Rise of Global Value Chains and Trade in Value Added

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Regional Seminar on International Trade Statistics (UNSD & NBS)

Contents
1. Change of trade pattern: increasing international trade in intermediate goods
2. Rise of Global Value Chains (GVCs)
3. How to measure GVCs
4. Trade in value added and bilateral trade balance
Change of trade pattern

◎ Pre-industrial Revolution:
→ The village market place
Low production technology, high transport cost, lack of information

◎ Industrial Revolution:
→ Mass-production, mass-consumption
Specialization in production, decrease of transportation cost

◎ Post-industrial Revolution:
→ Outsourcing, Fragmentation, Vertical Specialization, Global Supply Chains, Trade in tasks
Reduction of communication cost, trade barriers, flow of FDI

Simple concept of GVCs

Planning of product
R&D/Design/Testing production
Procurement of parts & components
Assembly
Final products
Marketing/sale/export
Customer service/user support
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Planning of product
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Fragmentation production

The fragmentation of production: The example of the Boeing 787 Dreamliner

Made in USA
↓
Made in the World
Linkage: Export share more than 10% (2000)

Linkage: Export share more than 10% (2007)
Contribution of trade in intermediate goods

Contribution rate
Before 2002 vs after 2002

Intermediate goods:
38% → 54%

Household consumption:
34% → 19%

Capital goods:
16% → 20%

Source: calculated by Bo MENG and Norihiko YAMANO, 2011 (using OECD data, preliminary)

How to measure GVCs

Why we need measurement of GVCs:

◎ Increasing complexity of GVCs
→ “What you see is No More what you get.”

◎ Policy needs
→ “You can’t manage what you can’t measure.”
Main data sources used in measuring GVCs

- Firm based data (Apple, Toyota)
  Micro level, but lack of global viewpoint
- Bilateral trade data (import and export)
  Global, but no inter-industry information
- National input-output data
  Inter-industry, but lack of global aspect
- International input-output data
  Inter-country, inter-industry, but time lag (almost 5 years)

Vertical specialisation

\[
\text{VS share} = \frac{\text{induced intermediate imports}}{\text{total exports}}
\]

(=Hummels, et al. (2001) ’s “Import contents of export”)
The change rate of VS share between 1995 and 2005

\[
\Delta \text{VS share} = f (\Delta m, \Delta B, \Delta e)
\]

m: import dependency,
B: domestic inter-industrial production system,
e: export structure.

Source: Meng et al. (2011)
The decomposition result of the change in VS share

Decomposition of fragmentation process

Applying international I-O based decomposition technique to the fragmentation measure:
Total Fragmentation degree = VS + IDF
VS: Conventional Vertical Specialisation indicator
IDF: Indirect Fragmentation Indicator (IDF)
Asian fragmentation index based on international IO data (1995/2005)

(1.0 = Goods and Services exported as final expenditure)

Source: Meng and Yamano (2011)

Trade in value added and its measurement

Components: $10.75
Retail price: $500.00 (Profit margin: 64%)
Assembly: $6.50
iPhone: $179.00

Source: Based on The iPhone example (Xing and Detert, 2010)
How to measure Trade in Value Added

- **Single national IO based measure**
  \[ u \cdot EX = V \cdot B \cdot EX + u \cdot M \cdot B \cdot EX \]
  (Total export) \hspace{1em} (domestic VA of export) \hspace{1em} (import contents of export)

- **International IO based measure**

  Country R’s export of value added to country S:
  \[ VA^{RS} = V^R \cdot L^{RR} \cdot FD^{RS} + V^R \cdot L^{RS} \cdot FD^{SS} \]

  => Trade balance:
  \[ \Sigma S VA^{RS} - \Sigma S VA^{SR} = \Sigma S EX^{RS} - \Sigma S EX^{SR} \]
Summary

- Change of trade pattern: 
  Trade in goods → Trade in Tasks

- Rise of GVCs: “Made in the world”

- Measure of GVCs and related policy issue: “Who produces for whom?”
Reference 1


WTO-IDE-JETRO (2011), Trade patterns and global value chains in East Asia: From trade in goods to trade in tasks, World Trade Organization.

