Trade, Unemployment, and Monetary Policy

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Question

- How does trade integration affect the conduct of monetary policy?
  - Incentives to cooperate across countries in monetary matters.
  - Desirability of alternative exchange rate arrangements.
- Increasing trade in the modern era of globalization likely to keep trade flows among the key determinants of international discussions on monetary matters.

Motivation

- Recent New Keynesian literature started to incorporate trade integration among the determinants of policy incentives.
  - Faia and Monacelli, 2008, Pappa, 2004, Lombardo and Ravenna, 2010, Coenen *et al.* 2007
- Limitations:
  - Exogenous trade structure and no trade-induced productivity gains.
  - Difficulties in reproducing cyclicality of trade flows (Engel and Wang, 2011) and business cycle implications of trade integration (Kose and Yi, 2001).

This Paper

- Two-country DSGE model combining workhorse frameworks in international trade and macro:
  - heterogeneous firms and endogenous producer entry (Melitz, 2003, Ghironi and Melitz, 2005);
  - equilibrium unemployment (Diamond, 1982, Mortensen and Pissarides, 1994);
  - sticky prices and wages.
- Trade integration captured by a reduction in "iceberg" trade costs.
- Model reproduces key empirical regularities about trade integration:
  - reallocation of market shares toward more efficient producers (Bernard, Eaton, Jensen, and Kortum, 2003);
  - more correlated business cycles among trading partners (Frankel and Rose, 1998, and many others).

Results

Optimal Monetary Policy

1. When trade linkages are weak:

- Optimal cooperative policy is inward-looking.
- Significant departures from price stability in the long run and over the business cycle.
  - Optimal policy uses inflation to narrow domestic inefficiency wedges.
  - Sub-optimal (historical Fed) policy is costly in terms of welfare.

2. Trade integration reduces optimal long-run inflation target:
   - Reallocation of market shares toward more productive firms increases efficiency.
   - Need of positive inflation to correct long-run distortions is reduced.

3. Over the business cycle:

- Optimal cooperative policy remains inward looking:
  - Trade-induced business cycle synchronization dampens the effects of international distortions: lack of risk sharing, incomplete exchange rate pass-through, terms-of-trade manipulation.
  - microfoundation for the findings in Benigno and Benigno (2003).
- However, sub-optimal (historical) policy results in larger welfare costs when trade linkages are strong.

Literature

- Trade Integration and Monetary Policy
  - Coenen, Lombardo, Smets and Straub, 2007, Faia and Monacelli, 2008, Pappa, 2004, Lombardo and Ravenna, 2010.
- Price stability in open economies:
  - Benigno and Benigno, 2003 and 2006, Catão and Chang, 2012, Corsetti and Pesenti, 2005, Corsetti, Dedola and Leduc, 2010, Galí and Monacelli, 2005 (and many others).
- Optimal policy with endogenous entry and product variety:
  - Bilbiie, Fujiwara, and Ghironi (forthcoming), Cacciatore, Fiori, and Ghironi (2012).

The Model

- Two countries: Home and Foreign.
- Cashless economy as in Woodford (2003).
- Representative household with a continuum of members along the unit interval.
- In equilibrium, some family members are unemployed, while some others are employed.
- Perfect insurance within the household: no ex post heterogeneity across individual members (Andolfatto, 1996, and Merz, 1995).

Household Preferences

- Representative Home household maximizes

$$E_0 \sum_{t=0}^{\infty} \beta^t [u(C_t) - l_t v(h_t)], \quad \beta \in (0,1).$$

- C_t aggregates imperfectly substitutable Home and Foreign "sectoral" consumption outputs:

$$C_t = \left[\int_0^1 C_t(i)^{\frac{\phi-1}{\phi}} di \right]^{\frac{\phi}{\phi-1}}, \quad \phi > 1.$$

  - $i \equiv (0,1)$ denotes a sector.

- Consumption-based price index:

$$P_t = \left[\int_0^1 P_t(i)^{1-\phi} di \right]^{\frac{1}{1-\phi}},$$

where $P_t(i)$ is the price index for sector i.

Production

- Two vertically integrated production sectors in each country.
- Upstream sector: perfectly competitive firms use labor to produce a non-tradable intermediate input.
- Continuum $(0, 1)$ of downstream sectors:
  - in each sector: representative monopolistically competitive multi-product firm;
  - purchases intermediate input and produces differentiated varieties of its sectoral output.
- This production structure greatly simplifies the introduction of labor market frictions and sticky prices.

Labor Market

- Each intermediate producer employs a continuum of workers.
- To hire new workers, firms need to post vacancies, incurring a per-vacancy cost of κ.
- Matching technology generates aggregate matches:

$$M_t = \chi U_t^{1-\varepsilon} V_t^{\varepsilon}, \qquad \chi > 0, 0 < \varepsilon < 1.$$

  where U_t = aggregate unemployment and V_t = aggregate vacancies.
- Each firm meets unemployed workers at rate $q_t \equiv M_t / V_t$.

Intermediate Goods Production

- Law of motion of employment, l_t (those who are working at time t), in a given firm:

$$l_t = (1 - \lambda) l_{t-1} + q_{t-1} v_{t-1}.$$

- The representative intermediate firm produces:

$$y_t^I = Z_t l_t h_t,$$

$$\begin{bmatrix} \log Z_t \\ \log Z_t^* \end{bmatrix} = \begin{bmatrix} \phi_{11} & \phi_{12} \\ \phi_{21} & \phi_{22} \end{bmatrix} \begin{bmatrix} \log Z_{t-1} \\ \log Z_{t-1}^* \end{bmatrix} + \begin{bmatrix} \epsilon_t \\ \epsilon_t^* \end{bmatrix}.$$

- Quadratic cost of adjusting the hourly nominal wage rate, w_t (Arseneau and Chugh, 2008):

$$\vartheta \pi_{w,t}^2 / 2, \quad \vartheta \geq 0,$$

where $\pi_{w,t} \equiv (w_t / w_{t-1}) - 1$.

