What goes around comes around: Export-enhancing effects of import-tariff reductions

Kazunobu Hayakawa, Jota Ishikawa, Nori Tarui
Purpose of this paper

✓ Empirical investigation of

Ishikawa & Tarui (2015) → under revision

“Backfiring with Backhaul Problems: Trade and Industrial Policies with Endogenous Transport Costs”
Purpose of Ishikawa & Tarui (2015)

1st purpose

➢ To introduce an international transport sector into a standard international trade model

➢ To construct the model, characteristics of international shipping are taken into account
Purpose of Ishikawa & Tarui (2015)

2nd purpose

➢ To explore the effects of policies
  ➢ Trade policy: tariffs
  ➢ Industrial policy: taxes in the transport sector

➢ We study how trade and industrial policies perform differently when transport costs are endogenous and subject to backhaul problems
Trade costs in international trade

- Anderson and van Wincoop (JEL, 2004)

- Trade costs: All costs incurred in getting a good to a final user other than the MC of producing the good itself

1. **Transport costs** (both freight costs and time costs)
2. **Trade barriers**: Policy barriers (tariffs and NTBs), Information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs
3. **Local distribution costs** (wholesale and retail)
Trade costs in international trade

✓ Anderson and van Wincoop (JEL, 2004)
“The death of distance is exaggerated. Trade costs are large, …”

➢ Ad-valorem tax equivalent of trade costs: 170% for industrialized countries

\[ 1.7 = 1.21(\text{transport costs}) \times 1.44(\text{trade barriers}) \times 1.55(\text{retail & distribution}) - 1 \]

❖ Ad-valorem tax equivalent of transport costs: 21%
  • Ad-valorem tax equivalent of freight costs: 10.7%
❖ Ad-valorem tax equivalent of tariffs and NTBs: 7.7%
Transport costs in trade theory

- Mostly neglected
- Deardorf (2014): “The most obvious cost of trade is transportation, but even this has been surprisingly neglected in trade theory.”
- Ad hoc even if not neglected
  - Implicit treatment
    - Exogenous
    - Symmetric
      - Iceberg type (Samuelson, 1952) is often assumed
      - Transport costs should be treated “explicitly” in trade theory

INTRODUCTION
Characteristics of international shipping

1. Market power
2. Asymmetric freight rates
3. Backhaul problem
Characteristics of international shipping (Market power)

Operator's share of the world liner fleet in TEU (twenty-foot equivalent unit) terms

<table>
<thead>
<tr>
<th>Rank</th>
<th>Operator</th>
<th>Country</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>APM-Maersk</td>
<td>Denmark</td>
<td>14.7%</td>
</tr>
<tr>
<td>2</td>
<td>Mediterranean Shipping Co</td>
<td>Switzerland</td>
<td>12.9%</td>
</tr>
<tr>
<td>3</td>
<td>CMA CGM Group</td>
<td>France</td>
<td>8.8%</td>
</tr>
<tr>
<td>4</td>
<td>China Cosco Shipping Group</td>
<td>China</td>
<td>7.4%</td>
</tr>
<tr>
<td>5</td>
<td>Evergreen Line</td>
<td>Taiwan</td>
<td>4.5%</td>
</tr>
</tbody>
</table>

INTRODUCTION

48.3%
Characteristics of international shipping

(Market power)

The liner trade is organized into cartels, or conferences

- Empirical evidence for market power
  - Sjostrom (1992)
  - Hummels, Lugovskyy and Skiba (2007)

- Joint operation
  - April, 2017: CMA CGM + Cosco + Evergreen + OOCL (Hong Kong) → share: 23.5%
Characteristics of international shipping

(Market power)

- Two large air cargo alliances
  - SkyTeam Cargo
    - Members of the SkyTeam airline alliance
  - WOW Alliance
    - SAS Cargo Group & Singapore Airlines Cargo
- Air cargo between Japan and US
  - Alliance between ANA and United \( \rightarrow \) Share: over 30%
- Air cargo between Japan and Europe
  - Alliance between ANA and Lufthansa \( \rightarrow \) Share: over 30%
Characteristics of international shipping

