MEASURING STRUCTURAL CHANGES IN TRADE INTEGRATION AND PRODUCTION NETWORK

Norihiko Yamano, Colin Webb and Geoffrey Hewings

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Contents

• Introduction
• Structural changes
  • External dependency
  • Economic landscape by country
  • Key sectors
• Risk of production disruptions
  • Concentration of export (supply) and import (sourcing)
  • Dominant partner share
  • Forward linkages on domestic and foreign productions
Known structural changes in international trade and production networks

• Evolution of global production networks (particularly in Asia)
• Fragmentation of production processes facilitated by reduction of various transaction costs
• Specialisations (comparative advantages) in specific production stages (tasks) rather than products
• Increasing trades in manufacturing parts and components
• Intra-industry trade

➔ Concerns of vulnerability of global value chains
Disruptions of production networks are observed by the unexpected events of natural and man-made disasters (2011 Earthquakes and Flood in Asia, Toyota and Honda)
Fragmentation of production processes

Final goods production in one region

Region A’s K - L
- Intermediates
- Intermediates
- Production of final goods 1
- Consumer A

Region B’s K - L
- Intermediates
- Intermediates
- Production of final goods 2
- Consumer B

Fragmented production process (an extreme case)

Foreign capital

Reg A
- Imd
- Final 1
- A

Reg B
- Imd
- B

Reg C
- Imd
- C

Reg D
- Imd
- D

Domestic transaction
International(interregional) trade
Economic theories of industry and trade

- Identification of trade and industrial production activities have been always in the central issues of economics and policy planners.
- For example,
  - Increasing return to scale and imperfect competition
  - Urban and regional economics: Economies of agglomeration and external
  - International economics: comparative advantage (Ricardo), factor endowments (H-O), intra-industry
  - Growth theory: endogenous growth model, regional innovation spillovers, intangible assets (knowledge/human capitals)
Concentration or divergence?

Concentration by economies of scale
- Internal economies (increasing return to scale)
- External / agglomeration economies
  - Localization: infrastructure sharing
  - Urbanization: Knowledge intensive economy

Divergence
- Constant return to scale type industries
- Higher transaction cost (services / heavy products)
- Diseconomies of scale (amenity, higher factor price)
- Geographical limitations on factor endowments
- Dispersion of risk
WIOD Data sources

• Bilateral Trade data
  • Basically cover all monetary flows of cross-border transactions
  • Over 5200 commodities (internationally harmonised)
  • Previous year data is available by summer of following year
  • Allows us to study by end-use categories: intermediates, household consumption, capital, mixed use (personal computers, mobile phones, passenger cars, etc)

• Annual Inter-country Input-Output and Supply-use tables
  • Explicitly links final demand, intermediate and value-added components by sector
  • Direct and indirect economic impacts can be measured
  • Fundamental data source for various global model: environment footprints, trade-in-value-added, productivity comparisons
Basic indicators on structural changes

WIOD’s Inter-country I-Os are loaded in REAL I-O, a generic toolbox of Input-Output (IO) analysis based on open-source architecture running on Windows XP/7

http://www.real.illinois.edu/realio/
Intermediate import share (Europe, 100% = total inputs)

Source: WIOD April 2012
Intermediate import share
(Other regions, 100%= total inputs)

Source: WIOD April 2012
Intermediate export ratio (manufacturing)

Source: OECD BTDIxE, 2011
Sector shares of output (1995 and 2009)

Source: WIOD April 2012
Economic landscape (MPM)

Source: WIOD April 2012
China (2009)  

Japan (2009)  

Source: WIOD April 2012  

Ref. Germany (2009)

Source: OECD I-O April 2012

### Key sectors (defined by FL and BL)

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Source: WIOD April 2012
Potential production disruptions?
Bilateral trade database and Inter-country Input-Output system for production disruption analyses

- WIOD-type dataset is useful for vulnerability analyses of global production network
- Identifying potential risks
- Evaluation of potential disruptions of global supply chains
- Contingency plans
Indicators to identify the risks of potential production disruptions

