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An Interdependence Model of Comparative Advantage by Network Theory

—In case of dyads in international trade networks—

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Abstract

Since the 1970s, researchers in international relations have asserted that the enhancement of interdependence between nations can reduce conflicts among them (Keohane and Nye 1973). Thus, interdependency between nations is regarded as desirable for the stability of the countries' networks. On the other hand, there has been no confirmation of empirical data on the benevolent effects of interdependency on the nations' networks.

This article aims to analyze the concept of interdependence into reciprocity and dependence, leading to quantifying both of them. To assess the usefulness of this approach, the empirical analysis of trade relations among five countries, namely, THE U.S.., China, Germany, Japan, and Korea from 1992 to 2020 was empirically analyzed with the aid of reciprocity index (R) and dependency index (D).

Keywords: revealed comparative advantage, network theory, interdependence, international trade, reciprocity, dependence

Ⅰ. INTRODUCTION

The degree of complexity in international relations continues to increase. Since the 1970s, researchers in international relations have asserted that the enhancement of interdependence between nations can reduce conflicts among them (Keohane and Nye, 1973). Since the 1980s, the study of interdependence has continued to develop in parallel with the progress of globalization. One of the most active areas of research on interdependence has been international economics, which was set up to deal with international trade (Krugman and Obstfeld, 2000).

Following this trend, people tend to regard interdependence between countries as desirable for the sake of the stability of their networks. However, there has not been sufficient empirical data to confirm the benevolent effects of interdependence on the nations' networks. What's more, Farrell and

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Newman (2019) argue that interdependence can be weaponized by some countries in order for them to gain a comparative advantage over others.

This article aims to develop a theory of interdependence between two actors using the network theory approach and to analyze the concept of interdependence in terms of reciprocity and dependence, leading to quantifying both of them.

For the purpose of evaluating the usefulness of this approach, we analyze the empirical data of trade relations among five countries, namely, the U.S., China, Germany, Japan, and Korea from 1992 to 2019 with the aid of the reciprocity index (R) and dependence index (D).

Ⅱ. AN INTERDEPENDENCE MODEL FROM A VIEWPOINT OF NETWORK THEORY

In this chapter, we develop an interdependence model from a viewpoint of network theory.

Relationships among multiple actors can be represented by a network. Therefore, an important question is what kind of network the interdependence relationship can be represented by. In recent years, the study of networks, or aiming to understand how multiple actors are connected to each other, has become very dynamic. However, there are still few studies that take the bond strength into account. In this article, we attempt to construct the theory of interdependence using network theory.

In our network model, there are actors and links between them. We regard actors as elements of a set. Each link has its direction and flow quantity, similar to an electric current or a river flow (Newman, 2010).

Ⅱ.A. MUTUALITY

Suppose there are n actors A1, A2, … , An. When a link from A1 to A2 and a link from A2 to A1 exist, and both links have the same flow quantity, we say the relation between A1 and A2 is perfectly mutual (figure Ⅰ. (a)). On the other hand, when the link from A1 to A2 has a large flow quantity and the link from A2 to A1 has a little flow quantity, we say the relation between A1 and A2 has little mutuality(figure Ⅰ. (b)).

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Figure I

Three Types Of Mutuality Between Two Actors

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Ⅱ.B. QUANTIFICATION OF MUTUALITY

We will quantify the strength of the link and let it have positive real number a. Let the flow quantity of the link from A1 to A2 be F(1,2), and from A2 to A1 be F(2,1). Then we quantify the degree of reciprocity between A 1and A2 as R(1,2) in the following way. There are two methods to quantifying the mutuality, namely, input flow approach and output flow approach.

Ⅱ.B.a. INPUT FLOW APPROACH

Let there be flows among A2, A3, A4, and A1 (figure. Ⅱ).

$$X(1,2) = \frac{F(2,1)}{F(2,1)+F(3,1)+F(4,1)} \qquad (1)$$

In (1), $X(1,2)$represents the proportion of input flow from A2 to A1 in the total input flow to A1.

$$X(2,1) = \frac{F(1,2)}{F(1,2)+F(3,2)F(4.2)} \qquad (2)$$

In general,

$$X(i,j) \equiv \frac{F(j,i)}{\sum_{k\neq i}^{n} F(k,i)} \qquad (3)$$

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FIGURE II

Mutuality In A Network Of Input Flows

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In (3), $X(j,i)$represents the proportion of input flow from Aj to Ai in the total input flow into Ai.

Next, we define the mutuality index between A1 and A2 in the following way.

$R(1,2) = X(1,2) - X(2,1)$

In general, we define the mutuality index between Ai and Aj in (4).

$R(i,j) \equiv X(i,j) - X(j,i)$ (4)

If $R(i,j) > 0$, A1 depends on A2 more than A2 depends on A1. On the other hand, if $R(i,j) < 0$ R(i,j) < 0, A2 depends on A1 more than A1 depends on A2.

We should note that $-1 \leq R(i,j) \leq 1$. An absolute value of $R(i,j)$ shows the degree of asymmetry between Ai and Aj. When $R(i,j) = +1\ or\ -1$, the relationship between Ai and Aj is completely unilateral, while if $R(i,j) = 0$, their relation is perfectly reciprocal.

II.B.b. OUTPUT FLOW APPROACH

$$Y(1,2) = \frac{F(1,2)}{F(1,2)+F(1.3)+F(1,4)} \quad (5)$$

$$Y(2,1) = \frac{F(2,1)}{F(2,1)+F(2,3)+F(2,4)} \quad (6)$$

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FIGURE Ⅲ

Mutuality In A Network Of Output Flows

Source) created by the author

In (5), Y(1,2) represents the proportion of output flow from A1 to A2 in the total output flow from A1 (figure Ⅲ).

In general,

$$Y(i,j) \equiv \frac{F(i,j)}{\sum_{k\neq i}^{n} F(i,k)} \qquad (7)$$

In (7), Y(i,j) represents the proportion of output flow from Ai to Aj in the total output flow from Ai.

Next we define the mutuality index between A1 and A2 in the following way.

$$R(1,2) = Y(1,2) - Y(2,1)$$

$$R(i,j) \equiv Y(i,j) - Y(j,i) \qquad (8)$$

If R(i,j) > 0, A1 depends on A2 more than A2 depends on A1. On the other hand, if R(i,j) < 0, A2 depends on A1 more than A1 depends on A2.

Ⅱ.C. DEPENDENCE

FigureⅣ

Two Types Of Dependence Between Two Actors

Source) created by the author

Suppose that there are n actors A1, A2, , An. When a link from A1 to A2 and a link from A2 to A1 exist, and A1 has only one link directed to others and A2 also has only one link directed to others, the dependence between A1 and A2 is maximal. On the other hand, when the link from A1 to A2 is nonexistent as well as from A2 to A1, the dependence between A1 and A2 is minimal (figure.Ⅳ).

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Ⅱ.D. QUANTIFICATION OF DEPENDENCE

Based on the quantification of reciprocity, which we formulated in 2.3, we quantify the degree of dependence as follows.

Ⅱ.D.a. INPUT FLOW APPROACH

From equation (3), we define dependence measure by input approach between $Ai\ and\ Aj$ as (9).

$$D(i,j) \equiv X(i,j) + X(j,i) \qquad (9)$$

Note that $0 \leq D(i,j) \leq 2$. The larger $D(i,j)$ is, the stronger the bond between $Ai\ and\ Aj$ is. However, $D(i,j)$ cannot indicate the degree of mutuality.

