Product Introductions, Currency Unions, and the Real Exchange Rate

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MIT          University of Chicago        MIT

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Motivation

- Classic theories of the real exchange rate (RER) assume traded goods adhere to the “Law of One Price” (LOP)

- Big literature shows LOP fails among traded goods (Engel 1999; Crucini et al. 2005; Gopinath et al. AER 2011)

- Understanding international relative prices matters for behavior of RER shocks
What We Do

1. Introduce large dataset of identical tradeable goods, sold by global retailers in three industries and dozens of countries.

2. LOP generally holds within Currency Unions, fails otherwise (including pegged regimes).

3. New decomposition shows RER at time of introduction is most important component of RER and moves closely with NER.
Price Data from Four Global Retailers

• Apple, IKEA, Zara, and H&M

• Among the largest global retailers (by sales) in technology, furniture, and apparel industries

• Headquartered in different countries, not jointly owned or related.

• Prices “scraped” off the retailer websites
How Does “Scraping” Work?

- Automatically detects product introductions
Online Prices

- Weekly prices for ~ 90K goods in 81 countries, from 2008 to 2012 (countries and time period vary for each retailer).

- Match identical products using retailer-specific id codes (larger overlap than UPCs, many countries).

- No price dispersion within-countries. Single retailer for each good.

- Prices include VAT taxes (US/Can are exceptions). Not within-country shipping costs. No info on quantities sold.

- Online and offline prices are identical. Confirmed with customer service and doing physical checks in each of these stores.
Online Prices Equal Offline Prices

(a) IKEA Online

(b) IKEA in Store
Good-level RER Definition

- \( p_i(z, t) \) is log price of \( z \) in country \( i \) in week \( t \)
- \( e_{ij}(t) \) is log exchange rate (units of currency \( i \) per unit of \( j \)'s)
- \( q_{ij}(z, t) \) is the log of the good-level RER:
  \[
  q_{ij}(z, t) = p_i(z, t) - e_{ij}(t) - p_j(z, t)
  \]
- \( q_{ij}(z, t) = 0 \) when the LOP holds
Good-level RERs $q_{ij}$ for $j = \text{United States}$
Good-level RERs $q_{ij}$ for $j = $ Spain
Good-level RERs $q_{ij}$ for $j = \text{Spain}$, by Store

(a) Apple

(b) IKEA

(c) H&M

(d) Zara
Currency Unions or the Euro Zone?

Zara only. Some countries have no online sales.
### Unconditional Averages

#### Average Absolute Value of Good-Level Log RER

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<td>All Data NER Pegs</td>
<td>0.149</td>
<td>0.047</td>
<td>0.164</td>
<td>0.141</td>
<td>0.142</td>
</tr>
<tr>
<td>All Data Floats</td>
<td>0.182</td>
<td>0.139</td>
<td>0.185</td>
<td>0.152</td>
<td>0.192</td>
</tr>
</tbody>
</table>
Results

- **Result 1**: LOP holds well within currency unions \((q \approx 0)\)
  - Single currency is more important for market segmentation than geography, culture, or tariffs.
  - Does not hold for hard pegs, so LOP is not just about lack of NER volatility.

- **Result 2**: We now introduce an RER decomposition
  - How much of the LOP deviation comes at the time of product introduction, is due to subsequent price changes, or stickiness with NER volatility?
RER Decomposition

- Let $i_i (z)$ be the $t$ at which good $z$ is first available in $i$
- Let $l_i (z, t)$ be the most recent $t$ when $z$ changed price in $i$
- Let $\bar{p}_i (z) = p_i (z, i_i (z))$ be the log price at introduction
- We can then write the price of $z$ in $i$ at $t$ as:

$$p_i (z, t) = \bar{p}_i (z) + \Delta_{i_i (z)}^{l_i (z, t)} p_i (z)$$
RER Decomposition

- Re-write this when translated into country $k$ currency units:

$$p_i(z, t) - e_{ik}(t) = \bar{p}_i(z) - e_{ik}(i_i(z)) + \Delta_{i_i(z)}^{l_i(z,t)}(p_i(z) - e_{ik}) - \Delta_{l_i(z,t)}^t e_{ik}$$

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<tr>
<th>Price at Introduction</th>
<th>Price Changes</th>
<th>Stickiness</th>
</tr>
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</table>

