Incomplete pass-through in import markets and permanent vs. transitory exchange-rate shocks

2nd Workshop on Macroeconomic Policy Research, Magyar Nemzeti Bank, October 2-3, 2003

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1. Overview

- First-glance empirical evidence for incomplete pass-through (pricing-to-market) and economic rationale
- Estimation of import supply functions for the U.S., Japan, Germany, France, and Italy
- Permanent and transitory exchange-rate changes in the context of dynamic optimizing behavior
- Decomposition of real exchange rates into a permanent and a transitory component
- Re-estimation of import supply functions with decomposed exchange rates
- Conclusion
Changes in the value of a country’s currency do not lead to congruent changes of import prices


\[ \frac{\Delta (p_M - p^*_Q - e)}{\Delta e} \] vary with the exchange rate \( (E) \).
2. Pricing behavior in imperfectly competitive markets


\[ P^f_M = \frac{\varepsilon}{1 + \varepsilon} C^f'(M, P^a_Q) \]

\[ \varepsilon = \frac{1}{P^f_q / P^f_M \cdot E} \]

(1) \[ P^f_M = \left[ \frac{P^f_Q}{P^f_M \cdot E} \right]^{\psi} \cdot C^f'(M, P^a_Q) \]

\[ r = e + p^a_Q - p_Q \]

(2) \[ p_M - p_Q = \gamma_0 + (1 - \gamma_1) r \]


(3) \[ L_t = E_t \sum_{i=0}^{\infty} \theta^i [\lambda (p_{t+i} - \tilde{p}_{t+i})^2 + \Delta p_{t+i}^2] \quad p_t = p_{M_t} - p_{Q_t} \]

\[ E_t \tilde{p}_{t+i} = (1 - \gamma_1) E_t r_{t+i} \]

(7) \[ \Delta p_t = -(1 - \mu) [p_{t-1} - (1 - \gamma_1) r_{t-1}] + \nu' G(\theta, \mu, \Pi, A) \Delta z_t \]
3. Estimation of import supply functions

Oil price as additional determinant of import prices:

Table 1: Pair-wise correlations of oil prices with exchange rates and import prices

<table>
<thead>
<tr>
<th></th>
<th>U.S.</th>
<th>Japan</th>
<th>Germany</th>
<th>France</th>
<th>Italy</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{Corr}(\Delta r_t, \Delta p_{oil_t})$</td>
<td>0.00</td>
<td>0.10</td>
<td>0.04</td>
<td>0.17</td>
<td>0.08</td>
</tr>
<tr>
<td>$\text{Corr}(\Delta p_t, \Delta p_{oil_t})$</td>
<td>0.54</td>
<td>0.43</td>
<td>0.44</td>
<td>0.38</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Unit-Root tests:

Augmented Dickey-Fuller: $H_0: \alpha = 1$

$$\Delta y_t = c_0 + (\alpha - 1)y_{t-1} + c_1t + \sum_{i=1}^{k-1} \beta_i \Delta y_{t-i} + \epsilon_t \quad \epsilon_t \sim \text{IID}(0, \sigma^2)$$

Kwiatkowski et al.: $H_0: d = 0$

$$y_t = \alpha + \beta t + d \sum_{i=1}^{t} u_i + \epsilon_t \quad \text{LM} = \sum_{t=1}^{T} S_t^2 / \hat{\sigma}_\epsilon^2 \quad S_t = \sum_{i=1}^{t} e_i$$
3. Estimation of import supply functions

Relative import prices and real exchange rates
### 3. Estimation of import supply functions

#### Results of the unit root tests

**Table 1: Unit root tests for the real exchange rates**

<table>
<thead>
<tr>
<th>variable</th>
<th>Lags (k)</th>
<th>det. comp. in test</th>
<th>ADF</th>
<th>ADF 1st diff.</th>
<th>KPSS (l = 8)</th>
<th>KPSS 1st diff. (l = 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_GER</td>
<td>4</td>
<td>C,T</td>
<td>-3.30*</td>
<td>-5.03***</td>
<td>0.128*</td>
<td>0.083</td>
</tr>
<tr>
<td>R_FRA</td>
<td>5</td>
<td>C,T</td>
<td>-3.31*</td>
<td>-5.32***</td>
<td>0.074</td>
<td>0.074</td>
</tr>
<tr>
<td>R_ITA</td>
<td>4</td>
<td>C,T</td>
<td>-2.46</td>
<td>-5.55***</td>
<td>0.157**</td>
<td>0.123</td>
</tr>
<tr>
<td>R_USA</td>
<td>5</td>
<td>C,T</td>
<td>-2.61</td>
<td>-3.55***</td>
<td>0.105</td>
<td>0.050</td>
</tr>
<tr>
<td>R_JAP</td>
<td>6</td>
<td>C,T</td>
<td>-2.70</td>
<td>-4.98***</td>
<td>0.133*</td>
<td>0.199</td>
</tr>
</tbody>
</table>

