
Aaditya Mattoo, World Bank
Prachi Mishra, IMF and Government of India
Arvind Subramanian, Peterson Institute

Second Annual IMF/WB/WTO Trade Workshop
June 5-6, 2013

The views expressed in this paper are those of the authors and do not necessarily represent those of any of the institutions to which the authors belong.
Motivation

• The real effects of exchange rate movements is one of the oldest questions in the international economics literature.

• A vast theoretical and empirical literature (using both macro and micro data) focuses on effects of exchange rate movements on the country themselves (Goldstein and Khan, 1985; Berman, Martin and Mayer (2011))
Motivation (contd.)

• Scarce evidence on *spillover effects* of exchange rate movements

• *Beggar-thy-neighbor effects*
  
  – Robinson (1947) observations about macroeconomic mercantilism
Why China?

• China’s exchange rate policy has been in discussion
  – Bernanke (2005) “global savings glut” hypothesis
  – High unemployment and low capacity utilization in industrial countries

• Discussions focused on industrial countries
  – Little attention on emerging and developing/emerging countries who compete closely with China in international markets

• China’s size
  – Potential spillover effects for many countries.
    • Largest exporter of goods in 2009.
    • Broadly diversified in the product space
Anecdotal evidence: falling competitiveness of China affecting developing countries

- “Bangladesh, With Low Pay, Moves In on China” (New York Times, July, 2010)
  – …… As costs have risen in China, long the world’s shop floor, it is slowly losing work to countries like Bangladesh, Vietnam and Cambodia…”
Question

• Do movements in China’s exchange have spillover effects for developing countries?

• Can we estimate the magnitude of “competitor-country” effect?
  – China’s exchange rate depreciates vis-à-vis say the US, how does it affect a developing country, which exports to the US market?
Preview of Findings

• Robust evidence for the existence of a statistically and economically significant competitor-country effect.

  – Exports to third-markets of countries with a greater degree of competition with China increases/decreases significantly more as the renminbi appreciates/depreciates.

  – 10% appreciation is associated with a 1.5-2% increase in developing country exports at the product level.
Roadmap

- Literature / contribution
- Theoretical framework
- Identification strategy
- Empirical specification
- Data
- Results
- Conclusions
Literature

• Macro literature on exchange rates and export volumes
  – Deardorff (1984); Hooper, Johnson and Marquez (2000); Thursby and Thursby (1987)

• Rising micro evidence
  – Dekle and Royoo (2002); Das, Roberts and Tybout (2001); Forbes (2002); Berman, Martin and Mayer (2011)

• Rising literature specific to China
  – Eichengreen and Tong (2004), Ahearne et. al., 2003
    • Add China’s exports in a gravity/total trade model
  – Eichengreen and Tong (2011)
    • Effect of renminbi revaluation on stock markets
Our contribution

• Focus on quantifying a very specific channel
  – Effect of China’s exchange rate movements on exports of countries competing with China in international markets

• To our knowledge, first paper to provide systematic empirical evidence on the channel
Theoretical framework – based on Feenstra, Obstfeld and Russ (2011)

• J countries, G different goods;
  – each country produces a range of distinct varieties of each good

• Constant elasticity of substitution consumption index for representative consumer in country j ($\eta$)

• Armington assumption: goods differentiated by their country of origin;
  – constant elasticity of substitution between domestically produced and foreign varieties of good g ($\omega_g$)
  – constant elasticity of substitution between different varieties of good g originating in different exporters ($\sigma_g$)
Import demand function

\[ V_{ij} = [\kappa_g^{ij} \left( \frac{P_{ij}^g}{P_{Fj}^g} \right)^{1-\sigma_g}] \ast [(1 - \beta_g^j) \left( \frac{P_{Fj}^g}{P_j^g} \right)^{1-\omega_g}] \ast [\alpha_g^j \left( \frac{P_j^g}{P_j^g} \right)^{1-\eta}] \ast P_j^j C_j \]
\[
\frac{\partial \ln V_{ij}^g}{\partial \ln E^{Cj}} = \frac{\partial \ln V_{ij}^g}{\partial \ln P_{g}^{Fj}} \ast \frac{\partial \ln P_{g}^{Fj}}{\partial \ln P_{g}^{Cj}} \ast \frac{\partial \ln P_{g}^{Cj}}{\partial \ln E^{Cj}}
\]

\[
= -(\sigma_g - \omega_g) \ast s_g^{Cj} \ast \mu_g^{Cj}
\]

\[P_{g}^{Cj} = \text{Price of Chinese goods in } j\]

\[= P_{g}^{C} \ast (1 / E^{Cj})^{\mu_{g}^{Cj}}\]

\[E^{Cj} = \text{Renminbi/importer currency}\]

\[s_g^{Cj} = \text{Share of China in } j's \text{ total imports of good } g\]

\[\mu_g^{Cj} = \text{Pass-through of Chinese exchange rate to import prices of Chinese goods in country } j\]
\[ V_{g(4)}^{ij} = \sum_{g=1}^{G} V_{g}^{ij} \]

\[
\frac{\partial \ln V_{g(4)}^{ij}}{\partial \ln E^{Cj}} = -\sum_{g=1}^{G} \left[ \left( \frac{V_{g}^{ij}}{V_{g(4)}^{ij}} \right) * s_{g}^{Cj} \right] * \mu_{g}^{Cj} * (\sigma_{g} - \omega_{g})
\]

