Market Structure and Exchange Rate Pass-Through

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Research Question

How do movements of the exchange rate affect “market toughness,” and to what extent can this explain incomplete pass-through?
Motivation I

Why do we care?

- Strategic price complementarities: Melitz and Ottaviano (2008), Atkeson and Burstein (2008), Gust et al. (2010 and 2011), Gopinath and Itskhoki (2010)
- If exchange rate moves “market toughness”, it leads to a firm’s optimal price not commoving 1-1 with exchange rate
- Can the incompleteness of long-run pass-through (e.g. Nakamura and Steinsson (2008)) be explained by such real rigidities?
Motivation II

Understanding the importance of strategic price complementarities is of interest because:

▶ It guides key modeling choices, also in the closed economy literature: already small menu costs have large effects if complementarities matter.
▶ It has direct relevance for monetary policy as we can understand how exchange rate affects inflation:
  ▶ What does a global “demise of the dollar” mean for US import inflation?
  ▶ What is the effect of a large trade-partner appreciation (China?) on the US?
  ▶ Can the changing structure of trade explain the decline in US PT? (see Marazzi and Sheets (2007))
Outline

1. Decomposing the Exchange Rate
   ▶ PT rate following broad USD movements.
   ▶ PT rate following idiosyncratic Trade Partner Currency (TPC) movements.

2. Decomposed Exchange Rate Shocks and Relevant Market Share:
   ▶ Does TPC PT depend on the trade partner’s market share?
   ▶ Does USD PT depend on the market share of domestic producers?

3. To what extent can a simple model of price complementarities explain PT rates when calibrated using our exchange rate decomposition, market share and other sector information?
Trade-Partner Currency vs USD Movements

Part I

Decomposing the exchange rate and PT
Trade-Partner Currency vs USD Movements

Idea:
Building on Gopinath and Itskhoki (2010), Glick and Rogoff (1995), we decompose the nominal exchange rate into two components:

- Global movements of the US: USD movements
- Trade-partner specific currency movements: TPC movements

Why do we decompose the exchange rate?

- Idiosyncratic country movements affect only few firms
- Common movements affect all importers
Trade-Partner Currency vs USD Movements

How do we decompose exchange rate movements?

Think about three currency movements: US, TP, rest of the world (ROW). Define global USD movement:

\[ \Delta USD_{ROW-TP,t} \equiv \sum_{c \in (C \supset \{TP,USA\})} \omega_{c,t} \Delta USD_{c,t} \]  

(1)

then,

\[ \Delta TPC_{TP,t} \equiv \Delta USD_{TP,t} - \Delta USD_{ROW-TP,t} \]  

(2)

where

- Note: the ROW is the anchor that tells us whether the USD appreciated or the TPC depreciated
- Also, ROW is different for each TP
Trade-Partner Currency vs USD Movements

Example 1: How do we calculate USD and TPC movements?

- Suppose there are 3 equally large US trade partners in the world: China, Canada, Mexico
- Exchange rate movements are:
  - USD/CNY: +10%
  - USD/MXN 0%
  - USD/CAD 0%
- Consider China as TP.
- ROW: Canada and Mexico.

Standard all-country, trade-weighted (TW) definition:
- TW movement: \( 0.33 \times (10\% + 0\% + 0\%) = 3.33\% \)

Our definition:
- USD movement: \( 0.5 \times (0\% + 0\%) = 0\% \)
- TPC movement: \( 10\% - 0\% = 10\% \)
Trade-Partner Currency vs USD Movements

Example 2: Do we address the correlation structure of XRs?

Now, exchange rate movements are:

- USD/CNY: +5%
- USD/MXN: -5%
- USD/CAD: -5%

Consider China as TP.

ROW: Canada and Mexico.

Standard all-country, trade-weighted (TW) definition:

- TW movement: $0.33 \times (5\% - 5\% - 5\%) = -5\%/3$

Our definition:

- USD movement: $0.5 \times (-5\% - 5\%) = -5\%$
- TPC movement: $5\% - (-5\%) = 10\$

$\Rightarrow$ Correlation structure does not affect decomposition.
Estimating Pass-Through

How do we estimate PT?