**Table 2: Unit root tests for the relative import prices and the oil price**

<table>
<thead>
<tr>
<th>variable</th>
<th>Lags (k)</th>
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<tr>
<td>P_GER</td>
<td>6</td>
<td>C,T</td>
<td>-2.25</td>
<td>-3.74***</td>
<td>0.180**</td>
<td>0.147</td>
</tr>
<tr>
<td>P_FRA</td>
<td>5</td>
<td>C,T</td>
<td>-2.58</td>
<td>-4.15***</td>
<td>0.157**</td>
<td>0.118</td>
</tr>
<tr>
<td>P_ITA</td>
<td>7</td>
<td>C,T</td>
<td>-1.81</td>
<td>-3.96***</td>
<td>0.147**</td>
<td>0.096</td>
</tr>
<tr>
<td>P_USA</td>
<td>7</td>
<td>C,T</td>
<td>-3.25*</td>
<td>-3.85***</td>
<td>0.136*</td>
<td>0.142</td>
</tr>
<tr>
<td>P_JAP</td>
<td>7</td>
<td>C,T</td>
<td>-2.53</td>
<td>-4.14***</td>
<td>0.111</td>
<td>0.072</td>
</tr>
<tr>
<td>POIL</td>
<td>1</td>
<td>C</td>
<td>-1.37</td>
<td>-5.23***</td>
<td>0.117</td>
<td>0.109</td>
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3. Benchmark Results

Structural shifts in the European supply functions

Germany | Italy | France
---|---|---

Summary of ECM estimations: sample 1975:1-2002:2, T=110

Significance of \((1-\mu)\) suggests cointegrating import supply relations – except for France

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<tr>
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<td>0.65</td>
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<tr>
<td>France</td>
<td>0.92</td>
<td>0.69</td>
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<tr>
<td>Italy</td>
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→ Coherence with results of previous studies
→ Hypothesis: different response to permanent and transitory exchange-rate changes matters
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→ Coherence with results of previous studies
→ Hypothesis: different response to permanent and transitory exchange-rate changes matters
A simple model for the decomposition of real exchange rate into a permanent component $q_t$ and a transitory component $s_t$

\[
\begin{align*}
(10a) \quad r_t &= q_t + s_t \\
(10b) \quad q_t &= q_{t-1} + u_t \quad (s_t, u_t) \sim \text{iid}[0, \text{diag}(\sigma_s^2, \sigma_u^2)] \\
\rightarrow \quad \Delta r_t &= u_t + \Delta s_t
\end{align*}
\]

Prediction of the target path in the adjustment cost model:

\[ E_t r_{t+i} = r_t - s_t \]

Corresponding ECM for dynamic import supply function:

\[
(11) \quad \Delta p_t = -(1-\mu)[p_{t-1} - (1-\gamma_1)r_{t-1}] + (1-\mu)(1-\gamma_1)\Delta r_t - (1-\mu)\theta\mu(1-\gamma_1)s_t
\]
4. Accounting for permanent and transitory exchange-rate changes

Implications for conventional estimates:

a) potential bias in estimated pass-through coefficients
b) imprecise forecasts

a) Monte-Carlo experiments to evaluate bias in estimates based on the simple model with AR(1) process for the transitory component $s_t$:

\[
\begin{align*}
    r_t &= q_t + s_t \\
    s_t &= \alpha s_{t-1} + e_t \quad 0 \leq \alpha < 1 \quad e_t \sim iidN(0, \sigma_e^2) \\
    q_t &= q_{t-1} + u_t \quad u_t \sim iidN(0, \sigma_u^2)
\end{align*}
\]

In general: tendency to underestimate the adjustment coefficient ($1-\mu$), and the short run pass-through elasticity

Downward bias increases with the variance of transitory shocks $e_t$ in relation to permanent shocks $u_t$.
4. Accounting for permanent and transitory exchange-rate changes

- Ambiguous results for the long run pass-through elasticity \((1-\gamma_1)\).
- Downward bias peaks at a relatively high degree of serial correlation in \(s_t\).
4. Accounting for permanent and transitory exchange-rate changes

b) simulation of a temporary 10% depreciation at time $t = 1$

1. considering model (10a) and (10b): $r_{t} = s_{t} = 0.1$

2. setting $\Delta r_{t} = 0.1$ and $\Delta r_{t+1} = -0.1$ in conventional ECM

→ Extract transitory component $s_{t}$ and include contemporaneous and possibly lagged values when estimating the dynamic import supply functions
Bivariate Blanchard-Quah decomposition:

- Joint process of two variables \((x_t, z_t)\) is governed by two shocks
- One variable is stationary \(\Rightarrow\) no impact of shocks on long-run level
- Other variable is non-stationary, but one of the shocks is assumed to have no long-run impact

