risk increase before crisis: ex-ante regulation
  - prevent fire sales and house price slumps during crisis: ex-post intervention.

What We Do

- Analyze optimal credit market policy in an infinite-horizon quantitative DSGE model with housing and financial frictions.
- Savers and Borrowers cannot trade freely due to collateral constraints tied to house prices
- Collateral constraints amplify movements in consumption and economic fluctuations.
- Solve the model with global solution methods: collateral constraint can be binding or slack.
- Analyze the role of state-contingent taxes in improving welfare.

Preview of Results

- Optimal credit market policy leans against the wind.
- A procyclical housing tax can improve welfare.
- The policy reduces the volatility of house prices and dampens house price reductions in recessions.
- Collateral constraints get loosened in recessions.
- Downside risks are mitigated. Average house prices increase on average, further loosening collateral constraints.
- Welfare gains with optimal tax are comparable to eliminating business cycle fluctuations.

Literature Review

- **Credit and Collateral Constraints**
  - Kiyotaki and Moore (1997), Iacoviello (2005),
- **Pecuniary Externalities**
  - Lorenzoni (2008), Bianchi (2011), Davila and Korinek (2017), Kehoe and Levine (1993), Geanakoplos and Polemarchakis (1986).
- **Housing, Collateral, and Business Cycles**
  - Aoki (2004), Guerrieri and Iacoviello (2017), Mendoza (2010), Garriga et al. (2017).
- **Macroeconomic Stability, Lean Against the Wind**
  - Goodhart and Hofmann (2010), Galí (2014), Svensson (2017), Bijlsma and Ewijk (2021), Jeanne and Korinek (2020).
- **Computational Methods**
  - Dynare's team; den Haan and Marcet (1990), Reiter (2009), Judd, Maliar, and Maliar (2011), Christiano and Fisher (2000), Grand and Ragot (2024).

Outline

- **The Model**
  - Savers
  - Borrowers
  - Equilibrium
  - The Tax
  - Implications of Collateral Constraints
- **Results**
  - Taxes and Welfare
  - Decomposing Welfare Effects of Taxes
- **Conclusions**

Savers' Problem

Maximization Problem:

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

subject to:

$$c'_t + k'_t + q_t h'_t - R_{t-1} b'_{t-1} = y'_t + q_t h'_{t-1} - b'_t + (1-\delta)\, k'_{t-1}.$$

$$y'_t = A_t h'^{\gamma}_{t-1} k'^{\alpha}_{t-1},$$

First Order Conditions:

$$\begin{aligned}
\frac{1}{c'_t} &= \beta' R_t E_t \frac{1}{c'_{t+1}}, \\
\frac{1}{c'_t} &= \beta' E_t \frac{1}{c'_{t+1}} \left(\alpha \frac{y'_{t+1}}{k'_t} + 1 - \delta \right), \\
\frac{q_t}{c'_t} &= \beta' E_t \frac{1}{c'_{t+1}} \left(q_{t+1} + \gamma \frac{y'_{t+1}}{h'_t} \right).
\end{aligned}$$

Borrowers' Problem

Maximization Problem:

$$E_0 \sum_{t=0}^{\infty} \beta^t \log c_t .$$

subject to:

$$\begin{aligned} c_t + q_t h_t + R_{t-1} b_{t-1} &= y_t + b_t + q_t h_{t-1}, \\ y_t &= A_t h_{t-1}^{\gamma} \\ b_t &\leq m q_t h_t . \end{aligned}$$

First Order Conditions:

$$\begin{aligned} &\frac{1}{c_t} = \beta R_t E_t \frac{1}{c_{t+1}} + \lambda_t \\ &\frac{q_t}{c_t} = \beta E_t \frac{1}{c_{t+1}} \left(q_{t+1} + \gamma \frac{y_{t+1}}{h_t} \right) + \lambda_t m q_t \\ &\lambda_t \geq 0, \; b_t \leq m q_t h_t, \; \lambda_t \left(b_t - m q_t h_t \right) = 0, \end{aligned}$$