Assume \( \mu_{g}^{Cj} = \mu_{g(4)}^{Cj} \)

\( \sigma_{g} - \omega_{g} = \sigma_{g(4)} - \omega_{g(4)} \)

[constant for all 6 digit products within the 4-digit]
\[
\frac{\partial \ln V_{ij}^{g(4)}}{\partial \ln E^{Cj}_{g(4)}} = I_{ijC}^{g(4)} \ast \left[ -\mu_{g(4)}^{Cj} \ast \left( \sigma_{g(4)} - \omega_{g(4)} \right) \right] \quad \text{(I)}
\]

\[
I_{ijC}^{g(4)} = \sum_{g=1}^{G} \left( \frac{V_{ij}^{g}}{V_{ij}^{g(4)}} \right) \ast s_{g}^{Cj}
\]

Value-based Index of competition for good \( g \) with China for exporter \( i \) in importing country \( j \)
Under symmetry assumption

\[ V_{g}^{ij} = K_{g}^{ij} \]

\[ S_{g}^{Cj} = S_{g(4)}^{Cj} \]

\[
\frac{\partial \ln V_{g(4)}^{ij}}{\partial \ln E_{Cj}} = CI_{g(4)}^{ijC} \ast \left[ -S_{g(4)}^{Cj} \ast \mu_{g(4)}^{Cj} \ast (\sigma_{g(4)} - \omega_{g(4)}) \right] - - - (II)
\]

\[ CI_{g(4)}^{ijC} = \frac{N_{g}^{ij}}{N_{g(4)}^{ij}} \]

= Count - based index of competition with China

= Number of 6 - digit lines which both \( i \) and China export to \( j \),

Total number of 6 - digit lines which \( j \) imports from \( i \)

within 4 - digit category
Summary of Key Predictions

1. Assuming \( g > g \)

\[
\frac{\ln V_{ij}^g}{\ln E_{Cj}^g} < 0
\]

2. The magnitude of the competitor country effect depends on the index of competition. Higher the index of competition, larger the magnitude of the third market effect.

3. The magnitude of the third market effect is higher
   (i) Higher the \( g \),
   (ii) lower the \( g \),
   (iii) higher \( Cj \).
Empirical specification

\[ \ln X_{ijpt} = \beta I_{ijp} \ln ER_{jt} + v_{jpt} + s_{ipt} + \gamma_{ijt} + \theta_{ijp} + \epsilon_{ijpt} \]

Hypothesis:
\( \beta \) is significant

\( \beta < 0 \)
Data

• Bilateral exports – UN Comtrade
  – Exporter, importer, product (HS-6 digit) year level
  – Deflated by US CPI
  – 57 importers (constituting 95% of total developing country exports 2008), 124 developing country exporters

• Exchange rates from the IFS
  – Renminbi/importer currency
  – Deflated by China’s CPI

• Information on product types
  – UN Broad Economic Classification (Pula, Gabor, and Peltonen, 2009) : Consumer/capital+intermediate
  – Rauch (1999) classification (homogenous/differentiated)
  – Peneder (2001) – skill intensity

• Period covered: 2000-2008
Value-based Index of Competition: By Region of Exporter
Figure 2: China's nominal bilateral exchange rate, 2000-08
(index, 2000=100; increase denotes depreciation)
Table 1. Exports from Developing Countries and Chinese Exchange Rates: Product-Level Evidence

<table>
<thead>
<tr>
<th>Value-based index of competition</th>
<th>[1]</th>
<th>[2]</th>
<th>[3]</th>
<th>[4]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index of competition with China*(\log) (exchange rate of importer with respect to China)</td>
<td>-0.18***</td>
<td>-0.23***</td>
<td>-0.13***</td>
<td>-0.35***</td>
</tr>
<tr>
<td></td>
<td>[0.002]</td>
<td>[0.001]</td>
<td>[0.001]</td>
<td>[0.004]</td>
</tr>
<tr>
<td>N</td>
<td>3,586,936</td>
<td>3,586,936</td>
<td>3,586,936</td>
<td>3,586,936</td>
</tr>
</tbody>
</table>

