Real Exchange Rate Adjustment In and Out of the Eurozone

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Real Exchange Rate Adjustment in Eurozone

- Popular view is real exchange rates do not adjust in Eurozone
  - Countries would be better off with floating rates

- Logic is based on Friedman's (1953) "Case for Flexible Exchange Rate"
  - Flexible exchange rates substitute for sticky nominal export prices
  - Achieve efficient terms of trade adjustment

- This paper examines data on real exchange rates in Europe, for countries in and not in the eurozone

- Also examines simple open-economy New Keynesian model

- Important caveat: we do not consider crisis period

Real Exchange Rates under Balassa-Samuelson

The Balassa-Samuelson model relates real exchange rates to changes in productivity of traded goods

- An increase in Home traded productivity will lead to a real Home appreciation
- This result holds as long as home bias in preferences is not too great

A simple extension of Balassa-Samuelson is to allow for changes in productivity of nontraded goods

- An increase in Home nontraded productivity will lead to a real Home depreciation
- Again, assuming home bias not too great.

We also consider the effect of differences in economies (in our model determined by differences in leisure preferences) that lead to differences in unit labor costs.

- Country with higher ULC has higher price level

Intuition of Friedman argument

- P_H - Home-currency price of Home good
- P_F^* - Foreign-currency price of Foreign good

- Friedman (and modern analysts) assume exporters set the price in their currency
- P_H and P_F^* adjust slowly
- If exchange rates are flexible, the terms of trade, SP_H / P_F^*, adjust freely and efficiently

Friedman's world assumes

- Prices are set in exporter's currency, even for consumers
- No capital flows. Nominal exchange rates clear goods market.
  - This latter assumption is clearly not applicable today

Modern Keynesian models

- Some prices for final purchasers are set in buyer's currency and adjust slowly
  - Relative prices $P_F \,/\, P_H$ and $P_F^* \,/\, P_H^*$ do not adjust automatically as S changes.
- Other prices set in producers' currencies, so $SP_F^* \,/\, P_H$ adjusts –
  - But S is responding to monetary and financial shocks

- Exchange rates are determined in asset markets
  - Influenced by expectations of future, risk premiums, monetary shocks, etc.
  - In LCP case, inefficient deviations from LOOP
  - In PCP case, inefficient TOT movements
  - Leads to inefficient wealth changes not based on productivity changes

Our tack

- Build a pretty standard open-economy New Keynesian model
  - Compare the implied behavior of real exchange rates under
    - Flexible prices (exchange rate regime doesn't matter)
    - Fixed exchange rates, sticky prices
    - Floating exchange rates, sticky prices

- Compare to behavior of real exchange rates for EU countries in and out of eurozone
  - How they correspond to relative prices of nontraded to traded goods
  - How they correlate with relative productivity in traded and non-traded sectors

- This is not a welfare analysis

Model Features

- Two country model, complete asset markets
- Households get utility from consumption and leisure
- Firms produce output using labor and fixed capital
- Households get utility from Home and Foreign goods
- Each good produced by a monopolist
- All goods use non-traded distribution services
- Price stickiness – Calvo pricing
- Under floating exchange rates, we consider LCP, PCP, and a mix of firms pricing in LCP and PCP.
- Productivity shocks in Home and Foreign, in both traded and non-traded goods production
- Leisure demand shocks that may proxy for changes in labor laws or union negotiations
- Monetary policy set by Taylor rule, with shocks
- In currency union, a common monetary policy
- Under floating rates, separate monetary policies and separate monetary policy shocks

Model Features

Households:

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{C_t^{1-\sigma}}{1-\sigma} - \chi_t \frac{N_t^{1+\phi}}{1+\phi} \right)$$

$$C_t = \left(\gamma^{\frac{1}{\theta}} C_{Tt}^{1-\frac{1}{\theta}} + (1-\gamma)^{\frac{1}{\theta}} C_{Nt}^{1-\frac{1}{\theta}} \right)^{\frac{\theta}{1-\theta}}$$

$$C_{Tt} = \left(\omega^{\frac{1}{\lambda}} C_{Ht}^{1-\frac{1}{\lambda}} + (1-\omega)^{\frac{1}{\lambda}} C_{Ft}^{1-\frac{1}{\lambda}} \right)^{\frac{1}{1-\frac{1}{\lambda}}}$$