Equilibrium

Market Clearing:

$$nb_t = (1-n)b'_t, \quad \text{(Debt Market Clearing)}$$
$$nh_t + (1-n)h'_t = 1, \quad \text{(Housing Market Clearing)}$$

Shock Process:

$$\ln A_t = \rho \ln A_{t-1} + \sigma\varepsilon_t, \quad \varepsilon_t \sim N(0,1).$$

Competitive Equilibrium:
A competitive equilibrium consists of sequences $\{c_t, h_t, b_t, c'_t, h'_t, b'_t, q_t, R_t\}$ satisfying the agents' optimality conditions, budget constraints, and market clearing conditions.

Implications of Binding Collateral Constraint

- The current consumption of the borrowers c_t is too low. The borrower would like to increase b_t and c_t.

$$\beta' R_t E_t \frac{c'_t}{c'_{t+1}} = 1 > \beta R_t E_t \frac{c_t}{c_{t+1}}.$$

- Inefficiency: Borrowers' marginal benefit of housing investment is higher than the marginal cost of funds.

$$\beta E_t \frac{c_t}{c_{t+1}} \frac{1}{q_t} \left(q_{t+1} + \gamma \frac{A_{t+1}}{h_t^{1-\gamma}} \right) > \beta E_t R_t \frac{c_t}{c_{t+1}}.$$

  - Borrowers would like to obtain additional funds and invest in housing.
  - Alternatively, the price of housing q_t is too low.
  - The collateral constraint would be alleviated if q_t increases. This is one of the mechanisms that will lead to welfare gains.

Calibration

Parameter	Value	Description
β	0.985	Discount factor of borrowers
β'	0.99	Discount factor of savers
α'	0.2	Capital share in production
γ	0.3	Housing share in borrowers' production
γ'	0.1	Housing share in savers' production
δ	0.025	Capital depreciation rate
m	0.8	Collateral requirement parameter
n	0.5	Share of borrowers
ρ	0.95	Persistence of shock
σ	0.0165	Standard deviation of shock

Annual Target	Value
Wealth/Annual GDP	5
Debt/Annual GDP	2
Stdev log GDP	6 percent
Stdev log C	5 percent
Stdev C borrowers	9 percent
Stdev C savers	4 percent
Frequency of binding constraint	41 percent

Solution Method

- **A**pproximate conditional expectations as polynomial functions of state variables:
  - Previous period housing stock (h_{t-1})
  - Previous period capital stock (k_{t-1})
  - Previous period debt level (b_{t-1})
  - Current productivity shocks (A_t)
- **Solution Process**:
  1. Initialize polynomial coefficients η^0 using the solution from Dynare+OccBin as a candidate solution
  2. Solve and simulate nonlinear equilibrium conditions for large T periods
  3. Generate a new set of time series conditional expectations
  4. Update polynomial coefficients via OLS
  5. Iterate until $\|\eta^j - \eta^{j-1}\| < \zeta$
- Euler equation errors quite small

The Tax

- Tax Rule:

$$\tau_t = \varepsilon \ln A_t. \tag{1}$$

- The tax is levied on the housing holdings of borrowers.
- The tax revenue is rebated lump-sum, ensuring revenue neutrality:

