Trade, Unemployment, and Monetary Policy

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Inflation Dynamics in a Post-Crisis Globalized Economy, Zurich, 2013.
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.

• 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

- Price stability in open economies:

- Optimal policy with endogenous entry and product variety:
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 $\kappa$.
- Matching technology generates aggregate matches:
  \[ M_t = \chi U_t^{1-\varepsilon} V_t^\varepsilon, \quad \chi > 0, \quad 0 < \varepsilon < 1. \]
  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:
  \[ y_t^l = Z_t l_t h_t, \]
  \[
  \begin{bmatrix}
  \log Z_t \\
  \log Z^*_t
  \end{bmatrix}
  =
  \begin{bmatrix}
  \phi_{11} & \phi_{12} \\
  \phi_{21} & \phi_{22}
  \end{bmatrix}
  \begin{bmatrix}
  \log Z_{t-1} \\
  \log Z^*_{t-1}
  \end{bmatrix}
  +
  \begin{bmatrix}
  \epsilon_t \\
  \epsilon^*_t
  \end{bmatrix}.
  \]

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

- 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 $\omega$ and defined over a continuum $\Omega$:

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

- The cost of the product bundle $Y_t$ is:

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

where $p_t^Y(\omega)$ is the nominal marginal cost of producing variety $\omega$.

- 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 $[z_{\text{min}}, \infty)$.
  - Use intermediate input to produce output, with real marginal cost:
    \[
    \varphi_{z,t} = \frac{p^y_t(z)}{P_t} = \frac{\varphi_t}{z}.
    \]
  - 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 $Y_t$).
  - $f_{x,t}$ 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:**

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

- **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.
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:

\[
\begin{align*}
    P_{d,t} &= \mu_{d,t} P_{d,t}^y, \\
    P_{x,t} &= \mu_{x,t} \tau_t^{-1} P_{x,t}^y / S_t \ (\neq \tau_t P_{d,t} / S_t).
\end{align*}
\]

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:

\[
\begin{align*}
    P_{d,t}^y / P_t &= \phi_t \left[ \int_{z_{\min}}^{\infty} z^{\theta-1} dG(z) \right]^{-\frac{1}{\theta-1}} = \phi_t / \tilde{z}_d \\
    P_{x,t}^y / P_t &= \phi_t \left[ \int_{z_{x,t}}^{\infty} z^{\theta-1} \frac{dG(z)}{1 - G(z_{x,t})} \right]^{-\frac{1}{\theta-1}} = \phi_t / \tilde{z}_{x,t}
\end{align*}
\]
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:

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

under the constraints of the competitive economy.

- We compare the Ramsey-optimal, cooperative policy to:
  - Historical central bank behavior under a flexible ER:
    \[ 1 + i_{t+1} = (1 + i_t)^{q_i} \left[ (1 + i) (1 + \pi_{C,t})^{q_{\pi}} \left( Y_{g,R,t} \right)^{q_Y} \right]^{1-q_i} . \]
  - Non-cooperative, optimal policy.
  - ER peg (historical behavior for the center).
OMP with Weak Trade Linkages

Long Run

• **Result:** optimal $\pi_C$ 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 $\eta$, 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:

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

with \( q_i = .60, q_Y = 0, q_{\pi_d} = 1.45, \) and \( q_{\pi_w} = 3.75. \)
- 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,
    \[
    \varphi = \left(1/\mu_d\right) N_d^{\theta-1} \tilde{z},
    \]
    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.
<table>
<thead>
<tr>
<th>Trade $\frac{GDP}{GDP}$</th>
<th>Gain from Ramsey-Optimal Policy (Relative to $\pi^C=0$)</th>
<th>Optimal Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.34%</td>
<td>1.40%</td>
</tr>
<tr>
<td>0.2</td>
<td>0.22%</td>
<td>1.20%</td>
</tr>
<tr>
<td>0.35</td>
<td>0.16%</td>
<td>1.05%</td>
</tr>
</tbody>
</table>
OMP and Trade Integration

Business Cycle

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

\[
\text{corr}(Y_{R,t}, Y_{R,t}^*) - \text{PCP}
\]

\[
\frac{\text{Trade}_{GDP}}{\text{GDP}} = 0.1 \quad \frac{\text{Trade}_{GDP}}{\text{GDP}} = 0.2 \quad \frac{\text{Trade}_{GDP}}{\text{GDP}} = 0.35
\]

