DISCUSSION OF “UNDERSTANDING MOVEMENTS IN AGGREGATE AND PRODUCT-LEVEL REAL-EXCHANGE RATES”
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Data:

- Quarterly average wholesale prices on food products for a large grocery retailer for 2004-2006
- Stores in multiple US states and Canadian provinces
- Underlying weekly data (can use to calculate frequency of price change)
Goal: Isolate the effect of markup fluctuations on relative prices

- Match products across regions within US and between US and Canada
- Most matches not identical
- e.g. Schweppes Raspberry Ginger Ale 2 Lts, Schweppes Ginger Ail 24Oz
- Collect own data on country of origin (e.g. "Made in the USA")
- Assume matched products have same production cost if produced in the same country
Main Findings:

1. Aggregate RER tracks movements in relative Canada-US unit labor costs (and nominal ER)

2. Large amount of variability in product-level RER’s

3. Product-level RER twice as variable for matches across countries as within countries
   - Product-level RER 3-4 times more variable than nominal ex. rate
   - True for both “exported” and domestically produced products

4. Tentative relationship between aggregate RER variability and price comovement across countries at category level

5. Inconclusive findings on RER for domestically produced vs. exported products (too few obs.)
Figure 4: Relation between Product and Aggregate Real Exchange Rates across Product Categories

<table>
<thead>
<tr>
<th>Correl_{inter}</th>
<th>\Delta Q_j</th>
<th>Coeff.</th>
<th>Std. Err.</th>
<th>t Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.3</td>
<td>-0.05</td>
<td>1.277</td>
<td>0.148</td>
<td>8.625</td>
</tr>
<tr>
<td>-0.2</td>
<td>0.15</td>
<td>1.126</td>
<td>0.123</td>
<td>9.089</td>
</tr>
<tr>
<td>-0.1</td>
<td>-0.2</td>
<td>1.072</td>
<td>0.118</td>
<td>8.980</td>
</tr>
<tr>
<td>0</td>
<td>0.3</td>
<td>0.918</td>
<td>0.099</td>
<td>9.234</td>
</tr>
<tr>
<td>0.1</td>
<td>-0.3</td>
<td>0.764</td>
<td>0.088</td>
<td>8.707</td>
</tr>
<tr>
<td>0.2</td>
<td>-0.4</td>
<td>0.610</td>
<td>0.077</td>
<td>8.004</td>
</tr>
<tr>
<td>0.3</td>
<td>-0.5</td>
<td>0.456</td>
<td>0.066</td>
<td>6.898</td>
</tr>
<tr>
<td>0.4</td>
<td>-0.6</td>
<td>0.302</td>
<td>0.055</td>
<td>5.494</td>
</tr>
</tbody>
</table>

The figure shows a negative correlation between \( \Delta Q_j \) (change in product aggregate real exchange rates) and Correl_{inter} (inter-product correlation). The table below provides the regression coefficients (Coeff.), standard errors (Std. Err.), and t-statistics (t Stat) for the intercept and the X Variable.
Figure 3: Canada-US Aggregate-Real Exchange Rates

- All Exports
- Relative Unit Labor Costs

- US Exports
- Relative Unit Labor Costs

- Canada and ROW Exports
- Relative Unit Labor Costs

- Domestically Produced
- Relative Unit Labor Costs
Related Literature:

- Pricing to market: Knetter, Feenstra
- Variability in RER: Engel, Engel and Rogers, Mussa

What do we gain from micro data?

- Analyze RER behavior at product level rather than category level (e.g. Engel and Rogers used category-level analysis)
- Product-level RER much more volatile at product level than at higher levels of aggregation
- Micro data facilitates cross-sectional analysis across categories
Model:
- Partial equilibrium: Takes movements in relative wages as given
- Firms can price discriminate across regions and countries
- Nested demand structure
- CES preferences across varieties
- Within each variety, prices are determined by Bertrand competition for perfectly substitutable products
  - Yields one active firm and one latent producer in each category
Model:

- All else equal, as firms raise prices → price elasticity rises
- Yields pricing to market if exporting firms face domestic competitors in their industry
  - Trade costs deliver this
- Paper emphasizes: Both trade costs and non-CES demand structure necessary to generate PTM
MY COMMENTS

1. How to interpret product-level RER between countries vs. between regions?
2. Calibration: What is an industry?
3. Interpretation of country of origin statistics
TABLE 1—CATEGORIES OF GOODS IN DISAGGREGATED CONSUMER PRICE INDEXES AND CITIES USED

