Financial frictions and optimal monetary policy in an open economy

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Outline

- Motivation
- Model
- Calibration
- Optimal policy
- Results
  - Sticky prices and financial frictions
  - Debt denomination
  - Non tradable goods
- Conclusions

Motivation

- Optimal Ramsey monetary policy in open-economy DSGE models abstract from financial frictions: we fill this gap.
- Financial frictions in DSGE models: Bernanke et al. (1999); Kiyotaki and Moore (1997); Carlstrom and Fuerst (1997)
- Financial frictions and monetary policy - normative analysis:
  - Closed economy: Curdia and Woodford (2008); Carlstrom et al. (2009); Demirel (2009); De Fiore and Tristani (2009)
  - Open economy: Faia (2008); Gertler et al. (2007); Devereux et al. (2006); Elekdag and Tchakarov (2007), Davis and Huang (2011).

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Our contribution and results

- Our Paper:
  - Highlight how openness affects the polilcy trade-offs under financial frictions
  - Exchange rate adjustment play an important role in the transmission mechanism
  - Compare “popular” policy regimes and assess their performance
  - No analytical results; intuition developed by starting from the simple NK model and building it up towards the fully-fledged version
- Main findings:
  - PPI targeting excessively procyclical and costly, especially if some goods are nontradable
  - Debt denomination affects optimal policy conduct.
  - Financial frictions decrease attractiveness of all standard price targeting rules, but do not exacerbate costs of a monetary union

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Fully-fledged model

- 2 countries
- 2 types of intermediate goods: tradables and nontradables
- Producer currency pricing: law of one price holds for tradable goods
- 3 types of final goods: consumption, investment and government spending
- Real and nominal rigidities:
  - Home bias
  - Monopolistic competition in goods markets
  - Sticky prices: Calvo
  - Investment adjustment costs
- Financial sector similar to Bernanke et al. (1999)

Financial sector

- Entrepreneurs:
  - Risk neutral
  - At the beginning of $t+1$ buy capital from capital producers
  - Financing: net worth N_{t+1} and bank loan $B_{E,t+1}$:

$$B_{E,t+1} = Q_{T,t}K_{t+1} - N_{t+1} \geq 0$$

  - Idiosyncratic shock $a_{E,t+1}$, $\log a_E \sim N(0, \varepsilon_{e,t}\sigma_E)$, after which capital equals $a_{E,t+1}K_{t+1}$
  - Rent capital services to firms, which gives rate of return:

$$R_{E,t+1} = \frac{R_{K,t+1} + (1-\tau)Q_{T,t+1}}{Q_{T,t}}$$

  - At the end of $t+1$ repay loans or go bankrupt

Financial sector

- Idiosyncratic shocks observed by entrepreneurs, but not by banks
- Costly state verification problem
- In essence the model is extended by:
  - a premium as an increasing function of the leverage of the entrepreneur: In equilibrium have

$$E_t R_{E,t+1} = \chi\left(\frac{Q_t K_{t+1}}{N_{t+1}}\right) R_t$$

  - and a law of motion for the net-worth of the entrepreneur

$$N_{t+1} = \varepsilon_{\nu,t} \upsilon \left[R_{E,t} Q_{T,t-1} K_t - \phi\left(\frac{Q_{t-1} K_t}{N_t}\right) R_{t-1} B_{E,t} \right] + T_{E,t}$$

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Calibration of the fully-fledged version of our model

- Based on euro area data, treating the rest of the world symmetrically (except for size and home bias)
- Steady-state: data averages
- Frictions: NAWM (Christoffel et al., 2008)
- Financial sector: Bernanke et al. (1999); Christiano et al. (2007)
- Shocks: productivity, preference, investment-specific, government spending, monetary policy, exit rate of entrepreneurs, riskiness
- Shocks calibrated to match moments of a standard set of macroaggregates and two financial variables:
  - Loans to firms
  - Spread on loans to firms

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Calibration results

Standard deviations

Variable	model	data
GDP	0.48	0.48
Consumption	0.48	0.48
Investment	1.33	1.31
Government spending	1.61	1.60
Inflation	0.30	0.36
Short-term interest rate	1.10	2.81
Entrepreneurs' debt	1.40	1.53
External financing premium	0.52	0.43

