

Tracing and Quantifying Thailand's Linkages to the Global Supply Chain: the Modification of World Input-Output Database (WIOD) and the Applications of Leontief Multiplier and Structural Path Analysis

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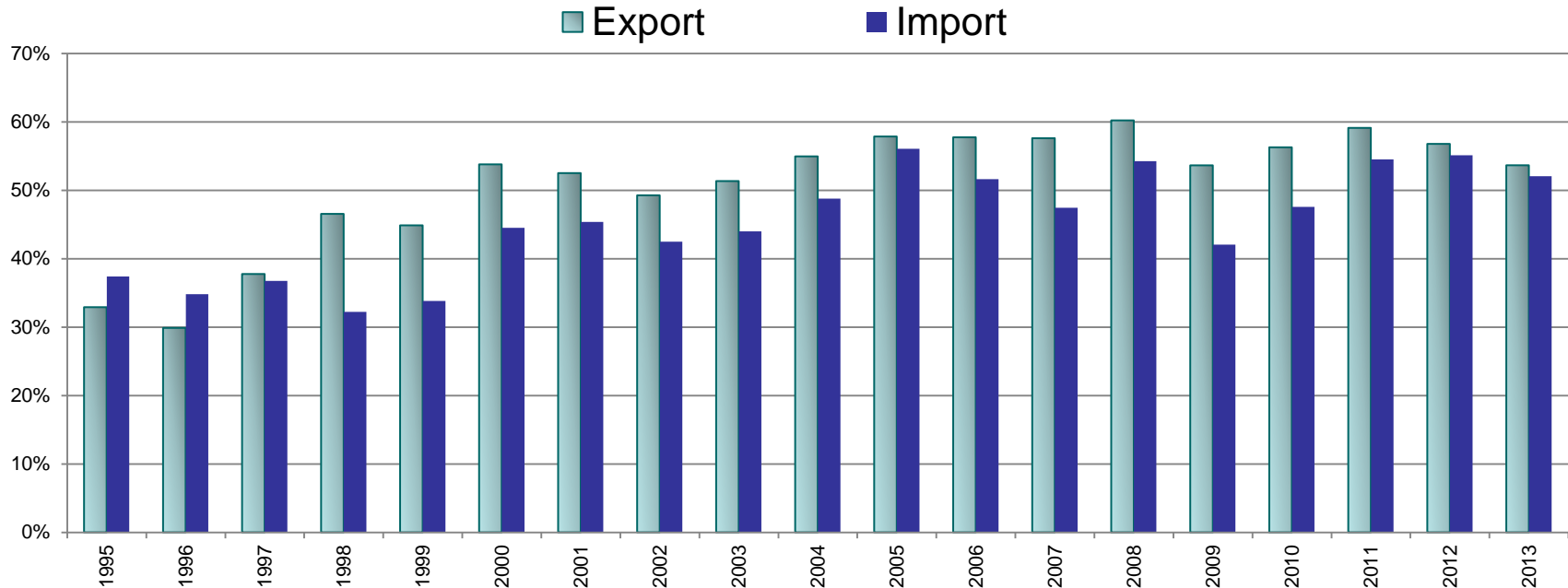
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Main topics

1. Introduction
2. Literature review
3. WIOD table with an extension of Thailand's data
4. Applications on Thailand's Domestic and International Trade Linkages
 - 4.1 Results from computation of Leontief backward and forward multipliers
 - 4.2 Results from Structural Path Analysis
5. Limitations and ongoing improvements

(1) Introduction

Percentage share as of GDP of export and import



Source: Bank of Thailand

- Settled on the **export-led growth** path, the trade openness has gradually deepened its role in Thai economy.
- As illustrated above, the international trade statistics show that both **import and export** are **main components** of Thailand's GDP.

(1) Introduction

Export: The major exported products are manufacturing products, which are mainly electronics and machinery.

Import: The biggest portion of imports is a combination of fuels, raw materials and intermediate parts.

FDI: Foreign Direct Investment (FDI) has been the important part of capital inflows.

- With this evolution of empirical evidences, the linkage of Thai economy to the global economy has been embedding into the network of global supply chain.
- The broader insight on the multifaceted linkage to the world economy is necessary for the country's current and future growth strategy.

(2) Literature review

(2.1) Fragmentation of production

- [Hummels et al. \(2001\)](#) introduced the definition of fragmentation of production, and states that the vertical production is account for 25% of total production.
- [Escaith et al.\(2010 and 2011\)](#) and [Lantz et al.\(2009\)](#) find that more than 50% of the international trade is the shipment of raw materials and intermediate goods.
- [Almad et al.\(2011\)](#), [Daudin et al.\(2006 and 2009\)](#), [Johnson and Noguera \(2012\)](#) and [Koopman et al.\(2008 and 2011\)](#) used the GTAP database and found the values of trade balance has to be adjusted to the volume of international shipment of intermediate goods.
- In some cases, this might lead to the magnitude of 30%-40% adjustment of the conventionally reported values of trade balance.

(2) Literature review

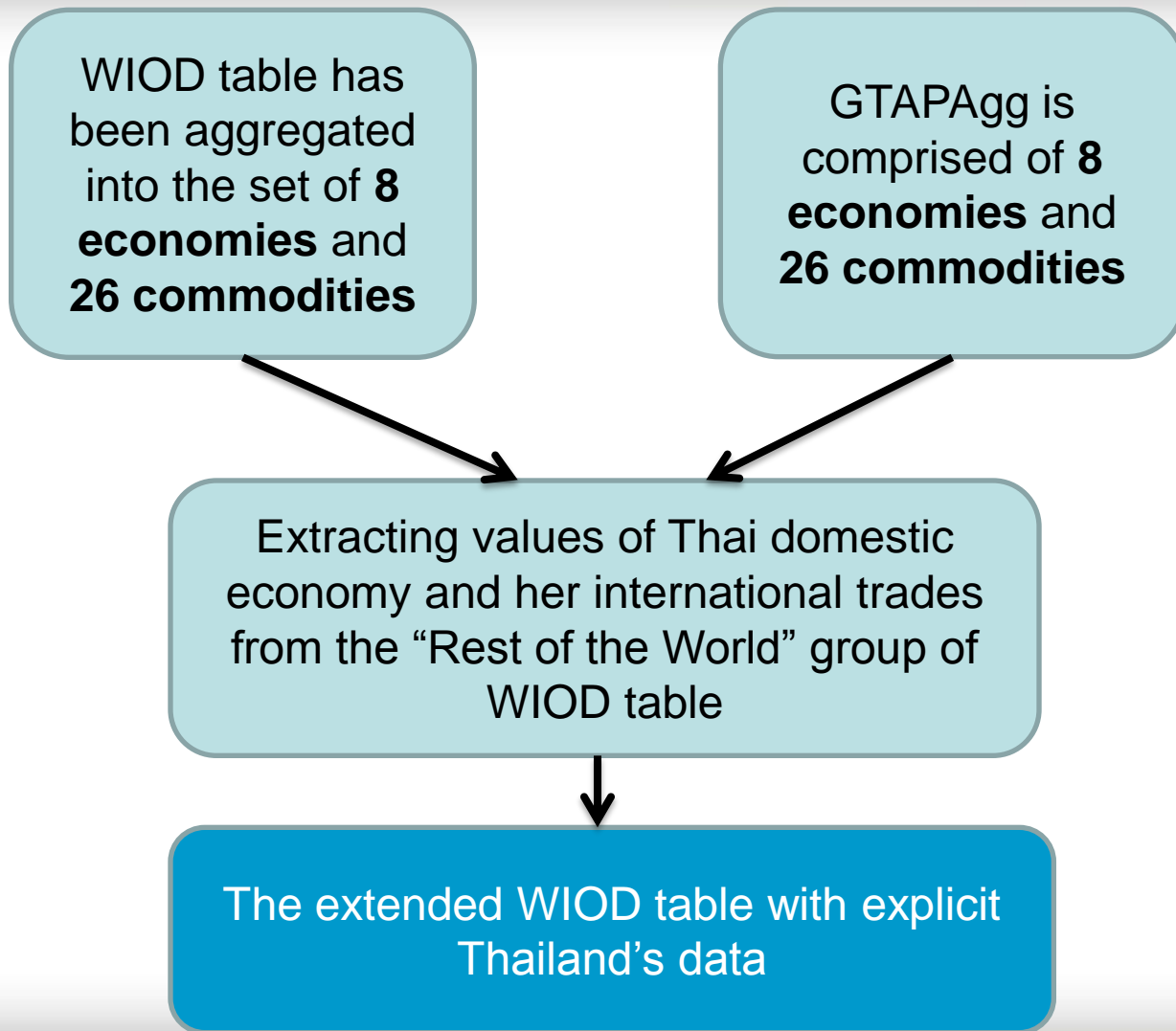
(2.2) World Input-Output Database (WIOD) and its application