(Asymmetric freight rates among directions)

Freight rates (market averages)
on three major liner trade routes (Fourth Quarter, 2009)

Dollars per TEU
(Twenty-foot equivalent unit)

<table>
<thead>
<tr>
<th>Route</th>
<th>Freight Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia-U.S.</td>
<td>1,280</td>
</tr>
<tr>
<td>U.S.-Asia</td>
<td>1,400</td>
</tr>
<tr>
<td>Europe-Asia</td>
<td>1,400</td>
</tr>
<tr>
<td>Asia-Europe</td>
<td>1,400</td>
</tr>
<tr>
<td>U.S.-Europe</td>
<td>1,800</td>
</tr>
<tr>
<td>Europe-U.S.</td>
<td>1,200</td>
</tr>
</tbody>
</table>

Source: UNCTAD Review of Marine Transport 2010 Table 4.5.
Characteristics of international shipping
(Asymmetric freight rates among directions)

Why are freight rates asymmetric among directions?

- Shipping involves a round trip
- Carriers have to commit to the shipping capacity to meet the maximum shipping volume
  ➔ “Backhaul problem” with imbalance in shipping volume in two directions
  “There is an opportunity cost associated with returning without a full load”

INTRODUCTION
Characteristics of international shipping
(Backhaul problem)

Introducing

Country A

with a full load

Imbalance in shipping volume in two directions

Without a full load

Country B

The backhaul problem makes shipping different from standard intermediate inputs

INTRODUCTION
EXTENSIONS
1. Multiple carriers
2. Different product-market structures
3 possible cases

1. Excess shipping capacity from country B to A
   - with a full load
   - without a full load

2. No excess shipping capacity
   - with a full load
   - with a full load

3. Excess shipping capacity from country A to B
   - without a full load
   - with a full load

Country A

Country B
Main result investigated in this paper

- Country $j$’s import tariffs decrease the freight rate from country $i$ to country $j$ and could increase the freight rate from country $j$ to country $i$

→ Country $j$’s import tariffs could affect the exporting sector by decreasing its exports
Figure 3 (b): Tariffs set by country B (with $\tau_A = 0$)

(Ishikawa and Tarui, 2015)

$\tau_B \uparrow \Rightarrow T_{AB} \downarrow, (T_{AB} + \tau_B) \uparrow, T_{BA} \uparrow \Rightarrow x_{AB}, x_{BA} \downarrow$

Freight rate

$x_{AB}, x_{BA}$

$(\Omega_A + \Omega_B - r)/2(\mu_A + \mu_B)$

$(\Omega_A - r)/2\mu_A$

$O$

$\tau_B$

$F$

$A'$

$B'$

Type 2B

Type 3B

$(\Omega_B \mu_A - \Omega_A \mu_B + r \mu_B)/\mu_A$
Empirical Specification

- Empirically examining two relationships
  - Tariffs $\rightarrow$ Freight rates of exporting: Positive?
  - Tariffs $\rightarrow$ Exports: Negative?

Freight rates from Country A to B $\downarrow$ Country A’s exports $\uparrow$

Country A

Tariff reduction

Country A’s imports $\uparrow$ = Demand for shipping from Country B to A $\uparrow$

Freight rates form Country B to A $\uparrow$

Country B
Empirical Specification

- Freight rates
  - Maritime Transport Costs database in the OECD
    - 8 destination x 137 origin at an HS 6-digit level during 2003-2007
    - Australia, New Zealand, the United States, Argentina, Brazil, Chile, Colombia, Ecuador, Peru, and Uruguay
  - Compute ad valorem freight rates in transporting products subject to containerized trade
    - All products except for HS codes 10, 1201-1207, 1507-1514, 25, 26, 2701-2716, 28, 29, 31, 72, 8701-8705, 8716, 8802, and 89

