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
- ...

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Model

- Agents $i \in I$

- Goods $\{X_{j,s}^i\}$ 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

\[
\sum_{s \in S} D^i_s Q_s \leq \Pi^i
\]

\[
\sum_{j \in J_s} P_{j,s} X^i_{j,s} \leq -T^i_s + (1 + \tau^i_{D,s}) D^i_s
\]

\[
\{ X^i_{j,s} \} \in B^i_s
\]
Agents’ Budget Sets

\[ \sum_{s \in S} D^i_s Q_s \leq \Pi^i \]

\[ \sum_{j \in J_s} P_{j,s} X^i_{j,s} \leq -T^i_s + (1 + \tau^i_{D,s}) D^i_s \]

\[ \{ X^i_{j,s} \} \in B^i_s \]

- macroprudential tax
- borrowing constraint
Government Budget Set

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

\[ \sum_{i \in I} (T_s^i - \tau_{D_s^i}^i D_s^i) + D_s^g = 0 \]
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

\[
\max_{I_s, P_s} \sum_{i \in I} \sum_{s \in S} \lambda^i V^i_s (I_s^i, P_s)
\]

\[
F(\{\sum_{i \in I} X^i_{j,s} (I_s^i, P_s)\}) \leq 0
\]

\[
\Gamma(\{P_{j,s}\}) \leq 0
\]
Planning Problem

- Planning problem

\[
\max_{I_s, P_s} \sum_{i \in I} \sum_{s \in S} \lambda^i V_s^i (I_s^i, P_s) \\
F\left( \{ \sum_{i \in I} X_{j,s}^i (I_s^i, P_s) \} \right) \leq 0 \\
\Gamma(\{P_{j,s}\}) \leq 0
\]
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**

\[
\frac{\lambda^i V_{I,s}^i}{1 - \sum_{j \in J_s} \frac{P_{j,s} X_{j,s}^i}{I_s^i} \frac{I_s^i X_{I,j,s}^i}{X_{j,s}^i} \tau_{j,s}} = \frac{\mu F_{j^*(s),s}}{P_{j^*(s),s}}
\]

social vs. private marginal utility of income

- **Prices**

\[
\nu \cdot \Gamma_{k,s} = \sum_{i \in I} \frac{\mu F_{j^*(s),s}}{P_{j^*(s),s}} \sum_{j \in J_s} P_{j,s} \tau_{j,s} S_{k,j,s}^i
\]
Corrective Interventions

Proposition (Corrective Financial Taxes).

\[
1 + \tau_{D,s}^i = \frac{1}{1 - \sum_{j \in J_s} \frac{P_{j,s} X_{j,s}^i}{I_s^i} \frac{I_{j,s}^i X_{j,s}^i}{X_{j,s}^i} \tau_{j,s}}
\]

- 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

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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:
  - multiple sectors
  - ...

- Map into general framework!
Applications

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  - liquidity trap and deleveraging
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- Many others:
  - multiple sectors
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- Map into general framework!

see also Korinek-Simsek (2013)

see also Farhi-Werning (2012a,b), Schmitt-Grohe-Uribe (2012)
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)
  - $t=0$: endogenous ex-ante borrowing decisions
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

\[ \tau^B_0 = \frac{\tau_1}{(1 - \tau_1)} \]

- 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
  - ...

Thursday, March 20, 14
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 $\phi_1$
  \[ V^1 = \sum_{t=0}^{2} \beta^t [u(C^1_t) - v(N^1_t)] \]
  \[ P_tC^1_t + B^1_t \leq W_tN^1_t + \Pi^1_t + \frac{1}{1 + i_t} B^1_{t+1} \]

- Type-2 agents (borrowers), mass $\phi_2$
  \[ V^2 = \sum_{t=0}^{2} \beta^t u(C^2_t) \]
  \[ P_tC^2_t + B^2_t \leq E^2_t + \frac{1}{1 + i_t} B^2_{t+1} \]
  \[ B^2_1 \leq P_1\bar{B}_1 \quad B^2_2 \leq P_2\bar{B}_2 \]
Households