- The fundamental concept of data structure and its application was introduced by [Leontief and Strout\(1963\)](#) and [Sanyal and Jones\(1982\)](#).
- [Dietzenbacher et al.\(2013\)](#) constructed the World Input-Output Database (WIOD) which are the annual tables of **1995-2011** covering the statistics of international trade and production structure of **35 sectors** and **40 economies**.
- Studies conducted by [Wang et al. \(2013\)](#), [Nagengast and Stehrer \(2014\)](#), [Koopman et al.\(2014\)](#), [Los et al.\(2014\)](#), [Johnson \(2014\)](#) and [Timmer et al. \(2014\)](#) utilize this set of data to investigate the global fragmentation of production and propose the alternative methodologies of estimating cross-country value-added creation.
- These WIOD tables are also main data sources for [Schwörer \(2013\)](#), [Timmer et al. \(2013\)](#) and [Ottaviano \(2014\)](#) to study impacts of the global production network on European economy.

3. WIOD table with the extension of Thailand's data

- The development of WIOD tables leads to the widespread application, especially a deeper and broader insight of global production network.
- However, there is a limitation on a specific country's application due to the limited number of economies covered in the original data set.
- Hence, this study introduces the methodology of extending the WIOD table to cover additional data of a specific economy.
- The following section introduces the procedure of including Thailand's domestic and international trade statistics into the original WIOD table.

3. WIOD table with the extension of Thailand's data



3. WIOD table with the extension of Thailand's data

The structure of modified WIOD table incorporating Thailand's data

	EU Industry	USA Industry	CHN Industry	JPN Industry	KOR Industry	TWN Industry	TH Industry	ROW Industry	
EU Industry	EU's intermediate use of domestic output	Intermediate use by USA (imported from EU)	Intermediate use by CHN (imported from EU)	Intermediate use by JPN (imported from EU)	Intermediate use by KOR (imported from EU)	Intermediate use by TWN (imported from EU)	Intermediate use by TH (imported from EU)	Intermediate use by ROW (imported from EU)	Final Demand of EU
USA Industry	Intermediate use by EU (imported from USA)	USA's intermediate use of domestic output	Intermediate use by CHN (imported from USA)	Intermediate use by JPN (imported from USA)	Intermediate use by KOR (imported from USA)	Intermediate use by TWN (imported from USA)	Intermediate use by TH (imported from USA)	Intermediate use by ROW (imported from USA)	Final Demand of USA
CHN Industry	Intermediate use by EU (imported from CHN)	Intermediate use by USA (imported from CHN)	CHN's intermediate use of domestic output	Intermediate use by JPN (imported from CHN)	Intermediate use by KOR (imported from CHN)	Intermediate use by TWN (imported from CHN)	Intermediate use by TH (imported from EU)	Intermediate use by ROW (imported from EU)	Final Demand of CHN
JPN Industry	Intermediate use by EU (imported from JPN)	Intermediate use by USA (imported from JPN)	Intermediate use by CHN (imported from JPN)	JPN's intermediate use of domestic output	Intermediate use by KOR (imported from JPN)	Intermediate use by TWN (imported from JPN)	Intermediate use by TH (imported from JPN)	Intermediate use by ROW (imported from JPN)	Final Demand of JPN
KOR Industry	Intermediate use by EU (imported from KOR)	Intermediate use by USA (imported from KOR)	Intermediate use by CHN (imported from KOR)	Intermediate use by JPN (imported from KOR)	KOR's intermediate use of domestic output	Intermediate use by TWN (imported from KOR)	Intermediate use by TH (imported from KOR)	Intermediate use by ROW (imported from KOR)	Final Demand of KOR
USA Industry	Intermediate use by EU (imported from TWN)	Intermediate use by USA (imported from TWN)	Intermediate use by CHN (imported from TWN)	Intermediate use by JPN (imported from TWN)	Intermediate use by KOR (imported from TWN)	TWN's intermediate use of domestic output	Intermediate use by TH (imported from TWN)	Intermediate use by ROW (imported from TWN)	Final Demand of TWN
TH Industry	Intermediate use by EU (imported from TH)	Intermediate use by USA (imported from TH)	Intermediate use by CHN (imported from TH)	Intermediate use by JPN (imported from TH)	Intermediate use by KOR (imported from TH)	Intermediate use by TWN (imported from TH)	TH's intermediate use of domestic output	Intermediate use by ROW (imported from TH)	Final Demand of TH
ROW Industry	Intermediate use by EU (imported from ROW)	Intermediate use by USA (imported from ROW)	Intermediate use by CHN (imported from ROW)	Intermediate use by JPN (imported from ROW)	Intermediate use by KOR (imported from ROW)	Intermediate use by TWN (imported from ROW)	Intermediate use by TH (imported from ROW)	ROW's Intermediate use of domestic output	Final Demand of ROW
	Value-Added of EU	Value-Added of USA	Value-Added of CHN	Value-Added of JPN	Value-Added of KOR	Value-Added of TWN	Value-Added of TH	Value-Added of ROW	

4. The Applications on Thailand's Domestic and International Trade Linkages

4.1 Results from computation of Leontief backward and forward multipliers

- The concept of Input-Output multiplier, introduced by [Leontief \(1936\)](#) and later extended by [Leontief \(1986\)](#), [Lahr and Dietzenbacher \(2001\)](#), [Dietzenbacher \(2004\)](#), [Breisinger, Thomas and Thurlow \(2009\)](#), quantitatively extracts the inter-industry relationship in the Input-Output table and identifies the contribution of each production sector to the whole economy by its multiplier's magnitude.
- The values of multipliers can be computed by conducting the row or column summation on the inversed matrix of input ratios (i.e. the "A matrix" in [Leontief \(1936\)](#) and [Leontief \(1986\)](#)).
- The obtained [backward multiplier](#) indicates the degree of impact of a particular sector on its suppliers along the supply chain (i.e. the [impacts on its upstream partners](#)).
- On the other hand, the obtained [forward multiplier](#) identifies the impacts of a particular sector on its [downstream connected industries](#).

