The relationship between the international-openness along with the industrial network and economic activity of each country

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Abstract

Nowadays, many studies about international trade and economic activity have contributed to the understanding of globalization. Studies about the relationship between economic activity and trade openness tend to treat a country as a unit of economic activity. On the other hand, Input-Output table, which enable us to consider the world-wide supply-chain, offers us features of many kinds of industry. When we mix the IO table and long-term viewpoint, we could get close to the nature about the effect of international trade on our economy.

The method used in the research is regression analysis. As the explanatory variable, we calculate an indicator which could measure how internationally-widely the industrial networks are extended, employing IO table. In order to define it, we use the sum of domestic transactions through the entire supply-chain and the sum of domestic and international transactions through the entire supply-chain.

The data used in the research is Long-run World Input-Output Database: Version 1.1. The data includes the industrial transactions among 23 industries of 25 countries from 1965 to 2000.

The original contribution of this research is we present evidence that the faster the international trade progresses with globalization, the wealthier each country gets.

Keywords: trade openness, multiregional input-output analysis, regression analysis, WIOD

1. Introduction

Nowadays, many studies about international trade and economic activity have contributed to the understanding of globalization (Duarte, *et al*., 2018; Shironitta, *et al*., 2019; Xu, *et al*., 2020). Many researchers have also worked on studies about the relationship between economic activity and trade openness a lot (Keho, 2017; Huchet-Bourdon , *et al*., 2018; Amna Intisar, et al., 2020; Raghutla, 2020). They tend to treat a country as a unit of economic activity. On the

other hand, Input-Output table, which enable us to consider the world-wide supply-chain, offers us features of many kinds of industry. When we mix the IO table and long-term viewpoint, we could get close to the nature about the effect of international trade on our economy.

The original contribution of this research is we present evidence that the faster the international trade progresses with globalization, the wealthier each country gets.

2. Methodology
2-1. Multi-Regional input-output analysis

This research uses World Input-Output Database. This is one of the Multi-Regional Input-Output tables (Miller and Blair, 2009; Suh, 2009; Timmer, *et al.*, 2015; Woltjer, *et al.*, 2021). The data includes the transaction values by manetary base among many industries in each nation or economic area. The structure of it is like as figure 1.

		$s=1$		$s=2$		f	x
		$j=1$	$j=2$	$j=1$	$j=2$		
$r=1$	$i=1$ $i=2$	$\mathbf{Z}^{r=1,s=1}$		$\mathbf{Z}^{r=1,s=2}$		$\mathbf{f}^{r=1}$	$\mathbf{x}^{r=1}$
$r=2$	$i=1$ $i=2$	$\mathbf{Z}^{r=2,s=1}$		$\mathbf{Z}^{r=2,s=2}$		$\mathbf{f}^{r=2}$	$\mathbf{x}^{r=2}$
VA		$\mathbf{VA}^{s=1}$		$\mathbf{VA}^{s=2}$			
x		$\mathbf{x}^{s=1}$		$\mathbf{x}^{s=2}$			

Figure 1. The structure of MRIO

$\mathbf{Z}^{rs}\left(=\left(z_{ij}^{rs}\right)\right)$ is the transaction matrix from country r to country s. Here, r and s are the variables of country, i and j are the variables of industry. $\mathbf{f}^{r}\left(=\left(f_{i}^{r}\right)\right)$ is the final demand vector toward the output from country r. $\mathbf{x}^{r}\left(=\left(x_{i}^{r}\right)\right)$ is the vector of output about the production of country r. $\mathbf{VA}^{s}\left(=\left(va_{j}^{s}\right)\right)$ is the vector of the value-added and va_{j}^{s} is the value-added of the production about the industry j in country s. Using $\mathbf{Z}^{rs}\left(=\left(z_{ij}^{rs}\right)\right)$ and $\mathbf{x}^{r}\left(=\left(x_{i}^{r}\right)\right)$, we could get the input

coefficient matrix $\mathbf{A}^{rs}\left(=\left(a_{ij}^{rs}\right)\right)$. a_{ij}^{rs} is the ratio of the input from industry i on country r toward industry j on country s.