Calibration results

Autocorrelations

Variable	model	data
GDP	0.34	0.24
Consumption	0.06	0.06
Investment	0.76	0.16
Government spending	0.96	0.96
Inflation	0.65	0.70
Short-term interest rate	0.94	0.98
Entrepreneurs' debt	0.51	0.18
External financing premium	0.91	0.81

Calibration results

Correlations

Variable	model	data
with GDP		
Consumption	0.72	0.65
Investment	0.45	0.80
Government spending	0.01	-0.21
Inflation	-0.36	-0.04
Short-term interest rate	-0.01	-0.04
Entrepreneurs' debt	0.12	0.26
External financing premium	-0.13	-0.22
other		
External premium-investment	-0.21	-0.12

Optimal monetary policy

- Optimality criterion: households' welfare
- Optimum: cooperative equilibrium under commitment in a timeless perspective (Woodford, 2003; Benigno and Benigno, 2006)
- Welfare costs: steady state consumption equivalent (in per cent)
- Numerical method: second order approximation
- Welfare costs presentation:
  - relative to cooperative equilibrium
  - scaled by output variance

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Monetary policy incentives

- Efficiency wedges:
  - Monopolistic competition (no subsidies available)
  - Price dispersion in sector $i = \{T, N\}$:

$$\Delta_{i,t} = \int_0^1 \left(\frac{P_{i,t}(z_i)}{P_{i,t}} \right)^{-\phi_i} dz_i$$

  - External finance premium:
    - Both in steady state and time varying

$$\chi_t = \frac{E_t R_{E,t+1}}{R_t}$$

  - Policy incentives related to open economy

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Monetary policy incentives

International allocation of capital and financial frictions

- $\beta E_t \left\{ \frac{\Lambda_{C,t+1}}{\Lambda_{C,t}} \frac{R_t}{\Pi_{C,t+1}} \right\} = 1$
- $E_t \left\{ \frac{\Lambda_{C,t+1}}{\Lambda_{C,t}} \left(\frac{\beta R_t}{\Pi_{C,t+1}} - \frac{\beta^* R_t^*}{\Pi_{C,t+1}^*} \frac{Q_{t+1}}{Q_t} \right) \right\} = 0$

Monetary policy incentives

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Simple symmetric NK model with capital accumulation

	Flexible prices
All shocks	
mean premium	0.3
stdev premium	23.4
stdev PPI	0.8
Home productivity	
mean premium	0.0
stdev premium	2.5
stdev PPI	0.7
Foreign productivity	
mean premium	0.0
stdev premium	2.5
stdev PPI	0.0

Simple symmetric NK model with capital accumulation

	Flexible prices	Sticky prices
All shocks		
mean premium	0.3	1.7
stdev premium	23.4	51.4
stdev PPI	0.8	0.1
Home productivity		
mean premium	0.0	1.5
stdev premium	2.5	20.9
stdev PPI	0.7	0.1
Foreign productivity		
mean premium	0.0	0.0
stdev premium	2.5	6.4
stdev PPI	0.0	0.0

Simple symmetric NK model with capital accumulation

- Under flexible prices, $\chi_{ss} \neq 0$: not optimal to erode steady-state premium
- Under flexible prices $stdev(\chi) \neq 0$: Capital would not respond optimally to shocks (capital proportional to net-worth – state variable)
- Under flexible prices $\chi_t = \chi_t^*$ in response to (asymmetric) productivity shocks: Expected return on capital equalized across countries like in IRBC.
  - Under sticky prices this is no longer true.

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Nominal Debt, sticky prices and return equalization

- Under sticky prices the exchange rate works as shock absorber
- The exchange rate adjustment has asymmetric effects on CPIs and hence on real value of debt
- Premia cannot be equalized any longer across countries, and neither will the expected return on capital be equalized
- This wedge is specific to open economy

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Nontradable goods

- With nontradable (sticky-price) goods the ability to use the exchange rate as shock absorber is hindered
  - E.g. a home productivity shock that calls for depreciation will upset the relative price of nontraded goods and foreign traded goods.
- The central bank has to trade-off:
  1. Steady-state distortions
  2. Relative price adjustments
  3. Movements in credit spreads
  4. cross-country comovements in credit spreads

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Simple symmetric NK model with capital accumulation

Welfare costs

	PPI targ.	CPI targ.	Mon. union
No financial frictions			
All shocks	0.000	0.077	0.077
Productivity shocks	0.000	0.076	0.077