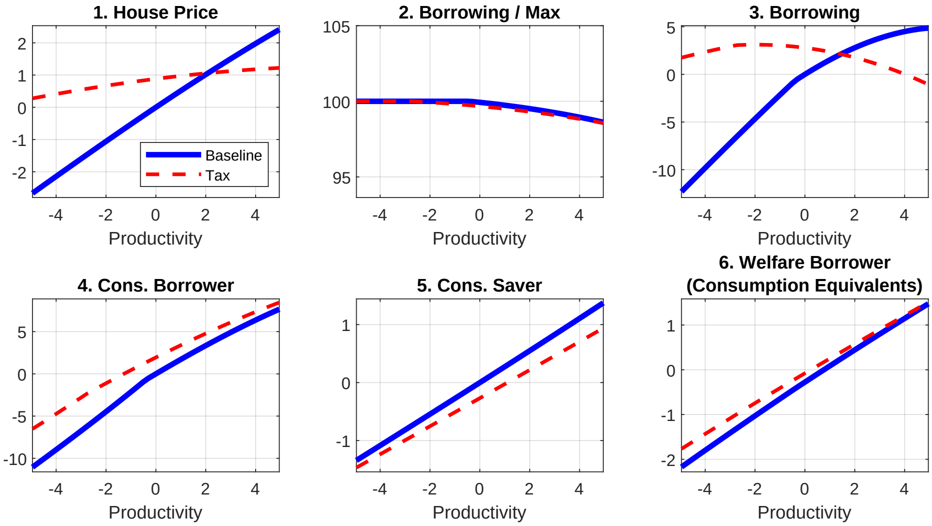
$$c_t + q_t h_t (1 + \tau_t) = b_t - R_{t-1} b_{t-1} - y_t + q_t h_{t-1} + T_t. \tag{2}$$

- The borrower's housing Euler equation becomes:

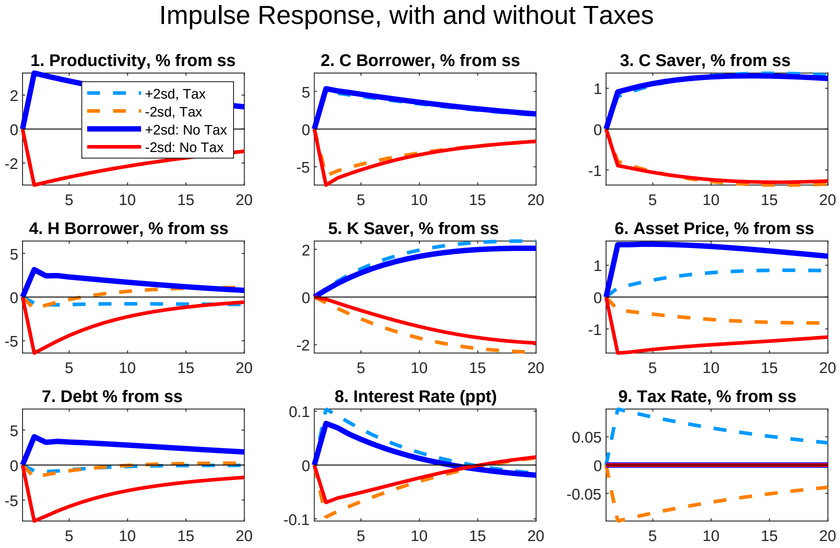
$$\frac{q_t \left(1 + \tau_t\right)}{c_t} = \beta E_t \frac{1}{c_{t+1}} \left(q_{t+1} + \gamma \frac{y_{t+1}}{h_t} \right) + \lambda_t m q_t. \tag{3}$$

- Importantly, the tax does not directly affect the collateral constraint.

Policy Functions with Housing Tax



Impulse Responses

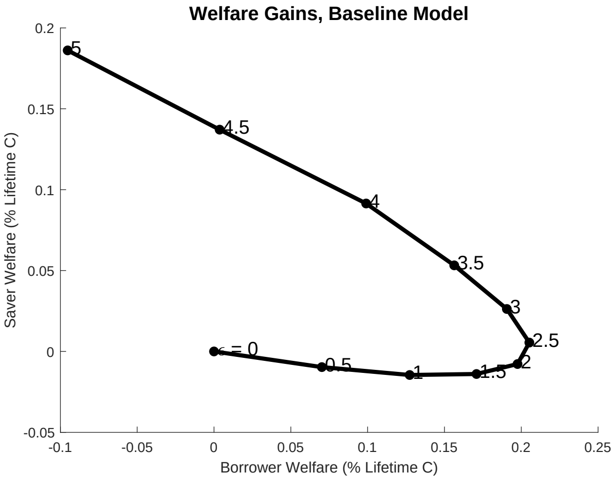


All variables start at their respective risk-adjusted steady state.