2-2. The measurement of the trade openness

In this research, the trade openness , or $D_p^{y,k}$, is defined as equation (1).

$$D_p^{y,k} = 1 - \frac{\sum_{i=1}^{n} a_{ip}^{y,k,k} \cdot f_p^{y,k}}{\sum_{r=1}^{C} \sum_{i=1}^{n} a_{ip}^{y,r,k} \cdot f_p^{y,k}} \quad (1)$$

Here, C is the number of countries and y refers year. $D_p^{y,k}$ ccould calucurate how broadly the supply chain, which is induced by the final demand toward the production of industry p in country k, extends overseas in year y. Figure 2 shows the brief idea about equation (1). It is clear from the figure 1 that the range of $D_p^{y,k}$ is from 0 to 1.
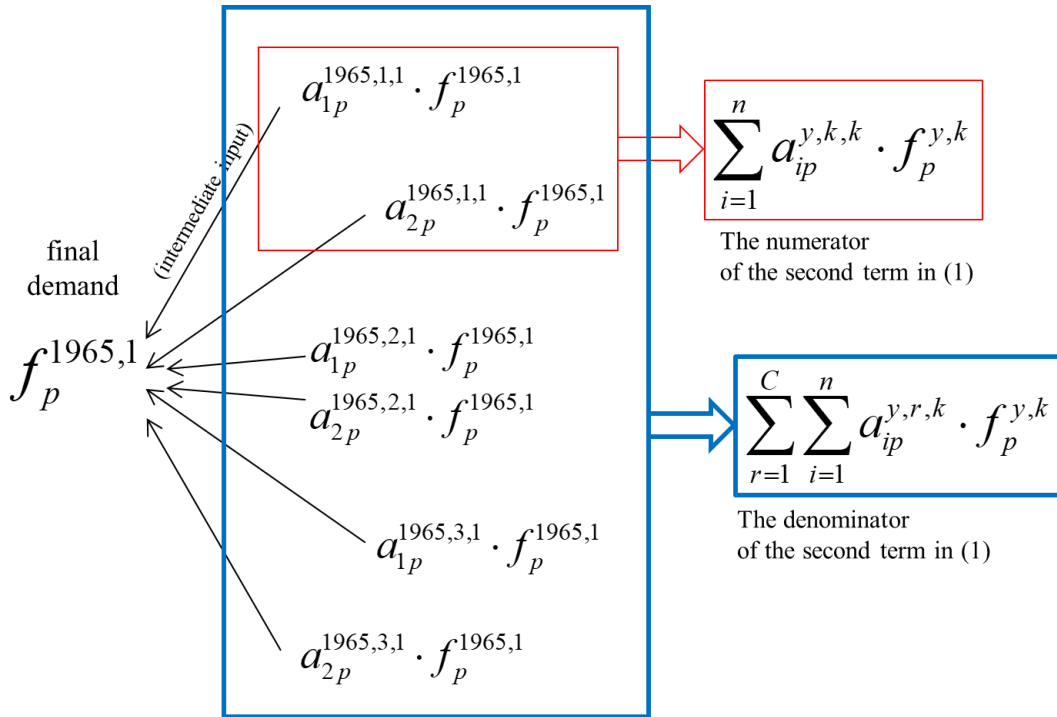

Figure 2. The coverage for the calculation of the trade openness.

2-3. The measurement of the economic activity

In this research, the economic activity, or $E_p^{y,k}$, is defined as equation (2).

$$E_p^{y,k} = \frac{va_p^{y,k}}{x_p^{y,k}} \quad (2)$$

$E_p^{y,k}$ could calculate how largely the value-added is made in a specific industry and this is adjusted the volume of the output.

2-4. The regression analysis

In this research, we try to find the simple relationship about the trade openness and economic activity. Regression fomula assumed in the study is $\hat{y} = \hat{\alpha} + \hat{\beta}x$. The data about $\hat{y}$ comes from $E_p^{y,k}$. The data about x comes from $D_p^{y,k}$. Using Multi-regional input-output table, we could separate the sample along with country or industry.

3. Data

The data employed in this research is Long-run World Input-Output Database: Version 1.1. The data includes the industrial transactions among 23 industries of 25 countries from 1965 to 2000[1]. Table 1 shows the list of countries and industries in this data.

Table 1. The list of countries and industries

Countries			Industries	
1 Australia	14 Hong Kong		1 Agriculture, Hunting, Forestry and Fishing	13 Transport Equipment
2 Austria	15 India		2 Mining and Quarrying	14 Manufacturing, Nec; Recycling
3 Belgium	16 Ireland		3 Food, Beverages and Tobacco	15 Electricity, Gas and Water Supply
4 Brazil	17 Italy		4 Textiles, Textile, Leather and Footwear	16 Construction
5 Canada	18 Japan		5 Pulp, Paper, Paper, Printing and Publishing	17 Wholesale and Retail Trade
6 China	19 Republic of Korea		6 Coke, Refined Petroleum and Nuclear Fuel	18 Hotels and Restaurants
7 Germany	20 Mexico		7 Chemicals and Chemical Products	19 Transport and Storage
8 Denmark	21 Netherlands		8 Rubber and Plastics	20 Post and Telecommunications
9 Spain	22 Portugal		9 Other Non-Metallic Mineral	21 Financial Intermediation
10 Finland	23 Sweden		10 Basic Metals and Fabricated Metal	22 Real Estate, Renting and Business Activities
11 France	24 Taiwan		11 Machinery, Nec	23 Community Social and Personal Services
12 United Kingdom	25 United States of America		12 Electrical and Optical Equipment	
13 Greece	26 Rest-of-World			