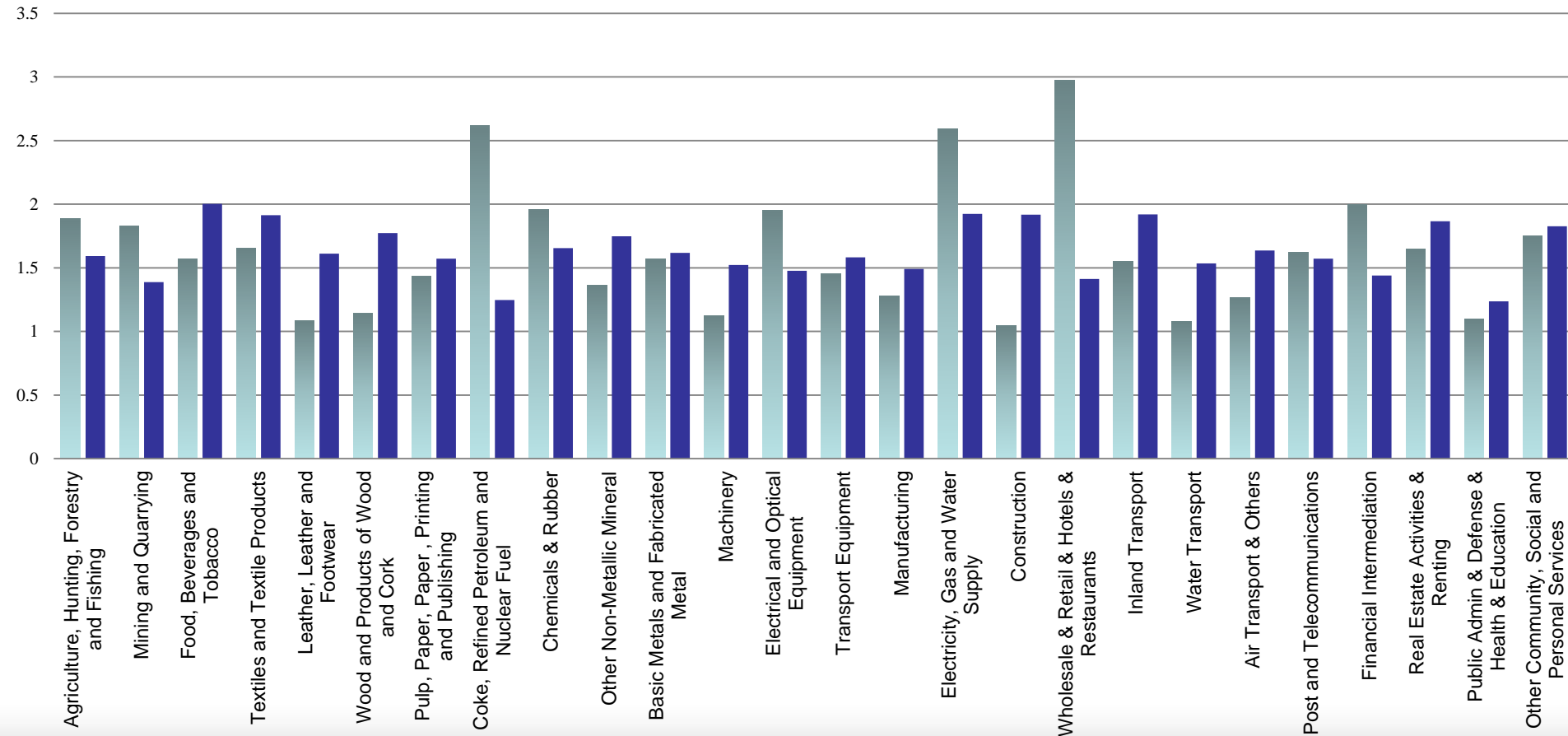
4.1 Results from computation of Leontief backward and forward multipliers

- High **domestic backward** multiplier
 - Functioning as the main **downstream** industry demanding a large network of domestic suppliers.
- High **domestic forward** multiplier
 - Functioning as the main **upstream** sector supplying intermediates to domestic downstream producers.

4.1 Results from computation of Leontief backward and forward multipliers

Domestic Multipliers

Forward Backward



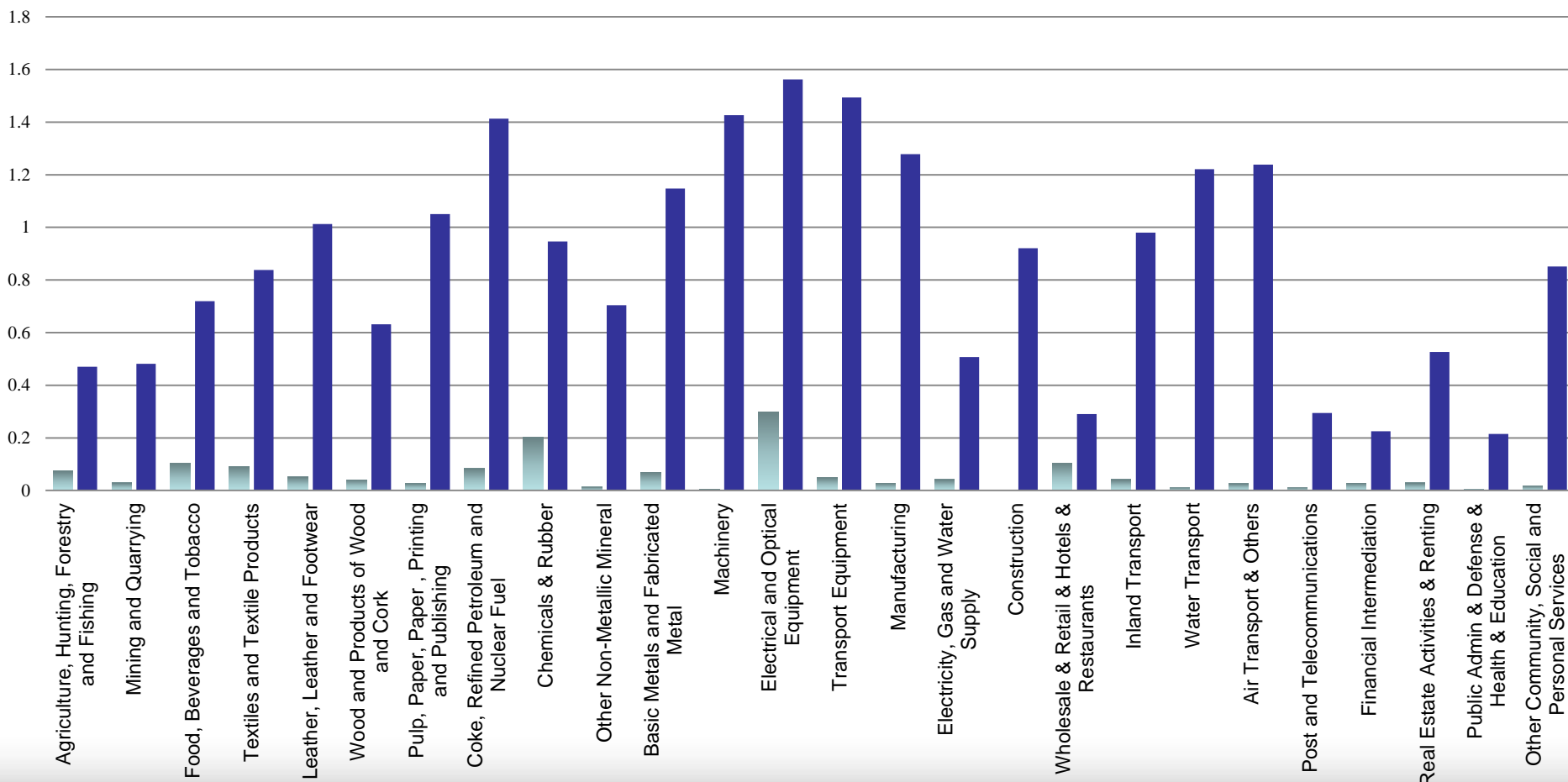
4.1 Results from computation of Leontief backward and forward multipliers