- Type-1 agents (savers), mass $\Phi_1$

\[ V^1 = \sum_{t=0}^{2} \beta^t [u(C^1_t) - v(N^1_t)] \]

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- Type-2 agents (borrowers), mass $\Phi_2$

\[ V^2 = \sum_{t=0}^{2} \beta^t u(C^2_t) \]

\[ P_tC^2_t + B^2_t \leq E^2_t + \frac{1}{1 + i_t} B^2_{t+1} \]

\[ B^2_1 \leq P_1 \bar{B}_1 \quad B^2_2 \leq P_2 \bar{B}_2 \]

- Policy

- Environment
Firms

- Final good produced competitively

\[ Y_t = \left( \int_0^1 Y_t^{\frac{e-1}{e}} (j) \, dj \right)^{\frac{e}{e-1}} \]

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

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

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

\[
\max \sum_{i} \lambda^i \phi^i V^i \\
\sum_{i=1}^{2} \phi^i C^i_t = \phi^1 A_t N^1_t + E^2_t \\
u'(C^1_1) = \beta (1 + i_1) u'(C^1_2) \\
i_1 \geq 0 \\
C^2_2 = E^2_2 - \bar{B}_2
\]
Planning Problem

$$\max \sum_{i} \lambda^i \phi^i V^i$$

$$\sum_{i=1}^{2} \phi^i C^i_t = \phi^1 A_t N^1_t + E^2_t$$

$$u'(C^1_1) = \beta (1 + i_1) u'(C^1_2)$$

$$i_1 \geq 0$$

$$C^2_2 = E^2_t - B_2$$

- Maps to general model
Labor Wedge

- Labor wedge

\[ \tau_t = 1 - \frac{v'(N^1_t)}{A_t u'(C^1_t)} \]

- First best  \( \tau_t = 0 \)
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

\[ P_{NT} C_{NT,t} + E P_{T,t}^* C_{T,t} + \frac{1}{(1 + i_t^*)(1 + \tau_t^B)} E B_{t+1} \leq \]

\[ W_t N_t + E P_{T,t}^* \bar{E}_{T,t} + \Pi_t - T_t + E B_t \]

- Capital controls to regain monetary autonomy

\[ 1 + i_t = (1 + i_t^*)(1 + \tau_t^B) \]
Firms

- Final non-traded good produced competitively

\[ Y_{NT,t} = \left( \int_0^1 Y_{NT,t}(j)^{1-\frac{1}{\varepsilon}} \, dj \right)^{\frac{1}{1-\frac{1}{\varepsilon}}} \]

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

\[ P_{NT} = (1 + \tau_L) \frac{\varepsilon}{\varepsilon - 1} \frac{\sum_{t=0}^1 \prod_{s=0}^{t-1} \frac{1}{(1 + i_s^*)(1 + \tau_s^B)} \frac{W_t}{A_t} C_{NT,t}}{\sum_{t=0}^1 \prod_{s=0}^{t-1} \frac{1}{(1 + i_s^*)(1 + \tau_s^B)} C_{NT,t}} \]
Government budget constraint

\[ T_t + \tau_L W_t N_t - \frac{\tau^B_t}{1 + \tau^B_t} B_t = 0 \]
Equilibrium

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

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

\[ C_{NT,t} = \alpha(p_t) C_{T,t} \]

- 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

\[
\begin{align*}
\max \sum_{t=0}^{2} \beta^t V(C_{T,t}, \frac{EP_{T,t}^*}{P_{NT}}) \\
PT_{T,0} [CT,0 - \bar{E}_0] + \frac{1}{1 + i^*_0} PT_{T,1} [CT,1 - \bar{E}_1] \leq 0
\end{align*}
\]
Planning Problem

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

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

- Maps to general model
Labor Wedge

- Labor wedge

\[ \tau_t = 1 + \frac{1}{A_t} \frac{U_{N,t}}{U_{CNT,t}} \]

- Departure from first best where \( \tau_t = 0 \)
Private vs. Social Value

Lemma.

\[ V_{C,T,t}(C_{T,t}, p_t) = U_{C,T,t} \left( 1 + \frac{\alpha_t}{p_t} \right) \]

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

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