<table>
<thead>
<tr>
<th>Good</th>
<th>United States</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Food at home</td>
<td>Food purchased from stores</td>
</tr>
<tr>
<td>2</td>
<td>Food away from home</td>
<td>Food purchased—restaurants</td>
</tr>
<tr>
<td>3</td>
<td>Alcoholic beverages</td>
<td>Alcoholic beverages</td>
</tr>
<tr>
<td>4</td>
<td>Shelter</td>
<td>Shelter – 0.2135 (water, fuel, and electricity)</td>
</tr>
<tr>
<td>5</td>
<td>Fuel and other utilities</td>
<td>Water, fuel, and electricity</td>
</tr>
<tr>
<td>6</td>
<td>Household furnishings and operations</td>
<td>Housing excluding shelter</td>
</tr>
<tr>
<td>7</td>
<td>Men’s and boy’s apparel</td>
<td>0.8058 (Men’s wear) + 0.1942 (boy’s wear)</td>
</tr>
<tr>
<td>8</td>
<td>Women’s and girl’s apparel</td>
<td>0.8355 (Women’s wear) + 0.1645 (girl’s wear)</td>
</tr>
<tr>
<td>9</td>
<td>Footwear</td>
<td>Footwear</td>
</tr>
<tr>
<td>10</td>
<td>Private transportation</td>
<td>Private transportation</td>
</tr>
<tr>
<td>11</td>
<td>Public transportation</td>
<td>Public transportation</td>
</tr>
<tr>
<td>12</td>
<td>Medical care</td>
<td>Health care</td>
</tr>
<tr>
<td>13</td>
<td>Personal care</td>
<td>Personal care</td>
</tr>
<tr>
<td>14</td>
<td>Entertainment</td>
<td>0.8567 (Recreation) + 0.1433 (reading material)</td>
</tr>
</tbody>
</table>

Note: The cities included are: Baltimore, Boston, Chicago, Dallas, Detroit, Houston, Los Angeles, Miami, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis, and Washington DC; Calgary, Edmonton, Montreal, Ottawa, Quebec, Regina, Toronto, Vancouver, and Winnipeg.

Vary with exchange rate changes. Alternatively, the markets for the nontraded marketing service might be more highly integrated on a national basis, so that $w'_{ij}$ is more similar between two sites within a country than in two places separated by a border. These marketing services are likely to be highly labor-intensive. To the extent that the two national labor markets are more separated than are local labor markets within a country, there would be more variation in cross-border prices than in within-country prices. There might also be direct costs to crossing borders because of tariffs and other trade restrictions. In addition, there may be more homogeneity to the relative productivity shocks, $\alpha_i/\alpha_j$, for city pairs within the same country than for cross-border city pairs, so that, from equation (1), cross-border pairs have more price volatility.

An important reason why the border matters is unrelated to equation (1): the price of a consumer good might be sticky in terms of the currency of the country in which the good is sold. Goods sold in the United States might have sticky prices in U.S. dollar terms, and goods sold in Canada might have sticky prices in Canadian dollar terms. The nominal exchange rate is, in fact, highly variable. In this case, the cross-border prices would fluctuate along with the exchange rate, but the within-country prices would be fairly stable. Price stickiness may be dependent upon market segmentation. It would be easier for a producer in one location to resist attempts to undercut his fixed nominal price if markets were separated.

The sticky-price explanation is a natural one that has been addressed in previous literature. Our test is in part inspired by Michael Mussa (1986), who noted that the variance of the real exchange rate based on all goods in the consumer price index is larger for Toronto versus Chicago, Vancouver versus Chicago, Toronto versus Los Angeles, and Vancouver versus Los Angeles than it is for Toronto versus Vancouver and Chicago versus Los Angeles when there are floating exchange rates between the United States and Canada. He attributes this pattern to sticky prices or, in his terms, nominal exchange-regime nonneutralities. Within the recent literature on pricing to market, Richard C. Marston (1990) and Alberto Giovannini (1988) specifically consider the role of nominal price stickiness.