4. Result and Discussion

Following the methodology described above, we could find the relationship between trade openness and the economic activity. Figure 3 shows the result focusing on the 'Agriculture, Hunting, Forestry and Fishing' industry of 'Japan'. From the figure, we could find that the broader trade openness progresses, the larger the economic activity gets. Fitness of sample toward regression seems to be appropriate. Figure 4 shows the result focusing on the 'Agriculture, Hunting, Forestry and Fishing' industry of 'Australia'. This result resembles that of Japan.

On the other hand, Figure 5, which is about USA, shows the different feature compared with previous two results. With the progress of the times, USA have expanded their supplier widely-overseas. But the economic activity, which is defined as the value-added per output, have not followed it.

More results and discussions focusing on other country or industry would be shown at the conference.

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[1] This data is available here.
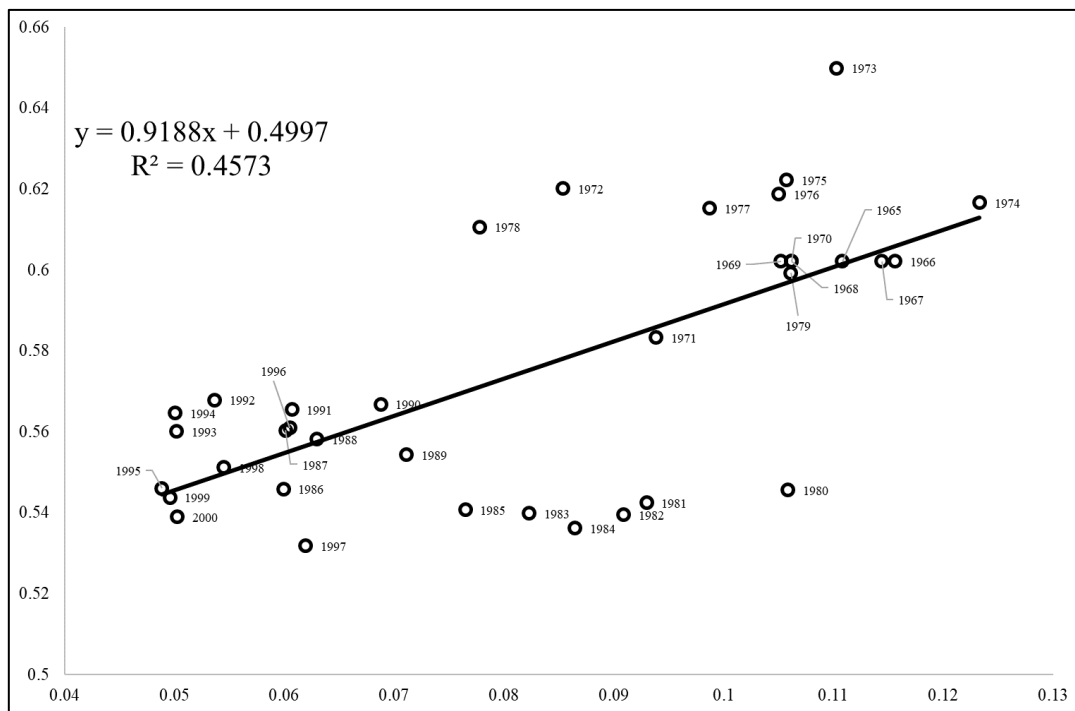(https://www.rug.nl/ggdc/valuechain/long-run-wiod?lang=en)