Intermediate Goods Production

- Job creation equation (FOC for l_t and v_t):

$$\frac{\kappa}{q_t} = E_t \left\{ \beta_{t,t+1} \left[(1-\lambda) \frac{\kappa}{q_{t+1}} + \varphi_{t+1} Z_{t+1} h_{t+1} - \frac{w_{t+1}}{P_{t+1}} h_{t+1} - \frac{\vartheta}{2} \pi^2_{w,t+1} \right] \right\}.$$

- Individual Nash wage bargaining:

$$\eta_t H_t + (1-\eta_t) J_t = 0.$$

  - $\eta_t = F\left(\frac{\partial H_t}{\partial w_t} / \frac{\partial J_t}{\partial w_t}, \eta \right)$ is the time-varying firm bargaining share.

  - $\frac{w_t}{P_t} h_t = \eta_t \left(\frac{v(h_t)}{u_{C,t}} + b \right) + (1-\eta_t) \left(\varphi_t Z_t h_t + E_t \beta_{t,t+1} \Omega_{t,t+1} J_{t+1} \right).$

- Hours, h_t, determined by firms and workers in a privately efficient way: $v_{h,t} / u_{C,t} = \varphi_t Z_t$.

Representative Multi-Product Firm

- Each sector i is populated by symmetric multi-product firms.
- Each firm produces a set of differentiated product varieties (or features), indexed by ω and defined over a continuum Ω:

$$Y_t = \left(\int_{\omega \in \Omega} y_t(\omega)^{\frac{\theta-1}{\theta}} d\omega \right)^{\frac{\theta}{\theta-1}}, \quad \theta > 1.$$

- The cost of the product bundle Y_t is:

$$P_t^y = \left(\int_{\omega \in \Omega}^{\infty} p_t^y(\omega)^{1-\theta} d\omega \right)^{\frac{1}{1-\theta}},$$

  where $p_t^y(\omega)$ is the nominal marginal cost of producing variety ω.
- The number of products created and commercialized by each producer is endogenous: $\Omega_t \subset \Omega$ available to consumers.

Representative Multi-Product Firm

- Product creation requires:
  - Sunk investment, $f_{e,t}$, in units of Y_t^I (R&D).
  - Creation of a new plant that will be producing the new variety.
- Plant characteristics:
  - Heterogeneous technologies indexed by constant relative productivity z.
  - z drawn from distribution $G(z)$ with support on $[z_{\min}, \infty)$.
  - Use intermediate input to produce output, with real marginal cost:

$$\varphi_{z,t} \equiv \frac{p_t^y(z)}{P_t} = \frac{\varphi_t}{z}.$$

  - Exogenous end-of-period "death" shock with probability $\delta \in (0, 1)$.

Representative Multi-Product Firm

- At time t, each final producer commercializes $N_{d,t}$ varieties and creates $N_{e,t}$ new products.
- Time to build as in Ghironi and Melitz (2005):

$$N_{d,t+1} = (1-\delta)(N_{d,t} + N_{e,t}).$$

- Exporting is costly: per-unit iceberg trade costs, $\tau_t > 1$, and fixed export costs, $f_{x,t}$ (in units of Y_t^I).
  - $f_{x,t}$ is paid for each exported product: $\overline{f}_{x,t} = N_{x,t} f_{x,t}$.
- Absent fixed export costs: $N_{d,t} = N_{x,t}$.
- Fixed export costs imply that only varieties produced by plants with sufficiently high productivity (above a cutoff level $z_{x,t}$) are exported:

$$N_{x,t} \equiv [1 - G(z_{x,t})] N_{d,t}.$$

Representative Multi-Product Firm

- In each period, the multi-product firm optimally determines:
  - Number of new products $N_{e,t}$.
  - Export productivity cutoff $z_{x,t}$.
  - Price of domestic and export bundles:

$$Y_{d,t} = \left[\int_{z_{\min}}^{\infty} y_{d,t}(z)^{\frac{\theta-1}{\theta}} dG(z)\right]^{\frac{\theta}{\theta-1}},$$

$$Y_{x,t} = \left[\int_{z_{x,t}}^{\infty} y_{x,t}(z)^{\frac{\theta-1}{\theta}} dG(z)\right]^{\frac{\theta}{\theta-1}}.$$

- Foreign firms solve an analogous problem.

Product Creation

- Product creation:

$$\varphi_t f_{e,t} = E_t \left\{ (1-\delta)\,\beta_{t,t+1} \left[\begin{array}{c} \varphi_{t+1}\left(f_{e,t+1} - \frac{N_{x,t+1}}{N_{d,t+1}} f_{x,t+1} \right) \\ + \frac{1}{\theta-1}\left(\frac{P^y_{d,t+1} Y_{d,t+1}}{P_{t+1} N_{t+1}} + \frac{P^y_{x,t+1} Y_{x,t+1}}{P_{t+1} N_{t+1}} \tau_{t+1} \right) \end{array} \right] \right\}.$$

- Export decision:

$$\frac{P^y_{x,t}}{P_t} Y_{x,t} \tau_t = \frac{(\theta-1)k}{[k-(\theta-1)]} f_{x,t} N_{x,t} \varphi_t.$$

- Varieties produced by plants with productivity below $z_{x,t}$ are distributed only in the domestic market.
- Endogenous time-varying composition of the traded bundle ($N_{x,t}$ fluctuates over time with changes in the profitability of export).

