Exchange Rate Adjustment in Financial Crises

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Debate over exchange rates

- Flexible exchange rates can work as shock absorbers (Obstfeld and Rogoff, 1995)

- But exchange rates tend to overshoot and volatile, exacerbate adverse shocks (Frankela, George Saravelosb, 2012; Laeven, Valencia, 2013)

- In addition, in 'global financial cycles', exchange rate movements may matter little for monetary policy (Rey, 2013, 2015)

Research questions

- What's the role of exchange rate movements and monetary policy in the presence of 'sudden stops' in capital markets?

- If monetary policy fails to stabilize macroeconomy effectively, should we deploy other policy instruments such as capital controls?

- In crisis-prone emerging markets, is traditional Mundell-Fleming trilemma still relevant or do we face a 'dilemma' instead?

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
- Use this to conduct a normative analysis of monetary policy and capital controls

Preview of results

Monetary policy

- ▶ Consider (a) strict inflation targeting rule, (b) optimal monetary policy and (c) the pegged regime
- ▶ In normal times, exchange rate regimes differ very slightly
- ▶ But in crises, pegged regime generates higher deleveraging, larger output and consumption losses than the floating regime due to larger inflation variation
- ▶ Monetary policy as a 'mopping up' response, rather than 'macroprudential' policy

Preview of results
Monetary policy and capital controls with commitment

- ▶ 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
  - ▶ and help regain monetary autonomy
- ▶ Under the floating, large subsidy of capital inflows is desirable, while moderate subsidy of capital inflows is optimal under the pegged
- ▶ Monetary policy and capital controls with commitment can stabilize the economy.

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
    - ▶ Farhi and Werning (2012, 2013), 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
- Competitive equilibrium no policy
- Capital controls

The 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
  - 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

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

Optimality conditions

- Labor supply (GHH preferences)

$$w_t = \chi l_t^\nu$$

- Optimal portfolio choices

$$q_t = \mu_t \kappa_t E_t \left\{ \frac{q_{t+1} e_t}{e_{t+1}} \right\} + E_t \left\{ \beta \frac{U_c(t+1)}{U_c(t)} (r_{K,t+1} + q_{t+1}) \right\}$$

$$1 = E_t \left\{ \beta \frac{U_c(t+1)}{U_c(t)} \frac{R_{t+1}}{\pi_{t+1}} \right\}$$

$$1 - \tau_{c,t} = \mu_t R_{t+1}^* + E_t \left\{ \beta \frac{U_c(t+1)}{U_c(t)} \frac{e_{t+1}}{e_t} R_{t+1}^* \right\}$$

- Complementary slackness condition

$$e_t \mu_t \left[\kappa_t E_t \left(\frac{q_{t+1} k_{t+1}}{e_{t+1}} \right) + b_{t+1}^* - \vartheta(1 + \tau_{N,t}) Y_{F,t} \right] = 0$$

The terms of trade/real exchange rate

- SOE can exploit its terms of trade monopoly
- Divorce this from optimal policy problem by assuming tax on imports of

$$\tau_N = \frac{1}{\rho - 1}$$

Production of wholesale goods

The optimal demand for intermediate inputs, labor, and capital
for the wholesale firm-household is given implicitly by

$$p_{M,t}\frac{\alpha_F M_t}{Y_{F,t}} = (1 + \tau_{N,t})e_t\left(1 + \vartheta\mu_t\right),$$

$$p_{M,t}\frac{\alpha_L M_t}{L_t} = w_t$$

$$p_{M,t}\frac{\alpha_K M_t}{K_t} = r_{K,t}$$

Final good production

- Consumption composite and CPI

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

- 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

$$-1 + \mu_t R_{t+1}^* + E_t \left\{ \beta \frac{U_c(t+1)}{U_c(t)} \frac{e_{t+1}}{e_t} R_{t+1}^* \right\} = 0,$$

- and other
- Omit the domestic bond Euler equation
- Key feature is no commitment - government takes future policy functions as given

Monetary policy under the pegged regime

Domestic inflation is determined by foreign inflation and the change in the real exchange rate,

$$\pi_t = \frac{e_{t-1}}{e_t}\pi_t^* = \frac{e_{t-1}}{e_t}$$

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
Policy variables		
α_π, α_Y, α_e	Coefficients in the Taylor rule	
τ_H	Subsidy to final goods producers	$\frac{1}{\theta-1}$
$\tau_{N,t}$	Import tax rate	$\frac{1}{\rho-1}$