- Combining with equivalent expression for $p_j(z, t) - e_{jk}(t)$:

$$q_{ij}(z, t) = \bar{p}_i(z) - e_{ik}(i_i(z)) - \bar{p}_j(z) + e_{jk}(i_j(z))$$

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<tr>
<th>Good-Level RER at Introduction</th>
<th>Changes in Demand</th>
<th>Stickiness</th>
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$$+ \Delta_{i_i(z)}^{l_i(z,t)}(p_i(z) - e_{ik}) - \Delta_{i_j(z)}^{l_j(z,t)}(p_j(z) - e_{jk}) - \left[ \Delta_{l_i(z,t)}^t e_{ik} - \Delta_{l_j(z,t)}^t e_{jk} \right]$$
RER Decomposition

- To eliminate dependence on 3rd countries we take the average of the decomposition when $k = i$ and when $k = j$. Results are robust to obvious alternatives.
- From now on, we write these terms as:

\[ q_{ij} (z, t) = q^I_{ij} (z, t) + q^D_{ij} (z, t) + q^S_{ij} (z, t) \]
Decomposition $q_{ij} = q_{ij}^{l} + q_{ij}^{D} + q_{ij}^{S}$ for $j =$ United States

(a) Good-level RER ($q_{ij}$)  
(b) RER At Intro ($q_{ij}^{l}$)  
(c) Changes in Demand ($q_{ij}^{D}$)  
(d) Stickiness ($q_{ij}^{S}$)
Decomposing Cross-Sectional Variation in $q_{ij}$
Importance of $q_{ij}^l$ for RER measurement

- Price indices use *changes*, not *levels*, so omit info in $q_{ij}^l$
  - For example, CPI-based RERs will not distinguish behavior for CU vs. Peg, because behavior is same after introduction

- Plausible Explanation for PPP Persistence Puzzle?
  - RER adjustment could happen via $q_{ij}^l$ instead of via price changes
  - However, the puzzle is not solved in our data: $q_{ij}^l$ co-moves closely with the NER
Good-level RERs at Introduction vs. NER, Raw Data

- Austria and USA
- Canada and USA
- China and USA
- Spain and USA
- Germany and USA
- Finland and USA
- France and USA
- Italy and USA
- Japan and USA
- Mexico and USA
- Sweden and USA
- United Kingdom and USA

○ Apple ▲ Ikea □ H & M ◈ Zara
Good-level RERs at Introduction vs. NER, Lowess

Austria and USA

Canada and USA

China and USA

Spain and USA

Germany and USA

Finland and USA

France and USA

Italy and USA

Japan and USA

Mexico and USA

Sweden and USA

United Kingdom and USA

- RER at Introduction
- Log Exchange Rate
Good-level RERs at Introduction vs. NER, Regression

**Dependent Variable:** Good-Level Log RER at Introduction $q_{ij}^l$

**Independent Variable:** Log NER

**Fixed Effects:** Country Pair Effects

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</tr>
</thead>
<tbody>
<tr>
<td>(i) All</td>
<td>Coef.</td>
<td>0.590</td>
<td>0.485</td>
<td>0.836</td>
<td>0.882</td>
</tr>
<tr>
<td></td>
<td>S.E.</td>
<td>(0.008)</td>
<td>(0.012)</td>
<td>(0.029)</td>
<td>(0.006)</td>
</tr>
<tr>
<td></td>
<td>Obs.</td>
<td>19,908,201</td>
<td>352,069</td>
<td>872,285</td>
<td>3,318,516</td>
</tr>
<tr>
<td>(ii) All</td>
<td>Coef.</td>
<td>0.715</td>
<td>0.617</td>
<td>0.989</td>
<td>1.046</td>
</tr>
<tr>
<td></td>
<td>S.E.</td>
<td>(0.025)</td>
<td>(0.030)</td>
<td>(0.048)</td>
<td>(0.027)</td>
</tr>
<tr>
<td></td>
<td>Obs.</td>
<td>602,325</td>
<td>25,447</td>
<td>57,576</td>
<td>142,284</td>
</tr>
</tbody>
</table>
Conclusions and Implications

- What determines market segmentation? Being in a currency union appears to be far more important than:
  - Distance
  - Culture
  - Taxes or tariffs
  - NER volatility

