Exchange Rate Adjustment in Financial Crises

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Motivation: Two-fold

- Crises in Emerging Markets: Sudden Stops
  - Mostly real models
  - Downplays role of relative price (terms of trade) adjustment
  - Downplays role of exchange rate regime in evaluation
- Policy Trilemma versus Dilemma
  - With volatile capital flows, financial vulnerabilities, is exchange rate regime important?
  - Fixed or Flexible exchange rates equally vulnerable to external shocks?
  - Capital controls needed to supplement monetary independence?
  - Should monetary policy be 'macro-prudential'?

This paper

- Compare exchange rate regimes in a small open-economy DSGE model
  - Financial frictions
  - Sudden stops associated with occasionally-binding credit constraints
  - Sticky nominal prices
- Describe outcomes under 'normal times' /'crisis times'
- Use this to conduct a normative analysis of monetary policy and capital controls

Dual roles for economic policies

- Floating regime
  - Monetary policy useful due to nominal rigidities
  - Capital controls fix pecuniary externalities caused by financial frictions
- Pegged regime
  - Capital controls fix pecuniary externalities
  - Capital controls to obtain monetary autonomy

Preview of results: Fixed vs. Flexible

- Outside of crises, independent monetary policy is of little benefit
- Volatility may be lower under a peg, depending on shock composition
- Frequency of sudden stops lower in a peg
- External debt is lower under a peg

Preview of results: Crises

- But crises much worse in a peg
- Key difference is ability to regain competitiveness through exchange rate adjustment

Preview of results: Optimal monetary policy

- In normal times strict price stability optimal (no role for macro-prudential policies)
- In crises, sharply depart from price stability

Preview results: Capital controls

- With flexible exchange rates, small inflow subsidies are beneficial
- Under a peg, capital inflow taxes are welfare improving

Related literature

- Theories
  - Pecuniary externalities and capital controls
    - Bianchi (2011), Bianchi and Mendoza (2013), Jeanne and Korinek (2010), Benigno et al. (2013), Stein (2012), Devereux, Young and Yu (2015)
  - Aggregate demand externalities and capital controls
    - Farhi and Werning (2012, 2014, 2015), Korinek and Simsek (2014)
  - Monetary policy
    - Fornaro (2015), Schmitt-Grohe and Uribe (2015), Davis and Presno (2015), Ottonello (2015), Devereux, Young and Yu (2015), Liu and Spiegel (2015)
- Empirics
  - Forbes and Warnock (2012), Rey (2015), Passari and Rey (2015), Bruno and Shin (2014,2015)

Road map

- The baseline model
- Calibration and numerical results
- Compare alternative monetary rules
- Capital controls

Small Open Economy model

- Wholesale good production
  - Imported intermediate goods, hire labor and rent capital
- Final good production
  - Use wholesale goods to produce varieties of consumption goods (sticky prices)
- Consumption composite
  - Domestically consumed or exported
- Firm-households
  - Own all domestic firms, make consumption-saving decisions
  - Accumulate capital (in aggregate fixed supply)
  - Supply labor (sticky wages in one version)
  - Borrow in dollars from the rest of the world (capital is collateral)

Firm-households

- Wholesale good production

$$M_t = A_t (Y_{F,t})^{\alpha_F} L_t^{\alpha_L} K_t^{\alpha_K}$$

- Foreign demand for domestic consumption composite

$$X_t = \left(\frac{P_t}{\mathcal{E}_t P_t^*} \right)^{-\rho} \zeta_t^*$$

- Budget constraint

$$P_t c_t + Q_t k_{t+1} + \frac{B_{t+1}}{R_{t+1}} + \frac{B_{t+1}^* \mathcal{E}_t}{R_{t+1}^*} (1 - \tau_{c,t}) \leq W_t l_t + k_t (R_{K,t} + Q_t) + B_t + B_t^* \mathcal{E}_t + T_t$$

$$+ \left[P_{M,t} M(Y_{F,t}, L_t, K_t) - (1 + \tau_{N,t}) Y_{F,t} P_{F,t}^* \mathcal{E}_t - W_t L_t - R_{K,t} K_t \right] + D_t$$

- Collateral constraint

$$\vartheta Y_{F,t} P_{F,t}^* (1 + \tau_{N,t}) - B_{t+1}^* \leq \kappa_t E_t \left\{ \frac{Q_{t+1} k_{t+1}}{\mathcal{E}_{t+1}} \right\}$$