- High **international backward** multiplier
 - Functioning as the main **downstream** industry demanding a large network of **international suppliers**.
- High **international forward** multiplier
 - Functioning as the main **upstream** sector supplying intermediates to international downstream producers

4.1 Results from computation of Leontief backward and forward multipliers

International Multipliers

Forward Backward

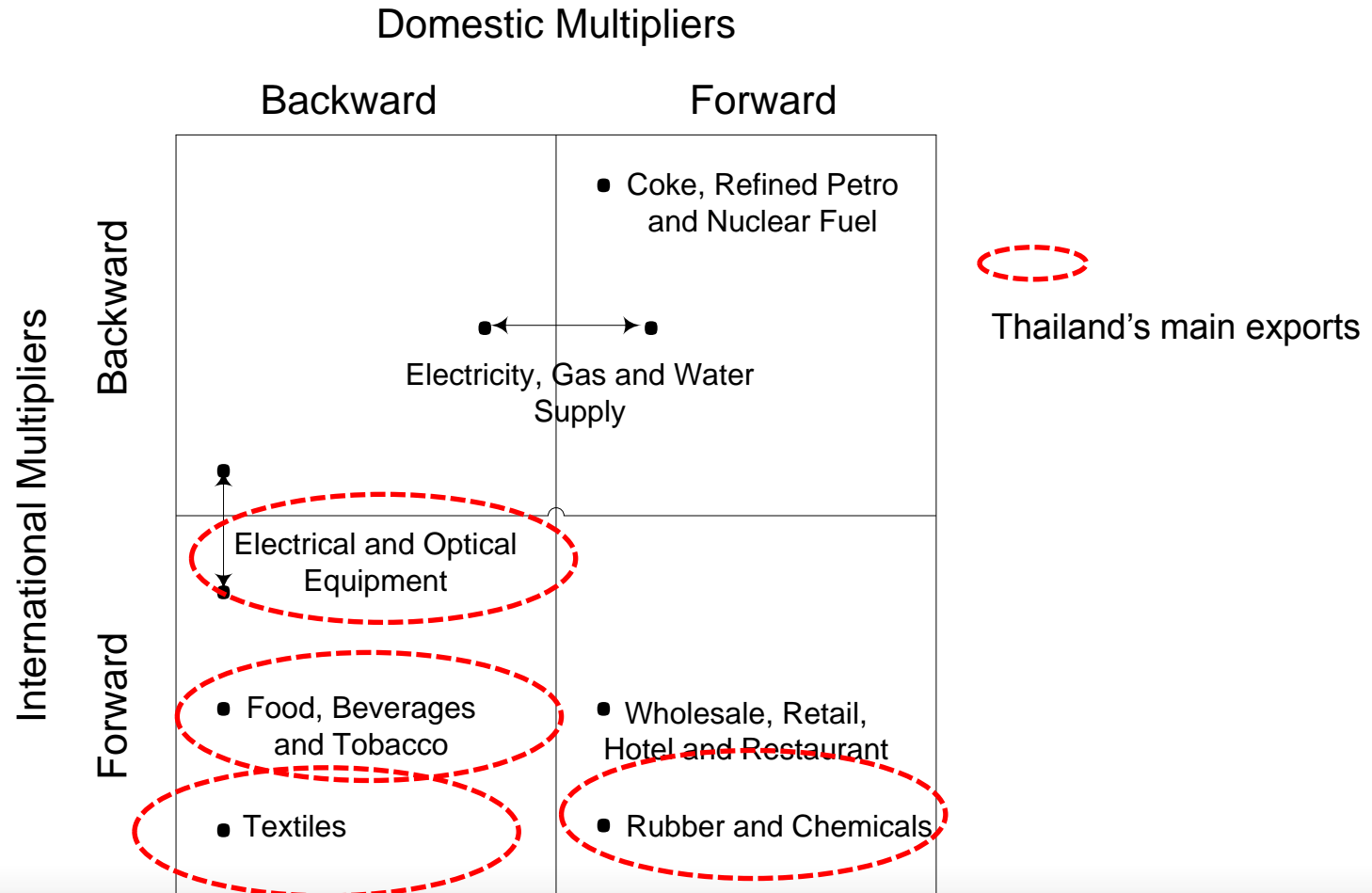


4.1 Results from computation of Leontief backward and forward multipliers

		Domestic Multipliers	
		Backward	Forward
International Multipliers	Backward	A major user of both imported and domestic intermediates	Mostly use imported intermediates to supply domestic uses
	Forward	Mostly use domestic intermediate to supply international uses	A major upstream industry supplying intermediates to both domestic and international uses

4.1 Results from computation of Leontief backward and forward multipliers

The relationships among top values of domestic and international multipliers



4. The Applications on Thailand's Domestic and International Trade Linkages

4.2 Results from Structural Path Analysis (SPA)

- As introduced by [Defourny and Thorbecke\(1984\)](#) and [Kahn and Thorbecke\(1989\)](#), the Structural Path Analysis (SPA) is the mathematical technique that decomposes the detail of Leontief multiplier.
- Specifically, this methodology reveals the network relationship of economy-wide impact transmission.
- Technically the SPA is based on the concept developed by [Lantner \(1974\)](#), which generates the values of all direct and indirect influences transmitted from the point of origin to the sector of destination.
- In this study, the SPA is applied to the newly constructed WIOD table, which incorporates the explicit data of Thailand.
- This computation decomposes Leontief multipliers and reveals details of direct and indirect paths of each multiplier.