$$C_{Ht} = \left(\kappa^{\frac{1}{\phi}} I_{Ht}^{1-\frac{1}{\phi}} + (1-\kappa)^{\frac{1}{\phi}} V_{Ht}^{1-\frac{1}{\phi}} \right)^{\frac{1}{1-\frac{1}{\phi}}}$$

$$C_{Ft} = \left(\kappa^{\frac{1}{\phi}} I_{Ft}^{1-\frac{1}{\phi}} + (1-\kappa)^{\frac{1}{\phi}} V_{Ft}^{1-\frac{1}{\phi}} \right)^{\frac{1}{1-\frac{1}{\phi}}}$$

Model Features

Price Indexes:

$$P_t = \left(\gamma P_{Tt}^{1-\theta} + (1-\gamma) P_{Nt}^{1-\theta}\right)^{\frac{1}{1-\theta}}$$

$$P_{Tt} = \left(\omega \tilde{P}_{Ht}^{1-\lambda} + \left(1-\omega\right) \tilde{P}_{Ft}^{1-\lambda}\right)^{\frac{1}{1-\lambda}}$$

$$\tilde{P}_{Ht} = \left(\kappa P_{Ht}^{1-\phi} + \left(1-\kappa\right) P_{Nt}^{1-\phi}\right)^{\frac{1}{1-\phi}}$$

$$\tilde{P}_{Ft} = \left(\kappa P_{Ft}^{1-\phi} + \left(1-\kappa\right) P_{Nt}^{1-\phi}\right)^{\frac{1}{1-\phi}}$$

Real Exchange Rate: $$RER_t = \frac{S_t P_t^*}{P_t}$$

Model Features

Household FOCs:

$$W_t = \chi_t P_t C_t^{\sigma} N_t^{\phi}$$

$$C_{Tt} = \gamma \left(\frac{P_{Tt}}{P_t} \right)^{-\theta} C_t$$

$$C_{Nt} = (1-\gamma) \left(\frac{P_{Nt}}{P_t} \right)^{-\theta} C_t$$

$$I_{Ht} = \kappa\omega \left(\frac{P_{Ht}}{\tilde{P}_{Ht}} \right)^{-\phi} \left(\frac{\tilde{P}_{Ht}}{P_{Tt}} \right)^{-\lambda} C_{Tt}$$

$$I_{Ft} = \kappa (1-\omega) \left(\frac{P_{Ft}}{\tilde{P}_{Ft}} \right)^{-\phi} \left(\frac{\tilde{P}_{Ft}}{P_{Tt}} \right)^{-\lambda} C_{Tt}$$

Model Features

Firms: $Y_{Ht}(i) = A_{Ht}N_{Ht}(i)^{\alpha}$

$$Y_{Nt}(i) = A_{Nt}N_{Nt}(i)^{\alpha}$$

Relative productivity shocks are key variables that move relative prices and real exchange rates in long run

Flexible prices:

- Serves as a benchmark.
- With optimal subsidy in place, prices are efficient
- Without subsidy, relation between relative prices and relative productivity mimics efficient prices
- However, the shocks to leisure demand might have an interpretation as an inefficient restriction in labor supply arising from unions or government regulations.

Model Features

Calvo pricing

- We compare the flexible price model to Calvo pricing.
- Under fixed exchange rates, the currency of pricing is irrelevant.
- Under flexible exchange rates, we consider LCP, PCP, and a version in which some firms price LCP and the rest PCP.