Ⅱ.D.b. OUTPUT FLOW APPROACH

From equation (7), we define dependence measure by output approach between $Ai\ and\ Aj$ as (10).

$$D(i,j) \equiv Y(i,j) + Y(j,i) \qquad (10)$$

Note that $0 \leq D(i,j) \leq 2$

Ⅲ EMPIRICAL ANALYSIS AND RESULTS

In this chapter, we apply the two indices which we defined in chapter2, to a case of international trade.

Ⅲ.A. DATA

In order to grasp major trends in international trade, we chose the top five major export nations, namely, the U.S., China, Germany, Japan, and Korea for analysis, as they were also major import countries.

In fact, their export share in world trade was 34%, and their import share was 37% in 2019 (Table Ⅰ), so we can understand the salient features of the world trade structure by conducting an analysis of these countries.

TABLE I

Export And Import Share Of THE U.S.., China, Germany, Japan, And Korea

Source) From **Error! Reference source not found.** database 2022

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Ⅲ.B. APPLICATION OF THE MODEL TO THE TRADE BETWEEN TWO COUNTRIES

Before we start our empirical analysis, we need to mention an index of revealed comparative advantage (Balassa, 1965) because our method is closely related to comparative advantage of nations. Therefore, it is appropriate to mention a metric proposed by Balassa (1965), which is called the revealed comparative advantage (RCA).

The definition of RCA of nation N in commodity C is the following formula.

$$RCA_{NC} = \frac{\frac{E_{NC}}{\sum_{C' \in S} E_{NC'}}}{\frac{\sum_{N' \in M} E_{N'C}}{\sum_{N' \in M, C' \in S} E_{N'C'}}}$$, where

E: Exports

N, N': Country index

M: Set of countries

C, C': Commodity index

S: Set of countries

This metric is comparing the proportion of the commodity C's export in the total exports of the country N with that of the commodity C's world export in world exports.

Our metrics are the proportion of the country N's export to N' in the total export of the country N and that of N's import from N' in the total import of N. While Balassa's analysis is limited to the export side, which is closely related to the supply side of economy, our approach also covers the import side analysis, which is related to the demand side of economy.

We conduct regression analysis of D and R in each pair of nations, and try to find some relations between these variables. We start the import side analysis in the next section.

Ⅲ.B.a. IMPORT SIDE ANALYSIS

Now we apply the input flow approach mentioned in chapter2 to an analysis of import.

Ⅲ.B.a.1. INDEX OF RECIPROCITY

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Corresponding to equation (1), we define mutuality between nation A1 and A2

$$X(1,2) \equiv \frac{\text{trade from A2 to the A2}}{\text{total import of A1}} \qquad (11)$$

$$X(2,1) \equiv \frac{\text{trade from the A1 to A2}}{\text{total import of A2}} \qquad (12)$$

In general, corresponding to equation (4), we define mutuality between nation Ai and Aj

$$R(i,j) \equiv X(\mathrm{i},\mathrm{j}) - X(\mathrm{i},\mathrm{j}) \qquad (13)$$

Ⅲ.B.a.2. INDEX OF DEPENDENCE

Corresponding to equation (9), we define dependence between nation Ai and Aj

$$D(\mathrm{i},\mathrm{j}) \equiv X(\mathrm{i},\mathrm{j}) + X(\mathrm{j},\mathrm{i}) \qquad (14)$$

Ⅲ.B.b. EXPORT SIDE ANALYSIS

We apply the output flow approach mentioned in chapter2 to an analysis of export.

Ⅲ.B.b.1. INDEX OF RECIPROCITY

Corresponding to equation (5), we define mutuality between nation A1 and A2 in the following way.

$$Y(1,2) \equiv \frac{\text{trade from A1 to A2}}{\text{total export of A1}} \qquad (15)$$

$$Y(2,1) \equiv \frac{\text{trade from the A2 to A1}}{\text{total export of A2}} \qquad (16)$$

In general, corresponding to equation (7), mutuality between Ai and Aj is formulated in equation (17).

$$R(\mathrm{i},\mathrm{j}) \equiv Y(\mathrm{i},\mathrm{j}) - Y(\mathrm{j},\mathrm{i}) \qquad (17)$$

Ⅲ.B.b.2. INDEX OF DEPENDENCE

Corresponding to equation (10), we define dependence between nation Ai and Aj in equation (18)

$$D(\mathrm{i},\mathrm{j}) \equiv Y(\mathrm{i},\mathrm{j}) + Y(\mathrm{j},\mathrm{i}) \qquad (18)$$

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Ⅲ.C. EMPIRICAL RESULTS

We propose a hypothesis that in case of two actors, linearity exists between R and D. In this section, we found that eighteen out of twenty cases support our hypothesis (confidence interval 95%, double tailed).

Hypothesis: linearity exists between R and D of each pair from 1992 to 2019

We have to note that the existence of linearity between R and D does not necessarily mean that some causal relationship exists between R and D.

Ⅲ. C.a. INPUT MODEL (IMPORT)

We examine ten pair out of five nations applying the import side approach.

Ⅲ. C.a.1 (THE U.S.., CHINA, IMPORT)

FIGURE V

D And R In The Case Of Import Between THE U.S.. And China

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.8836$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. V).

Ⅲ. C.a..2 (THE U.S.., GERMANY, IMPORT)

FIGUREVI

D And R In The Case Of Import Between THE U.S.. And Germany

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.6294$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure.VI).

Ⅲ. C.a.3 (THE U.S.., JAPAN, IMPORT)

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R^2 (0.4037) is not so high as other cases(figure.Ⅶ). However, 11 samples are enough to reject the null hypothesis (confidence interval 95%, double tailed), and we have 28 samples, which is satisfactory for the rejection.

FIGUREⅦ

D And R In The Case Of Import Between the U.S. And Japan

Source) Calculated by the author from the World Bank database

Ⅲ. C.a..4 (the U.S., KOREA, IMPORT)

Since $R^2 = 0.9905$ and sample size is 28, it is obvious that there is a linear relationship between D and R in the period of 1991-2019 (figure.Ⅷ).

FIGUREⅧ

D And R In The Case Of Import Between the U.S. And Korea

Source) Calculated by the author from the World Bank database

Ⅲ. C.a..5 (GERMANY, CHINA, IMPORT)

FIGUREⅨ

D And R In The Case Of Import Between China And Germany

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.9132$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. Ⅸ).

Ⅲ. C.a..6 (JAPAN, CHINA, IMPORT)

Since $R^2 = 0.0417$ (figure.Ⅹ), more than 90 samples are necessary to reject the null hypothesis (confidence interval 95%, double tailed), but we have only 28 samples, which is not satisfactory for

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the rejection. Therefore, we cannot confirm our hypothesis in this case. We observe that D has been almost unchanged, while R has been steadily decreasing from 1992 to 2019 (figure.XI). Due to the constancy of D, our regression analysis is not a useful method of analysis in this case.

FIGURE X

D And R In The Case Of Import Between Japan And China

Source) Calculated by the author from the World Bank database

FIGURE XI

Annual Trends Of D And R In The Case Of Import Between Japan And China

Source) Calculated by the author from the World Bank database

Ⅲ. C.a..7 (KOREA, CHINA, IMPORT)

FIGUREXII

D And R In The Case Of Import Between Korea And China

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.6602$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure.XII).