- Tariff rates
  - Average of applied tariff rates over commodities subject to containerized trade
  - Weighted average in terms of imports at a commodity-level (HS 6-digit)
    - Not taking the sample selection issue into account
**Empirical Specification**

\[ \ln \text{Freight}_{ijt} = \gamma_1 \ln(1 + \text{Tariff}_{ijt}) + \gamma_2 \ln(1 + \text{Tariff}_{jit}) + \gamma_3 \ln \text{Distance}_{ij} + \gamma_3 \text{Border}_{ij} + \gamma_4 \text{Colony}_{ij} + \gamma_5 \text{Language}_{ij} + u_{it} + u_{jt} + \epsilon_{ijt}. \]

Positive in Exporter’s tariffs

Negative in Importer’s tariffs

- Freight rates from Country A to B ↓
- Country A’s exports ↑
- Tariff reduction
- Country A’s imports ↑ = Demand for shipping from Country B to A ↑
- Freight rates from Country B to A ↑
Data Sources

- **Imports**
  - Used for a weight in tariff variables (imports at a fob basis)
  - BACI database in CEPII

- **Distance, Border, Colony, and Language**
  - CEPII website

- **Tariffs**
  - Obtaining raw data from the WITS database
  - Identifying the lowest tariff rates among all schemes available for each country pair at a tariff-line level
  - Converting to tariff rates at HS 6-digit level (simple average)
  - Computing the weighted average of tariff rates by using the average of HS six-digit level imports during 2003-2007 as a weight.
Figure 2. Distribution of Ad-valorem Freight Rates in 2007

Source: Authors computation using the Maritime Transport Costs database
Figure 3. Change of Tariff Rates from 2003 to 2007

*Source:* Authors computation using the WITS database
Table 1. Basic Statistics

<table>
<thead>
<tr>
<th>Analysis for Freight Costs</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln Freight</td>
<td>4,391</td>
<td>-2.890</td>
<td>0.711</td>
<td>-7.3627</td>
<td>-0.001</td>
</tr>
<tr>
<td>ln (1+Importer's tariffs)</td>
<td>4,391</td>
<td>0.071</td>
<td>0.053</td>
<td>0.000</td>
<td>0.343</td>
</tr>
<tr>
<td>ln (1+Exporter's tariffs)</td>
<td>4,391</td>
<td>0.082</td>
<td>0.084</td>
<td>0</td>
<td>0.836</td>
</tr>
<tr>
<td>ln Distance</td>
<td>4,391</td>
<td>9.128</td>
<td>0.661</td>
<td>5.371</td>
<td>9.894</td>
</tr>
<tr>
<td>Border</td>
<td>4,391</td>
<td>0.031</td>
<td>0.172</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Colony</td>
<td>4,391</td>
<td>0.003</td>
<td>0.050</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Language</td>
<td>4,391</td>
<td>0.242</td>
<td>0.429</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Gravity Analysis

| ln Value                           | 77,468 | 8.312  | 3.482     | 0        | 19.451   |
| ln Quantity                        | 77,468 | 7.112  | 3.919     | -6.908   | 19.074   |
| ln (1+Importer's tariffs)         | 77,468 | 0.073  | 0.078     | 0.000    | 1.859    |
| ln (1+Exporter's tariffs)         | 77,468 | 0.073  | 0.078     | 0        | 1.859    |
| ln Distance                        | 77,468 | 8.595  | 0.854     | 4.107    | 9.894    |
| Border                             | 77,468 | 0.025  | 0.157     | 0        | 1.000    |
| Colony                             | 77,468 | 0.019  | 0.137     | 0.000    | 1.000    |
| Language                           | 77,468 | 0.162  | 0.369     | 0.000    | 1.000    |
| ln Value of Materials              | 67,786 | 7.166  | 3.335     | 0.000    | 17.762   |
| ln Quantity of Materials           | 67,786 | 5.706  | 3.879     | -7.794   | 16.906   |
Table 2. Baseline Estimation Results