Estimate standard unconditional PT regression at n-month horizons for each exchange rate measure:

\[ \Delta p_{c,t} = \alpha_c + \sum_{j=0}^{n} \beta_j \Delta e_{c,t-j} + \sum_{j=0}^{n} \theta_j \Delta \pi_{c,t-j} + \gamma Z_t + \epsilon_{c,t} \]  

(3)

where

- \( c \) is a country
- \( e \) the log of one exchange rate measure
- \( n = 1, 2, ..., 25 \)
- controls \( Z_t \)

PT at horizon \( n \) is the sum of \( \beta_j \) up to \( j = n \).
Estimating Pass-Through

What is the data?

BLS micro price data:
- Data underlying U.S. IPP (import price index)
- Prices exclude intra-firm prices ("transfer pricing")
- Prices exclude ‘lumpy trade’ prices
- Individual "items" such as "Rug; 100% New Zealand wool; hand-tufted; hand-hooked; style name: XXX"
- Time frame: 1994-2005

Exchange rate data from IMF.
Estimating Pass-Through

Countries included:

- Major trade partners: China, Canada, Mexico, Japan, Germany, South Korea, United Kingdom, Taiwan, France, Ireland

- Minor trade partners: Austria, Denmark, Czech Republic, Finland, Greece, Hungary, Italy, Netherlands, Norway, Portugal, Singapore, Spain, Sweden, Switzerland
Results

Result 1:

Much larger estimated PT for global USD movements than TPC or nominal exchange rate movements
Results

Pass-Through into US Import Prices Following Nominal, USD, and Trade Partner Exchange Rate Changes

Estimated Pass-Through Horizon in Months

Market Structure and Exchange Rate Pass-Through
Pass-Through under Joint Estimation (With 95% C.I.)

Market Structure and Exchange Rate Pass-Through
Robustness

Are our results driven by specific sectors or countries?
Robustness

USD versus TPC Pass-Through Rates at the Sectoral Level

Estimated TPC Pass-Through vs. Estimate USD Pass-Through

Market Structure and Exchange Rate Pass-Through
Robustness

Pass-Through of USD and TPC Movements for Two Selected Industries

Estimated Pass-Through vs. Horizon in Months

Market Structure and Exchange Rate Pass-Through
## Robustness

**Table: Trade-Partner and USD Exchange Rate Pass-Through by Country**

<table>
<thead>
<tr>
<th>Country/Horizon</th>
<th>6 months</th>
<th>12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>0.16</td>
<td>0.32</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.1</td>
<td>0.18</td>
</tr>
<tr>
<td>Norway</td>
<td>0.16</td>
<td>0.2</td>
</tr>
<tr>
<td>Finland</td>
<td>0.07</td>
<td>0.13</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.18</td>
<td>0.23</td>
</tr>
<tr>
<td>UK</td>
<td>0.04</td>
<td>-0.44</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.01</td>
<td>0.16</td>
</tr>
<tr>
<td>Netherlands</td>
<td>-0.04</td>
<td>0.14</td>
</tr>
<tr>
<td>New Zealand</td>
<td>0.21</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>0.24</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>0.25</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Market Structure and Exchange Rate Pass-Through
Trade-Partner Currency vs USD Movements

**Result:**

Much larger estimated PT for global USD movements than TPC or nominal exchange rate movements

⇒ Consistent with price complementarities: if USD moves, relative price moves for all importers, so large PT

⇒ Consistent with important role of market power

⇒ Next, we use the cross-section of sectors to discern this view from alternative ones, for example large/persistent USD shocks, i.i.d. TPC shocks.
Pass-Through and Market Share

Part II

If price complementarities matter, shouldn’t PT vary with market share?
Pass-Through and Market Share

Two questions:

▶ Does PT following USD movements depend on the general openness (i.e. the import share) of the sector?
▶ Does TP following TPC movements depend on the import share of the trade partner in the sector?
Pass-Through and Market Share

Relate pass-through to market power directly by estimating:

$$\Delta p_{k,c,t} = \alpha_c + \sum_{j=0}^{n} \beta_j \Delta e_{c,t-j} + \sum_{j=0}^{n} \theta_j \Delta e_{c,t-j} \ast s_{k,c} + \gamma s_{k,c} + \epsilon_{k,c,t}$$

(4)

where have

- $e_{c,t}$ exchange rate measure
- $s_{k,c}$ measure of market share (of country $c$) in sector $k$
- Sectors defined at HS and NAICS six-digit level

Pass-through due to market power: $\theta(n) = \sum_{j=0}^{n} \theta_j$
Pass-Through and Market Share

Does a USD movement generate pass-through because it affects the market environment?

Market share measure - sectoral import penetration:

\[ 1 - m_{US,k} = 1 - \frac{Domestic\ Shipments_k}{Domestic\ Shipments_k + World\ Imports_k} \]

Exchange rate: USD movements
Pass-Through and Market Share

Sectoral Import Penetration and Pass-Through of USD Movements

Estimated Average Pass-Through

Horizon (Months)

-5% 5% 15% 25% 35% 45% 55% 65% 75% 85%

- Pass-Through in Market with 100% Penetration
- Pass-Through in Market with Mean Penetration
- Pass-Through in Market with 0% Penetration
Pass-Through and Market Share

Does a TPC movement depend on the import market share of the importer?

Market share measure - sectoral importer market share:

\[ m_{c,k} = \frac{\text{Imports}_{c,k}}{\text{World Imports}_k} \]

Exchange rate: TPC movements
Pass-Through and Market Share

Sectoral TP Import Share and TPC Pass-Through

Estimated Average Pass-Through

- Pass-Through of TP with 0% Import Share
- Pass-Through of TP with Mean Import Share
- Pass-Through of TP with 100% Import Share
Pass-Through and Market Share

**Result:**

⇒ Important role of market power for PT:
  ▶ Total import penetration
  ▶ Import market share

⇒ “Mass” of firms affected by the same shocks matters for PT.
  ▶ Next, we dig deeper into how the precise market structure matters for PT.
Model

Part III

Theory: Model and Estimation Exercise

Can a simple model of oligopoly pricing explain USD, TPC PT and how PT co-varies with market share?
Model

- Continuum of competitive firms producing final output

\[ c = \left( \int_0^1 y_k^{(1-1)/\eta} \, dk \right)^{\eta/(\eta-1)} \]

- \( N \) monopolists producing inputs

\[ y_k = \left( \sum_{n=1}^{N} q_{n,k}^{(\rho-1)/\rho} \right)^{\rho/(\rho-1)} \]

- Firms maximize profits subject to constant \( MC = \omega_{n,k} \)
- Closer substitutes within than across sectors: \( \rho > \eta \)
Mechanics of the Model

▶ A tiny firm $s_{n,k} \approx 0$ faces demand elasticity $\rho$, a monopolist $s_{n,k} = 1$ faces demand elasticity $\eta$

▶ With $s_{n,k} \in ]0, 1[$ demand elasticity is variable. It:
  ▶ Decreases in own cost/exrate
  ▶ Increases in the cost/exrate of other firms

▶ Of course, all prices react to all exchange rates. We next calculate the equilibrium effect of the exchange rate.
Model

Pricing:

$$P_{n,k} = \frac{\varepsilon(s_{n,k})}{\varepsilon(s_{n,k}) - 1} \omega_{n,k}$$

$$\varepsilon(s) = \left[ \frac{1}{\rho} (1 - s_{n,k}) + \frac{1}{\eta} s_{n,k} \right]^{-1}$$

Log-linearized:

$$\hat{P}_{n,k} = \Gamma(s_{n,k}) \hat{s}_{n,k} + \hat{w}_{n,k}$$

$$\hat{s}_{n,k} = (\rho - 1) \left( \hat{P}_k - \hat{P}_{n,k} \right)$$
Model

Pass-through depends on:

1. price complementarities: mass of firms co-moving with a country
2. precise distribution of firm sizes

Solve for equilibrium price and PT in two cases:

- all firms of equal size
- allowing for heterogenous firm size
Equilibrium price effect:

\[ \hat{P}_{n,k} = \gamma_{n,k} \left( \sum_{j \in N_k, TP} S_j \alpha_{n,k} \hat{w}_{n,k} \right) \left( 1 - \sum_{j \in N_k} S_j \gamma_{n,k} \right) + \alpha_{n,k} \hat{w}_{n,k} \]  

Equilibrium Effect on \( P_k \)’s response to \( P_k \)'s direct response to \( w_{n,k} \)

Market structure works through four channels:

- a direct cost effect, sensitivity \( \alpha_{n,k} \) depending on market share
- the total impact of TP-firms on the general price level
- second-round amplification by all firms in the industry
- reaction to aggregate price level effect at rate of \( \gamma_{n,k} \) depending on firm market share
Model: Equal-Sized Firms

Solve generalized formula for PT following TPC movement:

- Equal-sized firms: $\gamma_{n,k} = \bar{\gamma}$, $\alpha_{n,k} = \bar{\alpha}$.
- Assume $w_{USD} = 0$, $w_{TPC} \neq 0$. Normalize $w_{US} = 0$.
- Then, $\hat{P}_{TPC} = \bar{\gamma} \frac{1}{1 - \gamma} n_{TP} \bar{\alpha} \hat{w}_{TPC} + \bar{\alpha} \hat{w}_{TPC}$

| Effect of TPC on $\hat{P}_k$ | Direct Cost Effect |

- PT depends on market position of TP.
Model: Equal-Sized Firms

Solve generalized formula for PT following USD movement:

- Assume $w_{USD} \neq 0$, $w_{TPC} = 0$.
- Then,

$$\hat{P}_{USD} = \gamma \frac{1}{1 - \gamma} (n_{ROW} + n_{TP}) \bar{\alpha} \hat{w}_{USD} + \underbrace{\bar{\alpha} \hat{w}_{USD}}_{Direct\,Cost\,Effect}$$

- Effect of USD on $\hat{P}_k$

PT depends on degree of import penetration.
Model Proposition

Key implications:

- USD PT > TP PT as $n_{ROW} > 0$
- USD PT increasing in import penetration
- TPC PT increasing in TP market share
- Precise distribution of firm sizes matters
Model Estimation

Map model directly back to data:

- Can we match observed price changes with the calibrated model?
- How important are our findings economically? Can we explain pass-through differences across countries?
Model Estimation

Horizon in Months

Coefficient on Predicted Price Change

Upper Bound 95% C.I.

Lower Bound 95% C.I.
Can we qualitatively match actual pass through rates?

- Use model to predict PT at the three-digit NAICS level for each trade partner.
- Compare to actual, estimated PT.
- Significant, positive association?
- Regression slope of 1 and a constant of 0?
Model Estimation II: PT Rates

![Graph showing the relationship between estimated and predicted sectoral PT rates.](image-url)
Can we match PT rates?

- Aggregate to country level.
- Compare actual and estimated PT.
- Two tests:
  - Hard one: regression slope of 1 and a constant of 0?
  - Realistic One: how much of the variation in PT rates across countries and industries can we explain?
The $R^2$ of the volume weighted regression (red line) is 47%! 

Model Estimation II: PT Rates

Market Structure and Exchange Rate Pass-Through
Conclusion

Conclusion: Important role of market Structure for Pricing

- Pass-through for global USD movements larger than TPC or nominal exchange rate movements. Two to three times as large at long horizons.
- Oligopoly model of pricing can explain USD, TPC PT.
- Implications for modeling: nominal vs. real rigidities, PTM, decomposing the exchange rate
- Implications for policy-makers: US import inflation, TPC shocks