Ⅲ. C.a..8 (GERMANY, JAPAN, IMPORT)

FIGURE X III

D And R In The Case Of Import Between Germany And Japan

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.7484$ and sample size is 28, it is obvious that linearity exists between D and R in the

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period of 1992-2019 (figure. X Ⅲ).

Ⅲ. C.a..9 (GERMANY, KOREA, IMPORT)

FIGURE X Ⅳ

D And R In The Case Of Import Between Germany And Korea

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.6158$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. X Ⅳ).

Ⅲ. C.a..10 (JAPAN, KOREA, IMPORT)

FIGURE X V

D AND R IN THE CASE OF IMPORT BETWEEN KOREA AND JAPAN

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.9873$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. X V).

Ⅲ. C.b. OUTPUT MODEL (EXPORT)

We examine ten pair out of five nations applying the export side approach.

Ⅲ. C.b.1 (THE U.S., CHINA, EXPORT)

In case of U.S.-China, we cannot reject the null hypothesis because $R^2 = 0.0011$ (figure. X Ⅵ). However, by analyzing annual changes in D and R, namely, Δ D and Δ R, we observe that there is a strong linear relationship between Δ D and Δ R ($R^2 = 0.8$, figure. X Ⅶ)..

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FIGURE Ⅹ Ⅵ

D And R In The Case Of Export Between THE U.S.. And China

Source) Calculated by the author from the World Bank database

FIGURE Ⅹ Ⅶ

Annual Trends Of D And R In The Case Of Export Between THE U.S.. And China

Source) Calculated by the author from the World Bank database

Ⅲ. C.b.2 (THE U.S.., GERMANY, EXPORT)

FIGURE Ⅹ Ⅷ

D And R In The Case Of Export Between Germany And THE U.S..

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.6103$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. Ⅹ Ⅷ).

*Ⅲ. C.b.3 (*the *U.S., JAPAN, EXPORT)*

FIGURE Ⅹ Ⅸ

D And R In The Case Of Export Between the U.S. And China

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.7474$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. Ⅹ Ⅸ).

Ⅲ. C.b.4 (THE U.S.., KOREA, EXPORT)

FIGURE Ⅹ Ⅹ

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D And R In The Case Of Export Between THE U.S.. And Korea

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.9678$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. X X).

Ⅲ. C.b.5 (GERMANY, CHINA, EXPORT)

FIGURE X XI

D And R In The Case Of Export Between Germany And China

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.8757$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. X XI).

Ⅲ. C.b.6 (JAPAN, CHINA, EXPORT)

Since R^2 is 0.3016, 11 samples are enough to reject the null hypothesis (confidence interval 95%, double tailed), and we have 28samples, which is satisfactory(figure. X XⅡ).

FIGURE X XⅡ

D And R In The Case Of Export Between Japan And China

Source) Calculated by the author from the World Bank database

Ⅲ. C.b.7 (KOREA, CHINA, EXPORT)

FIGURE X X Ⅲ

D And R In The Case Of Export Between Korea And China

Since $R^2 = 0.9848$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. X X Ⅲ).

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Ⅲ. C.b 8 (GERMANY, JAPAN, EXPORT)

FIGURE X X Ⅳ

D And R In The Case Of Export Between Japan And Germany

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.7067$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. X X Ⅳ).

Ⅲ. C.b.9 (GERMANY, KOREA, EXPORT)

FIGURE X X V

D And R In The Case Of Export Between Korea And Germany

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.8317$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. X X V).

Ⅲ. C.b.10 (JAPAN, KOREA, EXPORT)

FIGURE X X VI

D And R In The Case Of Export Between Korea And Japan

Source) Calculated by the author from the World Bank database

Since $R^2 = 0.7394$ and sample size is 28, it is obvious that linearity exists between D and R in the period of 1992-2019 (figure. X X VI).

Ⅳ CONCLUSION

We have found that break down of interdependence into reciprocity and dependence is a useful method

in empirical analysis.

The article's first contribution is application of network theory to international economics.

A second contribution is the analysis of interdependence into sub-concept of reciprocity and dependence, and their quantification by network theory.

On the other hand, the limitation of this article is that our analysis is limited to two actors' relations. Therefore, for the next stage of our research, we need to expand our network method to analyze three actors' relations, namely, triad relations.

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TABLE I

Export And Import Share Of THE U.S.., China, Germany, Japan, And Korea

	Export share (%) in world export	Import share (%) in world import
THE U.S..	12.95	8.45
China	9.07	13.88
Germany	6.35	7.40
Japan	3.24	4.28
Korea	2.38	3.20
Total	33.99	37.21

Source) From World Bank database 2022

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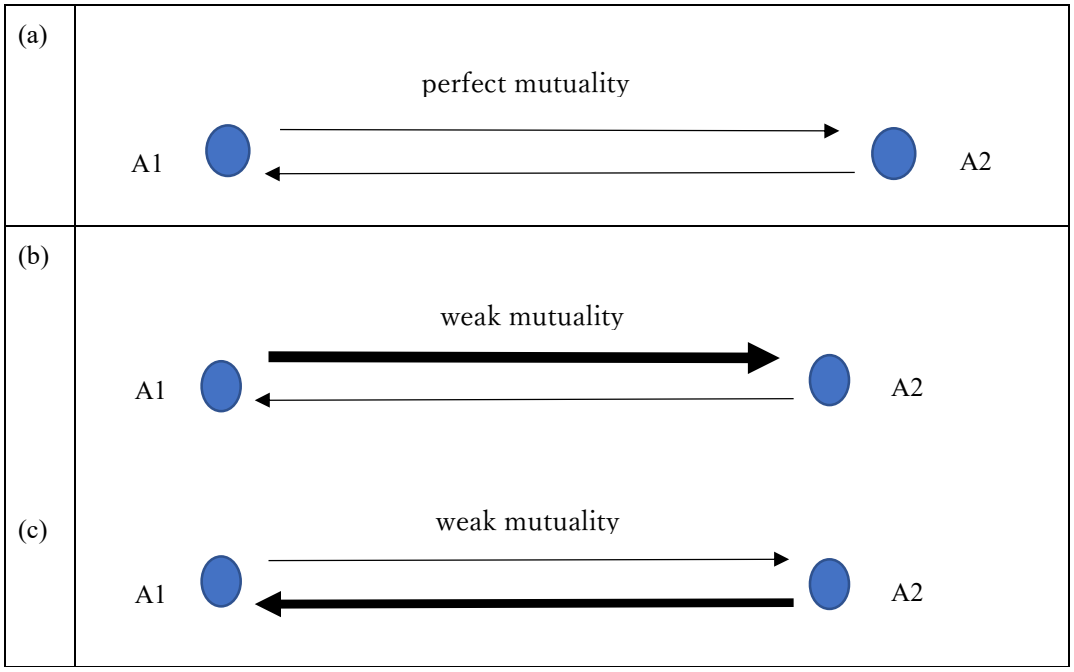

Figure I

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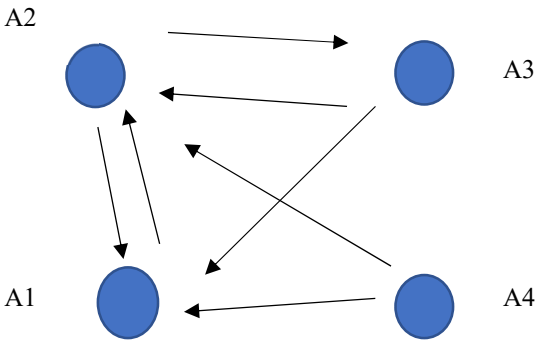

