Dominant Currencies
How firms choose currency invoicing and why it matters

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Preliminary and Incomplete

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Motivation

• Currency use in international trade is central for
  1. international transmission of shocks
  2. optimal monetary (exchange rate) policy

• Accumulated evidence in favor of endogenous currency choice
  — active firm-level decision
  — slow changes in the roles of individual currencies over time

• Dominant currencies: US dollar and Euro
  — welfare benefits?
  — macroeconomic consequences of a switch from dollar to euro

• Unique role of Belgian data:
  — detailed micro-level data suitable for firm-level analysis
  — substantial variation in currency use in the cross-section
Main Findings

1. Little role for PCP in imports / DCP in exports (ex-EU trade)

2. Instead, two dominant currencies:
   - regional Euro: dominates by count of (smaller) transactions
   - global US dollar: dominates by value of trade

3. Substantial variation in currency use within country × sectors. Firm-level characteristics key determinants of currency choice — import intensity, in particular in foreign currency — size of the firm — currency choice by competitors (strategic complementarities)

4. Currency choice feeds back into the dynamics of ERPT, and still matters at an annual horizon

5. This patterns are consistent with a sticky-price model of currency choice
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   - size of the firm
   - currency choice by competitors (strategic complementarities)

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5. This patterns are consistent with a sticky-price model of currency choice
Related Literature

1. Theory of currency choice and ERPT
   - Engel (2006)
   - Gopinath, Itskhoki and Rigobon (2010)
   - Mukhin (2018)

2. Firm-level analysis of exchange rate pass-through
   - Berman, Martin and Mayer (2012)

3. Empirical analysis of currency choice and dominant currencies
   - Goldberg and Tille (2008, 2016)
   - Gopinath and Rigobon (2008), Gopinath (2016)
   - Boz, Gopinath and Plagborg-Møller (2018)
THEORETICAL FRAMEWORK
Model Environment

• Consider a problem of a Belgian exporter \( i \) serving a given industry \( s \) in foreign country \( k \)

• Denote with \( e = e_k \) the log euro exchange rate with country \( k \); an increase in \( e \) corresponds to a depreciation of the euro

• The desired export price of the firm in foreign currency is:

\[
\tilde{p}_i^* = \arg \max \Pi_i(p_i^*|\Omega)
\]

— \( \Pi_i(\cdot) \) is profit (surplus) function
— state vector \( \Omega \) includes exogenous states (e.g., productivity), endogenous shocks (e.g., exchange rate) and competitor prices

• Desired price can be converted to euro or any currency \( \ell \):

\[
\tilde{p}_i = \tilde{p}_i^* + e, \\
\tilde{p}_i^\ell = \tilde{p}_i^* + e - e_\ell
\]
Desired Pass-through

- Desired markup:

\[ \tilde{p}_i = \tilde{\mu}_i + mc_i \]

- Price change decomposition (following AIK 2018):

\[ d\tilde{p}_i = \frac{1}{1 + \Gamma_i} dmc_i + \frac{\Gamma_i}{1 + \Gamma_i} (dz_k^* + de) + \varepsilon_i \]

- \( z_k^* \) is the competitor price index in destination market \( k \)
- \( \Gamma_i \equiv -\partial \tilde{\mu}_i / \partial p_i \) is the elasticity of the desired markup, increasing in the firm’s market share, \( \Gamma_i = \Gamma(S_i) \)
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- Desired exchange rate pass-through (ERPT):
  \[ \tilde{\psi}_i \equiv \mathbb{E} \frac{d\tilde{p}_i}{de} = \frac{1}{1 + \Gamma_i} \varphi_i + \frac{\Gamma_i}{1 + \Gamma_i} (1 - \Psi_k^*) \]
  - \( \varphi_i = dmc_i / de \) is the cost exposure to the exchange rate
  - \( \Psi_k^* \equiv -dz_k^* / de \) is the ERPT into the industry price
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  \tilde{\psi}_i \equiv \mathbb{E} \frac{d\tilde{p}_i}{de} = \varphi_i + \frac{\Gamma_i}{1 + \Gamma_i} [(1 - \psi_k^*) - \varphi_i]
  \]
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Prices Stickiness

- Prices are set before the uncertainty in $\Omega$ is realized. Specifically, in currency $\ell$ the preset price is:

$$\bar{p}_i^\ell = \arg\max_{\bar{p}_i^\ell} E \Pi_i(\bar{p}_i^\ell + e_\ell - e|\Omega)$$

- Ex post, firm can reset price with a Calvo probability $\theta$ ($\theta$ is increasing with time interval)
  
