Exchange Rates, Prices, and Trade

Alberto Cavallo, Associate Professor, Harvard Business School

Applications: Currency Unions and the Trade War

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Application 1: Currency Unions and the LOP


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 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.
Scraped price data from 4 large 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
- Daily prices for 90K goods, aggregated to weeks. 81 countries from 2008-2012. Coverages varies by retailer.
- Match identical products using retailer-specific id codes (larger overlap and coverage than region-specific UPCs)
- Prices include VAT taxes (US/Can are exceptions). Not within-country shipping costs. No info on quantities or exporting country (no passthrough estimates)
- Online and offline prices generally identical (Cavallo (2017))
- These companies have one online price per country (true for most of largest U.S. online retailers, like Walmart, CVS, etc.)
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 $j = \text{Spain}$
## Unconditional Averages

<table>
<thead>
<tr>
<th>Average Absolute Value of Good-Level Log RER</th>
<th>All Stores</th>
<th>Apple</th>
<th>IKEA</th>
<th>H&amp;M</th>
<th>Zara</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Data Currency Unions</td>
<td>0.062</td>
<td>0.005</td>
<td>0.117</td>
<td>0.021</td>
<td>0.087</td>
</tr>
<tr>
<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 and Implications

Result 1: **LOP holds well within currency unions**
- Evidence for both euro zone and dollarized countries
- Does not hold for hard pegs, so LOP not just about lack of NER volatility
- Both in cross-section and time series (Cavallo, Neiman, Rigobon (2015))

Result 2: **RER at time of introduction matters most and moves closely with NER**
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 $p_i(z) = p_i(z, i_i(z))$ 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:

$$p_i(z, t) - e_{ik}(t) = \underbrace{\bar{p}_i(z) - e_{ik}(i_i(z))}_{\text{Price at Introduction}} + \underbrace{\Delta_{i_i(z)}^{i(z, t)}(p_i(z) - e_{ik})}_{\text{Price Changes}} - \underbrace{\Delta_{i_i(z)}^{t}e_{ik}}_{\text{Stickiness}}$$

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

$$q_{ij}(z, t) = \underbrace{\bar{p}_i(z) - e_{ik}(i_i(z))}_{\text{Good-Level RER at Introduction}} - \underbrace{\bar{p}_j(z)}_{\text{Changes in Demand}} + \underbrace{e_{jk}(i_j(z))}_{\text{Stickiness}}$$

$$+ \underbrace{\Delta_{i_i(z)}^{i(z, t)}(p_i(z) - e_{ik})}_{\text{Price Changes}} - \underbrace{\Delta_{i_j(z)}^{i(z, t)}(p_j(z) - e_{jk})}_{\text{Changes in Demand}} - \underbrace{\Delta_{i_j(z)}^{t}e_{ik}}_{\text{Stickiness}}$$
RER Decomposition

- To eliminate dependence on 3rd countries we take the average of the decomposition when $k = i$ and when $k = j$.

- From now on, we write these terms as:

$$q_{ij}(z, t) = q_{ij}^L (z, t) + q_{ij}^D (z, t) + q_{ij}^S (z, t)$$

- Results are robust to obvious alternatives
Decomposition $q_{ij} = q^l_{ij} + q^D_{ij} + q^S_{ij}$ for $j = \text{United States}$

(a) Good-level RER ($q_{ij}$)
(b) RER At Intro ($q^l_{ij}$)
(c) Changes in Demand ($q^D_{ij}$)
(d) Stickiness ($q^S_{ij}$)
Decomposition $q_{ij} = q_{ij}^l + q_{ij}^D + q_{ij}^S$ for $j =$ Spain

(a) Good-level RER ($q_{ij}^l$)  
(b) RER At Intro ($q_{ij}^D$)  
(c) Changes in Demand ($q_{ij}^D$)  
(d) Stickiness ($q_{ij}^S$)
Good-level RERs at Introduction vs. NER, Lowess
Results and Implications

Result 1: LOP holds well within currency unions
- Evidence for both euro zone and dollarized countries
- Does not hold for hard pegs, so LOP not just about lack of NER volatility
- Both in cross-section and time series (Cavallo, Neiman, Rigobon (2015))

Result 2: RER at time of introduction matters most and moves closely with NER

Implications
- Market segmentation: currency union swamps geography, taxes, culture, NER rigidity
- Price convergence and the cost of internal devaluations
- Standard measures of RER may omit critical information (price indices do not include prices at introduction)
- RER at intro tracking NER suggest important role for variable markups and real rigidities
### Timeline - 2018-2020 U.S. Tariffs and Retaliation