FIGURE II

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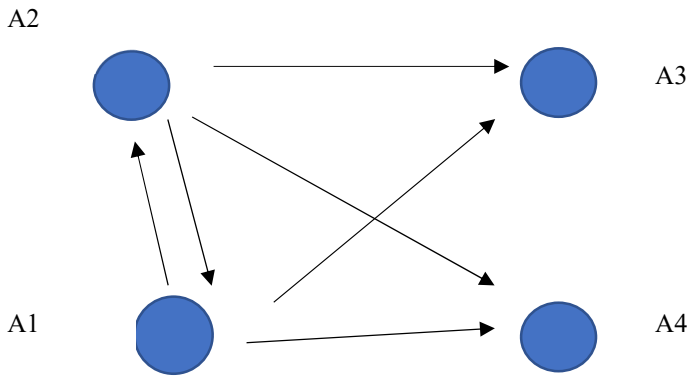

FIGURE Ⅲ

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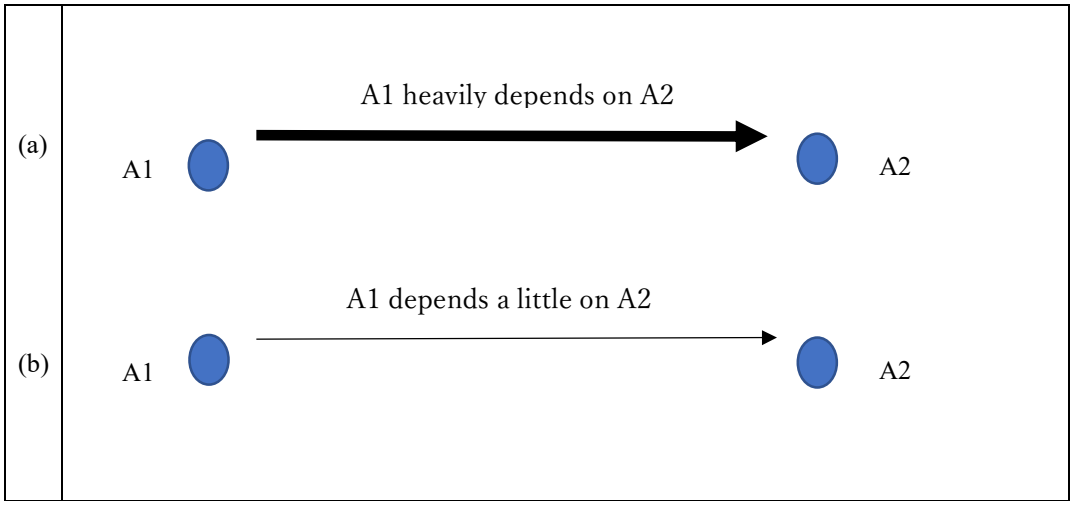

FigureIV

Two Types Of Dependence Between Two Actors

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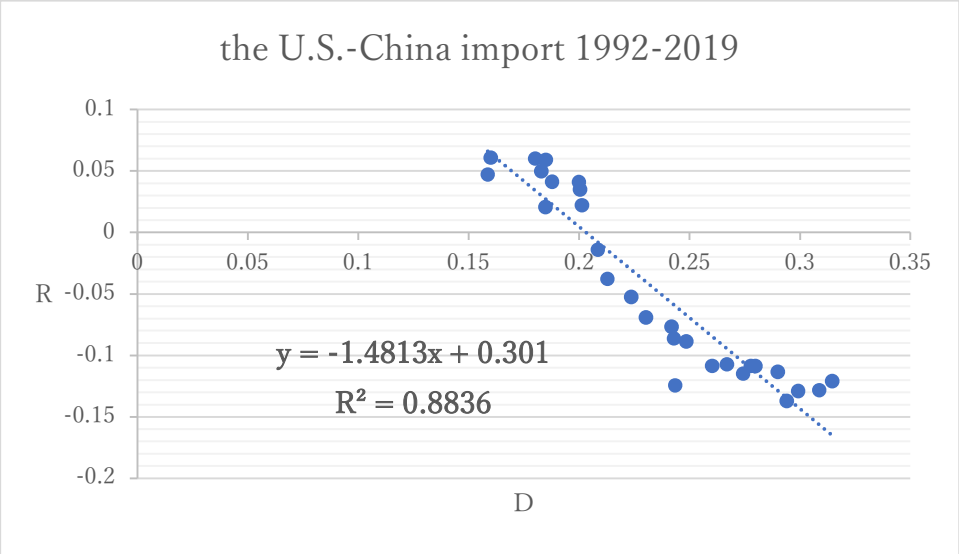

FIGURE V

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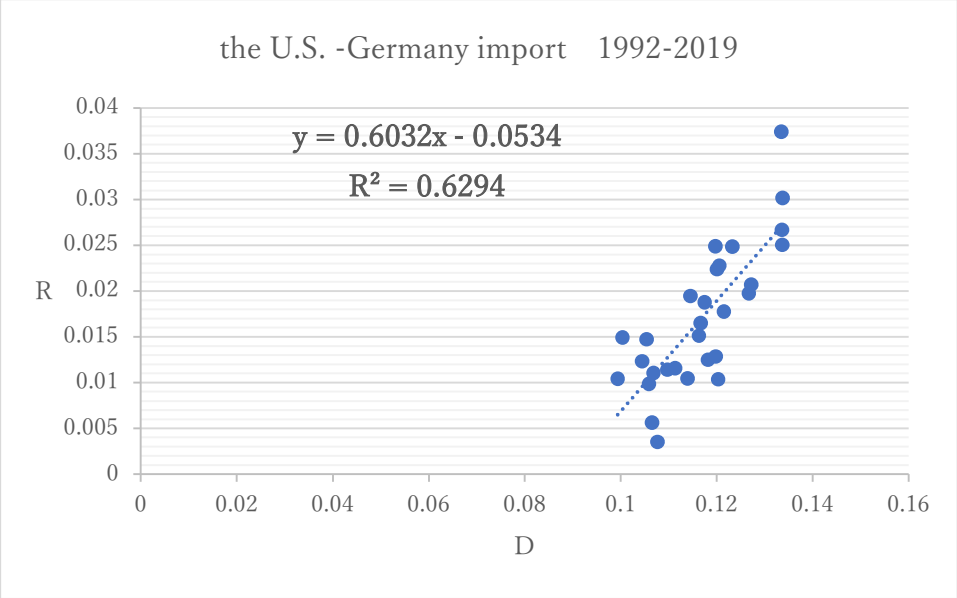
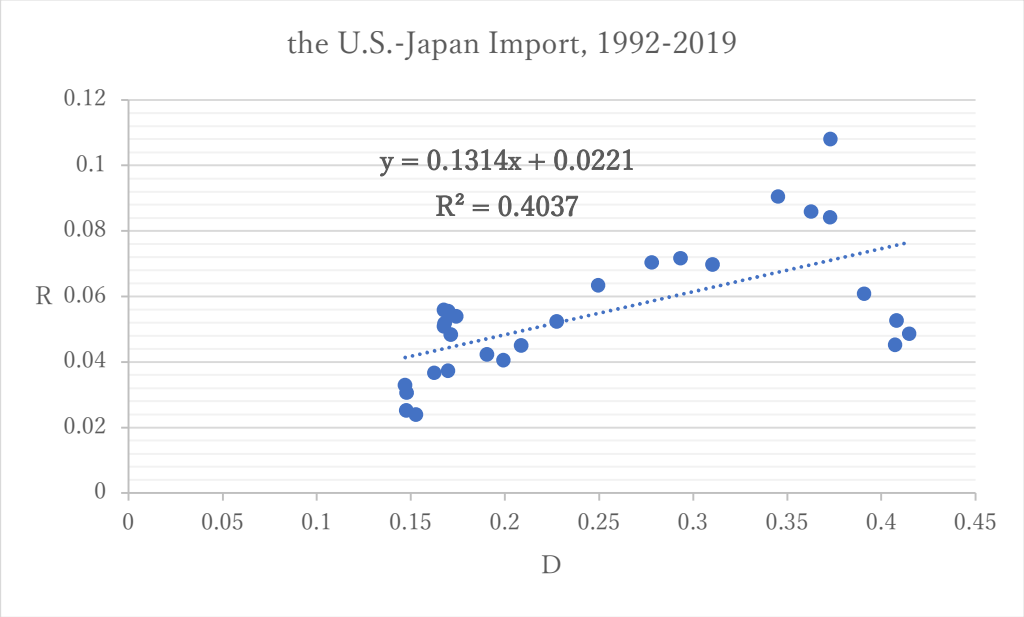