  — Gopinath, Itskhoki & Rigobon (2010) study a dynamic environment
  — Gopinath & Itskhoki (2010) study state-contingent price adjustment
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• Lemma 1 (Preset Prices) Normalize $\mathbb{E}e = \mathbb{E}e_\ell = 0$. Then the following certainty equivalence holds up to first order:

$$\bar{p}_i = \bar{p}_i^* = \bar{p}_i^\ell = \mathbb{E}\{\tilde{p}_i^\ell + e_\ell - e\} = \mathbb{E}\tilde{p}_i^*$$ for any currency $\ell$. 
Currency Choice

- Optimal currency choice $\ell$ for the preset prices solves:

$$
\ell = \arg \max_{\ell} \left\{ \max_{p_i} \mathbb{E} \prod_i (\bar{p}_i^\ell + e_\ell - e|\Omega) \right\}
$$
Currency Choice

- Optimal currency choice $\ell$ for the preset prices solves:

$$\ell = \arg \max_{\ell} \left\{ \max_{\ell} \mathbb{E} \prod_i (\bar{p}_i^\ell + e_\ell - e|\Omega) \right\}$$

- **Lemma 2 (Currency Choice)** *The optimal currency choice is second-order equivalent to:*

$$\ell = \arg \min_{\ell} \left\{ \text{var}(\tilde{p}_i^\ell) \right\} = \arg \min_{\ell} \left\{ \text{var}(\tilde{p}_i^* + e - e_\ell) \right\}.$$  

- the optimal currency $\ell$ ensures minimal variation in $\tilde{p}_i^\ell$. 

— PCP $\succ$ LCP: $\text{var}(\tilde{p}_i^\ell) < \text{var}(\tilde{p}_i^* + e - e_\ell) \iff \text{cov}(\tilde{p}_i^\ell, e) \text{var}(e) < \frac{1}{2}$
Currency Choice

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— the optimal currency $\ell$ ensures minimal variation in $\tilde{p}_i^\ell$

— e.g., if $\tilde{\psi}_i = \partial \tilde{p}_i / \partial e \approx 0$, then PCP $\tilde{p}_i$ is optimal
Currency Choice

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  - the optimal currency $\ell$ ensures minimal variation in $\tilde{p}_i^\ell$
  - e.g., if $\tilde{\psi}_i = \partial \tilde{p}_i / \partial e \approx 0$, then PCP $\tilde{p}_i$ is optimal
  - PCP $>\text{LCP}$: $\text{var}(\tilde{p}_i) < \text{var}(\tilde{p}_i^*) = \text{var}(\tilde{p}_i - e) \iff \frac{\text{cov}(\tilde{p}_i,e)}{\text{var}(e)} < \frac{1}{2}$
Currency choice:

\[ \nu_i = \begin{cases} 
0 \text{ (PCP),} & \text{if } \tilde{\psi}_i \approx 0 \\
1 \text{ (LCP or DCP),} & \text{otherwise, i.e. if } \tilde{\psi}_i \gg 0
\end{cases} \]

and recall desired pass-through

\[ \tilde{\psi}_i = \varphi_i + \frac{\Gamma_i}{1+\Gamma_i} [(1 - \Psi^*_k) - \varphi_i] \]

Estimating Equation I
Currency choice
Estimating Equation I

Currency choice

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\]

- Estimating equation:

\[
P_{\{\nu_i = 1\}} = \alpha_{sk} + \beta \varphi_i + \gamma S_i + \delta \tilde{\nu}_i
\] (*)

- Euro (PCP) less likely for import-intensive firms (high \(\varphi_i\)) and large exporters (high \(S_i\))

- Euro is less likely in industries with few firms choosing euro (high \(\tilde{\nu}_i\)) — strategic complementarities in currency choice
Exchange rate pass-through:

\[ \psi_i = \mathbb{E} \frac{\partial p_i}{\partial e} = (1 - \theta) \cdot \nu_i \chi_i + \theta \cdot \tilde{\psi}_i, \]

where \( \chi_i = 1 \) for LCP and \( \chi_i \in [0, 1] \) for DCP.
Estimating Equation II
Exchange rate pass-through

• Exchange rate pass-through:

\[ \psi_i = \mathbb{E} \left( \frac{\partial p_i}{\partial e} \right) = (1 - \theta) \cdot \nu_i \chi_i + \theta \cdot \tilde{\psi}_i, \]

where \( \chi_i = 1 \) for LCP and \( \chi_i \in [0, 1] \) for DCP

• Estimating equation for ERPT (augmenting AIK 2014):

\[ \mathbb{E} \Delta p_i \approx a_{sk} + \left[ b \varphi_i + c S_i + d \nu_i \right] \Delta e \quad (**) \]