4. The Applications on Thailand's Domestic and International Trade Linkages

4.2 Results from Structural Path Analysis (SPA)

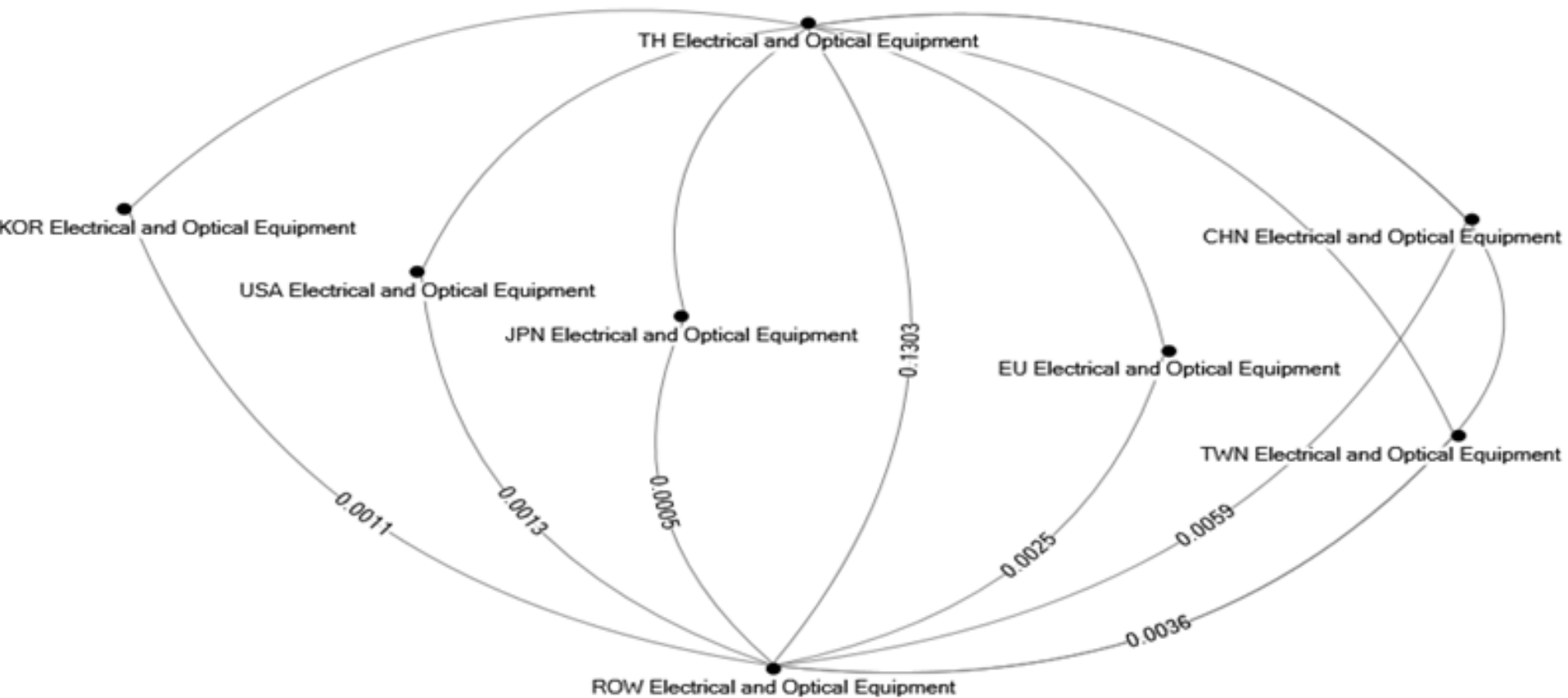
- Applying SPA to the modified WIOD table by focusing on **main exporting sectors** (ranked by magnitude of **international forward multipliers**), which are:
 - 4.2.1 Electrical and Optical Equipment
 - 4.2.2 Transport Equipment
 - 4.2.3 Machinery
 - 4.2.4 Manufacturing

4.2.1 SPA result: Electrical and Optical Equipment

- Main path #1: Thailand Elec. and Op. Equipment → ROW Elec. and Op. Equipment
- Main path #2: Thailand Elec. and Op. Equipment → JPN Elec. and Op. Equipment
- Main path #3: Thailand Elec. and Op. Equipment → CHN Elec. and Op. Equipment

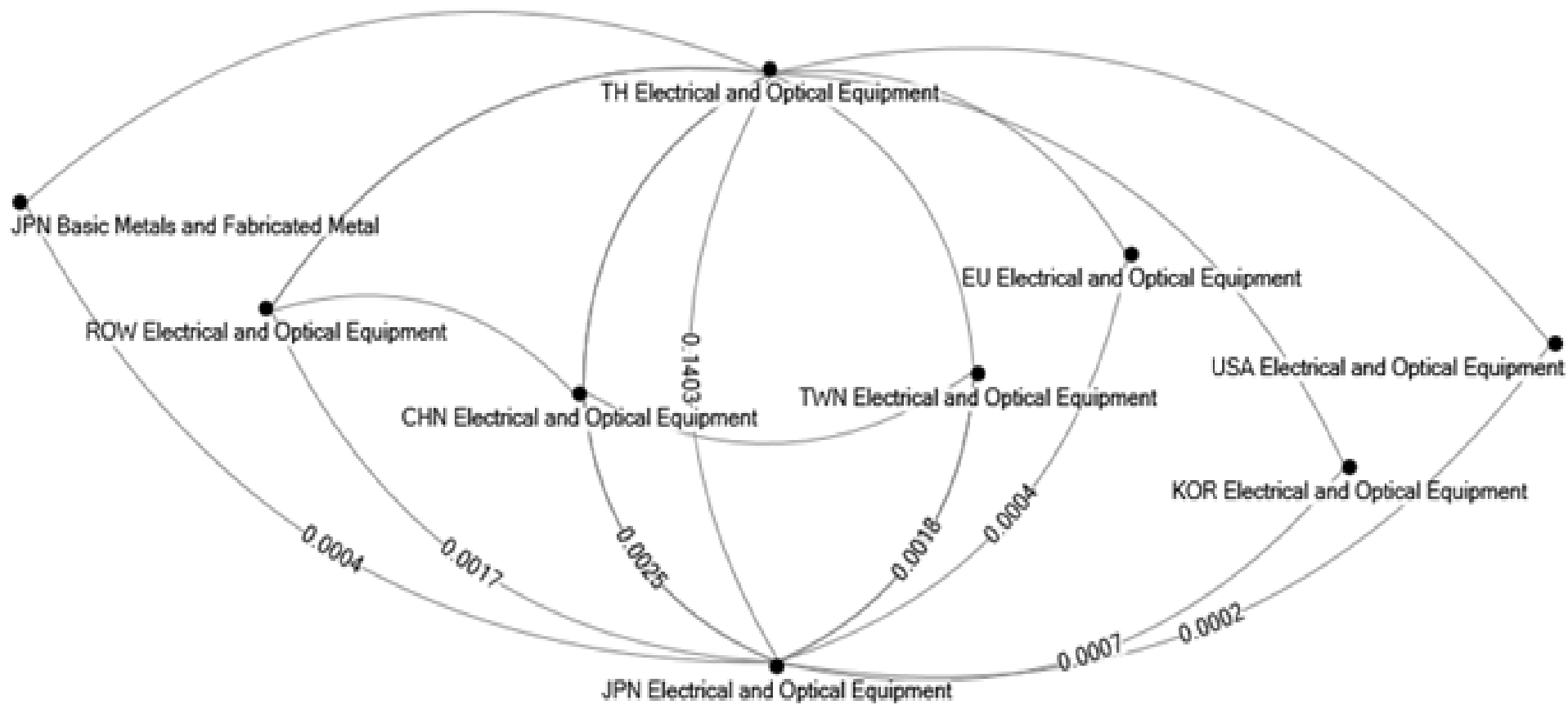
4.2 Results from Structural Path Analysis (SPA)