Taxes and Welfare

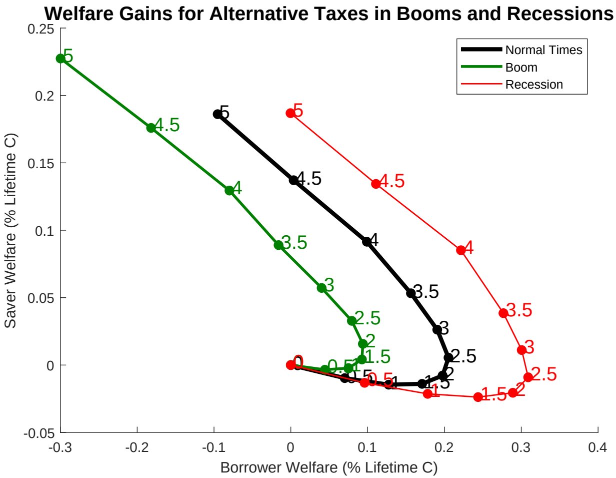
- Tax policies could enhance welfare by offsetting the absence of state-contingent securities.
- However, such welfare gains are typically small, akin to findings in open economy macroeconomics, where a one-period bond nearly completes the market.
- The presence of collateral constraints that affect and are affected by asset prices makes the welfare effects more relevant.
- We adopt a conditional welfare criterion reported as lifetime consumption equivalent compensation.
- We guess the model's policy functions using Dynare (and OccBin), and solve the model globally using Parameterized Expectations.

Pareto Frontier for the Benchmark Model



Welfare gains (in % lifetime consumption) from moving from zero to procyclical housing taxes.

Pareto Frontier for the Benchmark Mode: Boom vs Recession



Welfare gains (in % lifetime consumption) from moving from zero to procyclical housing taxes, starting in different stages of the business cycle.

Taxes and Welfare: Discussion

- $\epsilon = 3 \rightarrow$ For a \$350,000 house (median US house price), a 3% negative TFP shock yields a subsidy of about 300 dollars per year.
- House prices respond less to shocks.
- Average house price increases, even though tax policy is revenue neutral.
  - House prices do not decrease as much in downturns. Fire sales avoided.
  - House prices at t are higher since future fire sales are avoided.
- This allows for more borrowing during downturns and on average.
- Welfare gains larger the larger borrowers' consumption volatility and the larger the discount factor gap.

Decomposing Welfare Effects of Taxes

- The **total effect** of taxation on welfare is decomposed into three components:

$$\Delta W \approx \Delta W_{SR} + \Delta W_{LR} + \Delta W_{VAR}. \tag{4}$$

- **Short-run mean term** captures level effects early in the transition:

$$\Delta W_{SR} = \sum_{t=0}^{T} \beta^t \log E_0(c_t^{tax}) - \sum_{t=0}^{T} \beta^t \log E_0(c_t^{no\_tax}). \tag{5}$$

- The **Long-run mean term** captures long-run mean effects:

$$\Delta W_{LR} = \sum_{t=T+1}^{\infty} \beta^t \log E_0(c_t^{tax}) - \sum_{t=T+1}^{\infty} \beta^t \log E_0(c_t^{no\_tax}). \tag{6}$$

- The **variance component** measures effects from changes in volatility:

$$\Delta W_{VAR} = -\left(\sum_{t=0}^{\infty} \beta^t \frac{E_0\left(c_t^{tax} - E_0 c_t^{tax}\right)^2}{2(E_0(c_t^{tax}))^2} - E_0 \sum_{t=0}^{\infty} \beta^t \frac{E_0\left(c_t^{no\_tax} - E_0 c_t^{no\_tax}\right)^2}{2(E_0 c_t^{no\_tax})^2} \right). \tag{7}$$