The Competitive Equilibrium

Model Mean

	PI	M	Pegged
Probability of crisis	11.1	10.7	6.8
Conditional welfare ($b_t^* = -0.35$, $e_{t-1} = 1$)	0.38848	0.38848	0.38794
Effective consumption	0.3883	0.3883	0.3879
Output	0.6877	0.6877	0.6877
Savings	-0.3185	-0.3183	-0.3163
Real exchange rate	0.9871	0.9871	0.9874
Price markup	1.0000	1.0001	1.0005
Inflation	1.0000	1.0000	1.0000
Capital price	0.9364	0.9364	0.9338
External finance premium	0.0074	0.0074	0.0073

Model Mean in Crisis

	PI	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
Domestic interest rate	1.1042	1.1072	1.1654
External finance premium	0.0665	0.0690	0.1070

Model Standard Deviation

	PI	M	Pegged
Effective consumption	1.14	1.14	1.02
Output	1.80	1.79	1.65
Savings	1.31	1.31	0.80
Real exchange rate	0.69	0.70	0.30
Price markup	0.00	0.08	2.41
Inflation	0.00	0.01	0.30
Capital price	3.43	3.42	3.05
Domestic interest rate	5.76	5.77	5.89
External finance premium	3.91	3.92	3.58

Model Standard Deviation in Crisis

	PI	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
Domestic interest rate	15.29	15.56	18.68
External finance premium	10.08	10.23	10.60

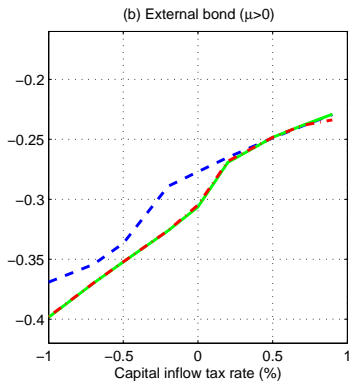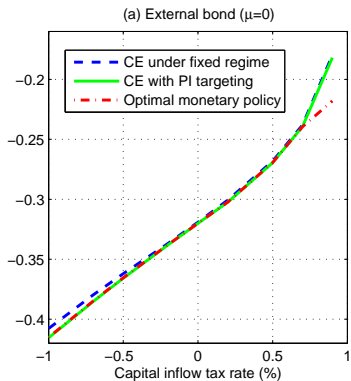# Crisis event analysis: No capital controls
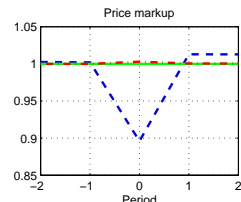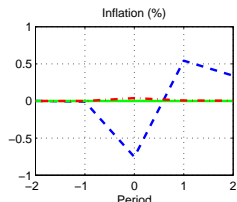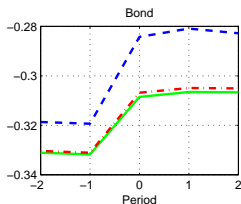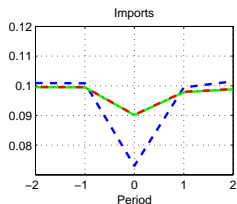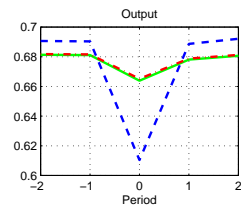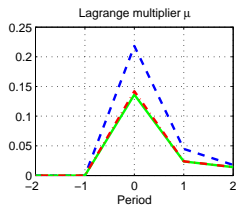
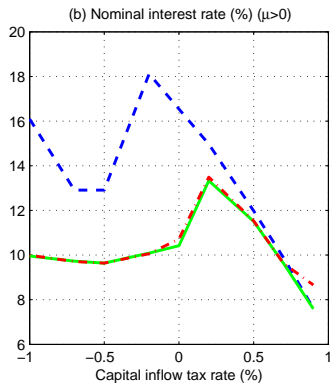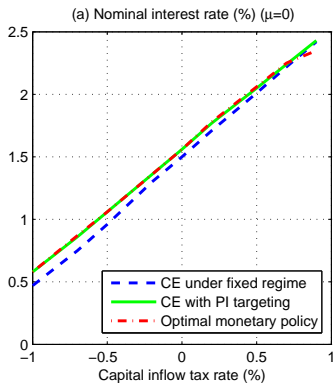# Crisis event analysis (cont'd): No capital controls
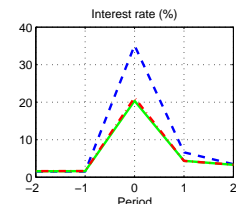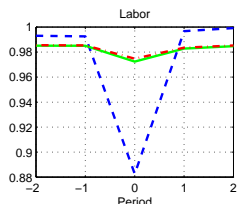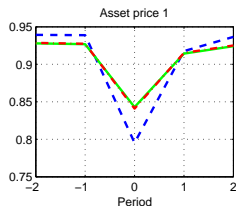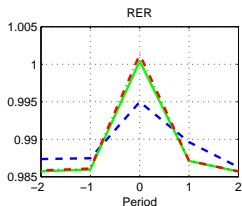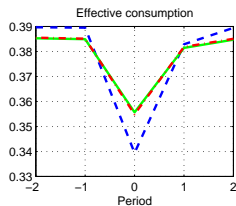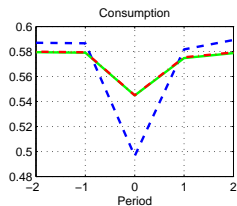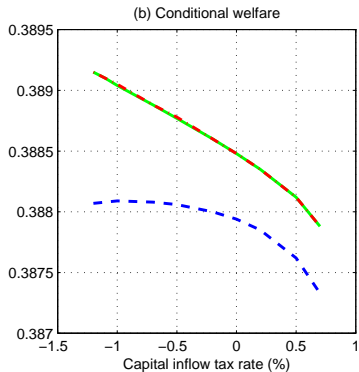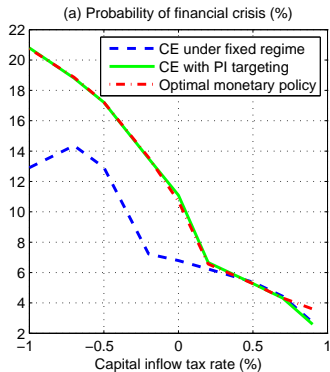
The Equilibrium with Constant Capital Controls