<table>
<thead>
<tr>
<th>DATE</th>
<th>U.S.</th>
<th>CHINA</th>
</tr>
</thead>
<tbody>
<tr>
<td>January -March 2018</td>
<td><strong>Safeguard tariffs</strong></td>
<td>Files WTO dispute</td>
</tr>
<tr>
<td></td>
<td>• Solar Panels (+30%, $8.5 bn)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Washing Machines (+20% to +50%, $1.8 bn)</td>
<td></td>
</tr>
<tr>
<td>March -April 2018</td>
<td><strong>National Security Tariffs</strong></td>
<td><strong>Retaliation</strong></td>
</tr>
<tr>
<td></td>
<td>• Steel (+25%, $10.2 bn)</td>
<td>• Tariffs on $3 bn of U.S. imports (aluminum waste, pork, fruits, nuts, and other U.S. products)</td>
</tr>
<tr>
<td></td>
<td>• Aluminum (+10%, $ 7.7 bn)</td>
<td></td>
</tr>
<tr>
<td>July 2018</td>
<td><strong>China Tariffs – Stage 1</strong></td>
<td><strong>Retaliation</strong></td>
</tr>
<tr>
<td></td>
<td>+25% on $34 bn</td>
<td>+25% on $34 bn</td>
</tr>
<tr>
<td>August 2018</td>
<td><strong>China Tariffs – Stage 2</strong></td>
<td><strong>Retaliation</strong></td>
</tr>
<tr>
<td></td>
<td>+25% on $16 bn</td>
<td>+25% on $16 bn</td>
</tr>
<tr>
<td>September 2018</td>
<td><strong>China Tariffs – Stage 3</strong></td>
<td><strong>Retaliation</strong></td>
</tr>
<tr>
<td></td>
<td>+10% on $200 bn</td>
<td>+10% on $50 bn</td>
</tr>
<tr>
<td></td>
<td>¼ are intermediate goods, ¼ are consumer goods.</td>
<td></td>
</tr>
<tr>
<td>December 2018</td>
<td>US and China agree to postpone other tariff increases while they negotiate</td>
<td></td>
</tr>
<tr>
<td>June 2019</td>
<td>Stage 3 tariffs increased to +25%</td>
<td>Stage 3 retaliation tariffs increased to +25%</td>
</tr>
<tr>
<td>September 2019</td>
<td><strong>China Tariffs – Stage 4</strong></td>
<td><strong>Retaliation</strong></td>
</tr>
<tr>
<td></td>
<td>+15% on $300 bn</td>
<td>+15% on $75 bn</td>
</tr>
<tr>
<td>January 2020</td>
<td><strong>Phase One Deal</strong></td>
<td></td>
</tr>
<tr>
<td>February 2020</td>
<td>Stage 4 tariffs reduced to +7.5%</td>
<td>Stage 4 retaliation tariffs reduced to +7.5%</td>
</tr>
</tbody>
</table>

Our Paper

Estimate tariff effect on prices and compare with exchange rate passthrough.

At the Border
- Product-level import and export prices
- Imports from China
- Retaliatory tariffs on US exports

At the Store
- Product-level data from largest US retailers with country of origin information for two specific retailers
- Imports from China

Jointly examining border and retail prices allows us to determine the incidence of the tariffs.

Our paper is largely silent on quantities and welfare. See Amiti, Redding, and Weinstein (2019) and Fajgelbaum et al. (2020).
Main Findings

US bearing the burden

- Chinese import tariffs passed through fully to US importers
  - Stark contrast to modest degree of exchange rate passthrough (also documented in Gopinath, Itskhan, and Rigobon (2010) and Gopinath et al. (2010))
  - Contrary to some claims, RMB depreciation did little to offset the impact of tariffs
  - Has implications for analysis of fiscal devaluations and border adjustment taxes

- Retaliatory tariffs on US exports saw significantly lower passthrough

- Difference in import vs export tariff passthrough explained by composition of goods and lower passthrough rates for undifferentiated goods

Uneven passthrough to consumers

- Differences across goods, but overall passthrough is low

- Using other margins of adjustment: avoiding tariffs by front-running and then diverting trade to other countries
Micro Data Sources

Trade prices: BLS International Price Program
- Transactional prices for imports and exports at the good level; used in construction of import and export price indices
- Sample used: Monthly data over 2005-2020 period
- Avoid compositional effects

Retail prices: The Billion Prices Project
- Posted prices from websites of over 30 large multi-channel retailers in the US
- Sample used: Daily data over 2017-2020 period
- Also have country of origin and HS code classifications for 2 individual retailers
At the Border: Imports from China

Prices paid by US importers jumped up by about the full amount of the tariffs and did not meaningfully decline afterwards.
In contrast, prices charged by US exporters fell by nearly 9% soon after the introduction of tariffs.