FIGUREVI

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1



FIGUREⅦ

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

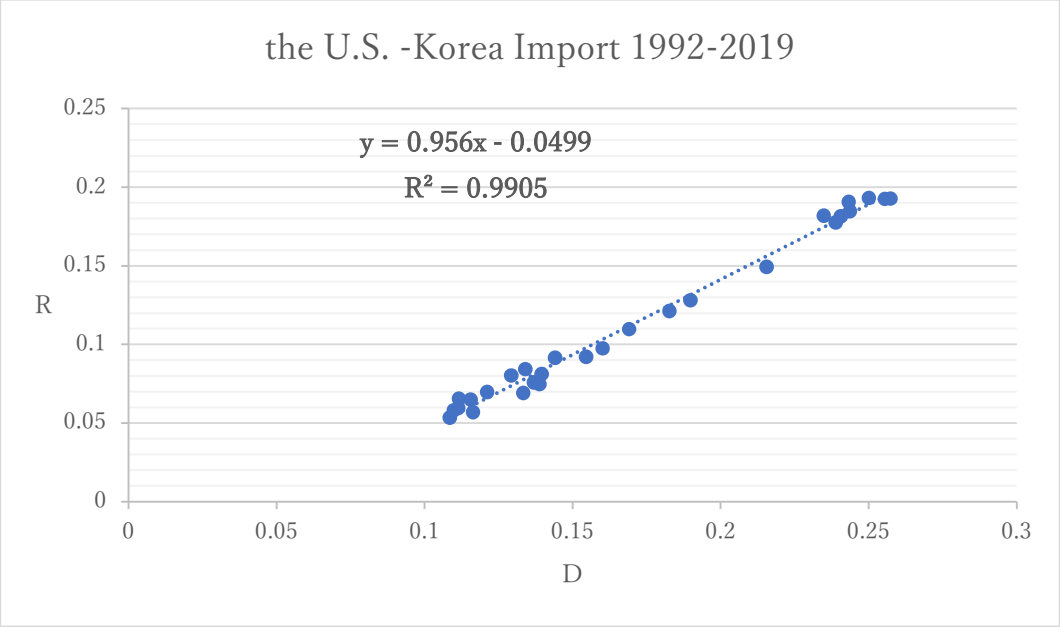


FIGURE Ⅷ

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

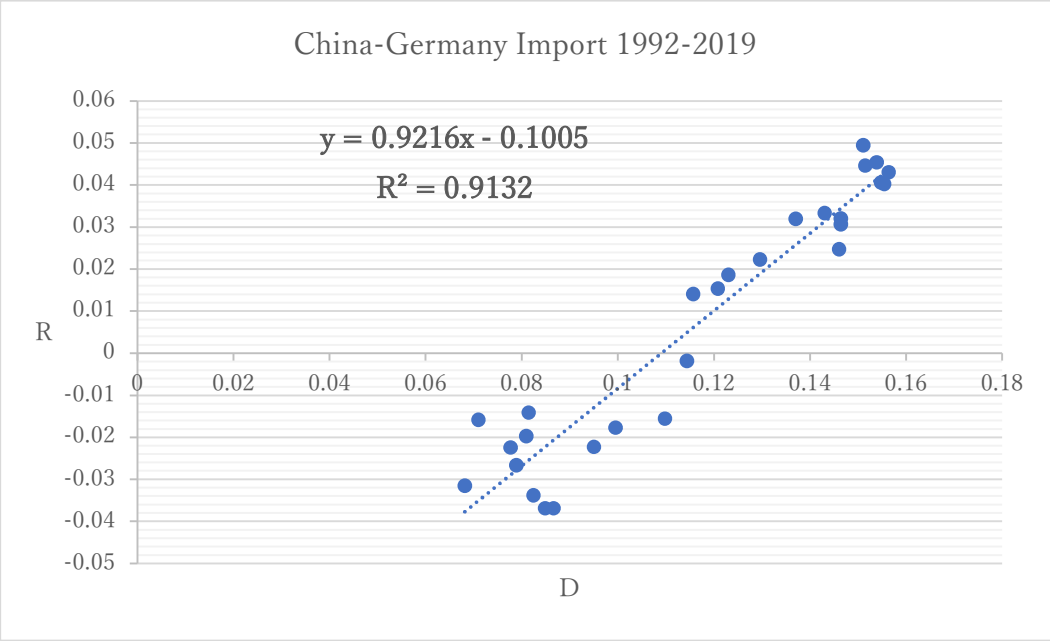


FIGURE Ⅸ