Final good production

- Consumption composite and CPI

$$Y_t = \left(\int_0^1 \left(Y_t(i) \right)^{\frac{\theta-1}{\theta}} di \right)^{\frac{\theta}{\theta-1}}, \quad P_t = \left(\int_0^1 \left(P_t(i) \right)^{1-\theta} di \right)^{\frac{1}{1-\theta}}$$

- Technology

$$Y_t(i) = M_t(i)$$

- Profits per period

$$D_{H,t}(i) \equiv (1 + \tau_{H,t}) P_t(i) Y_t(i) - P_{M,t} Y_t(i) - \phi \left(\frac{P_t(i)}{P_{t-1}(i)} \right) Y_t P_t$$

with asymmetric price adjustment cost $\phi \left(\frac{P_t(i)}{P_{t-1}(i)} \right)$.

- Inflation condition: the Phillips curve

Optimal monetary policy under discretion

- Policy maker maximizes the representative household's welfare
- Policy instrument: nominal interest rate R_{t+1}

$$V(b_t^*, Z_t) = \max_{\{\Xi\}} \left\{ U(C_t, L_t) + \beta E_t V\left(b_{t+1}^*, Z_{t+1}\right) \right\}$$

with

$$\Xi \equiv \{L_t, C_t, Y_t, Y_{F,t}, b_{t+1}^*, q_t, \mu_t, r_{K,t}, e_t, p_{M,t}, \pi_t\}$$

- subject to implementability constraints
- No commitment - government takes future policy functions as given

Quantitative assessment

Table: Parameter values

Parameter		Values
Preference		
β	Subjective discount factor	0.975
σ	Relative risk aversion	2
ν	Inverse of Frisch labor supply elasticity	1
χ	Parameter in labor supply	0.4
Production		
α_F	Intermediate input share in production	0.16
α_L	Labor share in production	0.57
α_K	Capital share in production	0.03
ϕ_P	Price adjustment cost	76
γ	Asymmetric price adjustment cost	-50
ϑ	Share of working capital	0.5
θ	Elasticity of substitution among imported varieties	10
ρ	Elasticity of substitution in the foreign countries	10
ζ	Steady state of foreign demand	0.117
R^*	Steady state of world interest rate	1.015
A	Steady state of TFP shock	1
ρ_A	Persistence of TFP shocks	0.95
σ_A	Standard deviation of TFP shocks	0.008
ρ_R	Persistence of foreign interest rate shocks	0.6
σ_R	Standard deviation of foreign interest rate shocks	0.00623
$p_{H,H}$	Transitional probability of high leverage to high leverage	0.975
$p_{L,L}$	Transitional probability of low leverage to low leverage	0.775

Compare monetary policies

1. Price Stability
2. Optimal Monetary Policy
3. Exchange Rate Peg

Crisis Frequency (% time at constraints)

Crises are less frequent in a peg

Table: Frequency

PI targeting	Optimal M	Pegged
11.1	10.7	6.8

Model moments normal times: mean

Table: External debt lower under a peg

	PI targeting	Optimal M	Pegged
Effective consumption	0.3908	0.3908	0.3896
Output	0.6906	0.6904	0.6905
Savings	-0.3200	-0.3200	-0.3191
Real exchange rate	0.9867	0.9867	0.9873
Price markup	1.0000	1.0000	1.0029
Inflation	1.0000	1.0000	1.0001
Capital price	0.9442	0.9440	0.9391
Interest rate	1.016	1.016	1.015

Model moments normal times: mean

Table: Lower absorption under a peg

	PI targeting	Optimal M	Pegged
Effective consumption	0.3908	0.3908	0.3896
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Interest rate	1.016	1.016	1.015

Model moments normal times: mean

Table: Lower collateral price under a peg

	PI targeting	Optimal M	Pegged
Effective consumption	0.3908	0.3908	0.3896
Output	0.6906	0.6904	0.6905
Savings	-0.3200	-0.3200	-0.3191
Real exchange rate	0.9867	0.9867	0.9873
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Interest rate	1.016	1.016	1.015

Model moments normal time: standard deviation

Table: Output volatility lower under the peg

	PI targeting	Optimal M	Pegged
Effective consumption	0.78	0.78	0.57
Output	1.80	1.79	0.97
Savings	1.23	1.23	0.74
Real exchange rate	0.59	0.59	0.28
Price markup	0.00	0.00	1.59
Inflation	0.00	0.00	0.26
Capital price	2.54	2.53	1.90

