A Theory of Macroprudential Policies in the Presence of Nominal Rigidities

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Tools for Macro Stabilization?

- Great Moderation:
  - soft consensus
  - monetary policy
- Great Recession:
  - broken consensus
  - rising popularity of macroprudential policies
- Challenge for economists: comprehensive framework encompassing monetary and macroprudential policies

This Paper

- Take up this challenge
- What key market failures?
- What policy interventions?

General Model

- Arrow-Debreu with frictions:
  - price rigidities
  - constraints on monetary policy
- Instruments:
  - monetary policy
  - macroprudential policy: taxes/quantity restrictions in financial markets
- Study constrained efficient allocations (2nd best)

Key Results

- Aggregate demand externalities from private financial decisions

- Generically
  - monetary policy not sufficient
  - macroprudential policies required

- Formula for optimal policies
  - intuitive
  - measurable sufficient statistics

Example

- Deleveraging and liquidity trap (Eggertson-Krugman)
  - borrowers and savers
  - borrowers take on debt
  - credit tightens...borrowers delever
  - zero lower bound
  - recession
- Result: macroprudential restriction on ex-ante borrowing

Growing Literature

- Farhi-Werning 2012a, Farhi-Werning 2012b
- Schmitt-Grohe-Uribe 2012
- Korinek-Simsek 2013
- ...

Model

- Agents $i \in I$

- Goods $\{X^i_{j,s}\}$ indexed by...
  - "state" $s \in S$
  - commodity $j \in J_s$

- "States":
  - states, periods
  - trade across states...financial markets
  - taxes or quantity controls available

Preferences and Technology

- Preferences of agent i

$$\sum_{s \in S} U^i(\{X^i_{j,s}\}; s)$$

- Production possibility set

$$F(\{Y_{j,s}\}) \leq 0$$

Agents' Budget Sets

$$\sum_{s \in S} D_s^i Q_s \leq \Pi^i$$

$$\sum_{j \in J_s} P_{j,s} X_{j,s}^i \leq -T_s^i + (1 + \tau_{D,s}^i) D_s^i$$

$$\{X_{j,s}^i\} \in B_s^i$$

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$$\sum_{j \in J_s} P_{j,s} X_{j,s}^i \leq -T_s^i + (1 + \tau_{D,s}^i) D_s^i$$

macroprudential tax

$$\{X_{j,s}^i\} \in B_s^i$$

borrowing constraint

Government Budget Set

$$\sum_{s \in S} D_s^g Q_s \leq 0$$

$$\sum_{i \in I} (T_s^i - \tau_{D,s}^i D_s^i) + D_s^g = 0$$

Nominal Rigidities

- Price feasibility set (vector)

$$\Gamma(\{P_{j,s}\}) \leq 0$$

- Captures many forms of nominal rigidities and constraints on monetary policy

Market Structure...

- Supply of goods...follow Diamond-Mirrlees (1971):
  - postpone discussion of market structure
  - "as if" government controls prices and production

- Applications:
  - spell out market structure
  - monopolistic competition with nominal rigidities
  - enough taxes to control prices...
  - ...but not enough to trivialize price rigidities...(2nd best)

Equilibrium

1. Agents optimize
2. Government budget constraint satisfied
3. Technologically feasible
4. Markets clear
5. Nominal rigidities

Planning Problem

- Planning problem

$$\max_{I_s^i, P_s} \sum_{i \in I} \sum_{s \in S} \lambda^i V_s^i(I_s^i, P_s)$$

$$F(\{\sum_{i \in I} X_{j,s}^i(I_s^i, P_s)\}) \leq 0$$

$$\Gamma(\{P_{j,s}\}) \leq 0$$

Planning Problem

- Planning problem

indirect utility function

$$\max_{I_s^i, P_s} \sum_{i \in I} \sum_{s \in S} \lambda^i V_s^i(I_s^i, P_s)$$

$$F(\{\sum_{i \in I} X_{j,s}^i(I_s^i, P_s)\}) \leq 0$$

$$\Gamma(\{P_{j,s}\}) \leq 0$$

Wedges

- Define wedges $\tau_{j,s}$ given reference good $j^*(s)$

$$\frac{P_{j^*(s),s}}{P_{j,s}} \frac{F_{j,s}}{F_{j^*(s),s}} = 1 - \tau_{j,s}$$

- First best... $\tau_{j,s} = 0$

FOCs

- Incomes

$$\frac{\lambda^i V^i_{I,s}}{1 - \sum_{j \in J_s} \frac{P_{j,s} X^i_{j,s}}{I^i_s} \frac{I^i_s X^i_{I,j,s}}{X^i_{j,s}} \tau_{j,s}} = \frac{\mu F_{j^*(s),s}}{P_{j^*(s),s}}$$