Simple symmetric NK model with capital accumulation

Welfare costs

	PPI targ.	CPI targ.	Mon. union
No financial frictions			
All shocks	0.000	0.077	0.077
Productivity shocks	0.000	0.076	0.077
Financial frictions			
All shocks	0.051	0.101	0.066
Productivity shocks	0.042	0.092	0.064

Simple symmetric NK model with capital accumulation and various frictions

Welfare costs of PPI targeting

Baseline	0.0000

Simple symmetric NK model with capital accumulation and various frictions

Welfare costs of PPI targeting

Baseline	0.0000
Home bias	0.0000

Simple symmetric NK model with capital accumulation and various frictions

Welfare costs of PPI targeting

Baseline	0.0000
Home bias	0.0000
Consumption habits	0.0007

Simple symmetric NK model with capital accumulation and various frictions

Welfare costs of PPI targeting

Baseline	0.0000
Home bias	0.0000
Consumption habits	0.0007
Nontradable goods	0.0034

Simple symmetric NK model with capital accumulation and various frictions

Welfare costs of PPI targeting

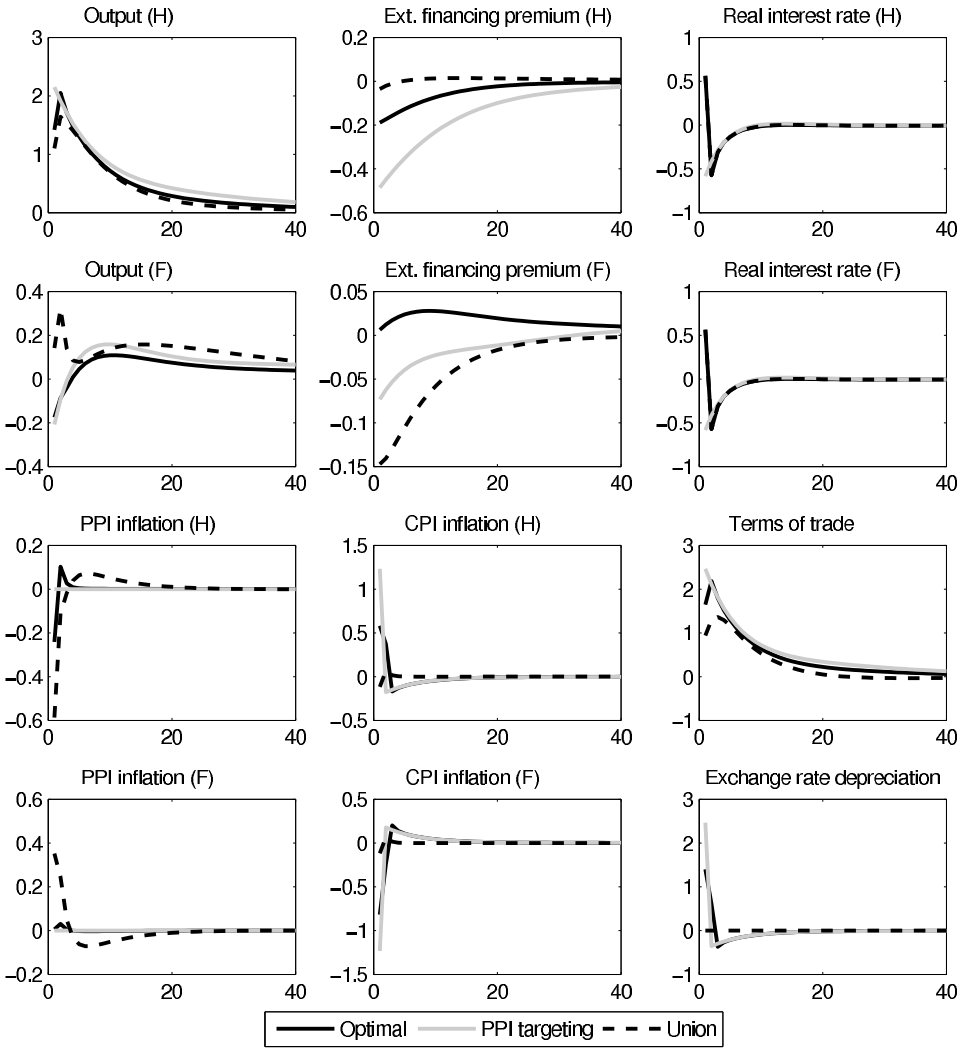
Baseline	0.0000
Home bias	0.0000
Consumption habits	0.0007
Nontradable goods	0.0034
Government	0.0001