Price Setting

- Prices are sticky: quadratic price adjustment costs (Rotemberg, 1982).
- Producer currency pricing (PCP) as benchmark:
  - When $f_{x,t} = 0$, the law of one price (LOP) determine the export price: $P_{x,t} = \tau_t P_{d,t} / S_t$.
  - When $f_{x,t} > 0$, LOP does not hold:

$$\begin{aligned} P_{d,t} &= \mu_{d,t} P^y_{d,t}, \\ P_{x,t} &= \mu_{x,t} \tau_t^{-1} P^y_{x,t} / S_t \ \left(\neq \tau_t P_{d,t} / S_t \right). \end{aligned}$$

- Intuition: $f_{x,t} > 0$ results in a different composition of $Y_{d,t}$ and $Y_{x,t}$, with different marginal costs of producing these bundles:

$$\begin{aligned} P^y_{d,t} / P_t &= \varphi_t \left[\int_{z_{\min}}^{\infty} z^{\theta-1} dG(z) \right]^{-\frac{1}{\theta-1}} = \varphi_t / \widetilde{z}_d \\ P^y_{x,t} / P_t &= \varphi_t \left[\int_{z_{x,t}}^{\infty} z^{\theta-1} \frac{dG(z)}{1 - G\left(z_{x,t}\right)} \right]^{-\frac{1}{\theta-1}} = \varphi_t / \widetilde{z}_{x,t} \end{aligned}$$

Household Intertemporal Decisions

- Incomplete international assets markets: non-contingent bonds, traded domestically and internationally.
  - Costs of adjusting bond holdings (steady-state determinacy and stationarity of the model).
  - Standard Euler equations for bond holdings.
- Home net foreign assets:

$$a_{t+1} + Q_t a_{*,t+1} = \frac{1 + i_t}{1 + \pi_{C,t}} a_t + Q_t \frac{1 + i_t^*}{1 + \pi_{C,t}^*} a_{*,t} + TB_t,$$

where TB_t is the trade balance.

Monetary Policy

- The world Ramsey authority maximizes aggregate welfare:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{1}{2} \left[u(C_t) - l_t v(h_t) \right] + \frac{1}{2} \left[u(C_t^*) - l_t^* v(h_t^*) \right] \right\},$$

  under the constraints of the competitive economy.

- We compare the Ramsey-optimal, cooperative policy to:
  - Historical central bank behavior under a flexible ER:

$$1 + i_{t+1} = (1 + i_t)^{\varrho_i} \left[(1 + i) (1 + \tilde{\pi}_{C,t})^{\varrho_\pi} \left(Y_{R,t}^g \right)^{\varrho_Y} \right]^{1-\varrho_i}.$$

  - Non-cooperative, optimal policy.
  - ER peg (historical behavior for the center).

OMP with Weak Trade Linkages

Long Run

- Result: optimal π_C is 1.4% when $Trade/GDP = 10\%$ ($\pi_C = \pi_d = \pi_x = \pi_w$).
- Symmetric long-run equilibrium features only two distortions:
  - firm monopoly power and positive unemployment benefits;
  - suboptimally low job-creation in steady state.
- Ramsey authority reduces the inefficiency wedge in job creation relative to $\pi_w = 0$:
  - $\pi_w > 0$ raises the firms' bargaining power η, favoring vacancy posting by firms.
- Tradeoff: resource costs of non-zero inflation and departure from the Hosios condition (since $\eta > \varepsilon$)

OMP with Weak Trade Linkages

Business Cycle

- Aggregate shocks modify the policy tradeoffs facing the Ramsey authority.
  - Reintroduce distortions eliminated by symmetric steady state.
- Trade-offs over the business cycle:
  - Domestic markups stabilization vs. unemployment stabilization.
  - Domestic vs. export markups stabilization.
  - Beneficial effects of manipulating inflation vs. costs.

OMP with Weak Trade Linkages

Business Cycle

- Optimal departures from price stability lower welfare costs of business cycles by approximately 20% relative to historical policy.
- Ramsey-optimal, cooperative policy is well approximated by an optimized inward-looking interest rate rule:

$$1+i_{t+1}=(1+i_t)^{\varrho_i}\left[(1+i)\left(1+\tilde{\pi}_{d,t}\right)^{\varrho_{\pi_d}}\left(1+\tilde{\pi}_{w,t}\right)^{\varrho_{\pi_w}}\left(Y^g_{R,t}\right)^{\varrho_Y}\right]^{1-\varrho_i},$$

  with $\varrho_i=.60$, $\varrho_Y=0$, $\varrho_{\pi_d}=1.45$, and $\varrho_{\pi_w}=3.75$.
- Not surprising: Trade linkages are weak and no need to address international distortions.

OMP and Trade Integration

Long Run

- Trade integration is a permanent symmetric reduction of iceberg trade costs.
- Lower trade costs reallocates market shares toward relatively more productive firms.
- Trade integration increases average productivity $\tilde{z}$:

$$\tilde{z} = \left\{ \left[\tilde{z}_d^{\theta-1} + \left(\frac{\tilde{z}_x}{\tau} \right)^{\theta-1} \frac{N_x}{N_d} \right] \right\}^{\frac{1}{\theta-1}}.$$

- This has implications for monetary policy.