II. Distance and the Border

A. The Regressions

We use consumer price data from 23 North American cities for 14 disaggregated consumer price indexes. The data cover the period
### Table 2—Average Price Volatility

<table>
<thead>
<tr>
<th>Good</th>
<th>U.S.—U.S.</th>
<th>Canada—Canada</th>
<th>U.S.—Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0139</td>
<td>0.0198</td>
<td>0.0247</td>
</tr>
<tr>
<td>2</td>
<td>0.0130</td>
<td>0.0100</td>
<td>0.0214</td>
</tr>
<tr>
<td>3</td>
<td>0.0185</td>
<td>0.0149</td>
<td>0.0271</td>
</tr>
<tr>
<td>4</td>
<td>0.0217</td>
<td>0.0085</td>
<td>0.0250</td>
</tr>
<tr>
<td>5</td>
<td>0.0486</td>
<td>0.0279</td>
<td>0.0498</td>
</tr>
<tr>
<td>6</td>
<td>0.0203</td>
<td>0.0097</td>
<td>0.0236</td>
</tr>
<tr>
<td>7</td>
<td>0.0483</td>
<td>0.0167</td>
<td>0.0461</td>
</tr>
<tr>
<td>8</td>
<td>0.0880</td>
<td>0.0178</td>
<td>0.0813</td>
</tr>
<tr>
<td>9</td>
<td>0.0618</td>
<td>0.0192</td>
<td>0.0505</td>
</tr>
<tr>
<td>10</td>
<td>0.0111</td>
<td>0.0186</td>
<td>0.0260</td>
</tr>
<tr>
<td>11</td>
<td>0.0443</td>
<td>0.0240</td>
<td>0.0628</td>
</tr>
<tr>
<td>12</td>
<td>0.0133</td>
<td>0.0190</td>
<td>0.0259</td>
</tr>
<tr>
<td>13</td>
<td>0.0258</td>
<td>0.0143</td>
<td>0.0271</td>
</tr>
<tr>
<td>14</td>
<td>0.0203</td>
<td>0.0083</td>
<td>0.0232</td>
</tr>
<tr>
<td>1–14</td>
<td>0.0321</td>
<td>0.0163</td>
<td>0.0367</td>
</tr>
</tbody>
</table>

Distance (miles): 1,024 (66 pairs) 1,124 (36 pairs) 1,346 (126 pairs)

**Notes:** Entries give the mean value of price volatility across all intercity combinations within the United States, within Canada, and across the U.S.—Canadian border, respectively. The measure of volatility is the standard deviation of the relative price series. Prices are measured as two-month differences. The average distance between cities is given in the final row. The sample period is September 1978—December 1994.

Our regressions attempt to explain $V(P_{j,k})$, the volatility of $P_{j,k}$. We estimate

$$V(P_{j,k}) = \beta_1 r_{j,k} + \beta_2 B_{j,k} + \sum_{m=1}^{n} \gamma_m D_m + u_{j,k}$$

where $r_{j,k}$ is the log of the distance between locations. As in the gravity model of trade, we posit a concave relationship between relative-price volatility and distance. $B_{j,k}$ is a dummy variable for whether locations $j$ and $k$ are in different countries. For reasons we have explained, we expect the coefficient on this variable to be positive. The regression error is denoted as $u_{j,k}$. Note this is a cross-section regression.

We also include a dummy variable in equation (2) for each city in our sample, $D_m$. That is, for city pair $(j, k)$ the dummy variables for city $j$ and city $k$ take on values of 1. There are a few reasons why we allow the level of the standard deviation to vary from city to city. First, there may be idiosyncratic measurement error or seasonals in some cities that make their prices more volatile on average. Second, for the cities that report prices only bimonthly, there may be additional volatility that is introduced by measurement error from the less frequent observation of prices. Third, as Table 2 indicates, there seems to be somewhat higher average volatility for U.S. cities than for Canadian cities. This may be because the United States is a more heterogeneous country. Either labor markets or goods markets may be less integrated, so there can be greater discrepancies in prices between locations. Alternatively, there may be differences in methodologies for recording prices that lead to greater discrepancies in prices between locations in one country compared to the other.\(^8\)

Table 3 reports our regressions for each of the 14 goods. We find strong evidence that distance is helpful in explaining price dispersion

\(^8\) We could impose the restriction that the coefficient on the dummy for all U.S. cities be equal, and that it be equal for all Canadian cities. In all of the regressions we report here, that restriction is strongly rejected.
## Table 2: Movements in Product-Level Real-Exchange Rates