social vs. private marginal utility of income

- Prices

$$\nu \cdot \Gamma_{k,s} = \sum_{i \in I} \frac{\mu F_{j^*(s),s}}{P_{j^*(s),s}} \sum_{j \in J_s} P_{j,s} \tau_{j,s} S^i_{k,j,s}$$

Corrective Interventions

Proposition (Corrective Financial Taxes).

$$1 + \tau^i_{D,s} = \frac{1}{1 - \sum_{j \in J_s} \frac{P_{j,s} X^i_{j,s}}{I^i_s} \frac{I^i_s X^i_{I,j,s}}{X^i_{j,s}} \tau_{j,s}}$$

- Imperfect stabilization with monetary policy
- Role for macroprudential policies:
  - corrective taxation (financial taxes)
  - quantity restrictions (financial regulation)

Aggregate Demand Externalities

- Assume "state" where a certain good is depressed
- Force agents with high propensity to spend on that good to move income to that "state"...
- ... increases spending...income...spending....
- ...stabilization benefits...
- ...not internalized by private agents

Aggregate Demand Externalities

- Assume "state" where a certain good is depressed

Keynesian cross

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Generic Inefficiency

Generic Inefficiency.
Generically, equilibria without financial taxes are constrained Pareto inefficient.

- Parallels the Geanakoplos-Polemarchakis (86) result for pecuniary externalities
- Bottom line:
  - monetary policy generically not sufficient
  - macroprudential policies necessary complement

Applications

- In paper
  - liquidity trap and deleveraging
  - international liquidity traps and sudden stops
  - fixed exchanges rates
- Many others:
  - multiplie sectors
  - ...
- Map into general framework!

Applications

- In paper
  - liquidity trap and deleveraging
  - international liquidity traps and sudden stops
  - fixed exchanges rates

see also Korinek-Simsek (2013)

see also Farhi-Werning (2012a,b), Schmitt-Grohe-Uribe (2012)

- Many others:
  - multiplie sectors
  - ...
- Map into general framework!

Liquidity Trap and Deleveraging

- Two types: borrowers and savers
- Consume and work in every period
- Three periods
  - t=1,2...deleveraging and liquidity trap as in Eggertsson and Krugman (2012)
  - t=0... endogenize ex-ante borrowing decisions

Ex-Ante Borrowing Restrictions

Proposition (Ex-Ante Borrowing Restrictions).

Labor wedges (inverse measure of output gap)

$$\tau_0 = 0 \quad \tau_1 \geq 0 \quad \tau_2 \leq 0$$

Impose binding debt restriction on borrowers at $t = 0$
or equivalent tax on borrowing

$$\tau_0^B = \tau_1 / (1 - \tau_1)$$

- Borrowers... high mpc in period 1
- Savers... low mpc in period 1
- Restricting period-0 borrowing stimulates in period 1
- Not internalized by agents

Monetary vs. Macroprudential Policy

- Policy debate:
  - use monetary policy to lean against credit booms
  - monetary policy targets full employment + no inflation, macroprudential policies targets financial stability
- Model...during credit boom
  - use monetary and macroprudential policies together
  - no tradeoff macro vs. financial stability $\tau_0 = 0$

Conclusion

- Joint theory:
  - monetary policy
  - macroprudential policies (financial taxes or regulation)
- Formula for optimal macroprudential policies:
  - intuitive
  - measurable sufficient statistics
- Also implications for redistribution

Conclusion

- Many applications:
  - liquidity trap and deleveraging
  - international liquidity trap and sudden stop
  - fixed exchange rates
  - ...