Figure 3. The result of regression analysis

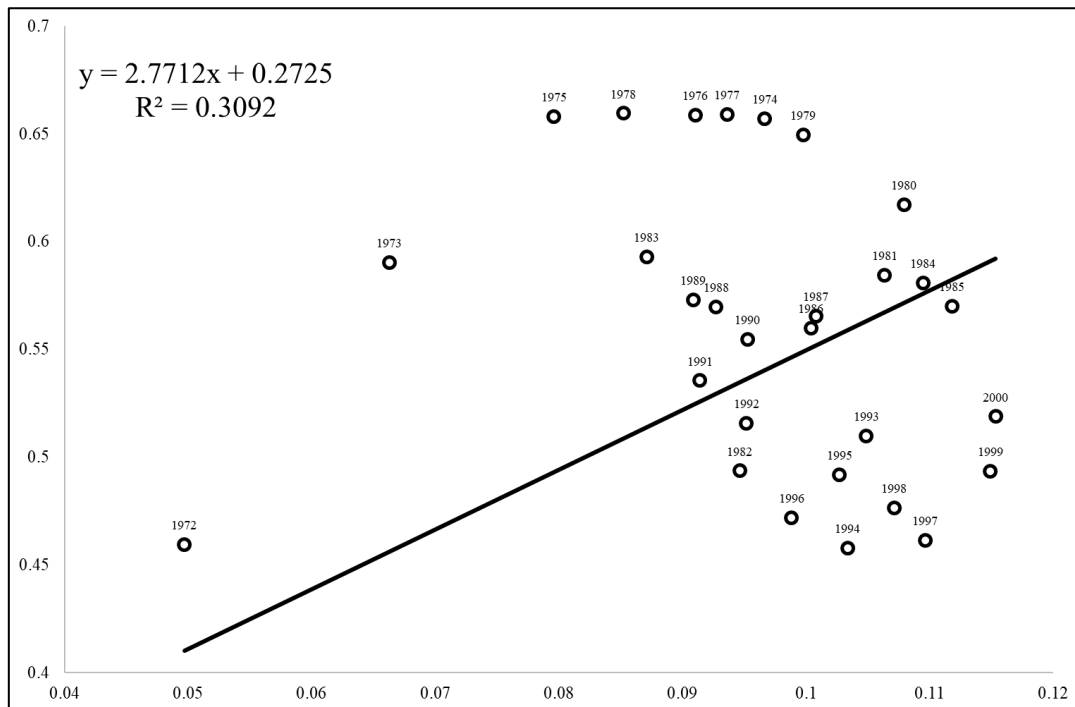(*k*='Japan'*, p*='Agriculture, Hunting, Forestry and Fishing')

Figure 4. The result of regression analysis

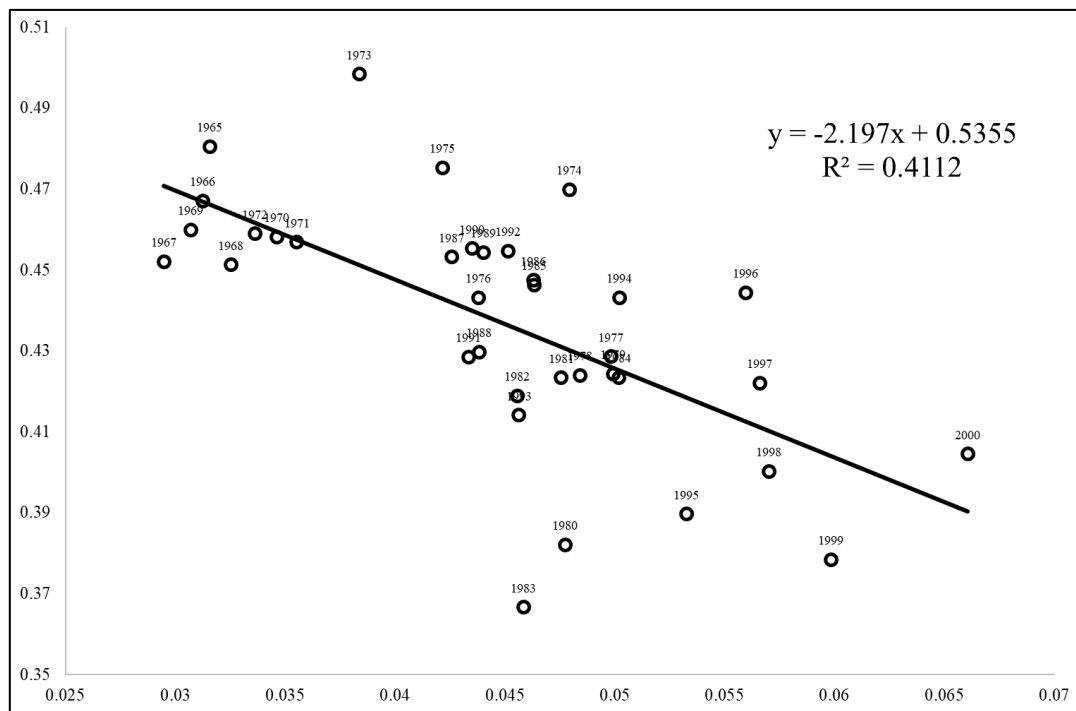(*k*='Australia'*, p*='Agriculture, Hunting, Forestry and Fishing')

Figure 5. The result of regression analysis
(*k*=’United States of America’, *p*=’Agriculture, Hunting, Forestry and Fishing’)

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