• Supply-side
  • Supply concentration (production activities, exports supplies) = variance (export share of good to world supply)
  • International forward linkage (Hirschman / Jones)
    \[ V (G) = Output, \ G = \text{Ghosh inverse}, \ V = \text{value-added} \]
    \[ FWDi = \sum_j G_{ij} \]

    VA supplied to domestic output = \[ X_{(Vd, d)} = V_d \ G_d \]
    VA supplied to domestic output = \[ X_{(Vd, f)} = V_d \ G_f \]

    Domestic supply ratio = \[ \frac{X_{(Vd, d)}}{X_{(Vd, d)} + X_{(Vd, f)}} \]

• Demand-side
  • Selection of trade partners
    Average partners purchasing share from country k = mean( Import_{kp} / \text{sum Import_p} )
Concentration index of exports (Textile, apparel and footwear) variance (export share of good to world supply)

Production textile and apparels is exports are concentrated (in particular household consumption goods)

HH consumption
Total
Intermediate
Concentration index of exports (Chemicals and Steel production) variance (export share of good to world supply)

Supplies of heavy industry become less concentrated

Export share variance ISIC 24ex2423

Export share variance ISIC 271+2731
Concentration index of exports (Electronics products)

variance (export share of good to world supply)

Computer production became diversified in late 1990s and concentrate again in the late 2000s. Productions of other electronics equipment diversified.

Communication equip. e.g phone, TV

Electric machinery
Concentration index of imports (Electronics products)

variance (import sourcing share to total import of countries)

Intermediate of communication equip. and electronic machinery significantly increased in latest 2000s => Emergence “risk”

Communication equipment

Electric machinery
Summary of concentration indices of export and import (1995-2009)

- **Export**
  - Supply
  - Global share

- **Divergence**

- **Concentration**

- **Import from Various Country**
  - Stable: Agricultural, Mining and Refinery

- **Late90s**
  - Agricultural, Mining and Refinery
  - Chemical and basic metals
  - Electric machinery
  - Electric machinery
  - Chemical and basic metals
  - Electric machinery
  - Computers
  - Computers
  - Textiles

- **Early00s**
  - Chemical and basic metals
  - Electric machinery
  - Computers
  - Communication equipments

- **Communication equipments**

- **Late00s**
  - Chemical and basic metals
  - Electric machinery
  - Computers
  - Communication equipments
  - Textiles

- **Late00s**
  - Chemical and basic metals
  - Electric machinery
  - Computers
  - Communication equipments
  - Textiles
Partners’ average purchasing ratio by sourcing country

ISIC 30: Computers

ISIC 32: Communication equipments
Partners’ average purchasing ratio by sourcing country

ISIC33: Optical and precision instruments

ISIC 34: Motor vehicles
ICIO Forward linkage and domestic supply ratio (ISIC24: chemical products)

Source: WIOD April 2012
ICIO Forward linkage domestic supply ratio
ISIC30-33: Electronics
ISIC34: Motor vehicles

Source: WIOD April 2012
ICIO Forward linkage domestic supply ratio
ISIC71-74 Business Services
ISIC J: Financial intermediation

Source: WIOD April 2012
Summary

- Not surprising results. But, empirically able to visualize the potential risks.
- Dominant supplying countries have shifted in many products. Concentrations of export supplies and import sourcing eventually may have increased risk of production disruption.
- Emergence of Chinese products in export / import markets are obvious, however, Chinese primary inputs end-up most in domestic market (e.g. final goods + near-final intermediates).
- Combining the indicator results, complex structures of global supply chains can be further examined.
Interregional Trade in the Midwest of the US

Activity tree structure for interregional/interactivity loops

Largest first interregional/activities feedback loop -13.2%

Second largest interregional/activities feedback loop - 8.3%

Third largest interregional/activities feedback loop - 4.3%
# Spatial Structure of Japan and US Economies

Table 12. Trade in Japan, 1990: Qualitative presentation of the hierarchy of inter-activities feedback loops.

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UK (2009)

Source: WIOD April 2012

US (2009)

Ref. Germany (2009)
Korea (1995)  
Source: OECD I-O April 2012

Korea (2005)  