Main Path #1 of **Thailand's Electrical and Optical Equipment** Export



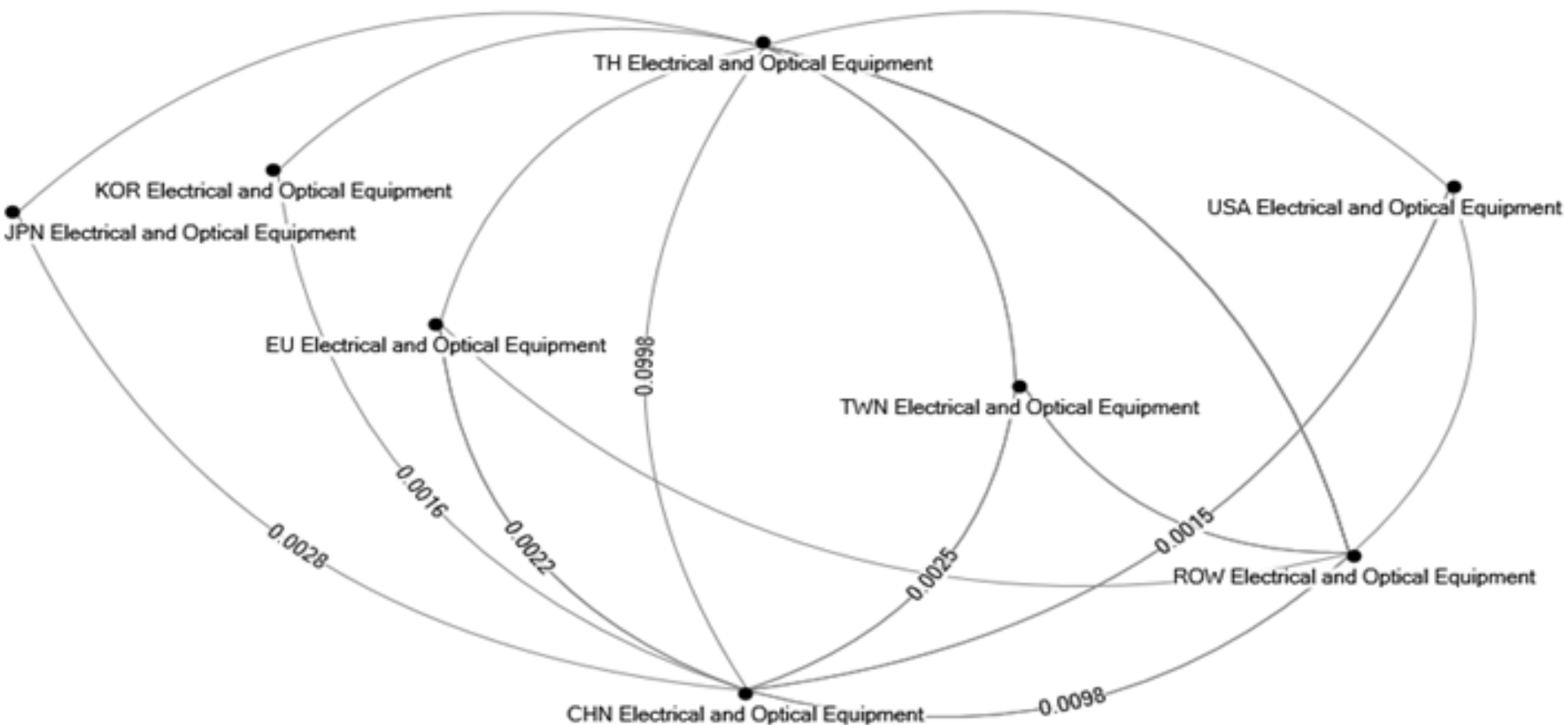
4.2 Results from Structural Path Analysis (SPA)