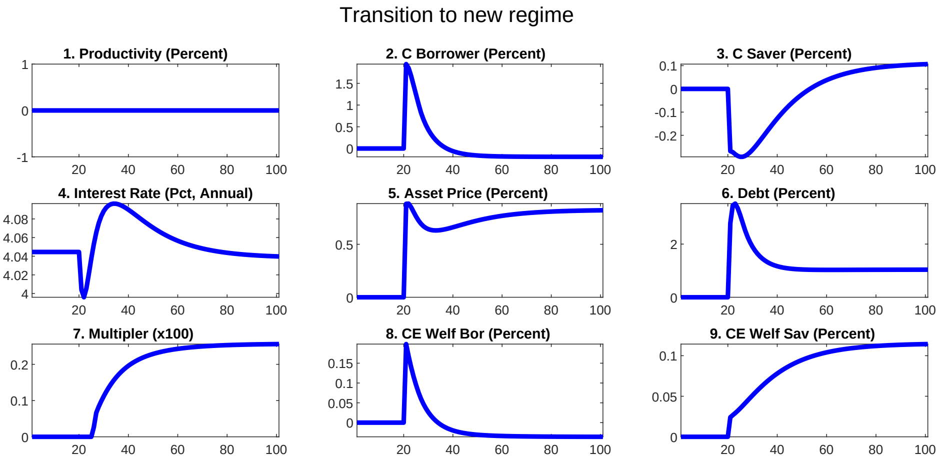
Decomposing Welfare Effects of Taxes

Consider that there were no tax interventions, and the economy is at its risk-adjusted steady state. The tax intervention kicks in:

- Higher asset prices $\rightarrow$ higher debt which allows for more consumption...
  ... and higher asset prices reduce downside consumption risk. $\Delta W_{SR} > 0$
- In the long term, debt and debt service costs increase; hence, borrowers' consumption settles at a lower level in the new steady state. $\Delta W_{LR} < 0$
- The lower volatility of consumption $\Delta W_{VAR} > 0$ contributes to the overall welfare gain for the borrower.

The effects of these changes on the saver are nearly a wash...

Full Simulation



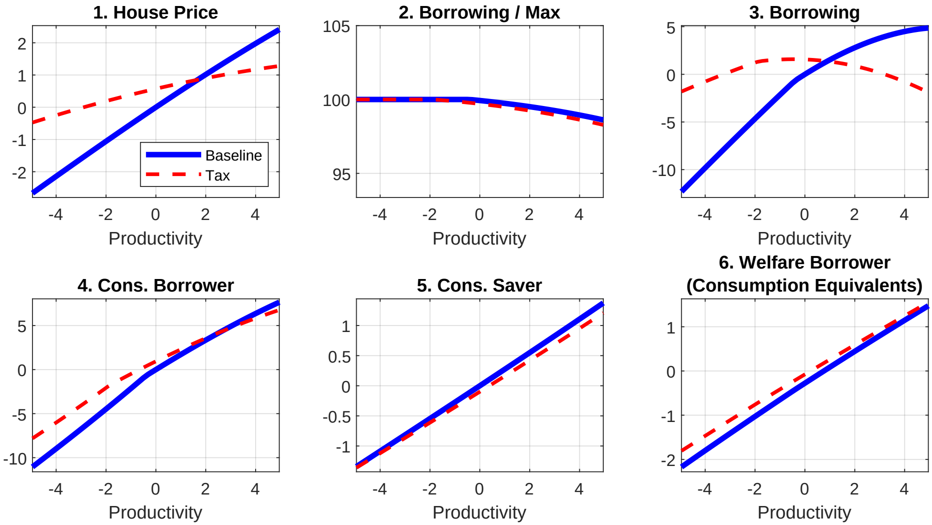
Model transition when agents receive news of new housing tax in period 20, starting from the risk-adjusted steady state of model without tax.