<table>
<thead>
<tr>
<th></th>
<th>(\frac{\text{Trade}_{GDP}}{\text{GDP}} = 0.1)</th>
<th>(\frac{\text{Trade}_{GDP}}{\text{GDP}} = 0.2)</th>
<th>(\frac{\text{Trade}_{GDP}}{\text{GDP}} = 0.35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical Rule</td>
<td>0.36</td>
<td>0.45</td>
<td>0.49</td>
</tr>
<tr>
<td>Ramsey</td>
<td>0.07</td>
<td>0.29</td>
<td>0.43</td>
</tr>
<tr>
<td>Peg</td>
<td>0.05</td>
<td>0.19</td>
<td>0.27</td>
</tr>
<tr>
<td>Nash</td>
<td>0.28</td>
<td>0.35</td>
<td>0.48</td>
</tr>
</tbody>
</table>

\[
\text{corr}(Y_{R,t}, Y_{R,t}^*) - \text{LCP}
\]

<table>
<thead>
<tr>
<th></th>
<th>(\frac{\text{Trade}_{GDP}}{\text{GDP}} = 0.1)</th>
<th>(\frac{\text{Trade}_{GDP}}{\text{GDP}} = 0.2)</th>
<th>(\frac{\text{Trade}_{GDP}}{\text{GDP}} = 0.35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical Rule</td>
<td>0.33</td>
<td>0.42</td>
<td>0.47</td>
</tr>
<tr>
<td>Ramsey</td>
<td>0.36</td>
<td>0.53</td>
<td>0.62</td>
</tr>
<tr>
<td>Peg</td>
<td>0.05</td>
<td>0.20</td>
<td>0.27</td>
</tr>
<tr>
<td>Nash</td>
<td>0.28</td>
<td>0.36</td>
<td>0.42</td>
</tr>
<tr>
<td>Trade/GDP</td>
<td>Optimized Rule</td>
<td>Historical Policy</td>
<td></td>
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<tr>
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<td></td>
</tr>
<tr>
<td>0.1</td>
<td>0.88%</td>
<td>18.62%</td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>3.13%</td>
<td>25.36%</td>
<td></td>
</tr>
<tr>
<td>0.35</td>
<td>3.15%</td>
<td>29.69%</td>
<td></td>
</tr>
</tbody>
</table>
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.
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:

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

- 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

<table>
<thead>
<tr>
<th>Optimized Rule</th>
<th>Historical</th>
<th>Nash</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{\text{Trade}}{\text{GDP}} = 0.1$</td>
<td>0.88%</td>
<td>18.62%</td>
</tr>
<tr>
<td>$\frac{\text{Trade}}{\text{GDP}} = 0.2$</td>
<td>3.13%</td>
<td>25.36%</td>
</tr>
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<td>$\frac{\text{Trade}}{\text{GDP}} = 0.35$</td>
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<td>29.69%</td>
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### Welfare Loss Relative to Ramsey-Optimal Policy: LCP

<table>
<thead>
<tr>
<th>Optimized Rule</th>
<th>Historical</th>
<th>Nash</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{\text{Trade}}{\text{GDP}} = 0.1$</td>
<td>2.17%</td>
<td>20.91%</td>
</tr>
<tr>
<td>$\frac{\text{Trade}}{\text{GDP}} = 0.2$</td>
<td>2.66%</td>
<td>29.09%</td>
</tr>
<tr>
<td>$\frac{\text{Trade}}{\text{GDP}} = 0.35$</td>
<td>3.16%</td>
<td>36.16%</td>
</tr>
</tbody>
</table>
## Exchange Rate Peg

### Welfare Loss Relative to Ramsey-Optimal Policy: PCP

<table>
<thead>
<tr>
<th>Flexible ER</th>
<th>Peg</th>
<th>Leader</th>
<th>Follower</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{Trade}{GDP} = 0.1$</td>
<td>18.62%</td>
<td>18.81%</td>
<td>43.45%</td>
</tr>
<tr>
<td>$\frac{Trade}{GDP} = 0.2$</td>
<td>25.36%</td>
<td>26.90%</td>
<td>45.40%</td>
</tr>
<tr>
<td>$\frac{Trade}{GDP} = 0.35$</td>
<td>29.69%</td>
<td>32.31%</td>
<td>48.39%</td>
</tr>
</tbody>
</table>