Model moments in crisis: mean

Table: In crisis, output and debt fall much more under a peg

	PI targeting	Optimal M	Pegged
Effective consumption	0.3677	0.3676	0.3634
Output	0.6645	0.6652	0.6492
Savings	-0.3064	-0.3047	-0.2770
Real exchange rate	0.9904	0.9908	0.9886
Price markup	1.0000	1.0014	0.9676
Inflation	1.0000	1.0002	0.9993
Capital price	0.8738	0.8734	0.8602
External finance premium	0.0665	0.0690	0.1070
Interest rate	1.104	1.107	1.165

Model moments in crisis: mean

Table: Markup much lower, External Finance Premium, Interest Rate much higher in a peg

	PI targeting	Optimal M	Pegged
Effective consumption	0.3677	0.3676	0.3634
Output	0.6645	0.6652	0.6492
Savings	-0.3064	-0.3047	-0.2770
Real exchange rate	0.9904	0.9908	0.9886
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Interest rate	1.104	1.107	1.165

Model moments in crisis: standard deviation

Table: Output, markup volatility much higher in a crisis

	PI targeting	Optimal M	Pegged
Effective consumption	2.10	2.14	2.77
Output	1.82	1.79	4.49
Savings	2.83	2.80	0.61
Real exchange rate	1.14	1.18	0.52
Price markup	0.00	0.21	6.07
Inflation	0.00	0.03	0.60
Capital price	5.70	5.79	7.72
External finance premium	10.08	10.23	10.60

Questions

- Why is crisis frequency lower under a peg?
  - Worse effects of crisis leads to higher precautionary savings, lower indebtedness
- Why is output volatility lower under peg?
  - Importance of productivity shocks

'Event' Analysis

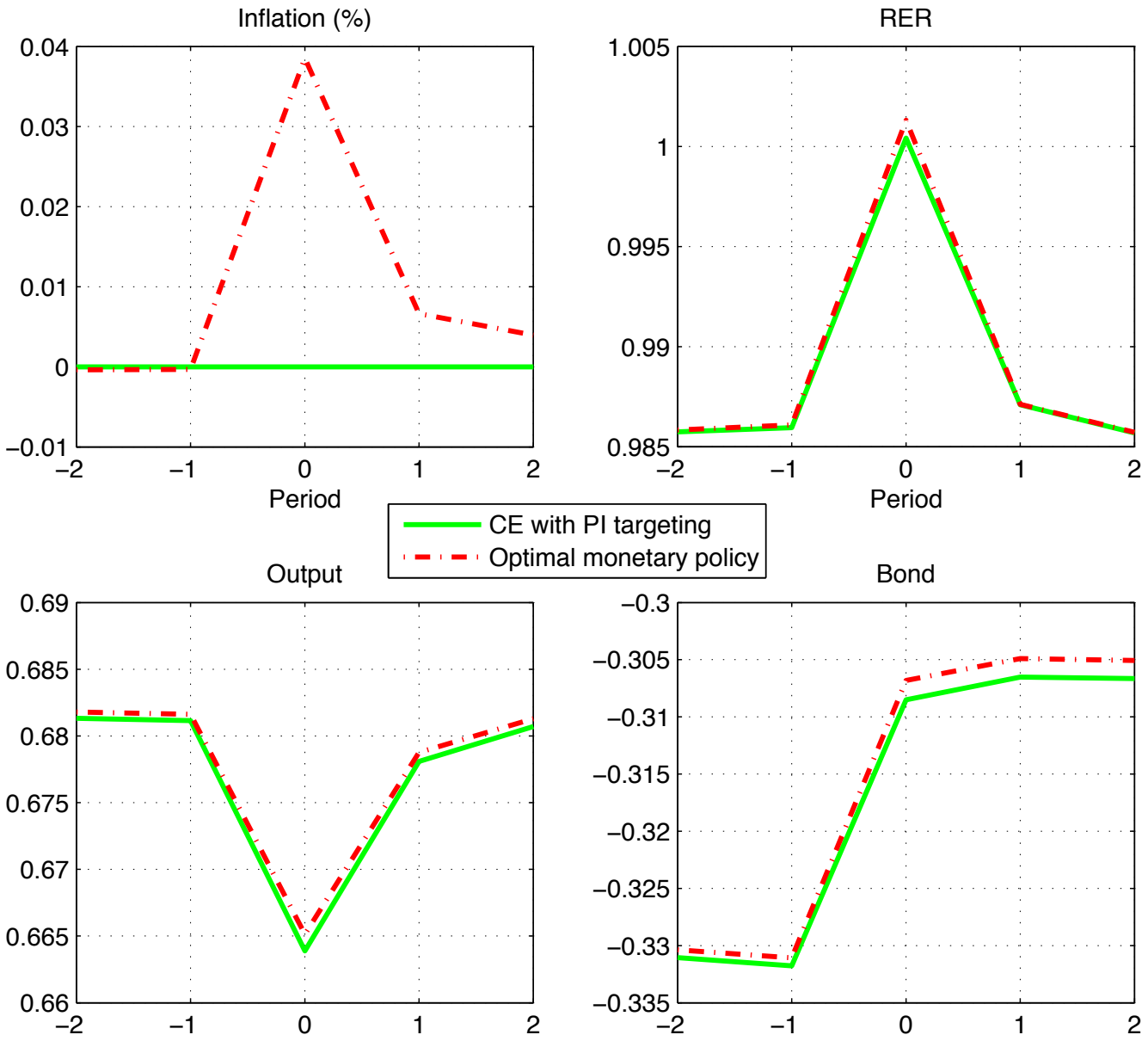
Define a crisis event as:

1. Constraint not binding for at least 2 periods
2. Binds in 3rd period
3. Average across all such events in simulations

   - In most cases, crisis is triggered by tightening of leverage constraint

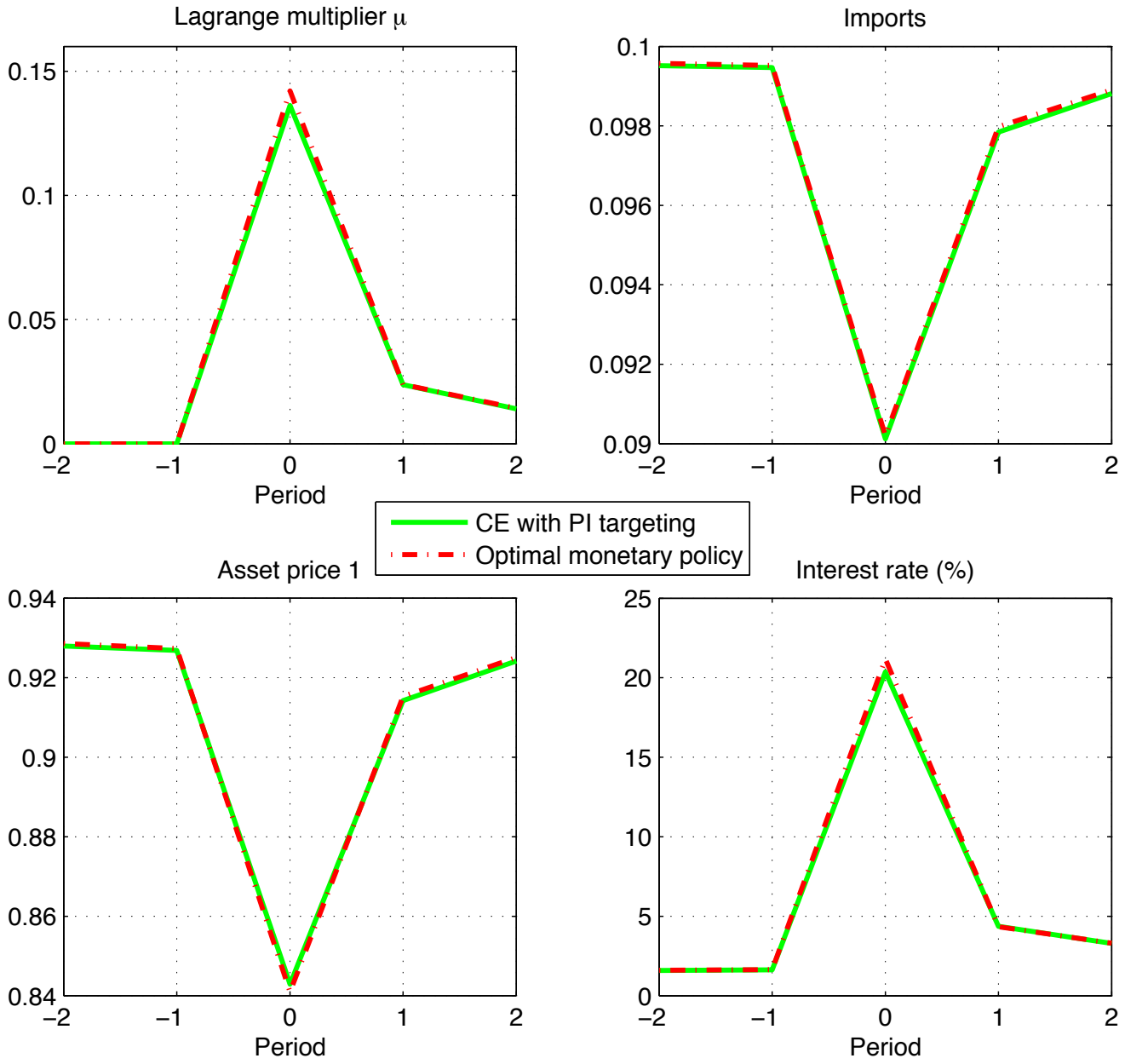