North California and British Columbia

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>All Exporters</th>
<th>US Exporters</th>
<th>Can Exporters</th>
<th>ROW Exporters</th>
<th>Domestic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Std\textsuperscript{intra,U.S.}</td>
<td>0.06</td>
<td>0.06</td>
<td>0.05</td>
<td>0.09</td>
<td>0.07</td>
</tr>
<tr>
<td>2</td>
<td>Std\textsuperscript{intra,Can}</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>3</td>
<td>Std\textsuperscript{inter}</td>
<td>0.12</td>
<td>0.11</td>
<td>0.11</td>
<td>0.15</td>
<td>0.14</td>
</tr>
<tr>
<td>5</td>
<td>Correl\textsuperscript{intra,U.S.}</td>
<td>0.78</td>
<td>0.76</td>
<td>0.76</td>
<td>0.73</td>
<td>0.74</td>
</tr>
<tr>
<td>6</td>
<td>Correl\textsuperscript{intra,Can}</td>
<td>0.88</td>
<td>0.85</td>
<td>0.85</td>
<td>0.95</td>
<td>0.84</td>
</tr>
<tr>
<td>7</td>
<td>Correl\textsuperscript{inter}</td>
<td>0.07</td>
<td>0.08</td>
<td>0.08</td>
<td>0.07</td>
<td>0.10</td>
</tr>
</tbody>
</table>
1. Volatility of Product-Level RER

- BJ: product-level RER between countries *much* more volatile than product-level RER across regions
- Difference can’t be accounted for by variability in nominal exchange rate (contrast vs. Engel and Rogers)
- Interpretation: Country-specific cost shocks combined with pricing to market
1. Volatility of Product-Level RER

Alternative interpretation:

- Recall that BJ analysis is based on many different stores for a single retail chain
- I analyzed a large cross-section of US supermarket retailers using barcode-level data (Nakamura, 2008)
  - 16% of the variation in prices common across all stores selling an identical product
  - 65% common to stores within a particular retail chain (but not across retail chains)
  - 17% is completely idiosyncratic to the store and product.
- Since BJ analyze only one store, intra country analysis picks up “retail chain” component (65% of variation)
- In Engel-Rogers analysis, these chain-level effects wash out since indexes are based on many products and stores
1. Volatility of Product-Level RER

- Suppose in contrast that US and Canada branches of Retailer X act like separate retail chains
- Estimate based on only one chain would underestimate the true volatility of the RER across regions within a country
- Remaining difference between inter and intra country RER volatility might be explained by exchange rate (Engel-Rogers conclusion)

- I also argue that large price movements uncorrelated across stores and products more likely to arise from dynamic pricing strategies than static demand/supply shocks (recall they are close to 10% per quarter!)
- Could matter for welfare implications
2. Calibration: What is an industry?

- Burstein and Jaimovich model: Pricing to market arises from the presence of a latent foreign competitor in an industry who is unaffected by foreign wage shock.
- Could look for evidence of such competitors by studying average market shares of US exports by category.
2. **Calibration: What is an industry?**

- Scatter plots suggest that many categories have a market share of 1 or 0 for US exports.
- Not necessarily supportive of presence of latent foreign competitor (definitely not true for orange juice!)
- Predictions of model depend crucially on this parameterization.
- No latent competitor in industry $\rightarrow$ No PTM.
  - Note: Importance of industry definition for extent of PTM not fundamental to all models of PTM.
2. **Calibration: What is an industry?**

- Paper focuses on model as a tractable way of generating PTM
- Model also has predictions for how pricing to market differs across categories depending on the “strength” of competition
- Paper does not analyze model’s predictions for relationship between PTM and presence of latent competitor because of the difficulty of defining the “industry”
  - e.g. Should market for juice include only orange juice, all juice or should it include soft drinks as well
- But BJ do use category market shares as a target in model calibration
  - Unclear whether we are supposed to take model’s predictions for market shares by category seriously or not
- Alternative approach: Use direct estimates of the curvature of demand based on price and quantity data
3. Interpretaion of Country of Origin Statistics

- BR collected country of origin statistics by looking at labels on product in US and Canada
- Objective: distinguish between true markup differences vs. differences in costs

Country of origin labeling:
- US: Products labeled as made in the U.S. must be “all or virtually all” made in the U.S.
- Canada: Country of origin reflects country of origin of food contents
- Canadian products must often be repackaged because of differences in labeling (French required), nutritional content requirements, sizes etc.
  - Probably one reason why the vast majority of BR matches are not “exact matches” (slight differences in size, name etc.)
3. **INTERPRETATION OF COUNTRY OF ORIGIN STATISTICS**

- Key assumption: Matched products have same production cost if produced in the same country.
- Canadian repackaging process may drive a wedge between cost of product sold in U.S. and Canada even if it is labeled as “Made in U.S.A.”
- Such “local costs” could exacerbate observed variability in the aggregate RER beyond the effects of true PTM.