At the Border: Export Prices

Figure 1(b): Export Price Indices (excluding tariffs)
Estimating Passthrough

Based on a standard model with variable markups, we estimate 1-year import passsthrough rates with:

\[
\Delta \ln \left( p_{i,j,k,t}^T \right) = \delta_k^T + \phi_{CN}^T + \phi_{CN}^{-\Omega} + \sum_{l=0}^{11} \gamma_l^T \Delta \tau_{i,t-l} \\
+ \sum_{l=0}^{11} \beta_l^{T,S} \Delta \ln \left( S_{j,t-l} \right) + \sum_{l=0}^{11} \beta_l^{T,X} \Delta \ln \left( X_{j,t-l} \right) + \epsilon_{i,j,k,t}
\]

- \( p_{i,j,k,t}^T \): Price of item \( i \) in sector \( k \) from country \( j \) at time \( t \)
- \( \delta_k^T \): Average sectoral inflation (Sectors: BLS “primary stratum” or 3-digit COICOP)
- \( \{ \phi_{CN}^T, \phi_{CN}^{-\Omega} \} \): Average differential inflation in affected and unaffected Chinese imports (only in imports specification)
- \( \Delta \tau_{k,t} \): Log newly imposed additional tariff rate (defined at the HS6 level)
- \( S_{j,t} \): Value of country \( j \) currency against the dollar
- \( X_{j,t} \): Country \( j \) aggregate price index
At the Border: Passthrough Rates

<table>
<thead>
<tr>
<th></th>
<th>US Imports from China</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Tariffs 1 yr.</td>
<td>$(\sum_{i=0}^{11} \gamma_i)$</td>
<td>-0.057</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.025)</td>
<td></td>
</tr>
<tr>
<td>Differentiated</td>
<td>$(\sum_{i=0}^{11} \gamma_i)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undifferentiated</td>
<td>$(\sum_{i=0}^{11} \gamma_i)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERPT 1 yr.</td>
<td>$(\sum_{i=0}^{11} \beta_i^S)$</td>
<td></td>
<td>0.218</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPI PT 1 yr.</td>
<td>$(\sum_{i=0}^{11} \beta_i^X)$</td>
<td></td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td></td>
<td>0.002</td>
<td>0.003</td>
</tr>
<tr>
<td>Obs.</td>
<td></td>
<td>835,722</td>
<td>835,722</td>
</tr>
</tbody>
</table>

- Prices of affected imports dropped slightly relative to trend, but this seems to be more strongly associated with the RMB's depreciation rather than the tariffs.
- Exchange rate pass-through is low, as documented in previous literature.
### At the Border: Passthrough Rates

#### Border Price Regression Analysis Using Monthly Data

<table>
<thead>
<tr>
<th></th>
<th>US Imports from China</th>
<th>US Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
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<tr>
<td></td>
<td>(0.023)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>Differentiated</td>
<td>$(\sum_{i=0}^{11} \gamma_i)$</td>
<td></td>
</tr>
<tr>
<td>Undifferentiated</td>
<td>$(\sum_{i=0}^{11} \gamma_i)$</td>
<td></td>
</tr>
<tr>
<td>ERPT 1 yr.</td>
<td>$(\sum_{i=0}^{11} \beta_i^5)$</td>
<td>0.218</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td></td>
</tr>
<tr>
<td>PPI PT 1 yr.</td>
<td>$(\sum_{i=0}^{11} \beta_i^X)$</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.038)</td>
<td></td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td>0.002</td>
<td>0.003</td>
</tr>
<tr>
<td>Obs.</td>
<td>835,722</td>
<td>835,722</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Tariff passthrough to pre-tariff export prices is about 30% (i.e., 70% to foreign importers).
Tariff passthrough to pre-tariff export prices is about 30% (i.e., 70% to foreign importers).

Substitutability plays a role in explaining the different export & import tariff passthroughs.