Crisis 'event' analysis under floating

Deviate from price stability in a crisis (but no macro-prudential monetary policy)



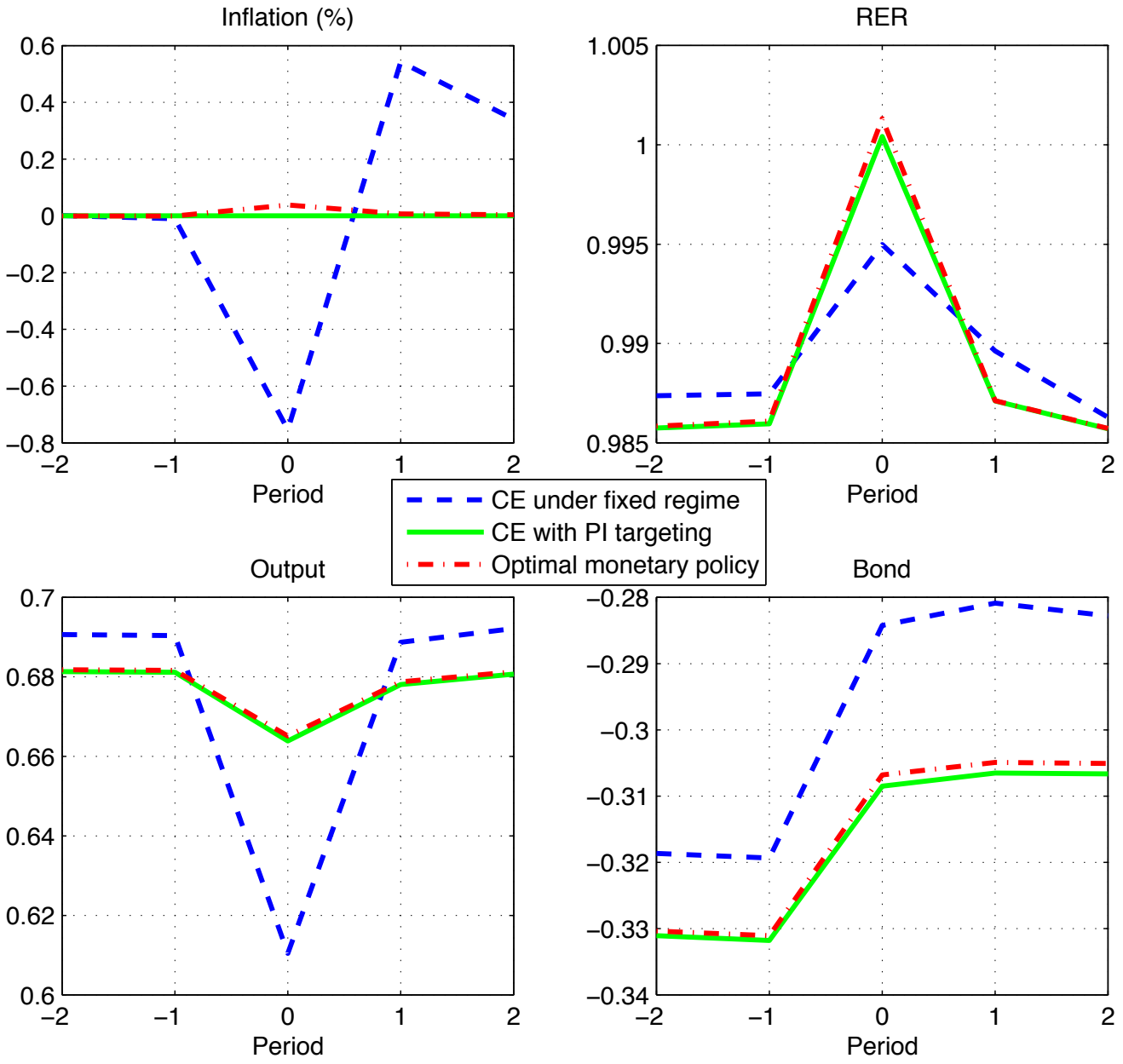
Crisis 'event' analysis under floating (cont'd)