- Macro implications
  - Optimal currency areas
  - Cost of “internal devaluations”
Conclusions and Implications

- Modeling and measurement of RER
  - PCP vs. LCP modeling
  - RER at Intro closely tracking NER contrasts sharply with canonical models of good-level price stickiness. Suggests greater role for real rigidities.
  - Standard measures of RER omit critical information → we need more focus on $q_{ij}^l$
EXTRA SLIDES
Extra Slides

- Euro Competition regulations
- Other Retailers
- Price Points
- Frequency and Life-Cycle
- Measure Passthrough?
- CU Regression Results
- Connecting good-level RER to aggregate RER
- Alternative Decompositions
# Summary Statistics

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<th>Zara</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) # Prod., World</td>
<td>89,705</td>
<td>9,078</td>
<td>60,040</td>
<td>9,402</td>
<td>11,185</td>
</tr>
<tr>
<td>(ii) # Prod., U.S.</td>
<td>33,602</td>
<td>4,349</td>
<td>17,597</td>
<td>4,107</td>
<td>7,549</td>
</tr>
<tr>
<td>(iii) # Countries</td>
<td>81</td>
<td>29</td>
<td>20</td>
<td>47</td>
<td>78</td>
</tr>
<tr>
<td>(v) Headquarters</td>
<td>United States</td>
<td>Sweden</td>
<td>Sweden</td>
<td>Spain</td>
<td></td>
</tr>
<tr>
<td>(vi) Industry</td>
<td>Consumer Electronics</td>
<td>Home/Office Furniture</td>
<td>Apparel</td>
<td>Apparel</td>
<td></td>
</tr>
<tr>
<td>(vii) Global Ind. Rank</td>
<td>3rd largest</td>
<td>1st largest</td>
<td>4th largest</td>
<td>3rd largest</td>
<td></td>
</tr>
<tr>
<td>(viii) Retail Revs ($B)</td>
<td>$100</td>
<td>$40</td>
<td>$25</td>
<td>$15</td>
<td>$15</td>
</tr>
</tbody>
</table>
“Live” Demonstration

- High-end (i.e. > $400) expresso maker sold by IKEA
  - Italy: www.ikea.com/it/it/catalog/products/40113043/
  - Finland: www.ikea.com/fi/fi/catalog/products/40113043/
  - Denmark: www.ikea.com/dk/da/catalog/products/40113043/

- Danish price is more than 12% higher
### Regression Results

**Dependent Variable:** Average Absolute Value of Good-Level Log RER

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<tbody>
<tr>
<td>(i) Outside of</td>
<td>0.153</td>
<td>0.091</td>
<td>0.033</td>
<td>0.110</td>
<td>0.189</td>
</tr>
<tr>
<td>Cur. Unions</td>
<td>(0.006)</td>
<td>(0.010)</td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>(ii) Pegged NER</td>
<td>-0.040</td>
<td>-0.072</td>
<td>-0.004</td>
<td>-0.001</td>
<td>-0.054</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.025)</td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>(iii) Log NER</td>
<td>-0.006</td>
<td>-0.004</td>
<td>-0.044</td>
<td>0.034</td>
<td>0.083</td>
</tr>
<tr>
<td>Volatility</td>
<td>(0.012)</td>
<td>(0.010)</td>
<td>(0.007)</td>
<td>(0.034)</td>
<td>(0.041)</td>
</tr>
<tr>
<td>(iv) Log Bilateral</td>
<td>0.015</td>
<td>0.028</td>
<td>0.007</td>
<td>0.012</td>
<td>0.017</td>
</tr>
<tr>
<td>Distance</td>
<td>(0.002)</td>
<td>(0.004)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>(v) Abs. Relative</td>
<td>0.003</td>
<td>0.001</td>
<td>0.036</td>
<td>0.007</td>
<td>0.000</td>
</tr>
<tr>
<td>Income</td>
<td>(0.002)</td>
<td>(0.005)</td>
<td>(0.009)</td>
<td>(0.006)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>(vi) Abs. Relative</td>
<td>-0.028</td>
<td>0.040</td>
<td>0.006</td>
<td>-0.023</td>
<td>-0.029</td>
</tr>
<tr>
<td>Taxes</td>
<td>(0.025)</td>
<td>(0.040)</td>
<td>(0.031)</td>
<td>(0.035)</td>
<td>(0.030)</td>
</tr>
<tr>
<td>Cty. Dummies:</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
Competition Policy

Highly unlikely that competition is driving our results because:

1. We asked European lawyers and the European Competition Commission, and they confirmed there are no laws requiring identical prices in all euro countries.