- Prices of undifferentiated imports and exports drop by over 27% of the tariff rate.
- However, these goods make up only 10% of affected imports and over half of affected exports.
Discussion of Border Results

Back-of-the-envelope calculations:

- A 20% import tariff is estimated to result in a 18.9% increase in US importers’ prices paid.
  - Consistent with Amiti, Redding, and Weinstein (2019) and Fajgelbaum et al. (2020).

- The 10% depreciation in the RMB since June 2018 lowered import prices by 2.2%, not nearly making up for the 10-25% in additional tariffs.

- In contrast, a 20% export tariff resulted in US exporters earning a 6.6% lower price on their exports, on average.
  - Prices of undifferentiated exports fell by much more in response to the tariff.
Discussion of Border Results

Broader implications:

- Evidence against assumption of symmetric tariff and exchange rate passthrough rates often used in analyses of border adjustment taxes or fiscal devaluation. (For example, in Farhi, Gopinath, and Itskhoki (2014) and Barbiero et al. (2019).)

- Higher passthrough for undifferentiated goods puts US at a disadvantage.
  - Undifferentiated goods make up 25% of total US exports to China and only 2% of total US imports from China.
At the Store: Micro Retail Prices

From border price analysis: Assuming a 50% imported goods cost share, full retail passthrough would entail a 9.4% increase in prices.

Two exercises:

- Case studies of specific goods using data from largest US retailers that are:
  - Easily identified in the retail price data and tariff harmonized codes
  - Come mostly from China

- Regression analysis using data from two retailers that also contains country-of-origin information
As studied in Flaaen, Hortacsu, and Tintelnott (2019) and oft-cited in the media, there appears to be a high degree of pass-through of washing machine tariffs to retail prices. Impacts on handbags, bicycles, and tires were delayed. But refrigerator prices have had no tariff-related increase.
Products with Country of Origin and HS codes

- These price indices combine some affected and unaffected goods (not all goods come from China, not all bicycles might be affected).

- We focus now on a subset of data with country of origin (COO) and HS code information for each individual good.

  - Retailer 1 is a retail hypermarket
    - COO scraped online, HS code based on product description

  - Retailer 2 is a home improvement retailer
    - COO and HS codes for direct imports provided by the retailer, other HS codes based on product description
Obtaining HS codes for individual products

https://uscensus.prod.3ceonline.com/
Retail micro data with country and HS code information

<table>
<thead>
<tr>
<th></th>
<th>Retailers 1 &amp; 2</th>
<th>Retailer 1</th>
<th>Retailer 2</th>
<th>Imported Products</th>
<th>Manual HS Classification</th>
<th>Direct Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products</td>
<td>94,115</td>
<td>37,840</td>
<td>56,275</td>
<td>59,978</td>
<td>25,319</td>
<td>6984</td>
</tr>
<tr>
<td>Exporting Countries</td>
<td>82</td>
<td>65</td>
<td>66</td>
<td>81</td>
<td>70</td>
<td>15</td>
</tr>
<tr>
<td>HS6 Categories</td>
<td>1,992</td>
<td>1,651</td>
<td>831</td>
<td>1,498</td>
<td>1,336</td>
<td>212</td>
</tr>
<tr>
<td>Products Imported</td>
<td>61,106</td>
<td>21,144</td>
<td>39,902</td>
<td>59,978</td>
<td>21,157</td>
<td>6,966</td>
</tr>
<tr>
<td>Products Imported from China</td>
<td>44,423</td>
<td>13,646</td>
<td>30,777</td>
<td>43,490</td>
<td>14,450</td>
<td>6,680</td>
</tr>
<tr>
<td>Products in Affected Categories</td>
<td>74,763</td>
<td>34,237</td>
<td>40,526</td>
<td>40,333</td>
<td>23,435</td>
<td>6,276</td>
</tr>
<tr>
<td>Products from China Affected</td>
<td>35,969</td>
<td>12,072</td>
<td>23,897</td>
<td>30,101</td>
<td>13,104</td>
<td>5,977</td>
</tr>
</tbody>
</table>