Monetary response only small real impact

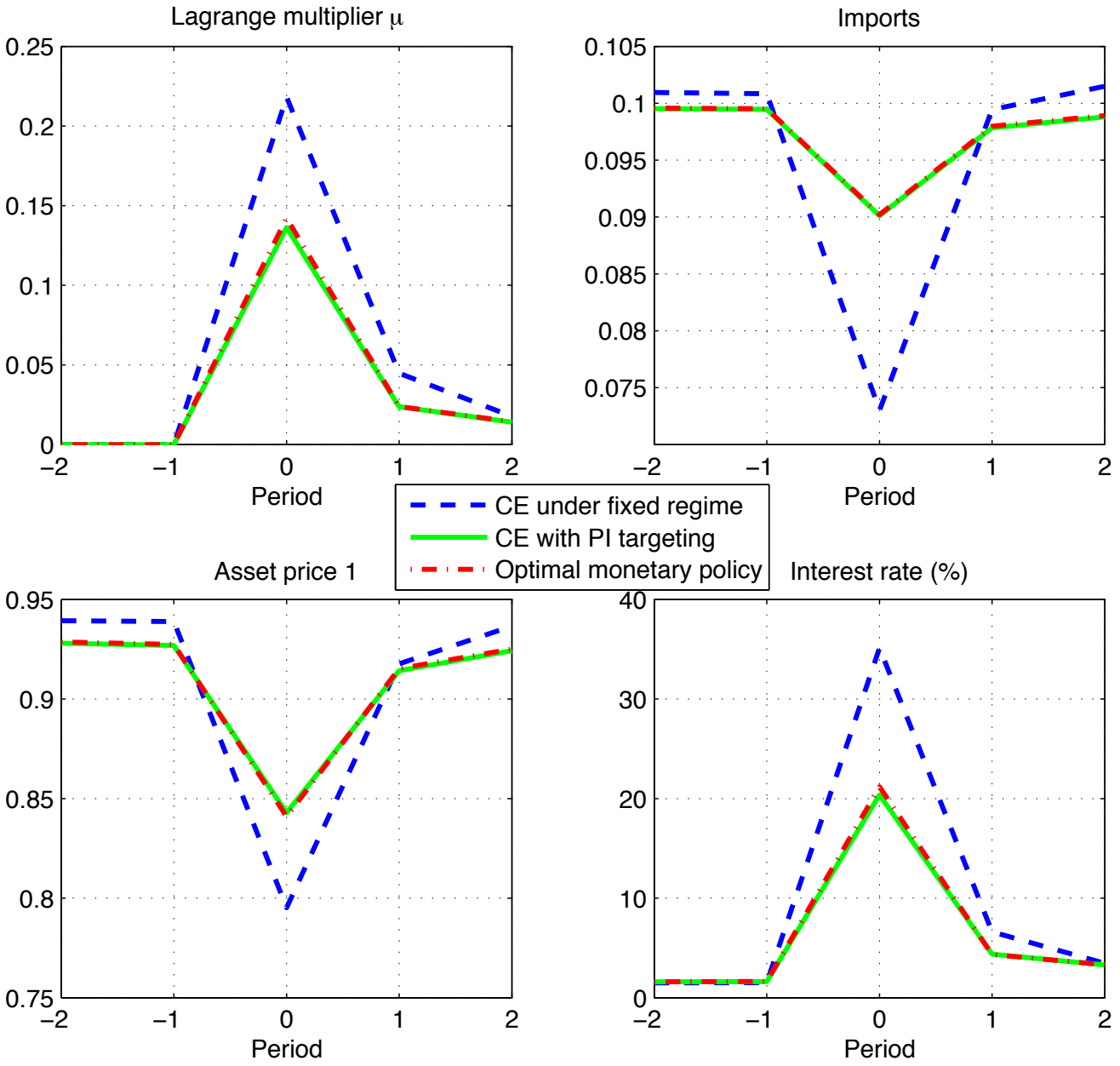


Crisis 'event' analysis: floating vs. pegged

Peg is sharply deflationary in crisis



Crisis 'event' analysis: floating vs. pegged (cont'd)