Monetary policy

$$r_t = \rho + \sigma_p \pi_t + \sigma_q (q_t - u_t) + \sigma_s (s_t - s_{t-1})$$

- Under fixed exchange rates, $\sigma_s \to \infty$
- Under floating exchange rates, $\sigma_s = 0$

Model Features

Equilibrium

Financial Markets (complete)

$$\frac{C_t^{-\sigma}}{P_t} = \frac{C_t^{*-\sigma}}{S_t P_t^*}$$

Goods Markets

$$Y_{Ht} = I_{Ht} + I_{Ht}^*$$

$$Y_{Ft}^* = I_{Mt} + I_{Mt}^*$$

$$Y_{Nt} = C_{Nt} + I_{HNt} + I_{MNt}$$

$$Y_{Nt}^* = C_{Nt}^* + I_{HNt}^* + I_{MNt}^*$$

Labor Markets

$$N_t = N_{Nt} + N_{Ht}$$

$$N_t^* = N_{Nt}^* + N_{Ht}^*$$

Intuition from decompositions

$q_t = (1-\gamma)q_{nt} + q_{Tt}$, where $1-\gamma$ is non-traded share in C

$q_{Nt} = p^*_{Nt} - p^*_{Tt} - (p_{Nt} - p_{Tt})$ - relative price of nontraded goods

$$q_{Tt} = \frac{1-\kappa}{\kappa} q_{Nt} + (2\omega - 1)\tau_t + \Delta_t,$$

where $1-\kappa$ is share of cost due to distribution,

$\tau_t = p^*_{Ft} - p^*_{Ht} = p_{Ft} - p_{Ht}$ - terms of trade

$\Delta_t = p^*_{Ht} + s_t - p_{Ht} = p^*_{Ft} + s_t - p_{Ft}$ - deviations from LOOP

Since effectively $2\omega \approx 1$, if no deviations from LOOP, then q_t, q_{Nt} and q_{Tt} should all be highly correlated.

Intuition from decompositions

All should be driven by productivity shocks and labor supply shocks:

- An increase in $a_{Ht} - a_{Ft}$ should lead to a decline in q_t, q_{Nt}, q_{Tt}
- An increase in $a_{Nt} - a^*_{Nt}$ should lead to an increase in q_t, q_{Nt}, q_{Tt}
- An increase in $\ln(\chi_t) - \ln(\chi^*_t)$ should lead to a decline in q_t, q_{Nt}, q_{Tt}

Price data

Price data are from Euorstat, based on Eurostat PPP project

Annual, 1995-2009, for 146 consumer goods

These are price level data.
We construct traded and non-traded indexes, using expenditure weights for each country

12 Eurozone countries, 6 non-Eurozone core European countries, as well as 13 non-Eurozone periphery European countries

Productivity and Unit Labor Cost Data

We construct sectoral level TFP data

- We comine the Groningen Grwoth and Development Center 1997 TFP level database with the KLEMS database on sectoral productivity indexes
- We use measures of tradeability to aggregate the indexes into a tradable and non-tradable TFP index for each country.
- See Appendix for details

Unit Labor Cost data are constructed from the OECD STAN database

- TFP data for 9 Eurozone countries (not Greece, Portugal or Luxembourg)
- TFP data for 6 non-EZ countries (Sweden, Denmark, UK, Hungary, Slovenia, Czech Republic)

Some Summary Statistics

Table 2. Standard deviations

	mean(std$_i$(.))				std(mean$_i$(.))			
variable	All	EZ	Float	East	All	EZ	Float	East
q	0.067	0.033	0.070	0.098	0.328	0.113	0.103	0.193
q_T	0.061	0.028	0.060	0.091	0.238	0.087	0.109	0.154
q_N	0.088	0.044	0.084	0.129	0.471	0.158	0.120	0.275
pn	0.045	0.032	0.043	0.059	0.253	0.107	0.119	0.133
a_T	0.059	0.055	0.075	0.055	0.129	0.121	0.083	0.014
a_N	0.031	0.031	0.019	0.045	0.155	0.093	0.078	0.017
$a_T - a_N$	0.049	0.040	0.070	0.052	0.119	0.111	0.151	0.027

Price Regressions

Eurozone: $q = a + b * qn$

Method:	Pooled	FE	RE	XS
$\hat{b}$	0.70**	0.60**	0.61**	0.71**
s.e.	(0.06)	(0.08)	(0.07)	(0.25)

Floating: $q = a + b * qn$

Method:	Pooled	FE	RE	XS
$\hat{b}$	0.26**	0.79**	0.72**	0.17
s.e.	(0.10)	(0.15)	(0.14)	(0.14)