**Panel B: Pricing Behavior**

<table>
<thead>
<tr>
<th></th>
<th>Retailers 1 &amp; 2</th>
<th>Retailer 1</th>
<th>Retailer 2</th>
<th>Imported Products</th>
<th>Manual HS Classification</th>
<th>Direct Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products Without Price Changes (%)</td>
<td>38</td>
<td>46</td>
<td>33</td>
<td>47</td>
<td>37</td>
<td>25</td>
</tr>
<tr>
<td>Mean Product Life (months)</td>
<td>22</td>
<td>20</td>
<td>23</td>
<td>18</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Abs. Val. Price Changes (med., %)</td>
<td>10.4</td>
<td>14.3</td>
<td>9.6</td>
<td>11.4</td>
<td>12.5</td>
<td>25.0</td>
</tr>
<tr>
<td>Abs. Val. Price Changes, Ex-Sales (med., %)</td>
<td>9.3</td>
<td>11.2</td>
<td>8.3</td>
<td>10.0</td>
<td>24.2</td>
<td>24.7</td>
</tr>
<tr>
<td>Implied Duration (med., months)</td>
<td>8.7</td>
<td>9.7</td>
<td>8.1</td>
<td>9.7</td>
<td>10.6</td>
<td>7.0</td>
</tr>
<tr>
<td>Implied Duration, Ex-Sales (med., months)</td>
<td>11.0</td>
<td>12.5</td>
<td>8.9</td>
<td>11.2</td>
<td>14.0</td>
<td>10.1</td>
</tr>
</tbody>
</table>

Table A6: Summary Statistics from Two Major US Retailers
At the Store: Small Overall Response

- For two retailers with country-of-origin, we conduct an analysis like the one for border prices.
- All products have started increasing in price since the tariffs were introduced, but there is no difference in the patterns for affected and unaffected goods.
At the Store: Passthrough Rates

\[ \Delta \ln \left( P_{i,j,k,t}^R \right) = \delta_k^R + \phi_{CN}^R,\Omega + \phi_{CN}^R,\Omega - \sum_{l=0}^{11} \gamma_i^R \Delta t_{i,t-l} + \epsilon_{i,j,k,t} \]

<table>
<thead>
<tr>
<th>Retail Price Regression Analysis Using Monthly Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Goods</strong></td>
</tr>
<tr>
<td>Tariff 1 yr. ( (\sum_{l=0}^{11} \gamma_{R,l}) )</td>
</tr>
<tr>
<td>Adj. ( R^2 )</td>
</tr>
<tr>
<td>Obs.</td>
</tr>
</tbody>
</table>

- A 20% import tariff is estimated to only increase retail prices by 0.7%.
- For a subsample with less HS classification bias, this value increases to 1.5%.
- For directly imported goods (for which the retailer provides HS codes), this value increases to 3.2%, indicating that firms are still absorbing a large share of the import price increase.
At the Store: Little Evidence of Spreading Price Increases

- For a single retailer, we compare prices of identical goods sold in the US and Canada.
- Similar pattern suggests limited tariff passthrough to consumer prices via widespread price hikes that also include unaffected goods.
At the Store: Front Running and Trade Diversion

- Data from bills of lading shows that these two retailers increased the fraction of their imports from China in the period just before the tariffs.
- Import sourcing was diverted away from China after tariffs were introduced.
Closing Remarks

- Our results show that within the first year of tariff introduction, price responses have put the cost of the trade war on US firms.
  - Import prices have seen at most a small decline and the low passthrough of exchange rates means that the RMB’s depreciation didn’t offset these increases.
  - On the contrary, US exporters had to lower their prices as retaliatory tariffs were concentrated in undifferentiated goods.
  - Retailers have yet to pass increased costs through to consumers.

- As the tariffs are perceived to be more permanent and as firms’ profits deteriorate:
  - Pressure on foreign exporters to reduce prices will increase as more firms shift supply chains.
  - Retail passthrough should increase.
Some Practice Exercises

- **Exercise 1: Tariff Passthrough**
  - Modify the replication code to show that Chinese and Non-Chinese goods had similar price trends after the tariffs. The solution graph should be similar to Figure 3a in the paper, but with only 2 price indices (with no distinction between affected and not affected categories.)
  - Then try this separately for Retailer 1 and Retailer 2.
  - https://doi.org/10.7910/DVN/JV7FCH

- **Exercise 2: Law of One Price**
  - Replicate Figure V for Apple (page 551 of QJE paper). You can ignore the red line in the original graphs.
  - You need to compute q with respect to Spain (j is country es ). So you will first need to transform the exchange rate data to obtain the bilateral rate between each country and the euro.
  - https://doi.org/10.7910/DVN/NV26Z6

- **Bonus:** Scrape data from one of the global retailers and check if our results still hold
Thank you