Liquidity Trap and Deleveraging

- Two types: borrowers and savers
- Three periods
  - t=1,2...deleveraging and liquidity trap as in Eggertsson and Krugman (2012)
  - t=0... endogenize ex-ante borrowing decisions
- Main result
  - restrict borrowing at t=0
  - **macroprudential** regulation

Households

- Type-1 agents (savers), mass ϕ_1

$$V^1 = \sum_{t=0}^{2} \beta^t [u(C_t^1) - v(N_t^1)]$$

$$P_t C_t^1 + B_t^1 \leq W_t N_t^1 + \Pi_t^1 + \frac{1}{1+i_t} B_{t+1}^1$$

- Type-2 agents (borrowers), mass ϕ_2

$$V^2 = \sum_{t=0}^{2} \beta^t u(C_t^2)$$

$$P_t C_t^2 + B_t^2 \leq E_t^2 + \frac{1}{1+i_t} B_{t+1}^2$$

$$B_1^2 \leq P_1 \bar{B}_1 \quad B_2^2 \leq P_2 \bar{B}_2$$

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policy

environment

$$B_1^2 \leq P_1 \bar{B}_1 \quad B_2^2 \leq P_2 \bar{B}_2$$

Firms

- Final good produced competitively

$$Y_t = \left(\int_0^1 Y_t^{\frac{\epsilon-1}{\epsilon}}(j)dj \right)^{\frac{\epsilon}{\epsilon-1}}$$

- Each variety
  - produced monopolistically
  - technology $Y_t(j) = A_t N_t(j)$
  - price set once and for all

$$\max_{P(j)} \sum_{t=0}^{2} \prod_{s=0}^{t-1} \frac{1}{1+i_s} \Pi_t(j)$$

$$\Pi_t(j) = \left(P(j) - \frac{1+\tau_L}{A_t} W_t \right) C_t \left(\frac{P(j)}{P} \right)^{-\epsilon}$$

Government

- Government budget constraint

$$B_t^g = \frac{1}{1+i_t} B_{t+1}^g + \tau_L W_t N_t^1$$

- Type-specific lump sum taxes in period 0 to achieve any distribution of debt...

$$B_0^g + B_0^1 + B_0^2 = 0$$

Equilibrium

- Households optimize
- Firms optimize
- Government budget constraints hold
- Markets clear

Planning Problem

$$\max \sum_i \lambda^i \phi^i V^i$$

$$\sum_{i=1}^{2} \phi^i C_t^i = \phi^1 A_t N_t^1 + E_t^2$$

$$u'(C_1^1) = \beta(1 + i_1)u'(C_2^1)$$

$$i_1 \geq 0$$

$$C_2^2 = E_2^2 - \bar{B}_2$$

Planning Problem

$$\max \sum_i \lambda^i \phi^i V^i$$

$$\sum_{i=1}^{2} \phi^i C_t^i = \phi^1 A_t N_t^1 + E_t^2$$

$$u'(C_1^1) = \beta(1 + i_1)u'(C_2^1)$$

$$i_1 \geq 0$$

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- Maps to general model

Labor Wedge

- Labor wedge

$$\tau_t = 1 - \frac{v'(N_t^1)}{A_t u'(C_t^1)}$$

- First best $\quad \tau_t = 0$

Ex-Ante Borrowing Restrictions

Proposition (Ex-Ante Borrowing Restrictions).

Labor wedges

$$\tau_0 = 0 \quad \tau_1 \geq 0 \quad \tau_2 \leq 0$$

Impose binding debt restriction

$$B_1^2 \leq P_1 \bar{B}_1$$

Equivalent to tax on borrowing

$$\tau_0^B = \tau_1 / (1 - \tau_1)$$

- Borrowers... high mpc in period 1
- Savers... low mpc in period 1
- Restricting period-0 borrowing stimulates in period 1
- Not internalized by agents

Capital Controls with Fixed Exchange Rates

- See Farhi-Werning (2012) and Schmitt-Grohe-Uribe (2012)
- Small open economy with a fixed exchange rate
- Traded and non-traded goods
  - endowment of traded good sold competitively
  - non-traded good produced from labor, sold monopolistically, rigid price
- Two periods: t=0,1
- Main result: use capital control to regain monetary policy autonomy