The effects of capital controls

- With floating exchange rates, time consistent capital controls may be welfare reducing (Devereux Young and Yu, 2016)
- Full commitment optimum faces large dimensionality problems
- Compare alternative ad-hoc constant capital inflow taxes/subsidies

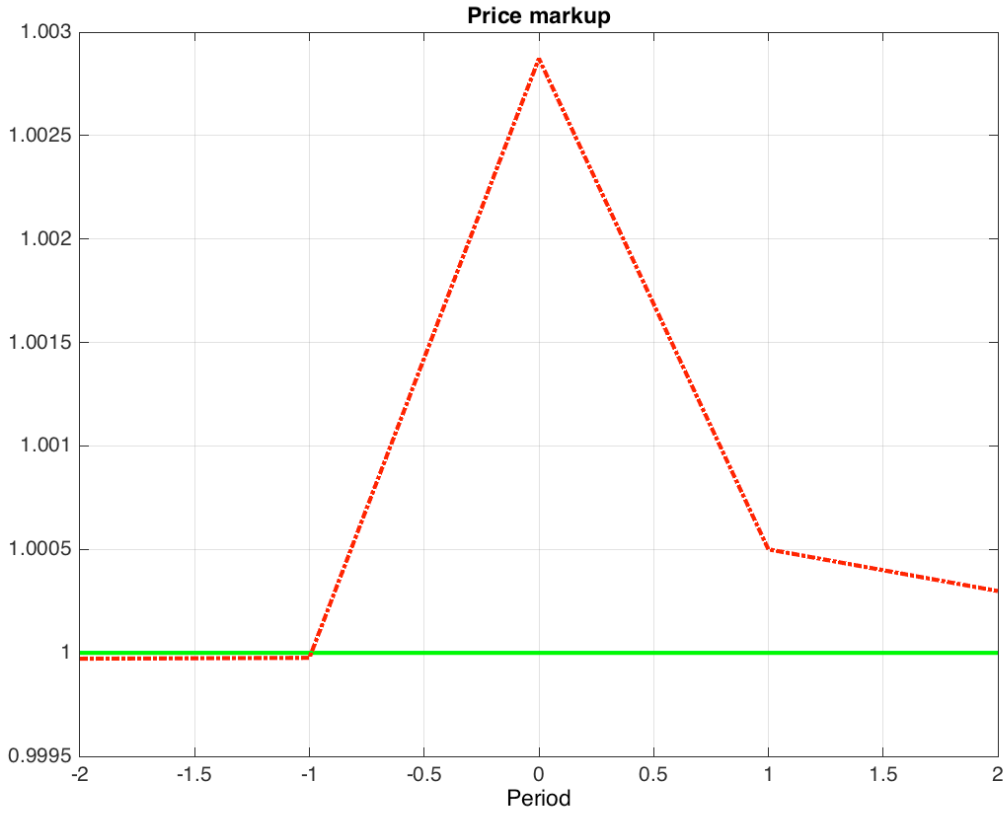
Sharp dichotomy between Floating and Peg

- Under floating exchange rates, a small constant capital inflow *subsidy* increases welfare
  - Logic: agents more impatient than ROW
  - Subsidy takes pecuniary externality into account: pushes up price of collateral
  - Increases borrowing capacity
  - Monetary policy maintains output close to flexible price equilibrium