<table>
<thead>
<tr>
<th></th>
<th>(I)</th>
<th>(II)</th>
<th>(III)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln (1+Importer's tariffs)</td>
<td>-0.694**</td>
<td></td>
<td>-0.731**</td>
</tr>
<tr>
<td>ln (1+Exporter's tariffs)</td>
<td></td>
<td>0.364**</td>
<td>0.387**</td>
</tr>
<tr>
<td>ln Distance</td>
<td>0.070**</td>
<td>0.060**</td>
<td>0.066**</td>
</tr>
<tr>
<td>Border</td>
<td>-0.371***</td>
<td>-0.354***</td>
<td>-0.364***</td>
</tr>
<tr>
<td>Colony</td>
<td>-0.370***</td>
<td>-0.384***</td>
<td>-0.371***</td>
</tr>
<tr>
<td>Language</td>
<td>0.042</td>
<td>0.052</td>
<td>0.046</td>
</tr>
<tr>
<td>Number of observations</td>
<td>4,391</td>
<td>4,391</td>
<td>4,391</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.2516</td>
<td>0.2514</td>
<td>0.2524</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is a log of ad-valorem freight rates. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. In the parenthesis is the heteroscedasticity-consistent standard error. In all specifications, we control for exporter-year and importer-year fixed effects.
Table 3. Robustness Checks

<table>
<thead>
<tr>
<th></th>
<th>Distance</th>
<th>Coastal</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln (1+Importer's tariffs)</td>
<td>-0.727**</td>
<td>-0.677**</td>
</tr>
<tr>
<td>ln (1+Exporter's tariffs)</td>
<td>0.388**</td>
<td>0.370**</td>
</tr>
<tr>
<td>ln Distance</td>
<td>0.237</td>
<td>0.071**</td>
</tr>
<tr>
<td>(ln Distance)^2</td>
<td>-0.010</td>
<td></td>
</tr>
<tr>
<td>Border</td>
<td>-0.343***</td>
<td>-0.364***</td>
</tr>
<tr>
<td>Colony</td>
<td>-0.373***</td>
<td>-0.362***</td>
</tr>
<tr>
<td>Language</td>
<td>0.047</td>
<td>0.022</td>
</tr>
<tr>
<td>Number of observations</td>
<td>4,391</td>
<td>3,865</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.2523</td>
<td>0.2248</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is a log of ad-valorem freight rates. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. In the parenthesis is the heteroscedasticity-consistent standard error. In all specifications, we control for exporter-year and importer-year fixed effects. In column “Coastal”, we exclude landlocked importers/exporters.
Excluding Landlocked Importers/Exporters

Freight rates from C to A = Freight rates from C to B + Freight rates from B to A
First-differenced Specification

\[ \Delta \ln \text{Freight}_{ijt} = \gamma_1 \Delta \ln (1 + Tariff_{ijt}) + \gamma_2 \Delta \ln (1 + Tariff_{jit}) + u_{it} + u_{jt} + \epsilon_{ijt} \]

- Eliminating not only time-invariant country pair effects but also all effects that are unchanged between two consecutive years
- More efficient than the specification with country pair fixed effects if the error terms are serially correlated and/or follow a random walk
Table 4. First Differenced Specification

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Coastal</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln (1+Importer's tariffs)</td>
<td>-1.769***</td>
<td>-1.723**</td>
</tr>
<tr>
<td>ln (1+Exporter's tariffs)</td>
<td>1.112</td>
<td>1.397*</td>
</tr>
<tr>
<td>Number of observations</td>
<td>3,097</td>
<td>2,765</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.097</td>
<td>0.0801</td>
</tr>
</tbody>
</table>