OMP and Trade Integration

Long Run

- Consider a symmetric steady state with $\pi_C = 0$.
- Trade integration reduces the negative effects of monopoly power and positive unemployment benefits:
  - Higher $\tilde{z}$ increases the average marginal revenue of a match, $\varphi = (1/\mu_d)\, N_d^{\frac{1}{\theta-1}}\, \tilde{z}$, pushing employment toward its efficient level.
- Result: Trade integration reduces the need to resort to positive inflation to erode markups.
  - productivity gains make price stability relatively more desirable.

	Gain from Ramsey-Optimal Policy (Relative to $\pi^C = 0$)	Optimal Inflation
$\frac{Trade}{GDP} = 0.1$	0.34%	1.40%
$\frac{Trade}{GDP} = 0.2$	0.22%	1.20%
$\frac{Trade}{GDP} = 0.35$	0.16%	1.05%

OMP and Trade Integration

Business Cycle

- Model correctly predicts that trade integration results in increased comovement.

	$corr(Y_{R,t}, Y^*_{R,t})$—PCP		
	$\frac{Trade}{GDP} = 0.1$	$\frac{Trade}{GDP} = 0.2$	$\frac{Trade}{GDP} = 0.35$
Historical Rule	0.36	0.45	0.49
Ramsey	0.07	0.29	0.43
Peg	0.05	0.19	0.27
Nash	0.28	0.35	0.48

	$corr(Y_{R,t}, Y^*_{R,t})$—LCP		
Historical Rule	0.33	0.42	0.47
Ramsey	0.36	0.53	0.62
Peg	0.05	0.20	0.27
Nash	0.28	0.36	0.42

	Welfare Loss Relative to Ramsey-Optimal Policy	
	Optimized Rule	*Historical Policy*
$\frac{Trade}{GDP} = 0.1$	0.88%	18.62%
$\frac{Trade}{GDP} = 0.2$	3.13%	25.36%
$\frac{Trade}{GDP} = 0.35$	3.15%	29.69%

OMP and Trade Integration

Business Cycle

- Characteristics of optimal policy do not change following trade integration.
- Appropriately designed, inward-looking interest rate rules still replicates the constrained efficient allocation.
- Benigno and Benigno (2003): Flexible exchange rates and domestic price stability are optimal when shocks are perfectly correlated across countries.
- Our model provides a structural microfoundation for their finding.
  - Business cycle correlation is an endogenous consequence of trade integration.
- As long as each central bank influences domestic distortions appropriately, increased synchronization dampens the effect of international distortions.

Sensitivity Analysis

- So far, one international distortion: lack of efficient risk sharing between Home and Foreign.
  - Consider other external distortions:
    - incomplete exchange rate pass-through;
    - strategic considerations in monetary policy setting.
- Physical capital accumulation.
- Other sources of business cycle fluctuations: inefficient shocks.

Local Currency Pricing

- Under LCP, firms set export prices in Foreign currency.
- Nominal exchange rate movements do not have expenditure switching effects.
- Benchmark two-country New Keynesian model:
  - Incomplete pass-through: impossible to jointly stabilize domestic and export markups (LOP does not hold).
  - Optimal-policy prescription: policymakers should pay attention to international relative price misalignments.
- In our model, LCP does not introduce new policy tradeoffs (but it modifies their nature): LOP does not hold also under PCP.

Unrestricted, Optimal Non-Cooperative Policy

- Two self-oriented central banks set monetary policy to maximize the welfare of domestic consumers.
- Home central bank maximizes:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[u(C_t) - l_t v(h_t) \right].$$

- Strategic game as in Benigno and Benigno (2006):
  - Each policymaker's strategy is specified in terms of each country's consumer price inflation rate, $\pi_{C,t}$, as a function of the sequence of shocks.
  - Two-country, open-loop Nash equilibrium: $\left\{ \pi^*_{C,t} \right\}_{t=0}^{\infty}$ taken as given.
- Foreign solves an analogous problem.

Welfare Loss Relative to Ramsey-Optimal Policy: PCP

	Optimized Rule	*Historical*	*Nash*
$\frac{Trade}{GDP} = 0.1$	0.88%	18.62%	0.0001%
$\frac{Trade}{GDP} = 0.2$	3.13%	25.36%	0.001%
$\frac{Trade}{GDP} = 0.35$	3.15%	29.69%	0.09%

Welfare Loss Relative to Ramsey-Optimal Policy: LCP

	Optimized Rule	*Historical*	*Nash*
$\frac{Trade}{GDP} = 0.1$	2.17%	20.91%	0.10%
$\frac{Trade}{GDP} = 0.2$	2.66%	29.09%	0.90%
$\frac{Trade}{GDP} = 0.35$	3.16%	36.16%	2.42%

Exchange Rate Peg

Welfare Loss Relative to Ramsey-Optimal Policy: PCP

	Flexible ER	*Peg*	
		Leader	Follower
$\frac{Trade}{GDP} = 0.1$	18.62%	18.81%	43.45%
$\frac{Trade}{GDP} = 0.2$	25.36%	26.90%	45.40%
$\frac{Trade}{GDP} = 0.35$	29.69%	32.31%	48.39%

Welfare Loss Relative to Ramsey-Optimal Policy: LCP

	Flexible ER	*Peg*	
		Leader	Follower
$\frac{Trade}{GDP} = 0.1$	20.91%	20.89%	44.90%
$\frac{Trade}{GDP} = 0.2$	29.09%	29.49%	47.34%
$\frac{Trade}{GDP} = 0.35$	36.16%	37.00%	51.97%

Conclusions

- DSGE model with micro-level trade dynamics and labor market frictions to re-examine classic questions on trade integration and international monetary policy.
- Trade-induced productivity gains reduce the need of positive inflation to correct long-run distortions.
- Trade-induced business cycle synchronization dampens the effect of international distortions:
  - Optimal cooperative policy remains inward looking and gains from cooperation are small relative to optimal non-cooperative behavior.
  - Inefficient domestic stabilization, however, results in larger welfare costs when trade linkages are strong.