世銀：http://go.worldbank.org/R156ABXQQ9

WTO: http://www.wto.org/english/res_e/statis_e/miwi_e/miwi_e.htm

Reference 2

- WTO-IDE-JETRO (2011), Trade patterns and global value chains in East Asia: From trade in goods to trade in tasks, World Trade Organization.
Production du groupe Toyota, 2004

Principaux flux de pièces détachées entre les filiales de Toyota

Source: www.toyota.com


付加価値

生产工程
Wassily Leontief (1906-1999).
Russian economist.

Application to the measure of GVCs:

\[ V \cdot (I + A^1 + A^2 + A^3 + \ldots + A^n) \cdot F = V \cdot (I - A)^{-1} \cdot F, \quad n \to \infty \]

Source: [http://www.iioa.org/leontief/Photos/photo-harvard.html](http://www.iioa.org/leontief/Photos/photo-harvard.html)
### Figure 5: Layout of Asian I-O 2000

<table>
<thead>
<tr>
<th>Country</th>
<th>Intermediate Demand (A)</th>
<th>Final Demand (F)</th>
<th>Export (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia (AI)</td>
<td>A A A A A A A A A A</td>
<td>F  F  F  F  F  F</td>
<td>E E E E E E</td>
</tr>
<tr>
<td>Malaysia (AM)</td>
<td>A A A A A A A A A A</td>
<td>F  F  F  F  F  F</td>
<td>E E E E E E</td>
</tr>
<tr>
<td>Philippines (AP)</td>
<td>A A A A A A A A A A</td>
<td>F  F  F  F  F  F</td>
<td>E E E E E E</td>
</tr>
<tr>
<td>Singapore (AS)</td>
<td>A A A A A A A A A A</td>
<td>F  F  F  F  F  F</td>
<td>E E E E E E</td>
</tr>
<tr>
<td>Thailand (AT)</td>
<td>A A A A A A A A A A</td>
<td>F  F  F  F  F  F</td>
<td>E E E E E E</td>
</tr>
<tr>
<td>China (AC)</td>
<td>A A A A A A A A A A</td>
<td>F  F  F  F  F  F</td>
<td>E E E E E E</td>
</tr>
<tr>
<td>Taiwan (AN)</td>
<td>A A A A A A A A A A</td>
<td>F  F  F  F  F  F</td>
<td>E E E E E E</td>
</tr>
<tr>
<td>Japan (AJ)</td>
<td>A A A A A A A A A A</td>
<td>F  F  F  F  F  F</td>
<td>E E E E E E</td>
</tr>
<tr>
<td>U.S.A. (AU)</td>
<td>A A A A A A A A A A</td>
<td>F  F  F  F  F  F</td>
<td>E E E E E E</td>
</tr>
</tbody>
</table>

**Freight and Insurance (BF)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Freight and Insurance (BF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea (AK)</td>
<td>K A K A K A K A K A K A K</td>
</tr>
<tr>
<td>U.S.A. (AU)</td>
<td>U A U A U A U A U A U A U</td>
</tr>
</tbody>
</table>

**Import from H.Kong (CH)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Import from H.Kong (CH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China (AC)</td>
<td>C A C A C A C A C A C</td>
</tr>
<tr>
<td>Taiwan (AN)</td>
<td>N A N A N A N A N A N</td>
</tr>
<tr>
<td>U.S.A. (AU)</td>
<td>U A U A U A U A U A U</td>
</tr>
</tbody>
</table>

**Import from EU (CO)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Import from EU (CO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China (AC)</td>
<td>C O C O C O C O C O</td>
</tr>
<tr>
<td>Taiwan (AN)</td>
<td>N O N O N O N O N O</td>
</tr>
<tr>
<td>U.S.A. (AU)</td>
<td>U O U O U O U O U O</td>
</tr>
</tbody>
</table>

**Import from the R.O.W. (CW)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Import from the R.O.W. (CW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China (AC)</td>
<td>C W C W C W C W C W C W</td>
</tr>
<tr>
<td>Taiwan (AN)</td>
<td>N W N W N W N W N W N W</td>
</tr>
<tr>
<td>Japan (AJ)</td>
<td>J W J W J W J W J W J W</td>
</tr>
<tr>
<td>U.S.A. (AU)</td>
<td>U W U W U W U W U W U W</td>
</tr>
</tbody>
</table>