Main Path #2 of Thailand's **Electrical and Optical Equipment** Export



4.2 Results from Structural Path Analysis (SPA)

Main Path #3 of Thailand's **Electrical and Optical Equipment** Export

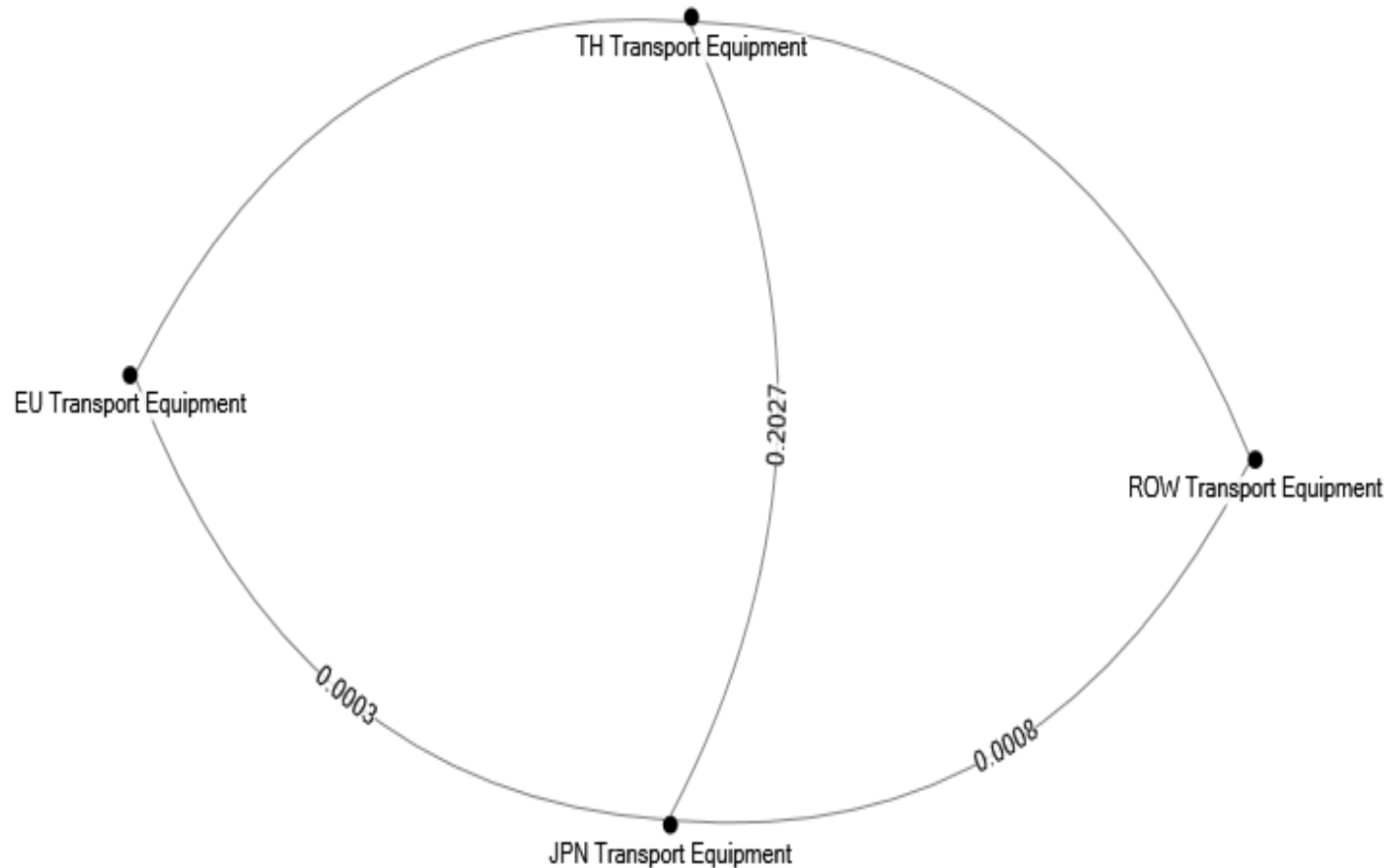


4.2.2 SPA result: Transportation Equipment

- Main path #1: Thailand Transp. Equipment → JPN Transp. Equipment

4.2 Results from Structural Path Analysis (SPA)

Main Path of Thailand's **Transport Equipment** Export

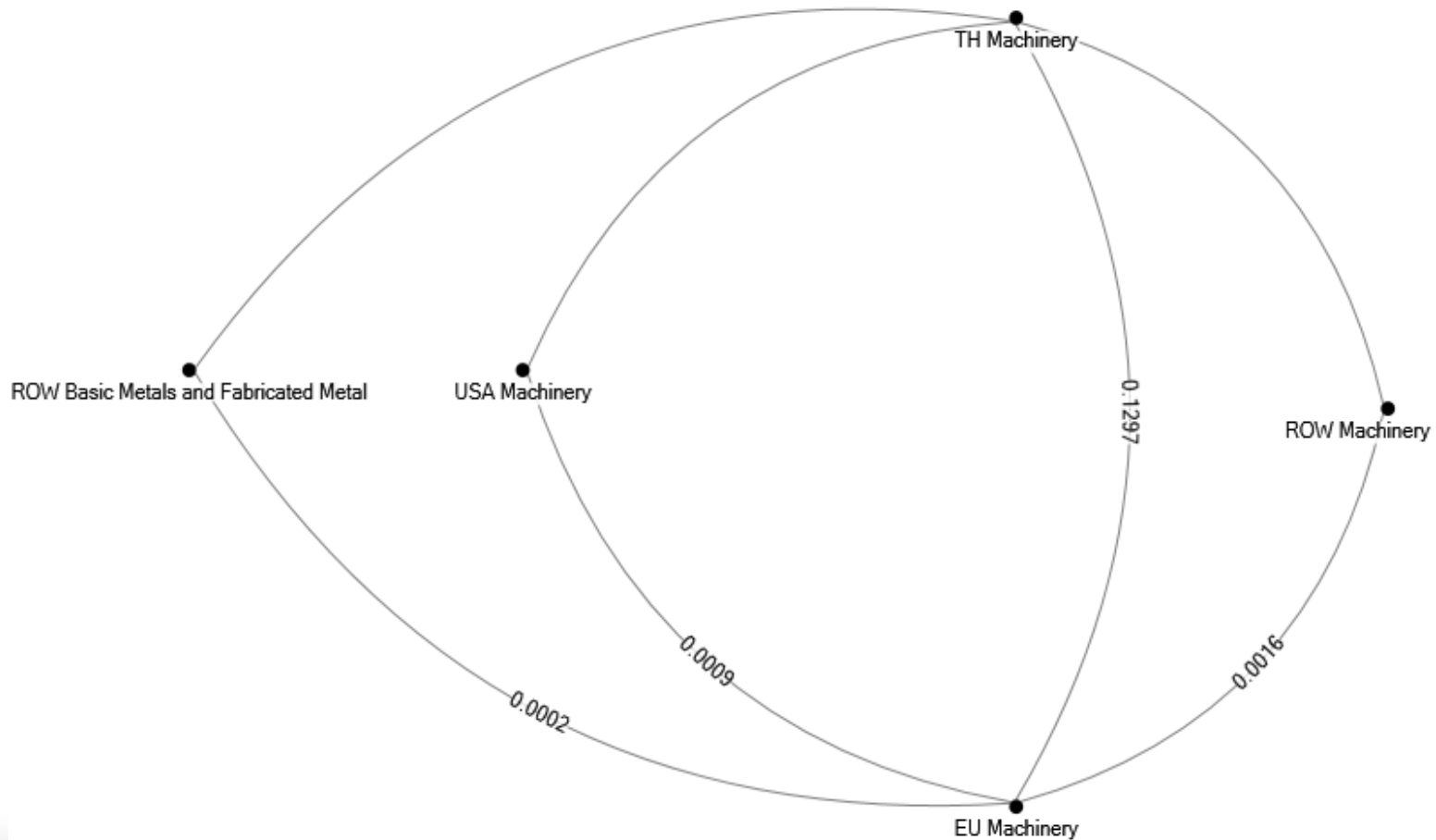


4.2.3 SPA result: Machinery Equipment

- Main path #1: Thailand Machinery Equipment → EU Machinery Equipment

4.2 Results from Structural Path Analysis (SPA)

Main Paths of Thailand's **Machinery** Export

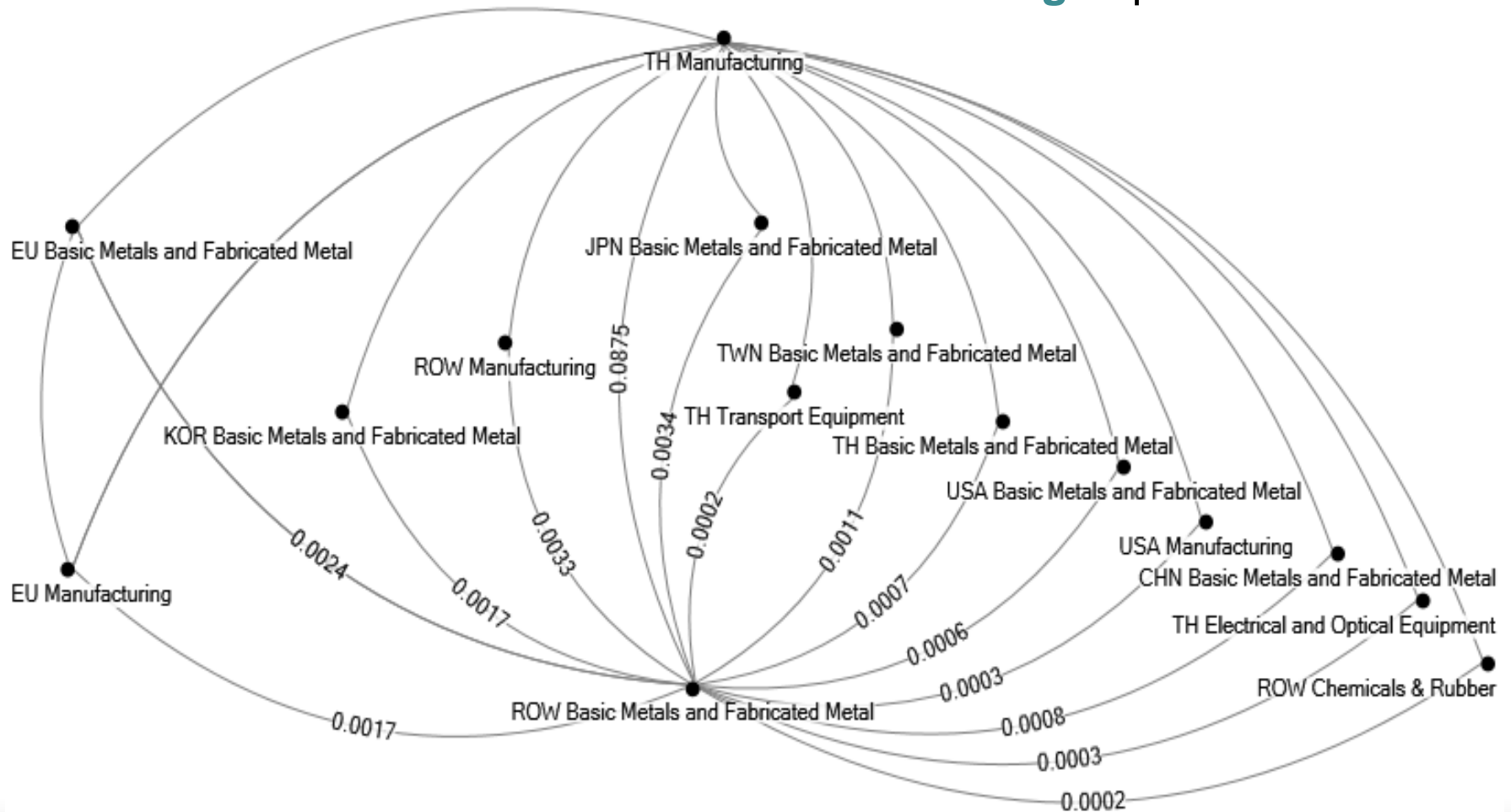


4.2.4 SPA result: Manufacturing

- Main path #1: Thailand Manufacturing → ROW Manufacturing
- Main path #2: Thailand Manufacturing → JPN Elec. and Op. Equipment