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

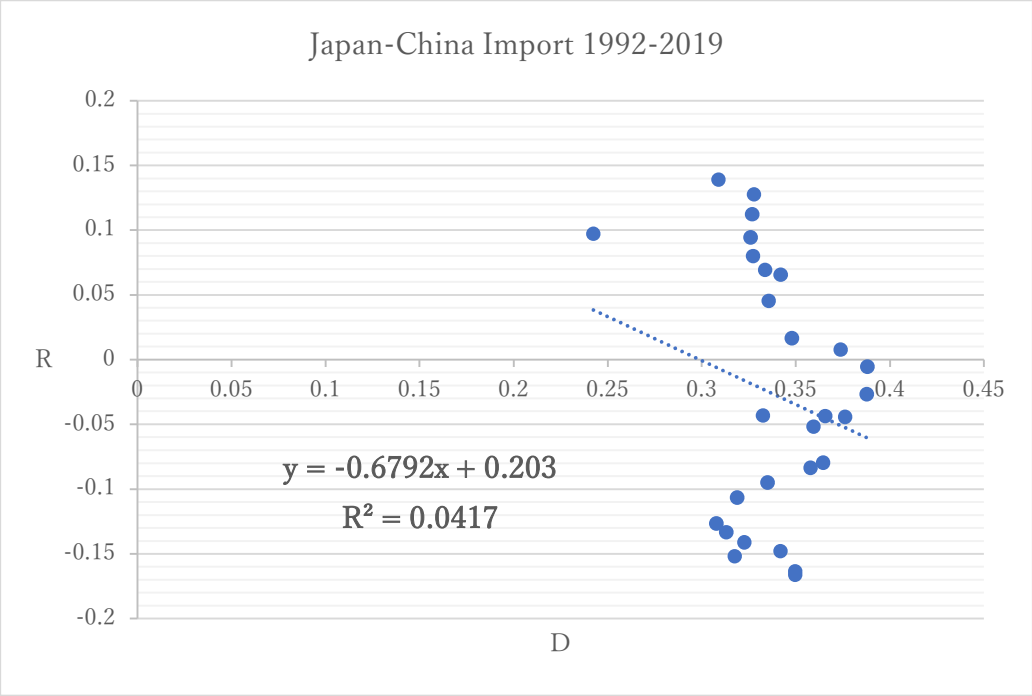


FIGURE X

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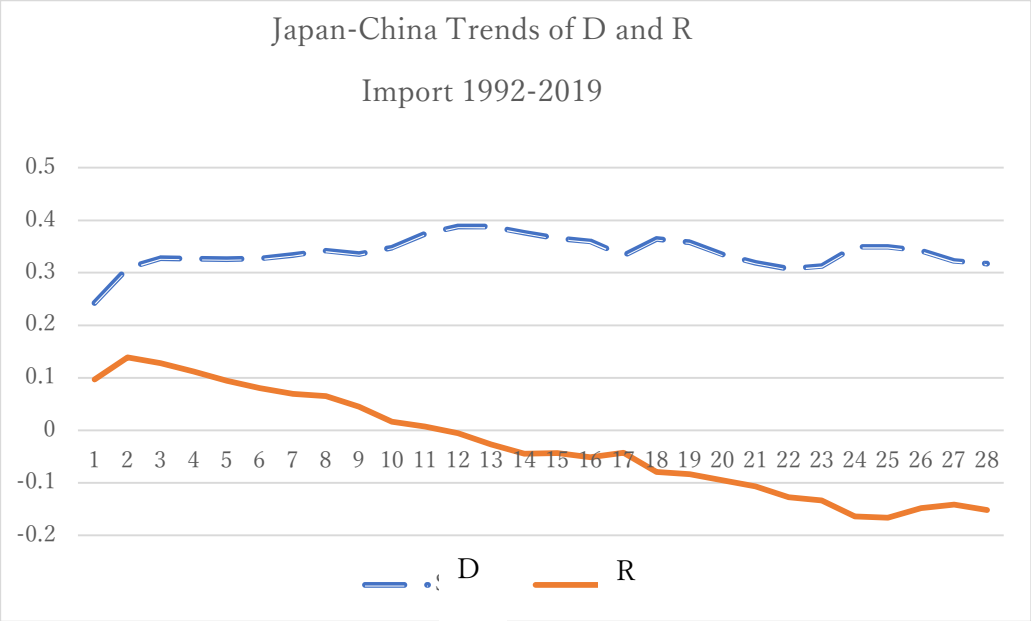

FIGURE XI

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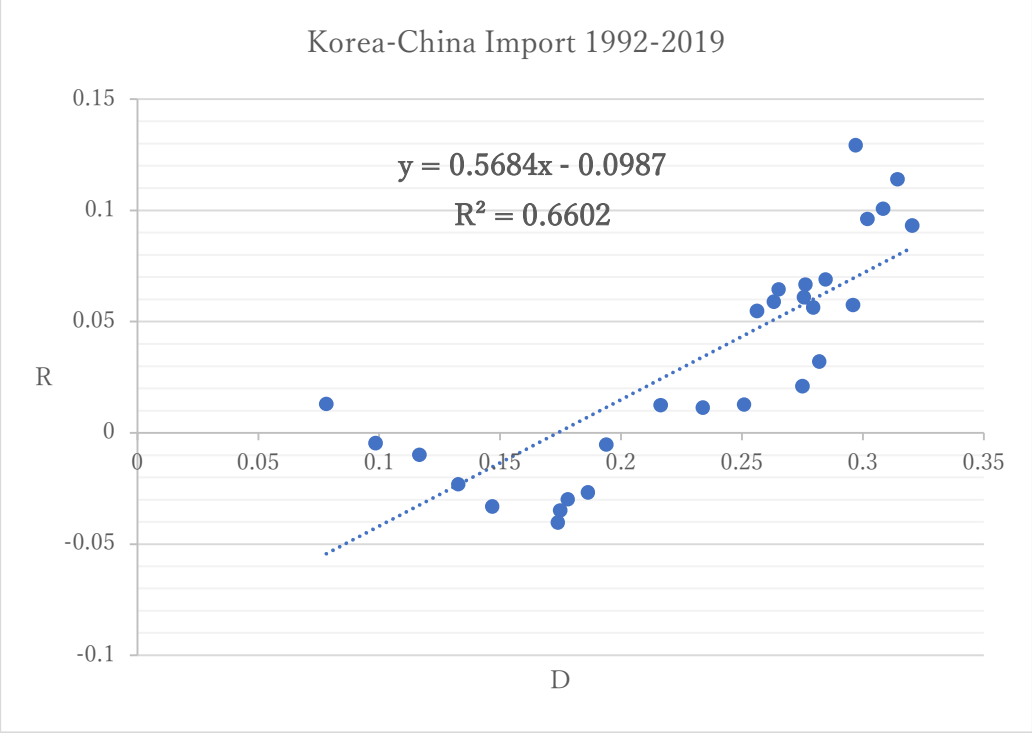