2. All product market regulations apply at the EU level, not the euro zone level, so would also apply to Denmark and Sweden.

3. Bailey and Whish (2012): “In United Brands v Commission the Court of Justice ruled that ‘it was permissible for a supplier to charge whatever local conditions of supply and demand dictate, that is to say that there is no obligation to charge a uniform price throughout the EU.’”

4. All countries had non-trivial number of price differences in the euro zone. Zara almost always charges different amounts in Spain/Portugal vs. rest of euro zone.

5. Inconsistent with results on dollarized countries vs. dollar pegs.
Retailer “Mango”, $q_{ij}$ for $j = \text{Spain}$
Retailer “Mango”, \(q_{ij}\) for \(j = \text{US}\)
## Other Retailers

### Average Absolute Value of Good-Level Log RER

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<td>0.20</td>
</tr>
<tr>
<td>Floats</td>
<td>0.139</td>
<td>0.185</td>
<td>0.152</td>
<td>0.192</td>
<td>0.18</td>
</tr>
</tbody>
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*Based on 5 days, 1300 goods, 52 countries
Price Points

Price Points Denmark

apple – dk

IDS = 3796, PRICES = 536, Mean GAP = 6.86%

ikea – dk

IDS = 13263, PRICES = 1034, Mean GAP = 7.72%

zara – dk

IDS = 4781, PRICES = 39, Mean GAP = 17.40%

handm – dk

IDS = 5076, PRICES = 39, Mean GAP = 22.87%
Price Points

Price Points Spain

apple – es

IDS = 2968, PRICES = 502, Mean GAP = 7.92%

ikea – es

IDS = 12755, PRICES = 2051, Mean GAP = 4.39%

zara – es

IDS = 9851, PRICES = 69, Mean GAP = 16.25%

handm – es

IDS = 5351, PRICES = 29, Mean GAP = 26.10%
# Unconditional Averages by Price Level

## Average Absolute Value of Good-Level Log RER

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<td>0.185</td>
<td>0.152</td>
</tr>
<tr>
<td>((p_i + p_j) &gt; $100)</td>
<td>Currency Unions</td>
<td>0.058</td>
<td>0.007</td>
<td>0.094</td>
<td>0.004</td>
</tr>
<tr>
<td>((p_i + p_j) &gt; $100)</td>
<td>NER Pegs</td>
<td>0.174</td>
<td>0.039</td>
<td>0.132</td>
<td>0.138</td>
</tr>
<tr>
<td>((p_i + p_j) &gt; $100)</td>
<td>Floats</td>
<td>0.187</td>
<td>0.135</td>
<td>0.160</td>
<td>0.162</td>
</tr>
<tr>
<td>((p_i + p_j) &gt; $400)</td>
<td>Currency Unions</td>
<td>0.041</td>
<td>0.010</td>
<td>0.084</td>
<td>0.021</td>
</tr>
<tr>
<td>((p_i + p_j) &gt; $400)</td>
<td>NER Pegs*</td>
<td>0.308</td>
<td>0.038</td>
<td>0.123</td>
<td>0.135</td>
</tr>
<tr>
<td>((p_i + p_j) &gt; $400)</td>
<td>Floats</td>
<td>0.169</td>
<td>0.138</td>
<td>0.148</td>
<td>0.161</td>
</tr>
</tbody>
</table>

*Based on a small number of observations.
Benefits of Using Online Prices

- Large quantity of data
- Identical products, but not “too identical” (less restrictive than UPC)
- Sold by single retailer in multiple countries
- Can observe price at introduction
- Allows precise estimate of role of NER
Environment (1/2)

- Many countries $i = 1..l$ with representative consumer (homothetic preferences)

- $\Omega_i(t)$ denotes goods available in $i$ at $t$.