Fixed effects

<table>
<thead>
<tr>
<th>Fixed effect</th>
<th>N</th>
<th>N</th>
<th>N</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>exporter<em>importer</em>product</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>exporter<em>importer</em>time</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>exporter<em>product</em>time</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>importer<em>product</em>time</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Index of competition with China*(\log(\text{exchange rate of importer with respect to China}))</td>
<td>Count-based index of competition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>-------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[5]</td>
<td>[6]</td>
<td>[7]</td>
<td>[8]</td>
</tr>
<tr>
<td>-0.25***</td>
<td>-0.23***</td>
<td>-0.16***</td>
<td>-0.22***</td>
<td></td>
</tr>
<tr>
<td>[0.001]</td>
<td>[0.001]</td>
<td>[0.000]</td>
<td>[0.002]</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>3,586,936</td>
<td>3,586,936</td>
<td>3,586,936</td>
<td>3,586,936</td>
</tr>
</tbody>
</table>

Fixed effects

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>exporter<em>importer</em>product</th>
<th>exporter<em>importer</em>time</th>
<th>exporter<em>product</em>time</th>
<th>importer<em>product</em>time</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
Robustness tests

• Drop outliers
• Alternative clustering
• Different years for initial index of competition
• Finger-Krenin index of export similarity
• Alternative measures of the exchange rate variable
• Control for other countries’ exchange rate
• Across regions of exporters
• Degree of product disaggregation
• Long differencing (2000 and 2008)
• Lags of exchange rate
• Long-run effects
Discussion of magnitudes

• “Competitor-country effect” of 1.5-2 percent due to a 10% depreciation of Chinese exchange rate, evaluated at the average index of competition
<table>
<thead>
<tr>
<th>Percentile of the index of competition</th>
<th>Value-based index</th>
<th>Count-based index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline Min Max</td>
<td>Baseline Min Max</td>
</tr>
<tr>
<td>10</td>
<td>-0.01 0.00 -0.01</td>
<td>0.00 0.00 0.00</td>
</tr>
<tr>
<td>50</td>
<td>-1.30 -0.47 -2.52</td>
<td>-1.99 -1.39 -3.74</td>
</tr>
<tr>
<td>90</td>
<td>-3.12 -1.13 -6.03</td>
<td>-2.22 -1.55 -4.17</td>
</tr>
</tbody>
</table>
Interpretation of the magnitudes: what should we expect based on theory? (contd.)

(1) $\sigma = 3$ (Feenstra, Obstfeld and Russ, 2011)
(2) $\omega = 1$ (Feenstra, Obstfeld and Russ, 2011)
(3) $\mu = 0.4$ (Gopinath et al., 2011; Campa and Goldberg, 2005)
(4) $s = 0.4$

\[
I_{g(4)}^{ijC} \beta^{Theory,Value} = -0.32
\]
\[
CI_{g(4)}^{ijC} \beta^{Theory,Count} = -0.29
\]
Table 8. Products Distinguished by Degree of Differentiation

Dependent variable = log(exports) at (exporter,importer, 4-digit product, year) level

<table>
<thead>
<tr>
<th>Value-based index</th>
<th>Homogenous</th>
<th>Differentiated</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
</tr>
</tbody>
</table>

Index of competition with China*log(exchange rate of importer with respect to China)

-0.339***
[0.010]

Index of competition with China*log(exchange rate of importer with respect to China)*Dummy for homogenous

-0.040***
[0.003]

N
981,310
2,679,680
1,326,035
Table 9. Products Distinguished by Domestic Value Added

Dependent variable = log(exports) at (exporter, importer, 4-digit product, year) level

<table>
<thead>
<tr>
<th></th>
<th>Value-based index</th>
<th></th>
<th></th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High domestic value added</td>
<td>Low domestic value added</td>
<td>Interaction</td>
<td></td>
</tr>
<tr>
<td>Index of competition with China* log(exchange rate of importer with respect to China)</td>
<td>-0.329***</td>
<td>-0.285***</td>
<td>-0.283***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.005]</td>
<td>[0.005]</td>
<td>[0.007]</td>
<td></td>
</tr>
<tr>
<td>Index of competition with China* log(exchange rate of importer with respect to China)* Dummy for high domestic value added</td>
<td></td>
<td></td>
<td></td>
<td>-0.125***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[0.013]</td>
</tr>
<tr>
<td>N</td>
<td>1,511,450</td>
<td>1,830,310</td>
<td>3,341,760</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

• Use detailed product-level data to develop an index of competition with China, based on the extent of a country’s overlap with China in its exports to third markets.
  – Two indices based on value and count

• Adaptation of the Feenstra, Obstfeld and Russ (2011) framework to derive the indices of competition and develop a novel identification strategy

• Robust evidence that an appreciation of China’s exchange rate benefits developing country exports.

• To our knowledge, first paper to provide systematic empirical evidence on “competitor country” effect.
Thank you!