	Parameter	Source/Target
Risk Aversion	$\gamma_C = 1$	Literature
Frisch elasticity	$1/\gamma_h = 0.4$	Literature
Discount Factor	$\beta = 0.99$	$r = 4\%$
Elasticity Matching Function	$\varepsilon = 0.4$	Literature
Firm Bargaining Power	$\eta = 0.4$	Literature
Home Production	$b = 0.54$	Literature
Exogenous separation	$\lambda = 0.10$	Literature
Vacancy Cost	$\kappa = 0.16$	$s = 60\%$
Matching Efficiency	$\chi = 0.68$	$q = 70\%$
Elasticity of Substitution	$\theta = 3.8$	Literature
Plant Exit	$\delta = 0.026$	$JD^{EXIT}/JD = 40\%$
Pareto Shape	$k_p = 3.4$	Literature
Pareto Support	$z_{\min} = 1$	Literature
Sunk Entry Cost	$f_e = 0.69$	Literature
Fixed Export Costs	$f_x = 0.005$	$(N_x/N) = 21\%$
Iceberg Trade Costs	$\tau = 1.75$	$(I + X)/Y = 10\%$
Rotemberg Wage Adj. Cost	$\vartheta = 60$	$\sigma_I/\sigma_{Y_R} = 0.56$
Rotemberg Price Adj. Cost	$\nu = 80$	Literature
Taylor - Interest Rate Smoothing	$\varrho_i = 0.71$	Literature
Taylor - Inflation Parameter	$\varrho_\pi = 1.62$	Literature
Taylor - Output Gap Parameter	$\varrho_Y = 0.34$	Literature
Bond Adjustment Cost	$\psi = 0.0025$	Literature

Validation

Variable	$\sigma_{X_R^U}$		$\sigma_{X_R^U}/\sigma_{Y_R^U}$		1st Autocorr		$corr(X_{R,t}^U, Y_{R,t}^U)$	
Y_R	**1.71**	1.50	**1**	1	**0.83**	0.79	**1**	1
C_R	**1.11**	0.94	**0.64**	0.63	**0.70**	0.73	**0.67**	0.87
I_R	**5.48**	5.50	**3.20**	3.68	**0.89**	0.80	**0.87**	0.86
I	**0.97**	0.82	**0.56**	0.56	**0.88**	0.72	**0.79**	0.81
w_R	**0.91**	0.79	**0.52**	0.53	**0.91**	0.92	**0.56**	0.76
X_R	**5.46**	2.40	**3.18**	1.66	**0.67**	0.70	**0.18**	0.17
I_R	**4.35**	2.08	**2.54**	1.39	**0.32**	0.69	**0.70**	0.77
TB_R/Y_R	**0.25**	0.39	**0.14**	0.26	**0.43**	0.71	**-0.47**	-0.48
$corr(C_{R,t}, C_{R,t}^*)$	**0.44**	0.16						
$corr(Y_{R,t}, Y_{R,t}^*)$	**0.51**	0.36						

Market Economy Distortions

- The Ramsey planner uses i_{t+1} and i^*_{t+1} to address the consequences of a set of distortions that exist in the market economy.
- Domestic distortions:
  - *Sticky prices*: $\Upsilon_{\pi_d,t} \equiv \nu \pi^2_{d,t}/2$ and $\Upsilon_{\pi_x,t} \equiv \nu \pi^2_{x,t}/2$.
  - *Sticky wages*: $\Upsilon_{\pi_w,t} \equiv \vartheta \pi^2_{w,t}/2$.
  - *Firm monopoly power*: $\Upsilon_{\varphi,t} \equiv 1/\mu_{d,t}$.
  - *Positive unemployment benefits*: $\Upsilon_{b,t} \equiv b$.
- International distortions:
  - *Incomplete markets*:$\Upsilon_{Q,t} \equiv \left(u^*_{C,t}/u_{C,t}\right) - Q_t$.
  - *Costs of adjusting bond holdings*:$\Upsilon_{a,t} \equiv \psi a_{t+1} + \psi a_{*,t+1}$.
- We solve for the first-best, optimal planning problem and show that market distortions affect four margins of adjustment and the resource constraint for consumption output.

Inefficiency Wedges

- Product creation margin: $\Upsilon_{\pi_d,t}$ and $\Upsilon_{\pi_x,t}$ result in time variation and lack of synchronization in domestic and export markups: $\Upsilon_{\mu_{d,t}} \equiv (\mu_{d,t-1}/\mu_{d,t}) - 1$ and $\Upsilon_{\mu_{x,t}} \equiv (\mu_{d,t}/\mu_{x,t}) - 1$.
- Job creation margin: $\Upsilon_{\varphi,t}$, $\Upsilon_{\pi_w,t}$ and $\Upsilon_{b,t}$ distort the outside option of firms and workers.
- Labor supply margin: $\Upsilon_{\varphi,t}$ and $\Upsilon_{a,t}$ induces a misalignment of relative prices between consumption goods and leisure.
- Cross-country risk sharing margin: $\Upsilon_{Q,t}$ implies inefficient risk sharing across countries.
- Consumption resource constraint: $\Upsilon_{\pi_d,t}$, $\Upsilon_{\pi_x,t}$ *and* $\Upsilon_{\pi_w,t}$ divert resources from consumption and creation of new products and vacancies.