\(\Rightarrow\) identification of two independent shocks from VMA representation of \((\Delta x_t, z_t)\)

Lee and Chinn (2002): joint process of \(r_t\) and current account in relation to nominal GDP \((CA_t)\) satisfy BQ assumptions:

- Two shocks govern the joint process: real demand and supply shocks \((\varepsilon^d_t)\) and nominal (financial market) shocks \((\varepsilon^n_t)\)
- CA is stationary
- Nominal shocks only have a temporary impact on \(r_t\)
Bivariate Blanchard-Quah decomposition

based on the joint process of $r_t$ and current account in relation to nominal GDP ($CA_t$) - Lee and Chinn (2002):

assumptions:

- Two shocks govern the joint process: real demand and supply shocks ($\varepsilon^r_t$) and nominal (financial market) shocks ($\varepsilon^n_t$)
- CA is stationary
- Nominal shocks only have a temporary impact on $r_t$
5. Decomposition of real exchange rates

Hypothesized model:  
\[
\begin{bmatrix}
\Delta r \\
CA_t
\end{bmatrix}_t = C(L) \begin{bmatrix}
\varepsilon^r \\
\varepsilon^n
\end{bmatrix}_t
\]

Steps in the decomposition:

1. Unit-root tests for \( CA_t \)  
   \( \rightarrow \) stationarity cannot be rejected

2. Estimation of the bivariate VAR:  
   \[
   \begin{bmatrix}
   \Delta r \\
   CA_t
   \end{bmatrix}_t = A(L) \begin{bmatrix}
   \Delta r \\
   CA_{t-1}
   \end{bmatrix}_t + \begin{bmatrix}
   e_1 \\
   e_{2,t}
   \end{bmatrix}
   \]
   \( \rightarrow \) selection of lag order using Akaike and Schwarz Bayesian criterion

3. Transformation into VMA:  
   \[
   \begin{bmatrix}
   \Delta r \\
   CA_t
   \end{bmatrix}_t = (I - A(L)L)^{-1} \begin{bmatrix}
   e_1 \\
   e_{2,t}
   \end{bmatrix}_t = (I - A(L)L)^{-1} C(0) \begin{bmatrix}
   \varepsilon^r \\
   \varepsilon^n
   \end{bmatrix}_t
   \]

4. Identification of \( C(0) \) shocks making use of:  
   \[
   [I - A(1)C(0)]_{1,2} = 0
   \]

5. Calculation of transitory and permanent components in \( r_t \)
   \[
   \Delta q_t = (1,0) \begin{bmatrix}
   (I - A(L)L)^{-1} C(0) \begin{bmatrix}
   \varepsilon^r \\
   0
   \end{bmatrix}_t
   \end{bmatrix}
   \]
   \[
   \Delta s_t = (1,0) \begin{bmatrix}
   (I - A(L)L)^{-1} C(0) \begin{bmatrix}
   0 \\
   \varepsilon^n
   \end{bmatrix}_t
   \end{bmatrix}
   \]
For Japan, Germany, France, and Italy real shocks and permanent exchange rate movements dominate.

U.S. real exchange rate is dominated by nominal shocks and transitory changes.
6. Re-estimation with additional information

Results for the augmented ECMs including transitory exchange rate components $s_t$, $s_{t-1}$,...:

- Only for the U.S. import price $s_{t-1}$ has a significant impact, for other countries at most $s_t$.
- Transitory component enters with correct (negative) sign.
- In many cases increase in short and long run pass-through.

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<th>Country</th>
<th>long run (1-$\gamma_1$)</th>
<th>short run</th>
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</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>0.79 $\uparrow$</td>
<td>0.44 $\uparrow$</td>
</tr>
<tr>
<td>Japan</td>
<td>0.85 $\sim$</td>
<td>0.75 $\sim$</td>
</tr>
<tr>
<td>Germany</td>
<td>1.00 $\uparrow$</td>
<td>0.63 $\sim$</td>
</tr>
<tr>
<td>France</td>
<td>1.38 $\uparrow$</td>
<td>0.74 $\uparrow$</td>
</tr>
<tr>
<td>Italy</td>
<td>1.04 $\uparrow$</td>
<td>0.49 $\sim$</td>
</tr>
</tbody>
</table>

- Changes in coefficients are broadly consistent with simulations, exception is adjustment coefficient (1-$\mu$).
7. Summary and Conclusions

- Estimation of ECMs for import supply relationships confirms incomplete pass-through of exchange rates

- Quadratic adjustment cost model highlights role of expected persistence of exchange rate changes
  - implications for estimation and forecasting

- Accounting for permanent and transitory exchange-rate movements in many cases increases ECM estimates of short and long run pass-through

- Predictions of simulations for bias in estimates are not fully supported by the data
  - indicative character of results
  - more extensive study about implications for estimation
  - alternative decompositions