*Notes:* The dependent variable is the first difference of a log of ad-valorem freight rates. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. In the parenthesis is the heteroscedasticity-consistent standard error. In all specifications, we control for exporter-year and importer-year fixed effects. In column “Coastal”, we exclude landlocked importers/exporters.
Empirical Specification for Trade

\[
\ln \text{Export}_{ijt} = \gamma_1 \ln(1 + \text{Tariff}_{ijt}) + \gamma_2 \ln(1 + \text{Tariff}_{jit}) + \gamma_3 \ln \text{Distance}_{ij} \\
+ \gamma_3 \text{Border}_{ij} + \gamma_4 \text{Colony}_{ij} + \gamma_5 \text{Language}_{ij} + u_{it} + u_{jt} + \epsilon_{ijt}
\]

- Negative in Exporter’s tariffs
- Negative in Importer’s tariffs

Freight rates from Country A to B ↓ → Country A’s exports ↑

Tariff reduction

Country A’s imports ↑ = Demand for shipping from Country B to A ↑ → Freight rates from Country B to A ↑
Empirical Issues for Analysis on Trade

- Estimating this gravity equation for not only trade values but also trade volume
- Obtained from the BACI database in CEPII
  - Using trade values at a fob basis
  - Trade quantity measured in ton
- Focusing on and aggregate trade over products subject to containerized trade
- Not taking into account the sample selection issue because of the use of weighted-average of tariff rates
Table 5. Estimation Results for Import Value and Quantity

<table>
<thead>
<tr>
<th></th>
<th>All Value</th>
<th>All Quantity</th>
<th>Materials Value</th>
<th>Materials Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln (1+Importer's tariffs)</td>
<td>-1.476***</td>
<td>-0.875***</td>
<td>-1.988***</td>
<td>-1.253***</td>
</tr>
<tr>
<td>ln (1+Exporter's tariffs)</td>
<td>-0.508***</td>
<td>-0.447***</td>
<td>-0.677***</td>
<td>-0.507***</td>
</tr>
<tr>
<td>ln Distance</td>
<td>-1.495***</td>
<td>-1.837***</td>
<td>-1.269***</td>
<td>-1.658***</td>
</tr>
<tr>
<td>Border</td>
<td>0.646***</td>
<td>0.807***</td>
<td>0.824***</td>
<td>1.210***</td>
</tr>
<tr>
<td>Colony</td>
<td>0.909***</td>
<td>1.093***</td>
<td>1.043***</td>
<td>1.231***</td>
</tr>
<tr>
<td>Language</td>
<td>0.805***</td>
<td>0.873***</td>
<td>0.653***</td>
<td>0.747***</td>
</tr>
<tr>
<td>Number of observations</td>
<td>77,468</td>
<td>77,468</td>
<td>67,786</td>
<td>67,786</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.7901</td>
<td>0.7078</td>
<td>0.7451</td>
<td>0.6429</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is a log of exports or export quantity. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. In the parenthesis is the heteroscedasticity-consistent standard error. In all specifications, we control for exporter-year and importer-year fixed effects. In column “Material”, we focus only on trade in material products.
Focusing on Trade in Intermediate Goods

- Other paths to yield the significant relationship between the exporter’s tariffs and exports?
- Excluding trade in finished products and focusing instead on trade in materials alone
  - 111, 112, 21, 31, 42, and 53 in the BEC

Diagram:

- Country A: Reducing tariffs on materials
- Increase in finished goods production
- Increase in material imports
- Increase in finished goods exports
- Country B
Discussion

Empirical support on theoretical predictions
- Lower tariffs by a country induce the transport firms to lower their freight rates on the country’s export
- Tariff reductions expand not only the country’s imports but its exports.

So... What goes around “really” comes around with an explicit transport sector under trade-policy
- Point to another potential gains from freer trade (cf. welfare analysis in Ishikawa and Tarui 2015)
Mahalo!