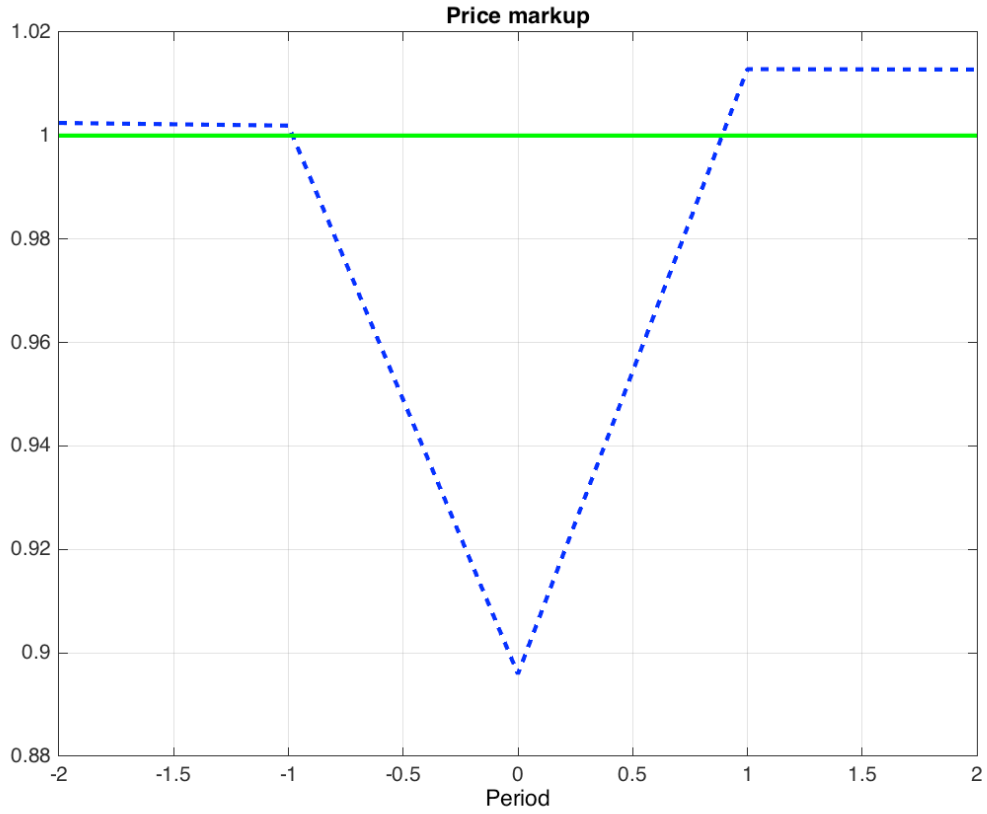
Sharp dichotomy between Floating and Peg

- Under a peg, a capital constant capital inflow tax increases welfare
  - Logic: conflict between pecuniary externality and nominal rigidity
  - Higher debt leads to much higher output collapse in a crisis, under a peg
  - Markups pushed further away from optimum
  - Productive inefficiency offsets benefits of increased borrowing capacity

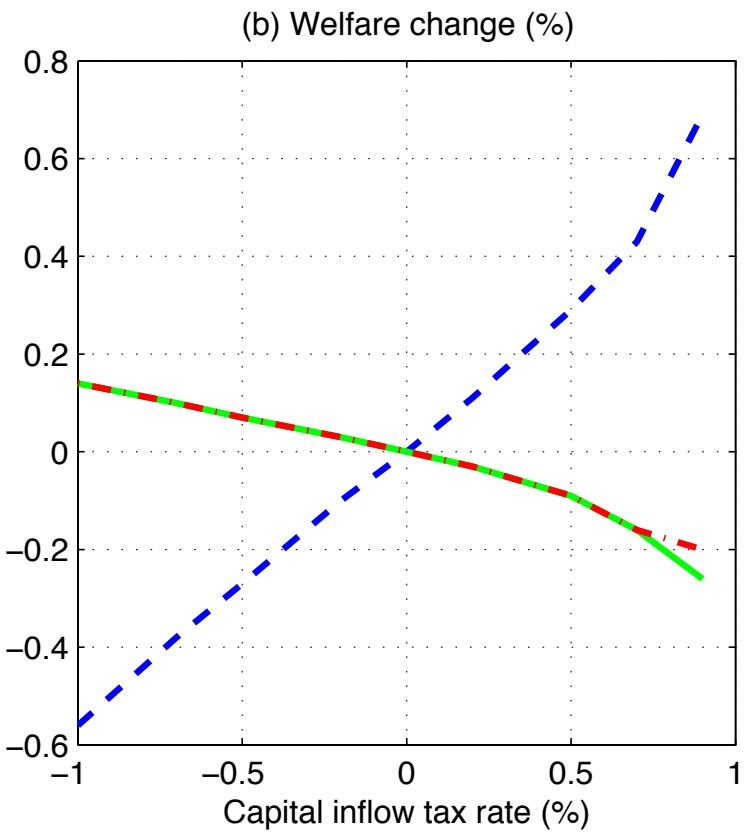
Price markup: Optimal Monetary Policy



Price markup: Peg



Welfare


(b) Welfare change (%)
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−1
−0.5
0
0.5
1
Capital inflow tax rate (%)

Conclusions

- Monetary policy should generate inflation during a crisis, even though it depreciates the currency
- No role for macro-prudential monetary policy
- Peg may have less frequent crises and less volatility, but crisis experience much worse
- Floating exchange rate regime requires capital inflow subsidy
- Pegged regime needs capital inflow tax to regain monetary autonomy
- 'Trilemma' still matters