### Welfare Loss Relative to Ramsey-Optimal Policy: LCP

<table>
<thead>
<tr>
<th>Flexible ER</th>
<th>Peg</th>
<th>Leader</th>
<th>Follower</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{Trade}{GDP} = 0.1$</td>
<td>20.91%</td>
<td>20.89%</td>
<td>44.90%</td>
</tr>
<tr>
<td>$\frac{Trade}{GDP} = 0.2$</td>
<td>29.09%</td>
<td>29.49%</td>
<td>47.34%</td>
</tr>
<tr>
<td>$\frac{Trade}{GDP} = 0.35$</td>
<td>36.16%</td>
<td>37.00%</td>
<td>51.97%</td>
</tr>
</tbody>
</table>
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.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Source/Target</th>
</tr>
</thead>
</table>
| Risk Aversion                 | \( \gamma_C = 1 \)  
Literature                      |
| Frisch elasticity             | \( 1/\gamma_h = 0.4 \)  
Literature                      |
| Discount Factor               | \( \beta = 0.99 \)  
\( r = 4\% \)                    |
| Elasticity Matching Function  | \( \epsilon = 0.4 \)  
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      | \( \theta = 60 \)  
\( \sigma_I / \sigma_Y = 0.56 \) |
| Rotemberg Price Adj. Cost     | \( \nu = 80 \)  
Literature                      |
| Taylor - Interest Rate Smoothing | \( \epsilon_i = 0.71 \)  
Literature                      |
| Taylor - Inflation Parameter  | \( \epsilon_\pi = 1.62 \)  
Literature                      |
| Taylor - Output Gap Parameter | \( \epsilon_Y = 0.34 \)  
Literature                      |
| Bond Adjustment Cost          | \( \psi = 0.0025 \)  
Literature                      |
## Validation

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\sigma_{X_R^U}$</th>
<th>$\sigma_{X_R^U}/\sigma_{Y_R^U}$</th>
<th>1st Autocorr</th>
<th>$corr(X_{R,t}^U, Y_{R,t}^U)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_R$</td>
<td>1.71</td>
<td>1.50</td>
<td>1</td>
<td>0.83 0.79 1 1</td>
</tr>
<tr>
<td>$C_R$</td>
<td>1.11</td>
<td>0.94</td>
<td>0.64 0.63</td>
<td>0.70 0.73 0.67 0.87</td>
</tr>
<tr>
<td>$I_R$</td>
<td>5.48</td>
<td>5.50</td>
<td>3.20 3.68</td>
<td>0.89 0.80 0.87 0.86</td>
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<tr>
<td>$l$</td>
<td>0.97</td>
<td>0.82</td>
<td>0.56 0.56</td>
<td>0.88 0.72 0.79 0.81</td>
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<tr>
<td>$w_R$</td>
<td>0.91</td>
<td>0.79</td>
<td>0.52 0.53</td>
<td>0.91 0.92 0.56 0.76</td>
</tr>
<tr>
<td>$X_R$</td>
<td>5.46</td>
<td>2.40</td>
<td>3.18 1.66</td>
<td>0.67 0.70 0.18 0.17</td>
</tr>
<tr>
<td>$I_R$</td>
<td>4.35</td>
<td>2.08</td>
<td>2.54 1.39</td>
<td>0.32 0.69 0.70 0.77</td>
</tr>
<tr>
<td>$TB_R / Y_R$</td>
<td>0.25</td>
<td>0.39</td>
<td>0.14 0.26</td>
<td>0.43 0.71 -0.47 -0.48</td>
</tr>
<tr>
<td>$corr(C_R,t, C_{R,t}^*)$</td>
<td>0.44</td>
<td>0.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$corr(Y_R,t, Y_{R,t}^*)$</td>
<td>0.51</td>
<td>0.36</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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*: $\Upsilon_{\pi_w,t} \equiv \theta \pi^2_{w,t} / 2$.
  - *Firm monopoly power*: $\Upsilon_\phi,t \equiv 1 / \mu_d,t$.
  - *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*: $\Upsilon_a,t \equiv \psi a_{t+1} + \psi a^*_t,t+1$.

- 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**: \( Y_{\pi_d,t} \) and \( Y_{\pi_x,t} \) result in time variation and lack of synchronization in domestic and export markups: 
  \[ Y_{\mu_d,t} \equiv \left( \frac{\mu_d,t-1}{\mu_d,t} \right) - 1 \] 
  and 
  \[ Y_{\mu_x,t} \equiv \left( \frac{\mu_d,t}{\mu_x,t} \right) - 1. \]

- **Job creation margin**: \( Y_{\varphi,t} \), \( Y_{\pi_w,t} \) and \( Y_{b,t} \) distort the outside option of firms and workers.

- **Labor supply margin**: \( Y_{\varphi,t} \) and \( Y_{a,t} \) induces a misalignment of relative prices between consumption goods and leisure.

- **Cross-country risk sharing margin**: \( Y_{Q,t} \) implies inefficient risk sharing across countries.

- **Consumption resource constraint**: \( Y_{\pi_d,t} \), \( Y_{\pi_x,t} \) and \( Y_{\pi_w,t} \) 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.