Households

- Preferences

$$\sum_{t=0}^{1} \beta^t U(C_{NT,t}, C_{T,t}, N_t)$$

- Budget constraint

$$P_{NT} C_{NT,t} + E P^*_{T,t} C_{T,t} + \frac{1}{(1+i^*_t)(1+\tau^B_t)} E B_{t+1} \leq$$

$$W_t N_t + E P^*_{T,t} \bar{E}_{T,t} + \Pi_t - T_t + E B_t$$

- Capital controls to regain monetary autonomy

$$1 + i_t = (1+i^*_t)(1+\tau^B_t)$$

Firms

- Final non-traded good produced competitively

$$Y_{NT,t} = \left(\int_0^1 Y_{NT,t}(j)^{1-\frac{1}{\epsilon}} dj \right)^{\frac{1}{1-\frac{1}{\epsilon}}}$$

- Each variety
    - produced monopolistically
    - technology $Y_{NT,t}(j) = A_t N_t(j)$
    - price set once and for all

$$P_{NT} = (1+\tau_L)\frac{\epsilon}{\epsilon - 1}\frac{\sum_{t=0}^{1}\prod_{s=0}^{t-1}\frac{1}{(1+i_s^*)(1+\tau_s^B)}\frac{W_t}{A_t}C_{NT,t}}{\sum_{t=0}^{1}\prod_{s=0}^{t-1}\frac{1}{(1+i_s^*)(1+\tau_s^B)}C_{NT,t}}$$

Government

- Government budget constraint

$$T_t + \tau_L W_t N_t - \frac{\tau_t^B}{1+\tau_t^B} B_t = 0$$

Equilibrium

- Households optimize
- Firms optimize
- Government budget constraints hold
- Markets clear

Indirect Utility

- Assume preferences
  - separable between consumption and leisure
  - homothetic over consumption

$$C_{NT,t} = \alpha(p_t) C_{T,t} \qquad\qquad p_t = \frac{EP^*_{T,t}}{P_{NT,t}}$$

- Define indirect utility

$$V(C_{T,t}, p_t) = U\left(\alpha(p_t) C_{T,t}, C_{T,t}, \frac{\alpha(p_t)}{A_t} C_{T,t}\right)$$

Planning Problem

$$\max \sum_{t=0}^{2} \beta^t V(C_{T,t}, \frac{EP^*_{T,t}}{P_{NT}})$$

$$P^*_{T,0}\left[C_{T,0} - \bar{E}_0\right] + \frac{1}{1+i^*_0} P^*_{T,1}\left[C_{T,1} - \bar{E}_1\right] \leq 0$$

Planning Problem

$$\max \sum_{t=0}^{2} \beta^t V(C_{T,t}, \frac{EP^*_{T,t}}{P_{NT}})$$

$$P^*_{T,0}\left[C_{T,0} - \bar{E}_0\right] + \frac{1}{1+i^*_0} P^*_{T,1}\left[C_{T,1} - \bar{E}_1\right] \leq 0$$

- Maps to general model

Labor Wedge

- Labor wedge

$$\tau_t = 1 + \frac{1}{A_t}\frac{U_{N,t}}{U_{C_{NT},t}}$$

- Departure from first best where $\tau_t = 0$

Private vs. Social Value

Lemma.

$$V_{C_{T,t}}(C_{T,t}, p_t) = U_{C_{T,t}} \left(1 + \frac{\alpha_t}{p_t}\tau_t\right)$$

$$V_p(C_{T,t}, p_t) = \frac{\alpha_{p,t}}{p_t} C_{T,t} U_{C_{T,t}}\, \tau_t$$

- Wedge social vs. private value of transfers:
  - labor wedge
  - relative expenditure share of NT

Capital Controls

Proposition (Capital Controls).
Impose capital controls

$$1 + \tau_0^B = \frac{1 + \frac{\alpha_1}{p_1}\tau_1}{1 + \frac{\alpha_0}{p_0}\tau_0}$$

- Aggregate demand externalities from agents' international borrowing and saving decisions
- Corrective macroprudential capital controls