Welfare Decomposition

		Welfare Change Decomposition		
	Total	**SR Mean (1)**	**LR Mean (2)**	**Variance (3)**
Borrower	0.19	0.18	-0.06	0.06
Saver	0.02	-0.03	0.06	-0.01

Total change in conditional welfare (measured in % change in consumption equivalents) from introducing a tax. Welfare calculated starting at the risk-adjusted steady state of the model without tax.

Comparison: Policy Functions with Borrowing Tax



Conclusions

- Procyclical housing tax can generate Pareto improvements by mitigating financial frictions and downside risks.
- The tax stabilizes house prices over the business cycle, preventing severe downturns.
- This leads to higher expected future house prices, relaxing borrowing constraints, and improving credit availability.
- Borrowers benefit from higher short-term consumption and reduced consumption volatility.
- Savers experience long-term welfare gains due to increased asset values and long-term consumption.
- These results are based on a revenue-neutral tax policy, focusing solely on efficiency improvements without bypassing the collateral constraint or being driven by redistribution motives.

Michel

Re: Topic Reply Notification - Handling stochastic trends

Michel Juillard <michel.juillard@ens.fr>
To Matteo Iacoviello

9/21/2006

We removed extra line breaks from this message.

I always keen on comparing the results of Dynare with the ones obtained by other software in order to find bugs in Dynare. Please tell me if you can't reconcile the computations. Then I will try to run them in parallel to see where the difference comes from.

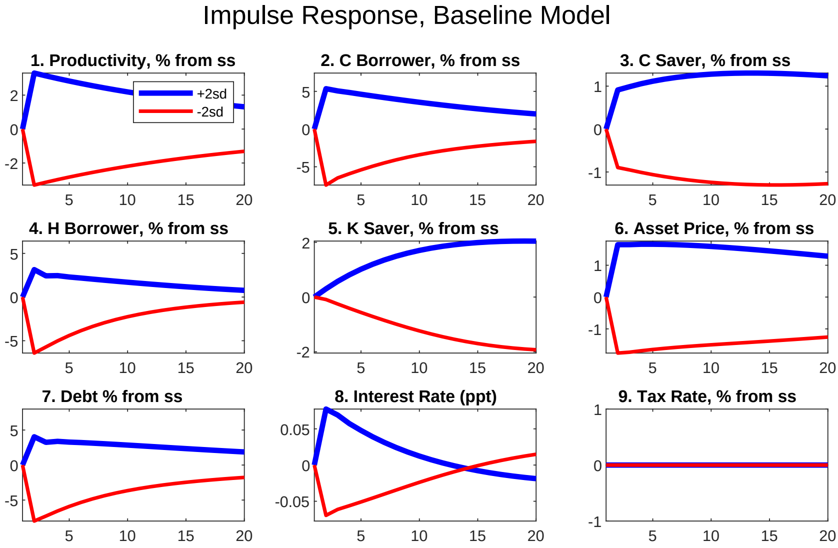
I got several inquiries about handling trends and will have to produce a note on that in the coming weeks.