FIGUREXII

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

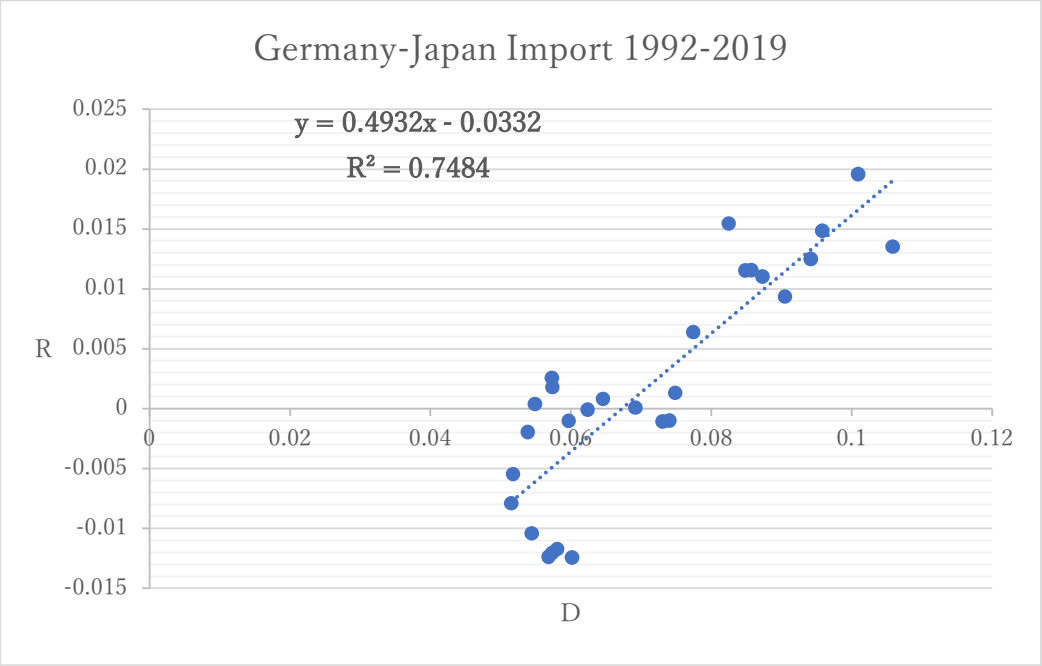

FIGURE X Ⅲ

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

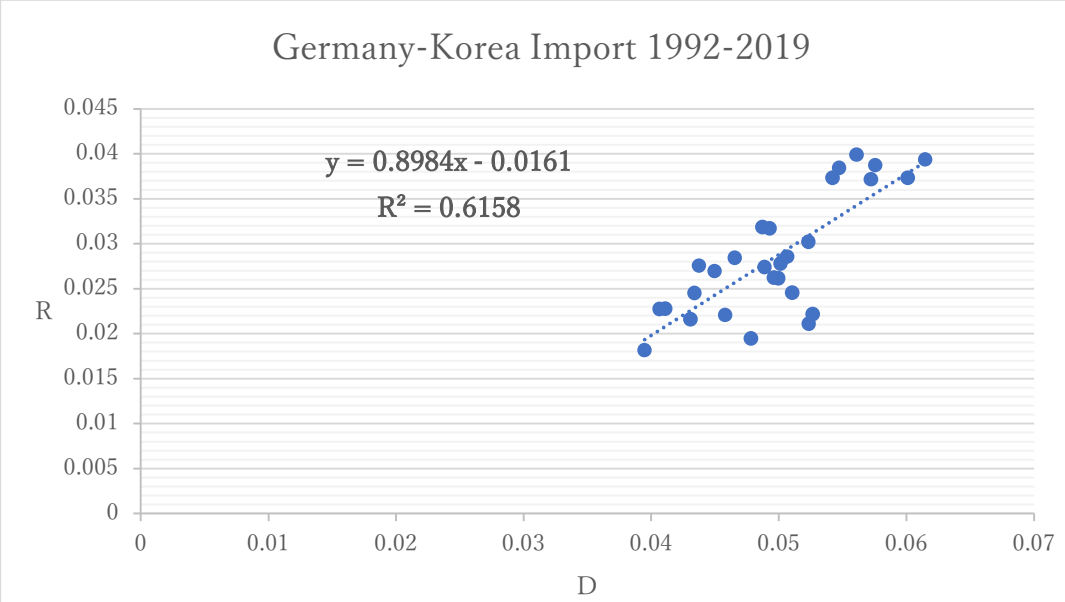

FIGURE XIV

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

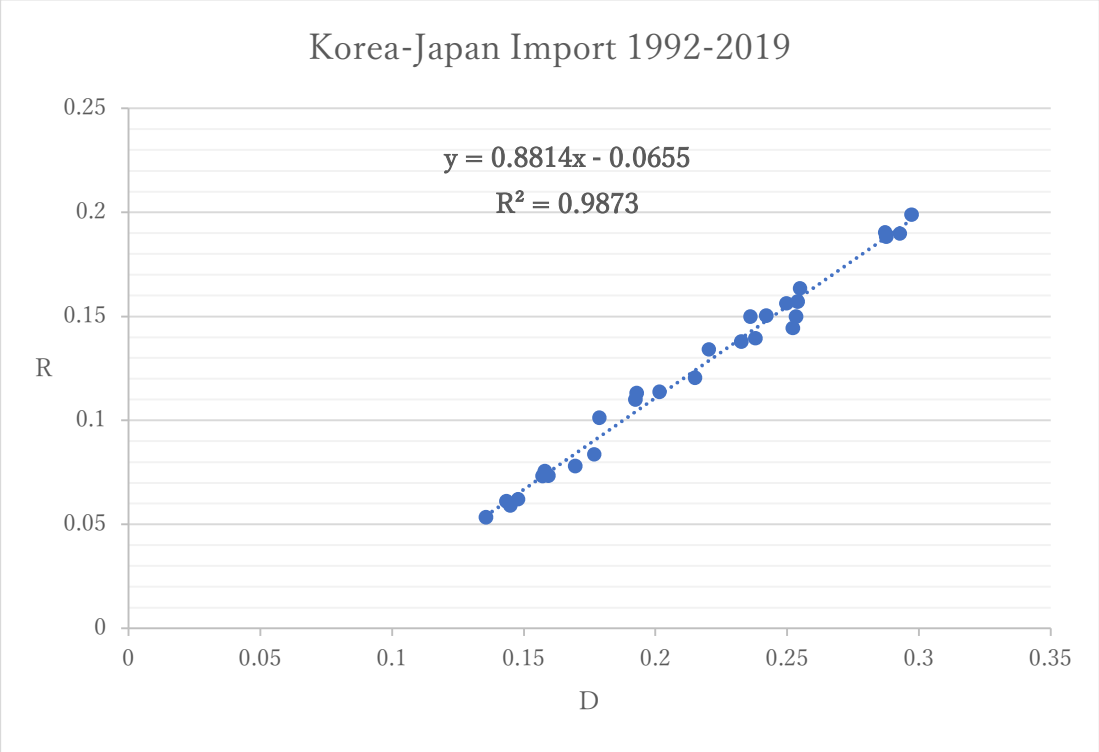

FIGURE X V

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

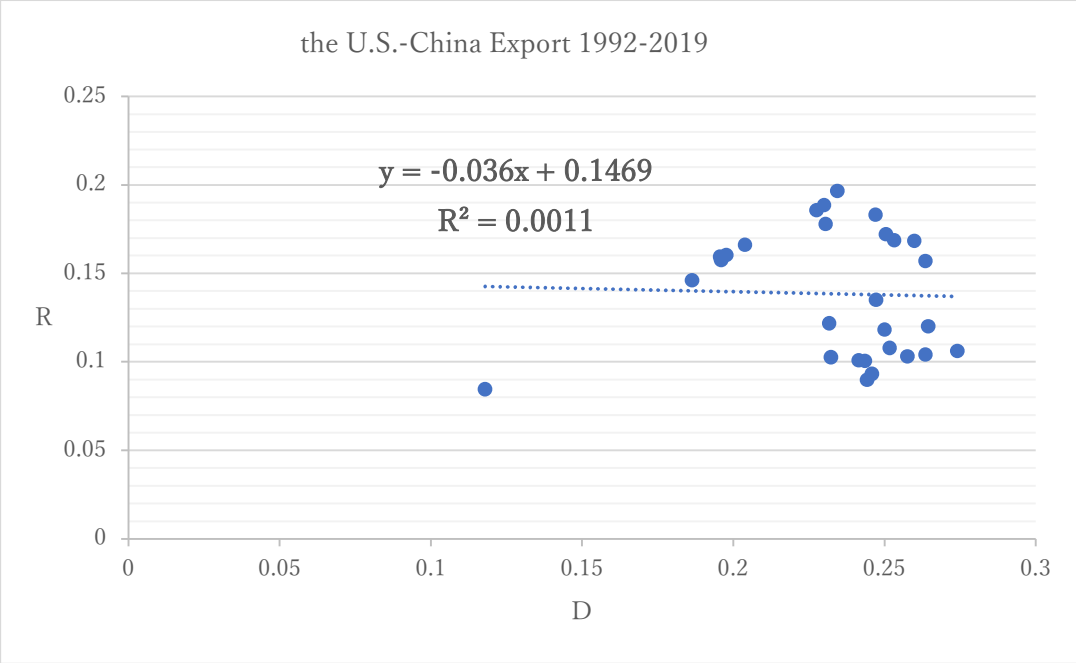