Simulations

Eurozone: $q = a + b * Traded + c * NonTraded + d * ULC$

Method:	Pooled	FE	RE	XS
$\hat{b}$	-0.76**	-0.18**	-0.26**	-0.93**
s.e.	(0.06)	(0.09)	(0.08)	(0.19)
$\hat{c}$	0.29**	0.36**	0.36**	0.27
s.e.	(0.08)	(0.18)	(0.13)	(0.22)
$\hat{d}$	-0.42**	-0.46**	-0.46**	-0.43**
s.e.	(0.08)	(0.07)	(0.08)	(0.20)

Floating: $q = a + b * Traded + c * NonTraded + d * ULC$

Method:	Pooled	FE	RE	XS
$\hat{b}$	-0.03	0.21	0.28	0.32
s.e.	(0.12)	(0.08)	(0.09)	(0.33)
$\hat{c}$	-1.37	-0.45	-1.43	-1.02
s.e.	(0.07)	(0.24)	(0.12)	(0.16)
$\hat{d}$	-0.92**	-0.57**	-0.53**	-1.53**
s.e.	(0.09)	(0.05)	(0.06)	(0.26)

Model Calibration

We assume standard parameters for elasticities:

γ and κ - non-tradable shares = 0.5

λ - elasticity of home/foreign goods = 8.0

ω - assume no home bias = 0.5

α - production function curvature = 1.0

σ - relative risk aversion = 2.0

ψ - Frisch elasticity of labor supply = 1.0

ϕ - elast. of subs. between good and dist. service = 0.25

θ - elast. of subs. between traded and nontraded = 0.7

β - set = 0.99 for quarterly data

δ_T, δ_N = 0.10 $\Rightarrow$ 10% price adjustment each quarter

productivity processes AR1: set to match data

labor supply shock process: set equal to productivity process

Model Calibration

	Fixed - Sticky	Flex Price	Data
Std dev (time series)	0.037 (0.030,0.042)	0.042 (0.036,0.050)	0.033
Std dev (cross-section)	0.101 (0.071,0.125)	0.106 (0.085,0.131)	0.113
Serial correlation	0.794 (0.720,0.880)	0.663 (0.570,0.759)	0.670
Regression of Real Ex. Rate on Relative Nontraded Price			
Time series	1.606 (1.567,1.628)	1.586 (1.558,1.617)	0.60
Cross-section	0.942 (0.791,1.052)	0.967 (0.877,1.068)	0.71

Discussion

Regression of Real Ex. Rate on productivity and ULC			
	Fixed - Sticky	Flex Price	Data
Time series Traded Prod	-0.131 (-0.162,-0.065)	-0.185 (-0.201,-0.169)	-0.18
Time series Nontraded Prod	0.512 (0.423,0.580)	0.194 (0.155,0.218)	0.36
Time series ULC	-0.421 (-0.580,-0.284)	-1.399 (-1.470,-1.320)	-0.46
Cross-section Traded Prod	-0.601 (-0.662,-0.498)	-0.588 (-0.654,-0.545)	-0.93
Cross-section Nontraded Prod	0.410 (0.015,1.150)	0.581 (0.143,0.955)	0.27
Cross-section ULC	-0.831 (-1.608,0.364)	-0.597 (-1.471,0.128)	-0.43

Discussion

- Real exchange rates are slightly less volatile and somewhat more persistent under sticky prices/ fixed exchange rates than under flexible prices

Why does the real exchange rate behavior looks so good under fixed exchange rates?

- Nominal prices do adjust. We have assumed fairly sticky prices (half life of over 1 year), but with regressions on annual data, the price adjustment is relatively large.
- Required real exchange rate adjustment is not large in the efficient economy.
- Price adjustment always goes in the right direction. This is in contrast to flexible exchange rates, where relative prices and real exchange rates respond to monetary and risk premium shocks

Conclusions

Not a welfare analysis of currency unions

Would need to consider, e.g.

- Loss of independence of monetary policy
- Gains from policy credibility
- May allow countries to overcome “orginal sin”
- May spur greater fiscal and political cooperation

Our data mostly are during “normal times”, and we have not considered either actual or optimal real exchange rate adjustment in crisis times.

Our point here is simply that real exchange rates have adjusted well in the Eurozone.