- Each good is manufactured in one plant and shipped internationally subject to good-country specific fixed cost, which generates differences in $\Omega$s

- First-order approximation around SS expenditure weights to log of ideal price index (up to a constant):

$$\hat{p}_i(t) = \sum_{z \in \Omega_i(t)} \omega_i(z) p_i(z, t),$$

with $\omega_i(z)$ denoting good $z$’s share of steady state spending
Assume $z$ has same SS expenditure shares when consumed:

$$
\hat{q}_{ij}(t) = \omega_{ij} \sum_{z \in \Omega_{ij}(t)} q_{ij}(z, t)
+ (1 - \omega_{ij}) \sum_{z \in \Omega_{i-j}(t)} (p_i(z, t) - e_{ij}(t))
- (1 - \omega_{ij}) \sum_{z \in \Omega_{j-i}(t)} p_j(z, t),
$$

where $\omega_{ij}$ is total share of all $z \in \Omega_{ij}(t)$ consumed in $i$ and $j$.

- $\Omega_{ij}(t) = \Omega_i(t) \cap \Omega_j(t)$ and $\Omega_{i-j}(t) = \Omega_i(t) - \Omega_j(t)$
- Product innovations are unmodeled
RER Decomposition - Timing Assymetries

- \( q_{ij}(z, t) \) is independent of \( k \), but decomposition isn’t

- But, note that if \( i_i(z) = i_j(z) \) and \( l_i(z, t) = l_j(z, t) \), we have:

\[
q_{ij}(z, t) = \underbrace{\bar{p}_i(z) - e_{ij}(i_i(z)) - \bar{p}_j(z)}_{\text{Good-Level RER at Introduction}} \\
+ \underbrace{\Delta_{l_i(z,t)}^{l_i(z,t)} (p_i(z) - p_j(z) - e_{ij})}_{\text{Heterogeneous Demand}} - \underbrace{\Delta_t^{l_i(z,t)} e_{ij}}_{\text{Stickiness}},
\]

which has no dependence on \( k \)

- So dependence on \( k \) is all about timing asymmetries
RER Decomposition

- To eliminate dependence on 3rd countries, caused by timing asymmetries, we take the average of the decomposition when $k = i$ and when $k = j$:

$$q_{ij}(z, t) = \bar{p}_i(z) - \bar{p}_j(z) - \frac{1}{2}e_{ij}(i_i(z)) - \frac{1}{2}e_{ij}(i_j(z))$$

- Introduction $q'_{ij}$

$$- \left[ \frac{1}{2}\Delta^{t}_{i}(z, t)e_{ij} + \frac{1}{2}\Delta^{t}_{j}(z, t)e_{ij} \right]$$

- Stickiness $q^s_{ij}$

$$+ \Delta^{l}_{i}(z, t)p_i(z) - \Delta^{l}_{j}(z, t)p_j(z) - \frac{1}{2}\Delta^{l}_{i}(z, t)e_{ij} - \frac{1}{2}\Delta^{l}_{j}(z, t)e_{ij}.$$
First Alternative RER Decomposition

- The first alternative sets \( q_{ij}^I = q_{ij}(z, i_{ij}^*(z)) \), where \( i_{ij}^*(z) = \max\{i_i(z), i_j(z)\} \)

- We leave the definition of \( q_{ij}^S \) unchanged

- This results in:

\[
q_{ij}(z, t) = q_{ij}(z, i_{ij}^*(z)) - \left[ \frac{1}{2} \Delta l_{i(z,t)} e_{ij} + \frac{1}{2} \Delta l_{j(z,t)} e_{ij} \right] + \Delta l_{i(z,t)}^i p_i(z) - \Delta l_{j(z,t)}^j p_j(z) - \frac{1}{2} \Delta l_{i(z,t)}^i e_{ij} - \frac{1}{2} \Delta l_{j(z,t)}^j e_{ij}
\]

- \( q_{ij}^D \neq 0 \), even if there are no price changes
Second Alternative RER Decomposition

- The second alternative sets $q^S_{ij} = -\Delta^t_{t^*_ij(z,t)}e_{ij}$, where $t^*_ij(z,t) = \max\{l_i(z,t), l_j(z,t)\}$