Kind regards

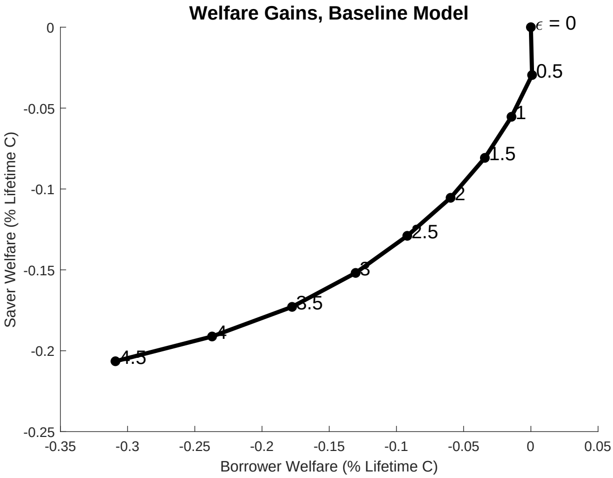
Michel

Appendix

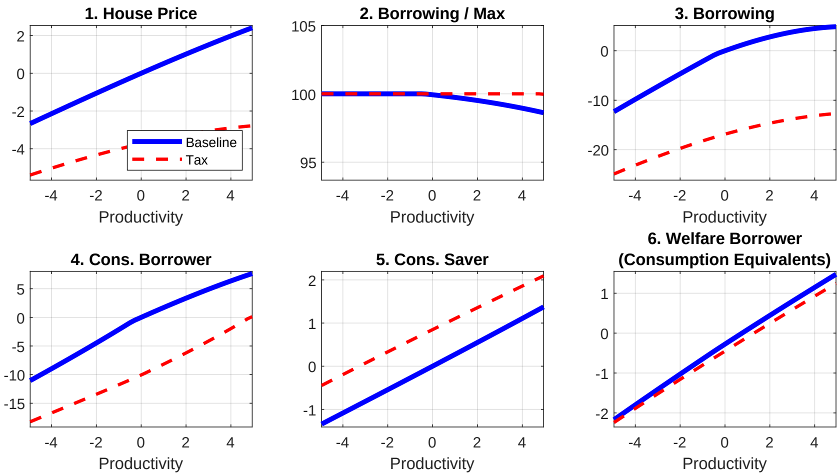
Impulse Responses, Baseline Model



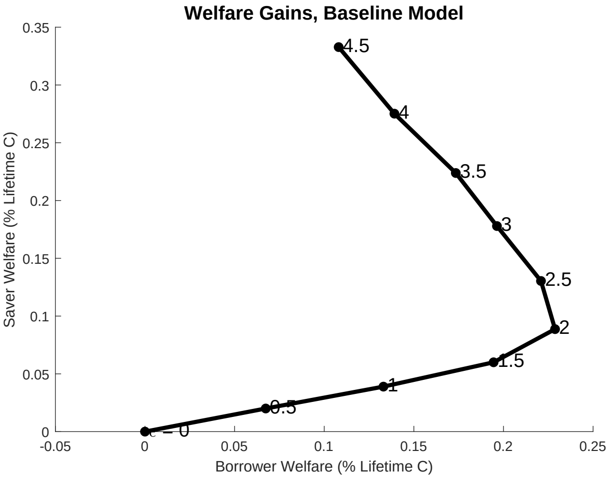
Model with Tax only in Expansions: Frontier



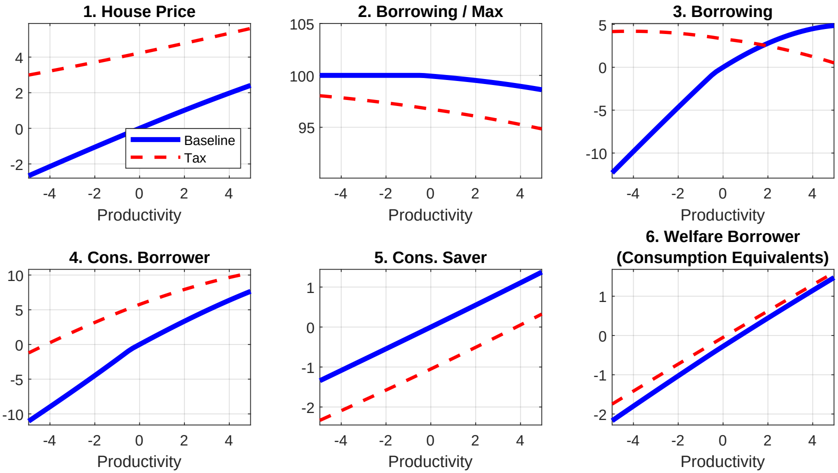
Model with Tax only in Expansions: Policy Functions