**Value Added (VV)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Value Added (VV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China (AC)</td>
<td>C V C V C V C V</td>
</tr>
<tr>
<td>Taiwan (AN)</td>
<td>N V N V N V N V</td>
</tr>
<tr>
<td>U.S.A. (AU)</td>
<td>U V U V U V U V</td>
</tr>
</tbody>
</table>

**Total Inputs (XX)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Inputs (XX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia (AI)</td>
<td>I X I X I X I X</td>
</tr>
<tr>
<td>Malaysia (AM)</td>
<td>M X M X M X M X</td>
</tr>
<tr>
<td>Philippines (AP)</td>
<td>P X P X P X P X</td>
</tr>
<tr>
<td>Singapore (AS)</td>
<td>S X S X S X S X</td>
</tr>
<tr>
<td>Thailand (AT)</td>
<td>T X T X T X T X</td>
</tr>
<tr>
<td>China (AC)</td>
<td>C X C X C X C X</td>
</tr>
<tr>
<td>Taiwan (AN)</td>
<td>N X N X N X N X</td>
</tr>
<tr>
<td>Japan (AJ)</td>
<td>J X J X J X J X</td>
</tr>
<tr>
<td>U.S.A. (AU)</td>
<td>U X U X U X U X</td>
</tr>
</tbody>
</table>

### Appendix 1

**IO based Factor decomposition technique**

\[
VS\ share = u \cdot m \cdot L \cdot EX/u \cdot EX = u \cdot m \cdot L \cdot e,
\]

\[
\Delta VS\ share = VS\ share_1 - VS\ share_0 = u(m_1\cdot L_1 \cdot e_1 - m_0\cdot L_0 \cdot e_0)
\]

\[
= u \cdot \Delta m \cdot (2L_0 \cdot e_0 + 2L_1 \cdot e_1 + L_0 \cdot e_1 + L_1 \cdot e_0)/6
\]

\[
+ u \cdot (2m_0 \cdot \Delta L \cdot e_0 + 2m_1 \cdot \Delta L \cdot e_1 + m_0 \cdot \Delta L \cdot e_1 + m_1 \cdot \Delta L \cdot e_0)/6
\]

\[
+ u \cdot (2m_0 \cdot L_0 + 2m_1 \cdot L_1 + m_0 \cdot L_1 + m_1 \cdot L_0) \cdot \Delta e / 6.
\]

\(\Delta m\): the change in import dependency,

\(\Delta L\): the change in domestic backward linkage,

\(\Delta e\): the change in export structure.
Appendix 2
Decomposition of fragmentation process

Total intermediate trade (3-country international I-O model):
\[ A \cdot X = A \cdot (I - A)^{-1} \cdot F = A \cdot B \cdot F \]

Trade induced by country 1’s exports of final goods (EX\textsubscript{1}):
\[ u \cdot A \cdot (I - A)^{-1} \cdot EX\textsubscript{1} \]

\[ = u \left( \begin{array}{ccc}
A^{21} & 0 & 0 \\
A^{31} & 0 & 0 \\
\end{array} \right) \cdot B \cdot \left( \begin{array}{c}
EX\textsubscript{1} \\
0 \\
0 \\
\end{array} \right) + u \left( \begin{array}{ccc}
0 & A^{12} & A^{13} \\
0 & 0 & A^{23} \\
0 & 0 & A^{32} \\
\end{array} \right) \cdot B \cdot \left( \begin{array}{c}
EX\textsubscript{1} \\
0 \\
0 \\
\end{array} \right) + u \left( \begin{array}{ccc}
0 & 0 & 0 \\
0 & A^{11} & 0 \\
0 & 0 & A^{22} \\
0 & 0 & A^{33} \\
\end{array} \right) \cdot B \cdot \left( \begin{array}{c}
EX\textsubscript{1} \\
0 \\
0 \\
\end{array} \right) \]

\[ = \Phi_1 + \Phi_2 + \Phi_3 \]

\[ \Phi_1: \text{VS based on single I-O table} \]
\[ \Phi_2: \text{Indirect Fragmentation (IDF) index} \]
\[ \Phi_1 + \Phi_2: \text{Total Fragmentation (TF) index} \]
\[ \Phi_3: \text{induced intra-country transaction} \]
Inter-country backward linkages in Asian Region
(Based on International Leontief Inverse)

1990

2008

Taiwan
Japan
Korea
China
Philippines
Thailand
Malaysia
Singapore
Indonesia

http://www.ide.go.jp/