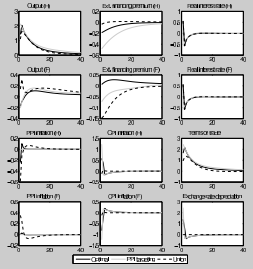
Simple symmetric NK model with capital accumulation and various frictions

Welfare costs of PPI targeting

Baseline	0.0000
Home bias	0.0000
Consumption habits	0.0007
Nontradable goods	0.0034
Government	0.0001
Financial frictions	0.0509

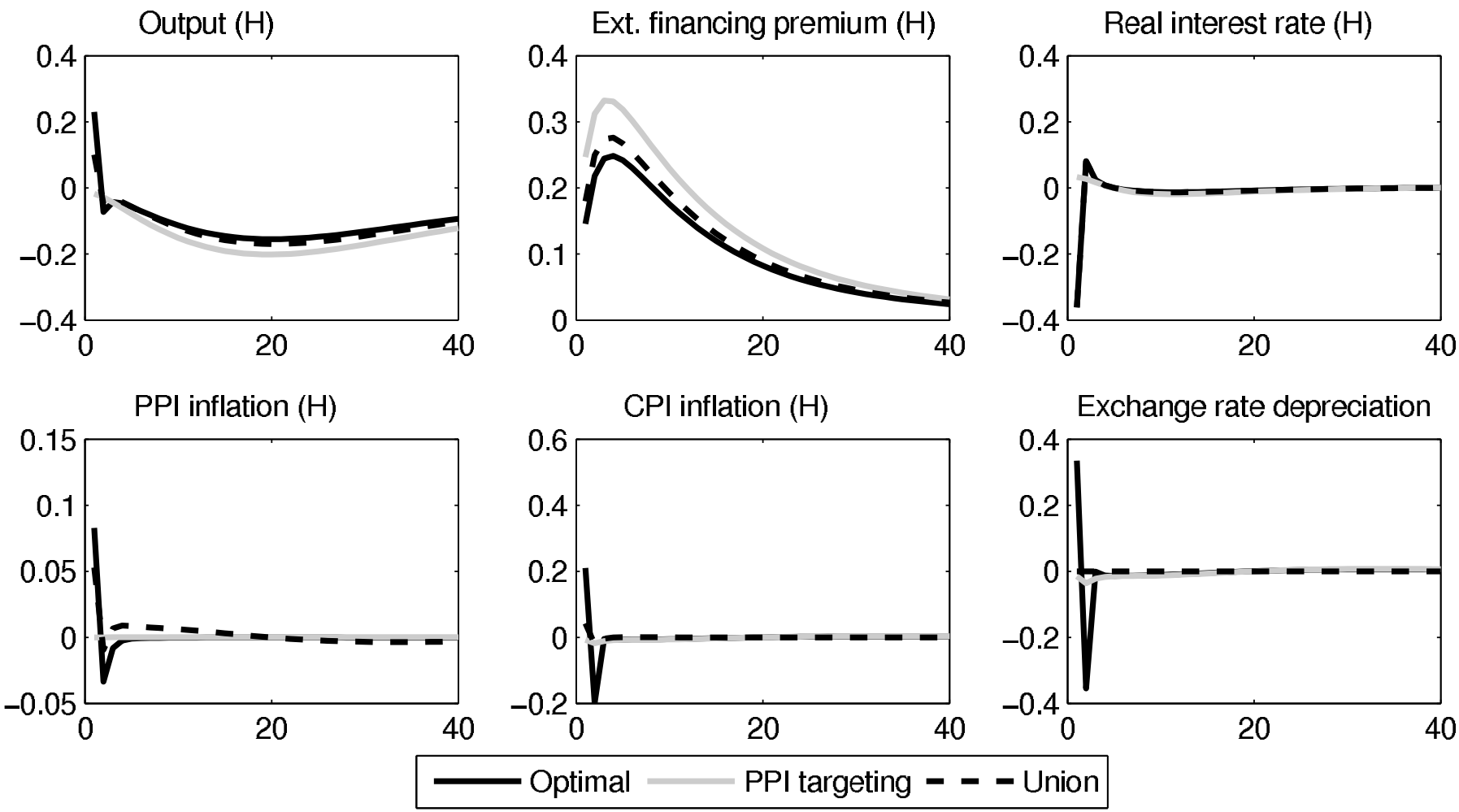
Symmetric NK: home technology



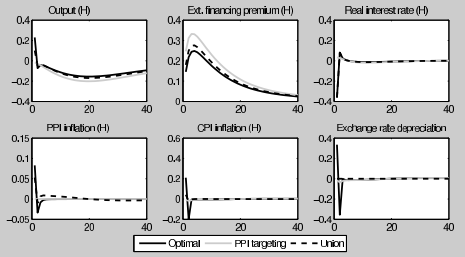


1. PPI stability needs expansion: premia fall further
2. Implied depreciation widens the premium gap
3. Optimal policy tightens on impact: less depreciation
4. Union: premium-gap widens...
5. Union and flex prices imply equalization of premia
6. Union and sticky: needs to expand more to offset fall in PPI...
7. ...Home return goes down, foreign return goes up
8. Expansion in both countries is inconsistent with equalization of returns and premia

Symmetric NK: home NW shock



Symmetric NK: home NW shock



1. Except for tech shocks, for other shocks PEG better than PPI (diff 2 rows!)
2. NW shock acts like COST PUSH shock...
