Industry Heterogeneity and Exchange Rate Pass-Through

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Summary

Goal: Estimate ERPT by industry, evaluating the role of:

- Imported intermediate inputs
- Strategic complementarities

Methodology:

- Unit values from customs data to measure ERPT
- Imported inputs share from industrial census
- De Loecker and Warzynski to estimate markups

Findings:

- Large differences in imported intermediate input share
- Smaller differences in markup variability
- Low correlation with ERPT
Theoretical framework: Export prices

Assumptions:

- Price in sector $k$: $p_{C_i}^k = \mu_{C_i}^k + mc_C^k$
- $mc_C^k = [1 - \alpha^k] w_C + \alpha^k \sum_{l=C, i, j} \gamma_l^k p_{ln} + e_l$
- Wages, productivities and foreign prices are constant

CDGG '17: $\Delta p_{C_i}^k = \frac{1}{1+\Gamma^k} \left[ \frac{\alpha^k \gamma_i^k}{1-\alpha^k \gamma_H^k} + \Gamma^k \right] \Delta e_i + \frac{1}{1+\Gamma^k} \frac{\alpha^k \gamma_j^k}{1-\alpha^k \gamma_H^k} \Delta e_j$

- $\Gamma^k \equiv \frac{\partial \mu_{ni}^k}{\partial [p_{ni}^k + e_n - p_i^k]}$: ‘markup elasticity’

If $\Delta e_i = \Delta e_j$: $\frac{\Delta p_{C_i}^k}{\Delta e} = 1 - \frac{1}{1+\Gamma^k} \frac{1-\alpha^k}{1-\alpha^k \gamma_H^k}$

- $\frac{\Delta p_{C_i}^k}{\Delta e} = 0$ when $\Gamma^k = 0$ & $\gamma_H^k = 1$
- Decreases with $\gamma_H^k$, increases with $\Gamma^k$
Theoretical framework: Export prices

Assumptions:

- Price in sector $k$: $p_{Ci}^k = \mu_{Ci}^k + mc_C^k$
- $mc_C^k = [1 - \alpha^k] w_C + \alpha^k \sum_{l=C,i,j} [\gamma_l^k p_{ln} + e_l]$
- Wages, productivities and foreign prices are constant

CDGG '17: $\Delta p_{Ci}^k = \frac{1}{1+\Gamma^k} \left[ \frac{\alpha^k \gamma_i^k}{1-\alpha^k \gamma_H^k} + \Gamma^k \right] \Delta e_i + \frac{1}{1+\Gamma^k} \frac{\alpha^k \gamma_i^k}{1-\alpha^k \gamma_H^k} \Delta e_j$

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Theoretical framework: Export prices

Assumptions:
- Price in sector $k$: $p^k_{Ci} = \mu^k_{Ci} + mc^k_C$
- $mc^k_C = [1 - \alpha^k] w_C + \alpha^k \sum_i \gamma^k_i p_{ln} + e_l$
- Wages, productivities and foreign prices are constant

CDGG '17: $\Delta p^k_{Ci} = \frac{1}{1 + \Gamma^k} \left[ \frac{\alpha^k \gamma^k_i}{1 - \alpha^k \gamma^k_H} + \Gamma^k \right] \Delta e_i + \frac{1}{1 + \Gamma^k} \frac{\alpha^k \gamma^k_i}{1 - \alpha^k \gamma^k_H} \Delta e_j$

- $\Gamma^k \equiv \frac{\partial \mu^k_{ni}}{\partial [p^k_{ni} + e_n - p^k_i]}$: ‘markup elasticity’

If $\Delta e_i = \Delta e_j$: $\frac{\Delta p^k_{Ci}}{\Delta e} = 1 - \frac{1}{1 + \Gamma^k} \frac{1 - \alpha^k}{1 - \alpha^k \gamma^k_H}$

- $\frac{\Delta p^k_{Ci}}{\Delta e} = 0$ when $\Gamma^k = 0$ & $\gamma^k_H = 1$
- Decreases with $\gamma^k_H$, increases with $\Gamma^k$
Comment I: Taking model to the data

- If $\Delta e_i = \Delta e$: 
  $$\frac{\Delta p^k_{Ci}}{\Delta e} = 1 - \frac{1}{1+\Gamma^k} \frac{1-\alpha^k}{1-\alpha^k \gamma^k_H}$$
  - Decreases with $\gamma^k_H$. Increases with $\Gamma^k$

- In the data: $\Delta e_i \neq \Delta e_j$. Empirical implementation:
  $$\Delta p^k_{Ci,t} = \beta_i \Delta e_{i,t} + \beta_j \Delta e_{j,t} + \varepsilon_{i,t}$$

  - $\beta_i = \frac{1}{1+\Gamma^k} \left[ \frac{\alpha^k \gamma^k_i}{1-\alpha^k \gamma^k_H} + \Gamma^k \right]$
    - Increases with $\gamma^k_H$ (keeping $\gamma^k_i$ constant). Increases with $\Gamma^k$
  
  - $\beta_j = \frac{1}{1+\Gamma^k} \frac{\alpha^k \gamma^k_j}{1-\alpha^k \gamma^k_H}$
    - Increases with $\gamma^k_H$ (keeping $\gamma^k_j$ constant). Decreases with $\Gamma^k$!
Comment I: Taking model to the data

- If $\Delta e_i = \Delta e$: 
  \[
  \frac{\Delta p^k_{Ci}}{\Delta e} = 1 - \frac{1}{1+\Gamma^k} \frac{1-\alpha^k}{1-\alpha^k \gamma^k_H}
  \]
  - Decreases with $\gamma^k_H$. Increases with $\Gamma^k$