— ERPT into foreign-currency prices is low for large (high \( S_i \)) and import-intensive (high \( \varphi_i \)) exporters

— ERPT is low for non-PCP (euro) firms, particularly in short run (\( d \) decreases with time horizon)
DATA
Dataset

We merge 3 micro-level datasets on Belgian firms:

1. **NBB and Customs**: New data on currency choice of Belgian firms at the firm-product-country-month level for both imports and exports from February 2017 to March 2018
   - CN 8-digit level (over 10,000 products)
   - Only extra-EU trade. We focus on 11 OECD countries.

2. **Customs**: Import and export data on values and quantities at firm-product-country level
   - Annual data from 2012 to 2017

3. **VAT**: firm-level data on firm characteristics
   - Includes material costs, wagebill and employment

Baseline industry definition: NACE 4-digit level
Key Variables

- **Currency use**: \( \nu_{ikt} = 0 \) for Euro and \( \nu_{ikt} = 1 \) for non-Euro, by firm-industry-destination-time

- **Export price change**: in euros by firm-product-destination-time

\[
\Delta p_{ikt} = \Delta \log \frac{\text{Export Value}_{ikt}}{\text{Export Quantity}_{ikt}}
\]

- **Import intensity**: at the firm-year level

\[
\varphi_{it} \equiv \frac{\text{Total non-EU import value}_{it}}{\text{Total variable costs}_{it}}
\]

— and further split by currency (Euro vs non-Euro):

\[
\varphi_{it} = \varphi_{it}^E + \varphi_{it}^X
\]

- **Firm size**: market share \( S_{ikt} \) and \( \log \text{Employment}_{it} \)
STYLIZED FACTS
## Currency Use in Trade
### Outside EU

<table>
<thead>
<tr>
<th></th>
<th>Exports</th>
<th>Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count share</td>
<td>Value share</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>Diff</td>
</tr>
<tr>
<td>Euro</td>
<td>0.691</td>
<td>0.388</td>
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<tr>
<td>Dollar</td>
<td>0.207</td>
<td>0.475</td>
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<tr>
<td>Other</td>
<td>0.102</td>
<td>0.137</td>
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</table>

1. **Euro and US dollar dominate trade flows**
   - PCP is uncommon for imports and LCP uncommon for exports
   - some presence of LCP in exports for differentiated goods

2. **Euro is dominant by count vs Dollar dominates by value**
   - even though US accounts for less than 5% of Belgian exports
   - smaller transaction are predominantly priced in Euros
Euro and US Dollar
Imports vs exports

(a) Euro

(b) Dollar
Dominant Currencies

(a) Imports

(b) Exports
### Variance Decomposition

**Currency choice in exports**

<table>
<thead>
<tr>
<th>Dep.var.: $i_{ikt}$</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<tr>
<td>Adjusted $R^2$</td>
<td>0.126</td>
<td>0.386</td>
<td>0.461</td>
<td>0.539</td>
<td>0.563</td>
<td>0.681</td>
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</table>

**Fixed effects:**
- country ✓ ✓ ✓ ✓ ✓ ✓
- HS-4 industry ✓
- HS-8 industry ✓
- country×HS-4 ✓ ✓ ✓
- firm ✓ ✓ ✓

---

Value-weighted projections of $i_{ikt}$ on different sets of fixed effects

- Almost *no* variation in currency choice over time, at the level of the firm-product-destination
- Firm fixed effects are key determinants of currency choice
EMPIRICAL RESULTS
## Currency Choice