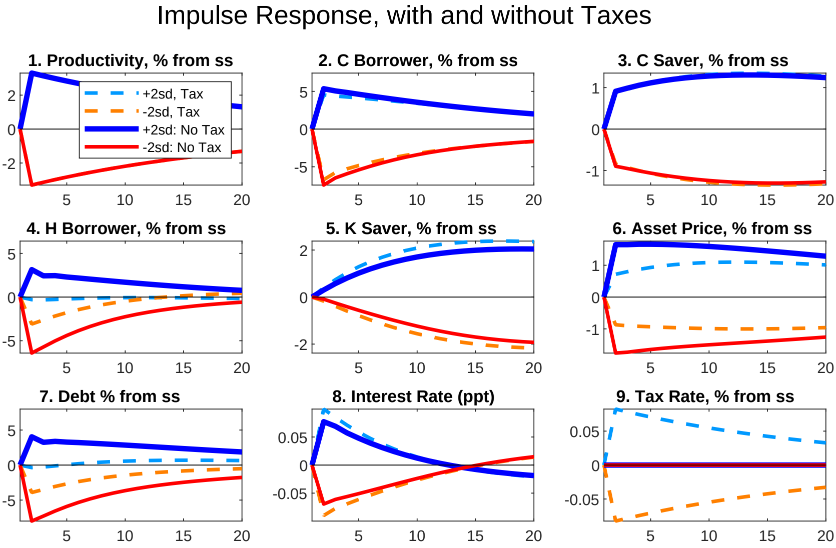
Model with Tax only in Recessions: Frontier



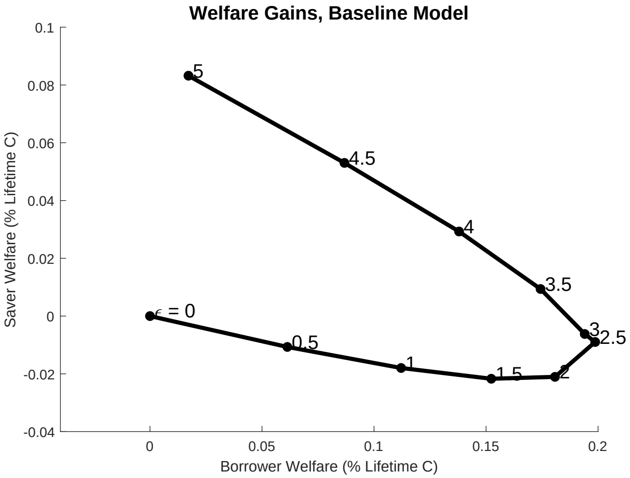
Model with Tax only in Recessions: Policy Functions



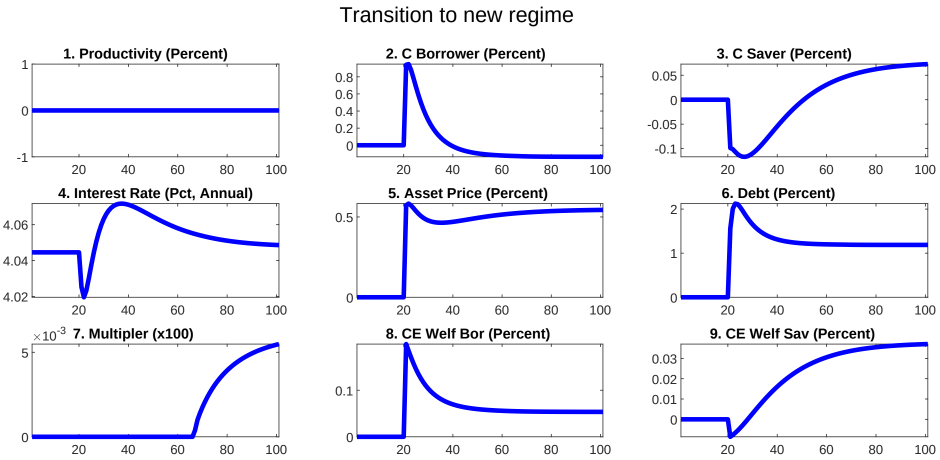
Model with Borrowing Tax: Impulse Response



Model with Borrowing Tax: Frontier



Model with Borrowing Tax: Transition



Euler Equation Errors, Baseline Model