- We leave the definition of $q^l_{ij}$ unchanged

- This results in:

\[
q_{ij}(z,t) = \left[ \tilde{p}_i(z) - \tilde{p}_j(z) - \frac{1}{2}e_{ij}(i_iz) - \frac{1}{2}e_{ij}(ijz) \right] - \Delta^t_{t^*_ij(z,t)}e_{ij} + \left[ \Delta^l_{l_i(z,t)}p_i(z) - \Delta^l_{l_j(z,t)}p_j(z) - \frac{1}{2}\Delta^t_{t^*_ij(z,t)}e_{ij} - \frac{1}{2}\Delta^t_{t^*_ij(z,t)}e_{ij} \right]
\]

- $q^D_{ij} \neq 0$, even if there are no price changes
Third Alternative RER Decomposition

- The third alternative combines both changes
- This results in:

\[
q_{ij}(z, t) = q_{ij}(z, i_{ij}^*(z)) + \Delta_{i_{ij}^*(z)}^{t_{ij}^*(z, t)} q_{ij}(z) - \Delta_{t_{ij}^*(z, t)}^t e_{ij}
\]

- \( q_{ij}^D = 0 \) only if there are no price changes
- Pros/cons of each. Paper details why we prefer baseline.
- Appendix shows all results are highly robust to any of these.
Cross-Sectional Variance Decomposition

- To formalize and quantify this, we write:

\[ \sigma^2_{ij}(t) = (\tilde{\sigma}^I_{ij})^2(t) + (\tilde{\sigma}^D_{ij})^2(t) + (\tilde{\sigma}^S_{ij})^2(t), \]

where \( \sigma^2_{ij}(t) = \text{Var}_z(q_{ij}) \).

- We’ve split the (small) covariance terms equally:

\[ (\tilde{\sigma}^I_{ij})^2(t) = (\sigma^I_{ij})^2(t) + \sigma^I_{ij}D(t) + \sigma^I_{ij}S(t), \]

where \( (\sigma^I_{ij})^2 = \text{Var}_z(q^I_{ij}) \) and \( \sigma^I_{ij}D = \text{Cov}_z(q^I_{ij}, q^D_{ij}) \).

- We then average over weeks \( t \).
Decomposition, Stickiness, and Entry/Exit

- If prices don’t change, $q_{ij}^D = 0$ by construction. Share of all products (those with $\geq 52$ weeks) with any changes:
  - Apple: 18% (39%)
  - IKEA: 30% (51%)
  - H&M: 3% (-)
  - Zara: 9% (-)

- If products constantly enter and exit, $\sigma_{ij}^2 = (\tilde{\sigma}_{ij}^l)^2$ by construction. Mean duration for U.S. pairs:
  - Apple: 31 weeks
  - IKEA: 55 weeks
  - H&M: 8 weeks
  - Zara: 9 weeks

- We consider “Reduced Sample” of goods with both $\geq 1$ price change and $\geq 52$ weeks. Takeaway still holds qualitatively.
Relationship Between RERs at Intro and NER

- For IKEA and H&M, RER at Intro moves 1:1 with NER
- For Apple and Zara, RER at Intro moves 0.7:1 with NER
- Cannot therefore explain PPP Puzzle with this
- Rejects adjustment cost models where RER shocks disappear with price changes. After all, introduction price is new price.
- How compares to ER passthrough? Can’t tell exactly, but seems like even less adjustment
Plausible Explanation of PPP Puzzle?

- Suppose prices never change (so RER of existing goods tracks NER), but goods frequently enter/exit

  - If $q_i^l$ drawn i.i.d. from distribution with mean $\bar{q}$, average RER cannot wander too far from $\bar{q}$ (product life cycle would be critical for RER half-life)

  - But since price indices ignore intros, our measures of RER could still wander arbitrarily from $\bar{q}$

- However, the puzzle is not solved in our data: $q_i^l$ moves closely with NER.
Measuring Passthrough Is Hard Without Knowing Exporter

- We don’t know identity of exporting country

- Imagine unobserved exporter is Japan. PT to Spain is 0.75 and to US is 0.25.

- Prices change only due to exchange rate

- 10% depreciation of euro-yen with no change in dollar-yen produces 7.5% appreciation of Spain-US relative price

- 10% appreciation of the dollar-yen with no change in euro-yen produces 2.5% appreciation

- But both scenarios produce same movement in dollar-euro

- In other work, trying to use panel to make progress on this