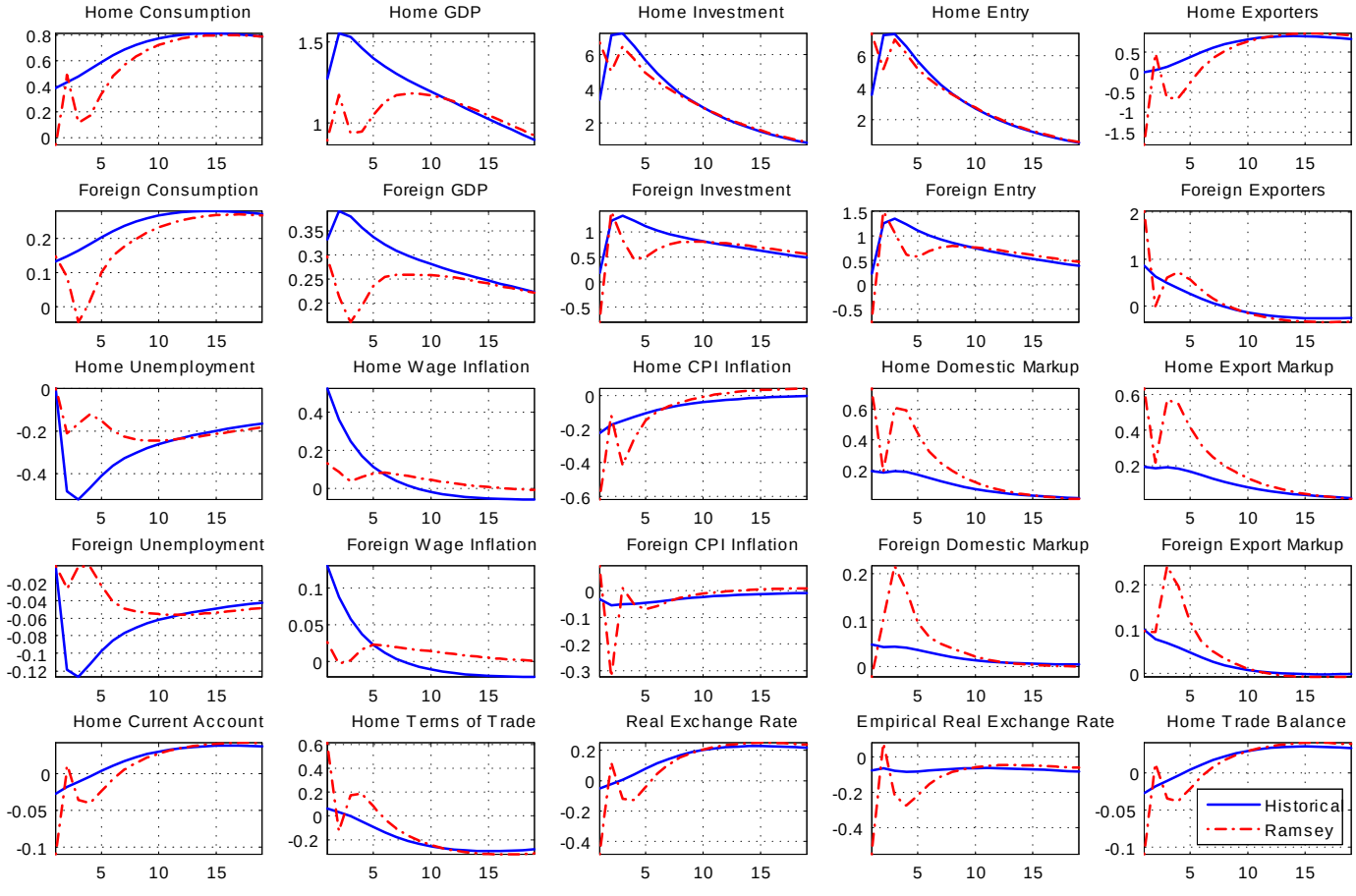

Figure 1: Home Productivity Shock, no trade linkages and producer currency pricing.

Variables are in percentage deviations from the steady state. Unemployment and inflation are in deviations from the steady state.