3. Need monetary tightening for price stability: yet contraction increases premia – trade off!
4. Optimal policy: some initial easing with swings of FX
5. Union: closer to optimal – more inflation reduces premium
6. Carlstrom et al.: initial tightening (overall easing) with larger premium...
7. ... richer model generate immediate easing.

Role of debt denomination

Welfare costs

Table 9. Welfare costs: the role of debt denomination

	PPI targ.	CPI targ.	Mon. union
Domestic currency debt denomination			
All shocks	0.051	0.101	0.066
Productivity (H)	0.025	0.044	0.031
Productivity (F)	0.018	0.048	0.033
Foreign currency debt denomination			
All shocks	0.061	0.105	0.071
Productivity (H)	0.000	0.055	0.041
Productivity (F)	0.055	0.044	0.029

Welfare costs

Table 9. Welfare costs: the role of debt denomination

	PPI targ.	CPI targ.	Mon. union
Domestic currency debt denomination			
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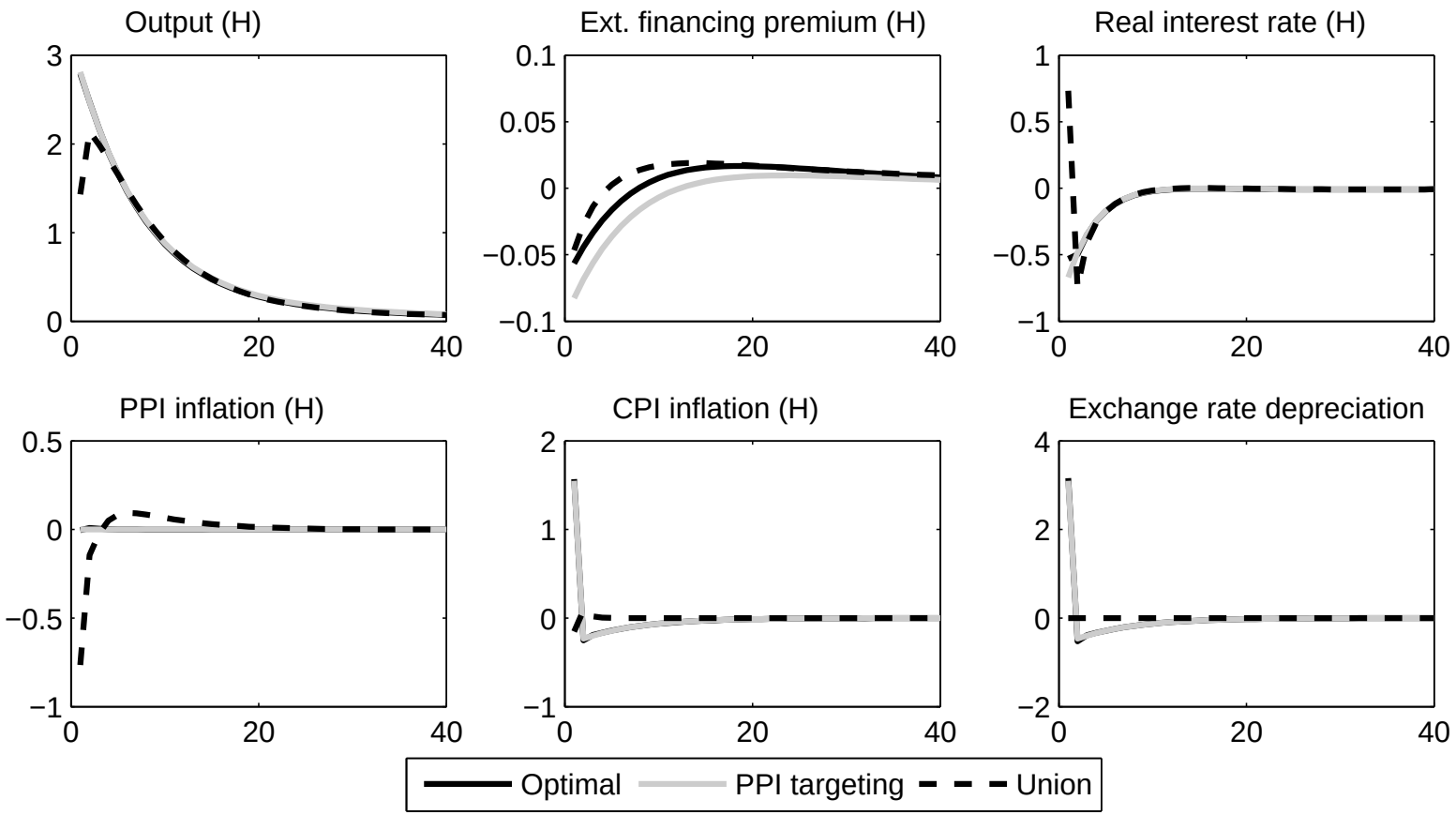
Foreign currency debt denomination			
All shocks	0.061	0.105	0.071
Productivity (H)	0.000	0.055	0.041
Productivity (F)	0.055	0.044	0.029