Linear probability regressions

<table>
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<tr>
<th>Dep. var.: $P{i_{ikt} = 1}$</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\varphi_i$</td>
<td>0.403**</td>
<td>0.275**</td>
<td>0.239*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.187)</td>
<td>(0.130)</td>
<td>(0.140)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\varphi_i^E$</td>
<td></td>
<td>0.222</td>
<td>0.161</td>
<td>0.110</td>
<td>0.186</td>
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<tr>
<td></td>
<td></td>
<td>(0.282)</td>
<td>(0.193)</td>
<td>(0.206)</td>
<td>(0.280)</td>
<td></td>
<td></td>
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<tr>
<td>$\varphi_i^X$</td>
<td></td>
<td>0.637***</td>
<td>0.419***</td>
<td>0.398***</td>
<td>0.565***</td>
<td></td>
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<td></td>
<td></td>
<td>(0.165)</td>
<td>(0.130)</td>
<td>(0.142)</td>
<td>(0.171)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\log Empl_i$</td>
<td>0.098***</td>
<td>0.085***</td>
<td>0.085***</td>
<td>0.099***</td>
<td>0.086***</td>
<td>0.086***</td>
<td>0.100***</td>
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<tr>
<td></td>
<td>(0.030)</td>
<td>(0.017)</td>
<td>(0.019)</td>
<td>(0.029)</td>
<td>(0.017)</td>
<td>(0.019)</td>
<td>(0.029)</td>
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<tr>
<td>$\bar{\varphi}_{ikt}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.119***</td>
<td></td>
</tr>
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<td>(0.024)</td>
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<td>137,988</td>
<td>139,109</td>
<td>138,341</td>
<td>138,185</td>
<td>125,327</td>
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<tr>
<td>R²</td>
<td>0.259</td>
<td>0.440</td>
<td>0.495</td>
<td>0.263</td>
<td>0.441</td>
<td>0.496</td>
<td>0.275</td>
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</tbody>
</table>

Fixed Effects:
- year ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
- country ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
- HS8 ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
- country×HS4 ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓

- Variation in $\varphi_i$ or $\varphi_i^X$ explains an 18p.p. variation in prop currency choice
- Variation in size (employment) explains up to 50p.p. variation
## Exchange rate pass-through

<table>
<thead>
<tr>
<th>Dep. var.: $\Delta p_{ikt}$</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta e_{kt}$</td>
<td>0.002</td>
<td>-0.044</td>
<td>-0.048</td>
<td>0.001</td>
<td>-0.048</td>
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<tr>
<td></td>
<td>(0.031)</td>
<td>(0.030)</td>
<td>(0.032)</td>
<td>(0.032)</td>
<td>(0.032)</td>
</tr>
<tr>
<td>$\Delta e_{kt} \cdot \varphi_i$</td>
<td>0.609***</td>
<td>0.366**</td>
<td>0.350**</td>
<td>0.609***</td>
<td>0.366**</td>
</tr>
<tr>
<td></td>
<td>(0.187)</td>
<td>(0.163)</td>
<td>(0.161)</td>
<td>(0.187)</td>
<td>(0.163)</td>
</tr>
<tr>
<td>$\Delta e_{kt} \cdot \varphi^E_i$</td>
<td>0.332</td>
<td>0.144</td>
<td>0.144</td>
<td>0.332</td>
<td>0.144</td>
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<tr>
<td></td>
<td>(0.266)</td>
<td>(0.274)</td>
<td>(0.274)</td>
<td>(0.266)</td>
<td>(0.274)</td>
</tr>
<tr>
<td>$\Delta e_{kt} \cdot \varphi^X_i$</td>
<td>0.846***</td>
<td>0.534***</td>
<td>0.534***</td>
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<td>0.534***</td>
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<tr>
<td></td>
<td>(0.253)</td>
<td>(0.192)</td>
<td>(0.192)</td>
<td>(0.253)</td>
<td>(0.192)</td>
</tr>
<tr>
<td>$\Delta e_{kt} \cdot S_{ik}$</td>
<td>0.110*</td>
<td>0.098</td>
<td>0.094</td>
<td>0.110*</td>
<td>0.094</td>
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<tr>
<td></td>
<td>(0.058)</td>
<td>(0.059)</td>
<td>(0.059)</td>
<td>(0.059)</td>
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<tr>
<td>$\Delta e_{kt} \cdot \iota_{ikt}$</td>
<td>0.264***</td>
<td>0.295***</td>
<td>0.291***</td>
<td>0.264***</td>
<td>0.295***</td>
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<tr>
<td></td>
<td>(0.046)</td>
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<td># obs.</td>
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<td>73,514</td>
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<tr>
<td>R²</td>
<td>0.063</td>
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<td>Year F.E.</td>
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<td>✓</td>
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<tr>
<td>Country×HS4 F.E.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Dynamics of ERPT
by currency of invoicing

Regression horizon, months

-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
1.2

LCP
DCP
PCP

Value-weighted projection coefficients of $\Delta p_{ikt}$ on $\Delta e_{kt}$ at different time horizons by bins of currency choice
SUMMARY
Summary and Future Work

• Two dominant currencies: global US dollar and regional Euro

• Currency choice is shaped by firm-level characteristics, which determine desired ERPT

• Currency choice feeds back into the dynamics of ERPT, and still matters at an annual horizon

• There are strategic complementarities in currency choice, which may lead to multiple equilibria and persistence

• Consistent with sticky-price model of currency choice

• Effects of a shift in currency use away from the US dollar?