- In the data: $\Delta e_i \neq \Delta e_j$. Empirical implementation:
  \[
  \Delta p^k_{Ci, t} = \beta_i \Delta e_{i, t} + \beta_j \Delta e_{j, t} + \varepsilon_{i, t}
  \]

- $\beta_i = \frac{1}{1+\Gamma^k} \left[ \frac{\alpha^k \gamma^k_i}{1-\alpha^k \gamma^k_H} + \Gamma^k \right]$
  - Increases with $\gamma^k_H$ (keeping $\gamma^k_i$ constant). Increases with $\Gamma^k$

- $\beta_j = \frac{1}{1+\Gamma^k} \frac{\alpha^k \gamma^k_j}{1-\alpha^k \gamma^k_H}$
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- In the data: $\Delta e_i \neq \Delta e_j$. Empirical implementation:
  
  $$\Delta p_{Ci,t}^k = \beta_i \Delta e_{i,t} + \beta_j \Delta e_{j,t} + \epsilon_{i,t}$$

  - $\beta_i = \frac{1}{1+\Gamma^k} \left[ \frac{\alpha^k \gamma_i^k}{1-\alpha^k \gamma_H^k} + \Gamma^k \right]$
    - Increases with $\gamma_H^k$ (keeping $\gamma_i^k$ constant). Increases with $\Gamma^k$

  - $\beta_j = \frac{1}{1+\Gamma^k} \frac{\alpha^k \gamma_j^k}{1-\alpha^k \gamma_H^k}$
    - Increases with $\gamma_H^k$ (keeping $\gamma_j^k$ constant). Decreases with $\Gamma^k$!
Import prices

- If $\Delta e_i = \Delta e$:
  \[
  \frac{\Delta p_i^k}{\Delta e} = \frac{1}{1+\Gamma^k} + \frac{\Gamma^k}{1+\Gamma^k} \frac{1-\gamma_H^k}{1-\alpha^k \gamma_H^k}
  \]
  - $\frac{\Delta p_i^k}{\Delta e} = 1$ if $\Gamma^k = 0$
  - Increases with $\gamma_H^k$ (if $\Gamma^k > 0$), Decreases with $\Gamma^k$

- If $\Delta e_i \neq \Delta e_j$:
  \[
  \Delta p_i^k = \beta_i \Delta e_i + \beta_j \Delta e_j
  \]

- $\beta_i = \frac{1}{1+\Gamma^k} \left[ 1 + \frac{\gamma_i^k \Gamma^k}{1-\alpha^k \gamma_H^k} \right]$
  - Increases with $\gamma_H^k$ (keeping $\gamma_i^k$ constant), Decreases with $\Gamma^k$

- $\beta_j = \frac{\Gamma^k}{1+\Gamma^k} \frac{\gamma_i^k}{1-\alpha^k \gamma_H^k}$
  - Increases with $\gamma_H^k$, Increases with $\Gamma^k$
Comment II: Measuring imported input shares

- Paper measures $1 - \gamma_{H}^k$
  - but $\gamma_i^k$ and $\gamma_j^k$ enter separately in the model
  - **Suggestion:** link import data to recover $\gamma_i^k$ and $\gamma_j^k$?

- $\alpha^k$ can also vary across sectors
  - **Suggestion:** measure from the Industrial survey
Comment III: Measuring complementarities

- Paper measures markups by industry, computes CV across years
  - Larger CV may reflect more variable markups, or larger shocks
  - Hard to map to $\Gamma^k$

- A more direct approach:
  \[
p_{Ci,t}^k = \mu_{Ci,t}^k \left( p_{Ci,t}^k + e_{i,t} - p_{i,t} \right) + mc_{n,t}^k
  \]
  \[
  \Delta p_{Ci,t}^k = \frac{-\Gamma^k}{1 + \Gamma^k} \Delta e_{i,t} + \frac{1}{1 + \Gamma^k} \Delta mc_{n,t}^k
  \]

- Estimate: $\Delta p_{Ci,t}^k = \beta_i \Delta e_{i,t} + \frac{1}{1 + \Gamma^k} \Delta mc_{n,t}^k$
  - Control for $\Delta mc_{n,t}^k$ with firm FE (so that $\Delta e_{i,t}$ won’t matter)
  - Assumption: $\Delta mc_{n,t}^k$ common across destinations
Comment III: Measuring complementarities

- Paper measures markups by industry, computes CV across years
  - Larger CV may reflect more variable markups, or larger shocks
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- A more direct approach:

$$p^{k}_{Ci,t} = \mu^{k}_{Ci,t} \left( p^{k}_{Ci,t} + e^{i,t} - p^{i,t} \right) + mc^{k}_{n,t}$$

$$\Delta p^{k}_{Ci,t} = \frac{-\Gamma^{k}}{1+\Gamma^{k}} \Delta e^{i,t} + \frac{1}{1+\Gamma^{k}} \Delta mc^{k}_{n,t}$$

- Estimate: $\Delta p^{k}_{Ci,t} = \beta_{i} \Delta e^{i,t} + \frac{1}{1+\Gamma^{k}} \Delta mc^{k}_{n,t}$
  - Control for $\Delta mc^{k}_{n}$ with firm FE (so that $\Delta e_{j}$ won’t matter)
  - Assumption: $\Delta mc^{k}_{n}$ common across destinations
Summary

- Interesting paper with lots of potential
  - Impressive data work, linking customs with industrial surveys
  - Provides

- Main comments:
  - Tighten relation between theory and model
  - Alternative measurement of import shares and complementarities