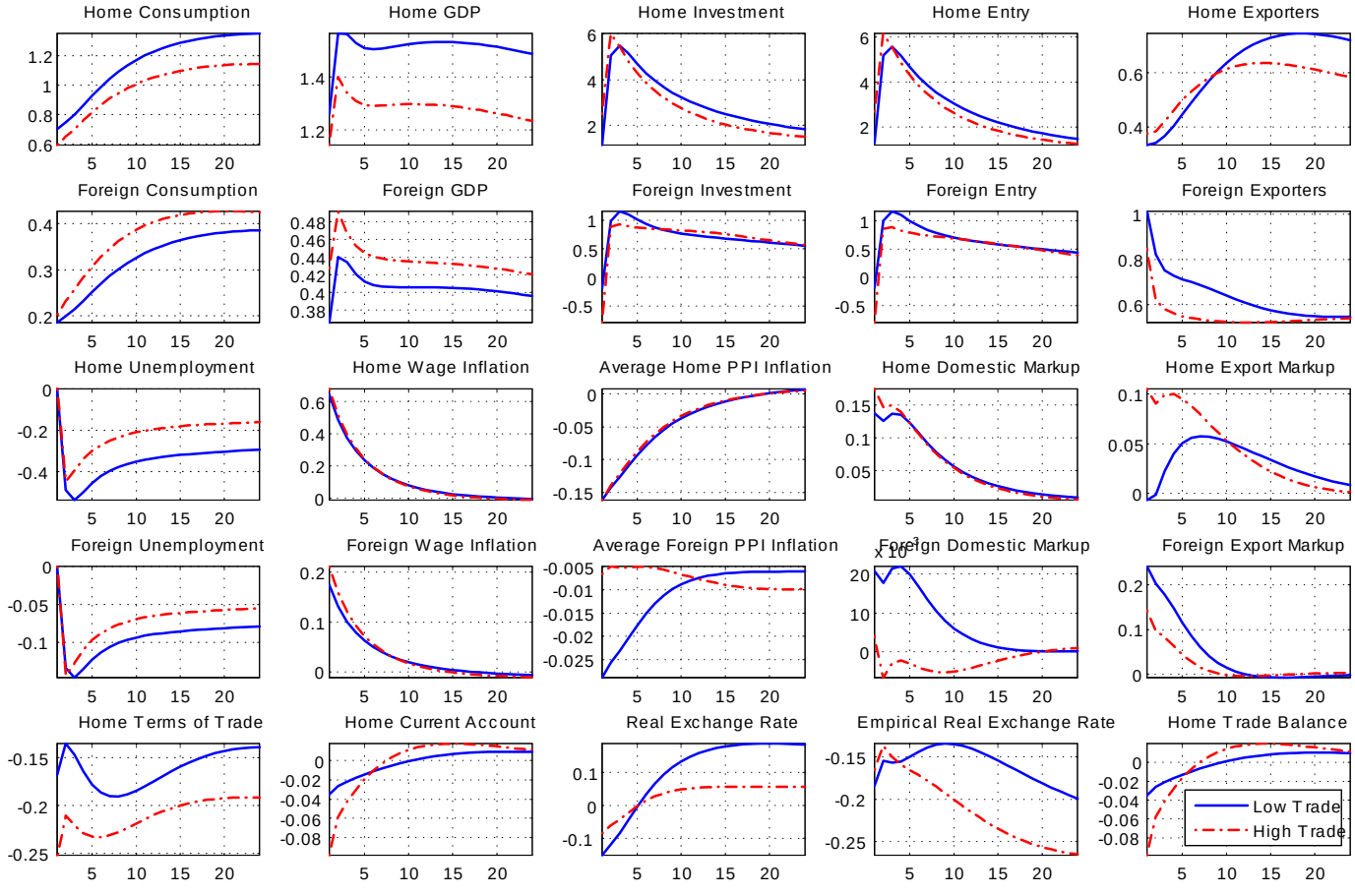

Figure 2: Home Productivity Shock, trade integration and producer currency pricing.

Variables are in percentage deviations from the steady state. Unemployment and inflation are in deviations from the steady state.