External borrowing

(a) External bond (μ=0)

(b) External bond (μ>0)

CE under fixed regime
CE with PI targeting
Optimal monetary policy

Capital inflow tax rate (%)

Nominal interest rates

(a) Nominal interest rate (%) (μ=0)

(b) Nominal interest rate (%) (μ>0)

- CE under fixed regime
- CE with PI targeting
- Optimal monetary policy

Capital inflow tax rate (%)

Welfare

(a) Probability of financial crisis (%)

- CE under fixed regime
- CE with PI targeting
- Optimal monetary policy

Capital inflow tax rate (%)

(b) Conditional welfare

Capital inflow tax rate (%)

Conditional vs. unconditional welfare

(a) Conditional welfare change (%)

- - - CE under fixed regime
——— CE with PI targeting
-·-·- Optimal monetary policy

(b) Unconditional welfare change (%)

Capital inflow tax rate (%)
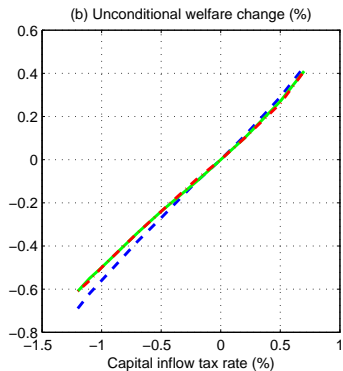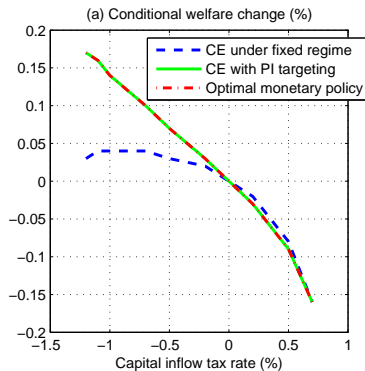
Conclusions

- Monetary policy should generate inflation and depreciate the currency in crises
- Floating exchange rate regime requires large capital inflow subsidy
- Pegged regime needs moderate capital inflow subsidy to regain monetary autonomy
- 'Trilemma' still matters