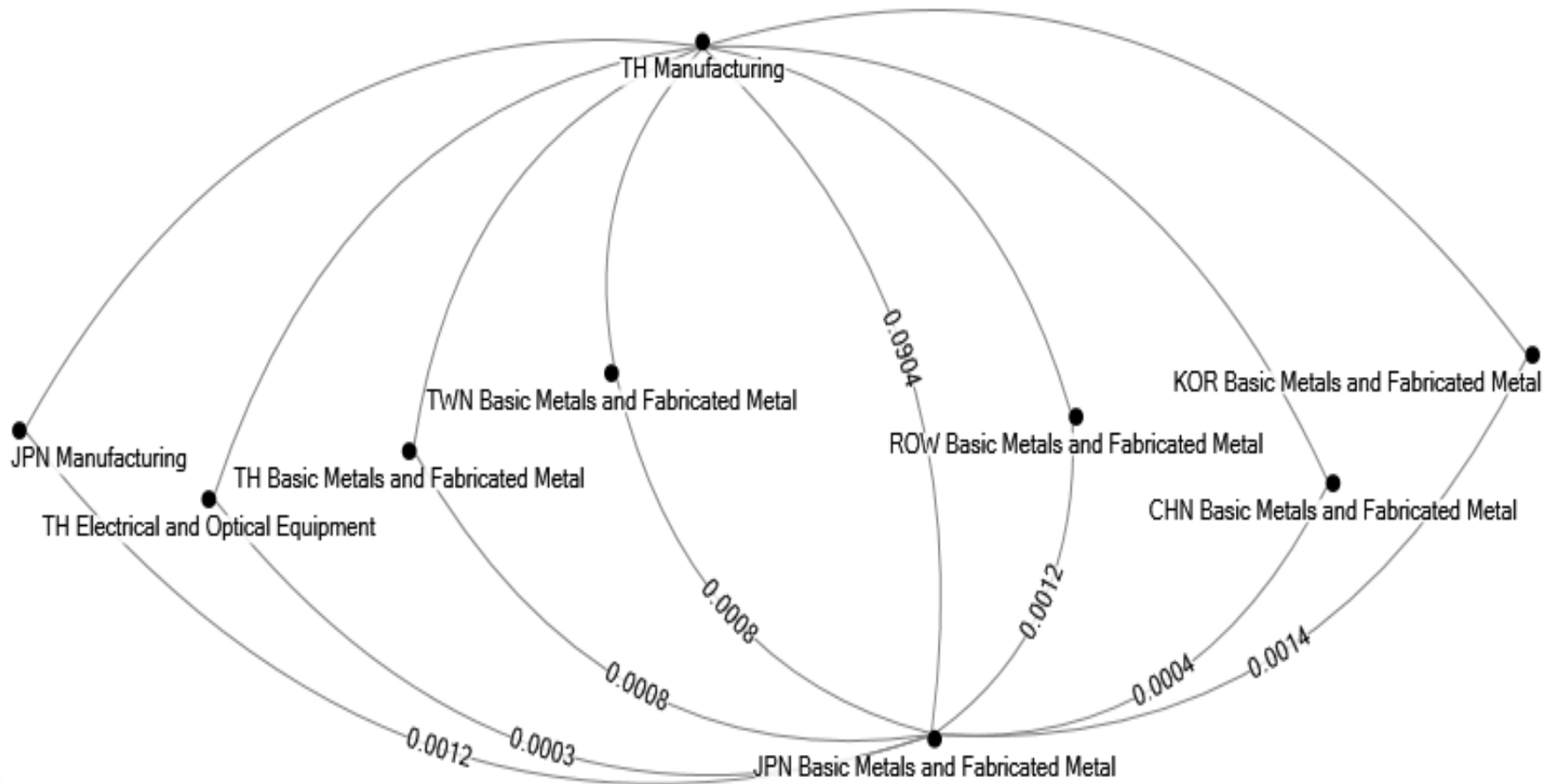
4.2 Results from Structural Path Analysis (SPA)

Main Path #1 of Thailand's **Manufacturing** Export



4.2 Results from Structural Path Analysis (SPA)

Main Path #2 of Thailand's **Manufacturing** Export



(5) Limitations and ongoing improvements

Data: only one year which is 2007

- Comparing the estimated structures and main findings with other world input-output tables
 - OECD's world input-output database
 - Eora Multi-Region Input-Output database

Computation technique: SPA's concept is actually based on path and network analysis (not based on economic theory)

- Comparing results obtained from other methods
 - Wang et al. (2013) – NBER working paper No. 19677
 - Koopman et al. (2014) – American Economic Review

Thank you

Credit: All PowerPoint Templates used in this presentation were obtained from www.fppt.com