1. Performance of PPI depends on source of shocks: Good (bad) for home (F) tech.
2. Equal shocks – ranking same as non-euroizes
3. Euroization: now depreciation offsets drop in premia
4. Euroization: optimal policy doesn't need to tighten (similar to PPI targ.)
5. If shock is foreign, get appreciation under PPI targ.: premia drop further...
6. ...optimal policy need tightening
7. If large leverage and elastic premia, union is better.

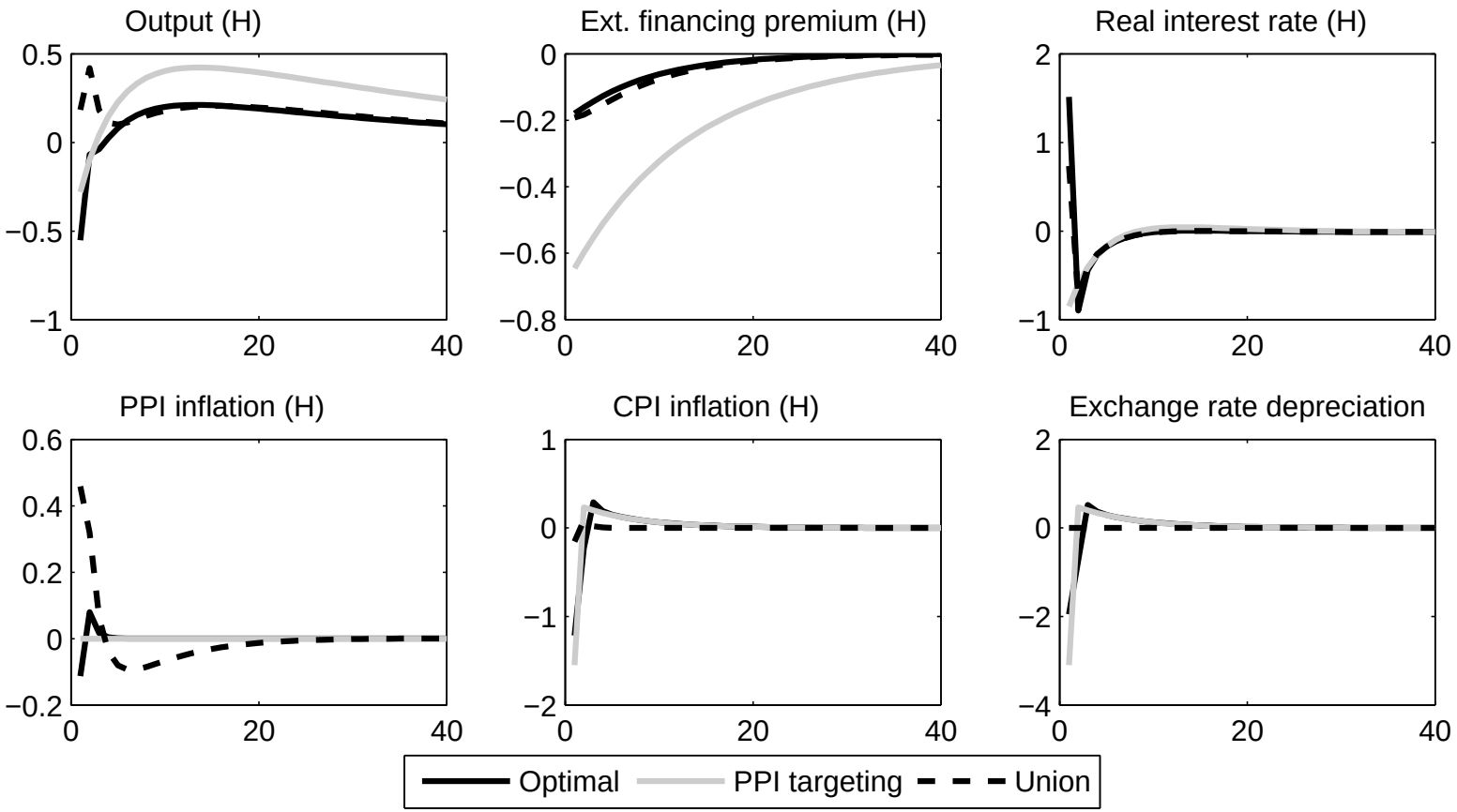
Euroized debt

Home productivity shock



Euroized debt

Foreign productivity shock



Role of nontradable goods

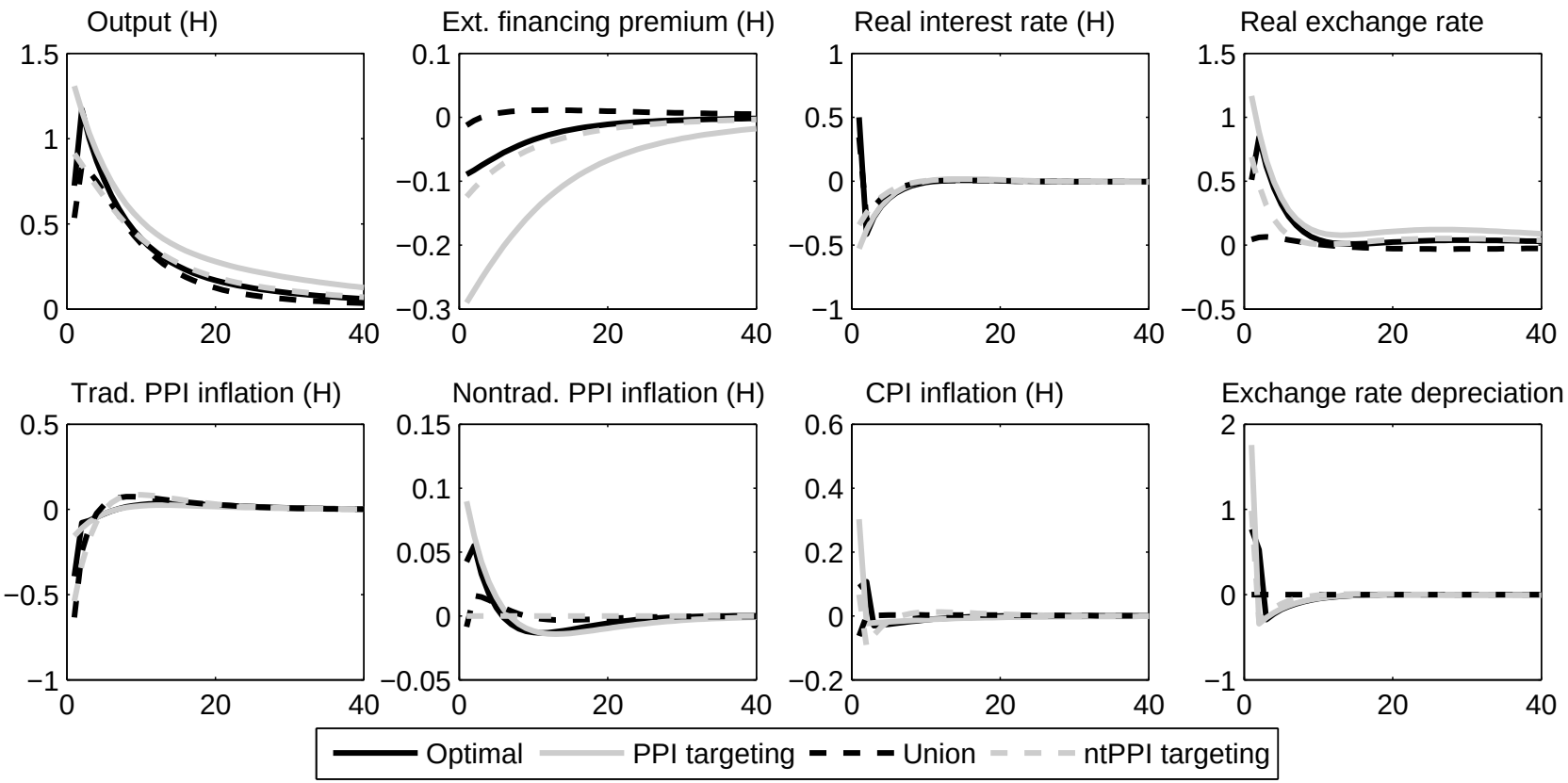
Welfare costs

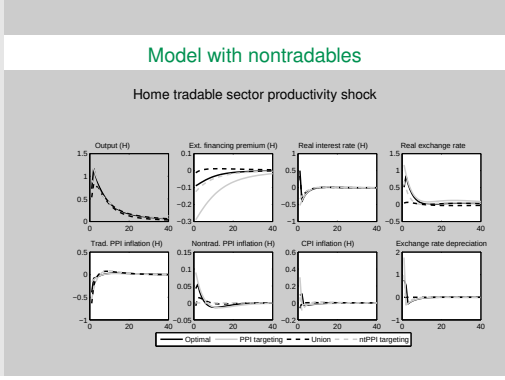
Table 10. Welfare costs: the role of nontradables

	PPI targ.	CPI targ.	Mon. union	ntPPI targ.
No financial frictions				
All shocks	0.003	0.068	0.124	0.042
Trad. productivity (H)	0.004	0.012	0.017	0.007
Nontrad. productivity (H)	0.003	0.019	0.044	0.004