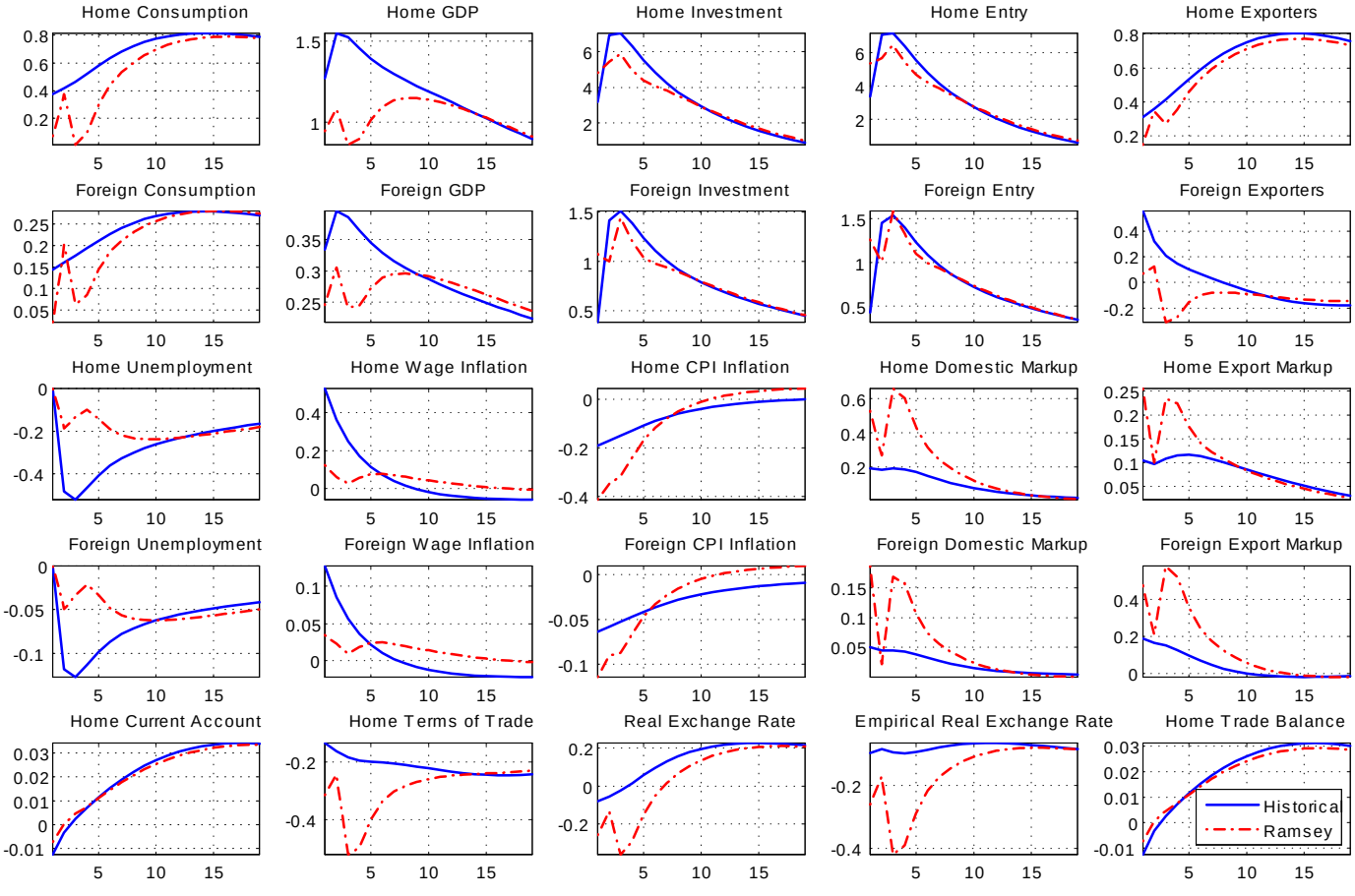

Figure 3: Home Productivity Shock, no trade linkages and local currency pricing.

Variables are in percentage deviations from the steady state. Unemployment and inflation are in deviations from the steady state.

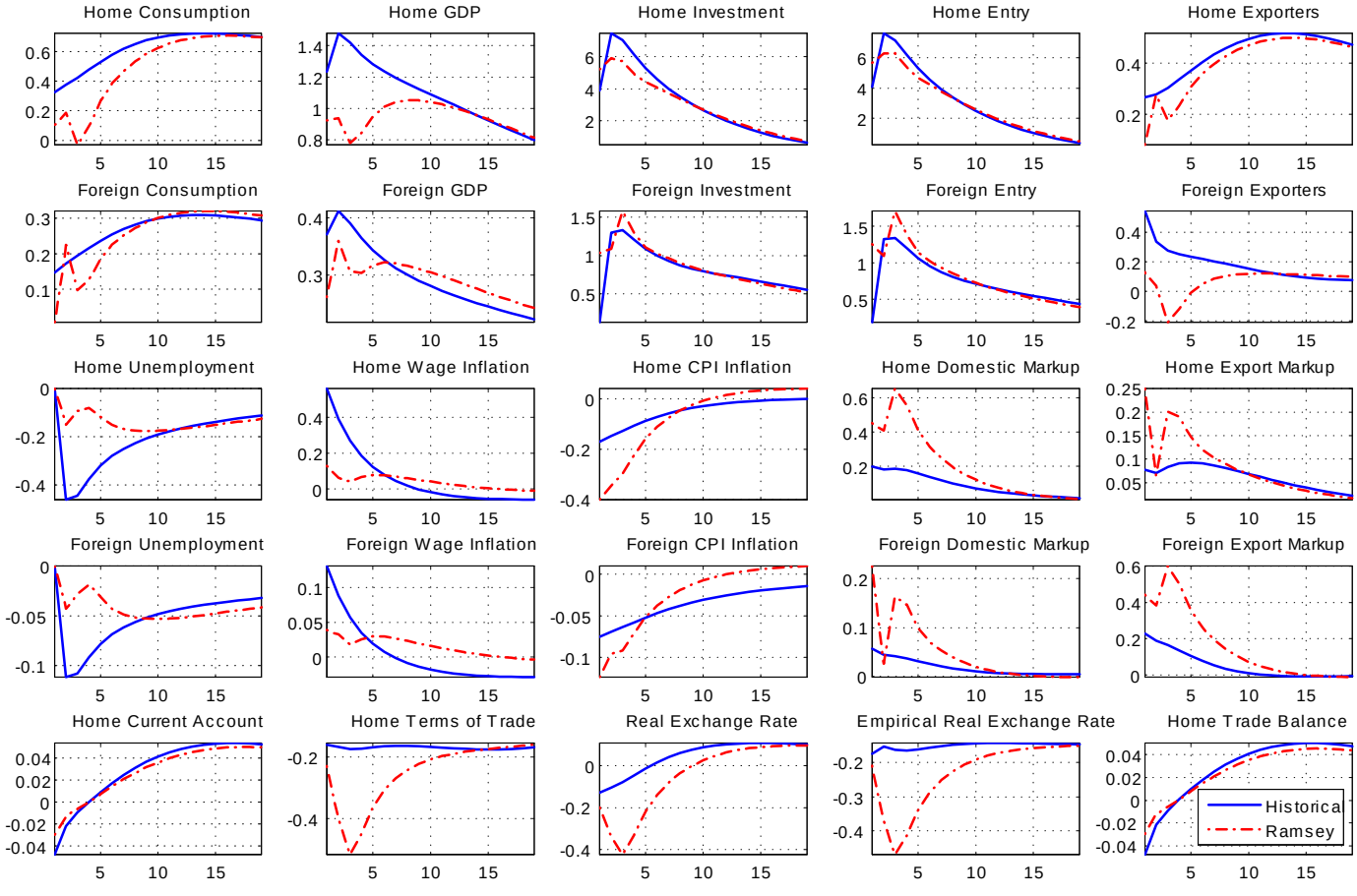

Figure 4: Home Productivity Shock, trade integration and local currency pricing.

Variables are in percentage deviations from the steady state. Unemployment and inflation are in deviations from the steady state.