Trad. productivity (F)	-0.002	0.030	0.037	0.020
Nontrad. productivity (F)	-0.001	0.006	0.025	0.012
Domestic currency debt denomination				
All shocks	0.095	0.131	0.141	0.130
Trad. productivity (H)	0.042	0.018	0.015	0.008
Nontrad. productivity (H)	0.008	0.018	0.048	0.044
Trad. productivity (F)	0.005	0.039	0.032	0.013
Nontrad. productivity (F)	0.004	0.019	0.031	0.029
Foreign currency debt denomination				
All shocks	0.117	0.130	0.131	0.158
Trad. productivity (H)	0.003	0.021	0.019	0.008
Nontrad. productivity (H)	0.005	0.021	0.052	0.003
Trad. productivity (F)	0.047	0.040	0.030	0.022
Nontrad. productivity (F)	0.036	0.023	0.025	0.101

Model with nontradables

Home tradable sector productivity shock





1. x-country equalization of premia not optimal under NT shocks
2. Optimal FX movement drives premia apart (though still try stabilize them)
3. PPI targ.& NT suboptimal. Losses are magnified by financial frictions
4. NT prices less flexible
5. Keeping PPI stable needs more expansion since little help from exchange rate: premium drops even more
6. Union not so bad since FX not so key as with T only
7. Targeting NT-prices would go closer to optimal: not so much expansion.
8. EUROIZATION: now union is good only if $NT > 80\%$
9. Introducing other shocks makes NT-price stabilization worse than PPI targ.

Conclusions

- Financial frictions create trade-off between price stabilization and credit spread minimization
- PPI targeting over-expansionary: premia fall too much
- In open economy incentive to equalize premia
- Exchange rate interact with premia-related incentives
- Important welfare implications, especially with nontradables
- If debt denominated in foreign currency: performance of PPI targeting vs. monetary union depends on the relative variance of domestic and foreign shocks
- Financial frictions do not exacerbate costs of a monetary union