FIGURE X VI

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

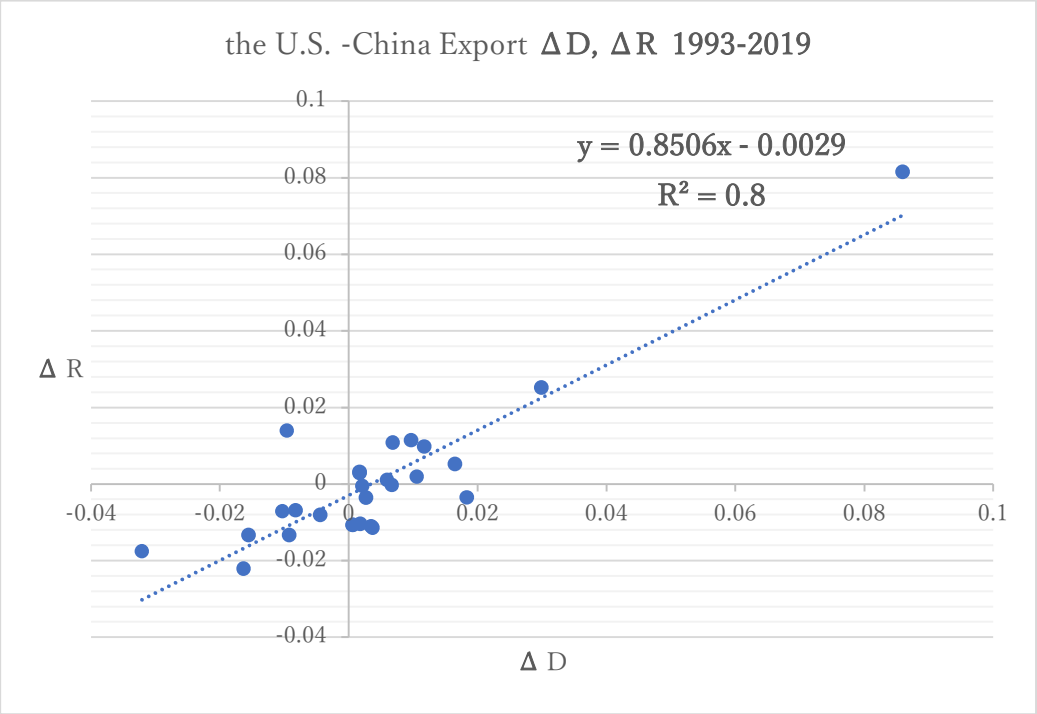

FIGURE XVII

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

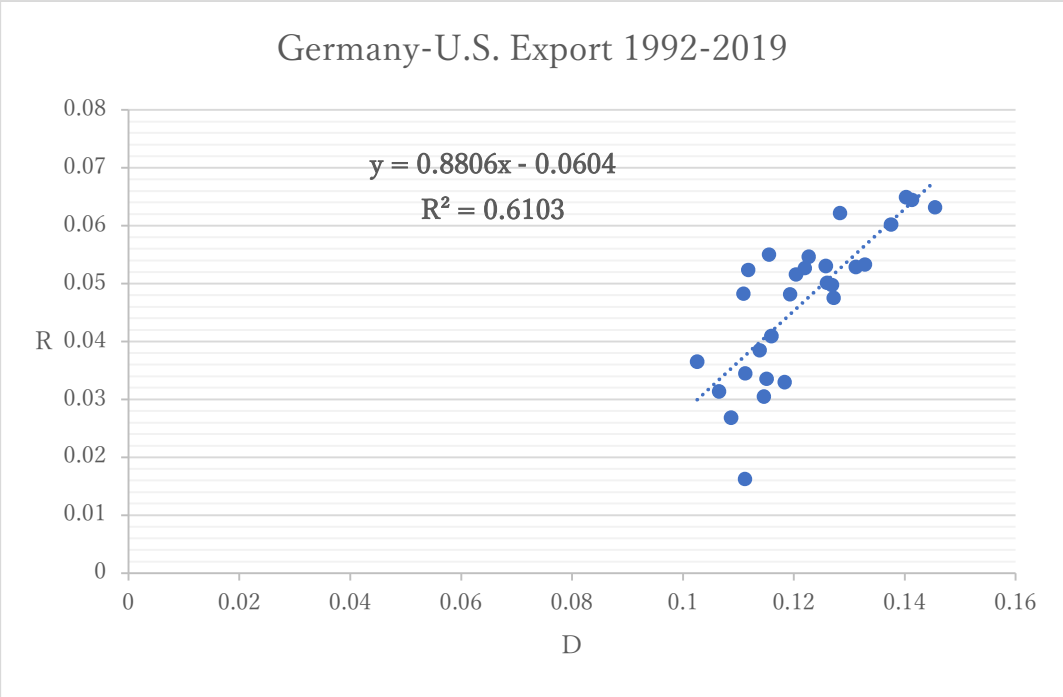

FIGURE XVIII

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

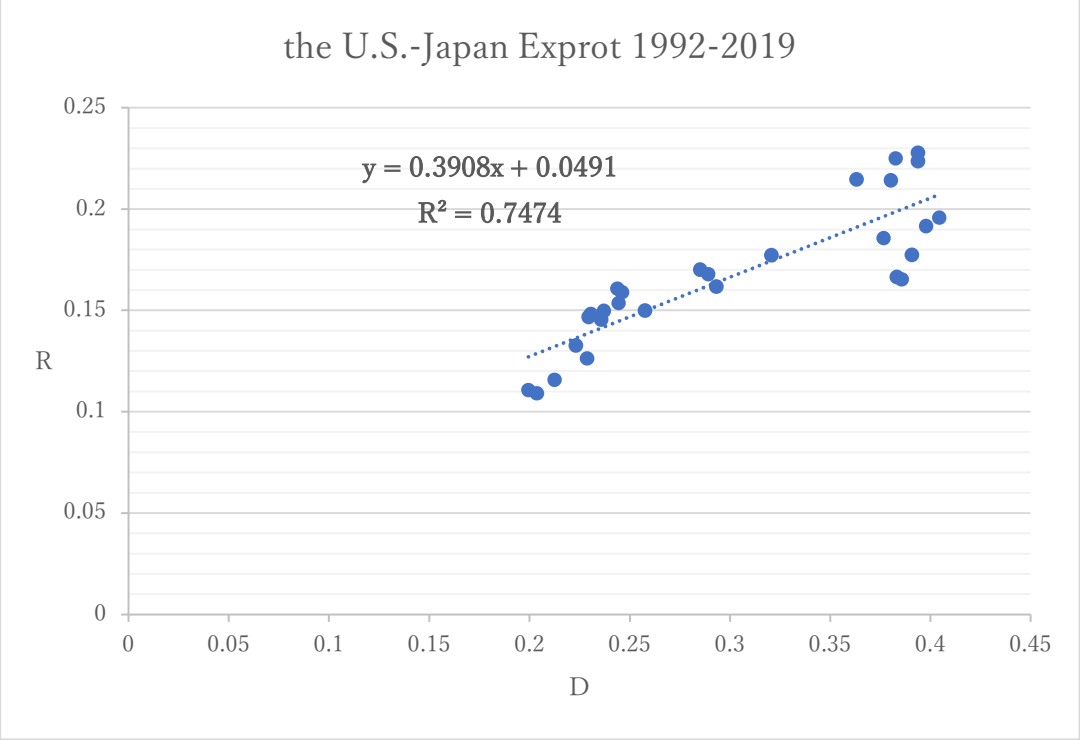

FIGURE X IX

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

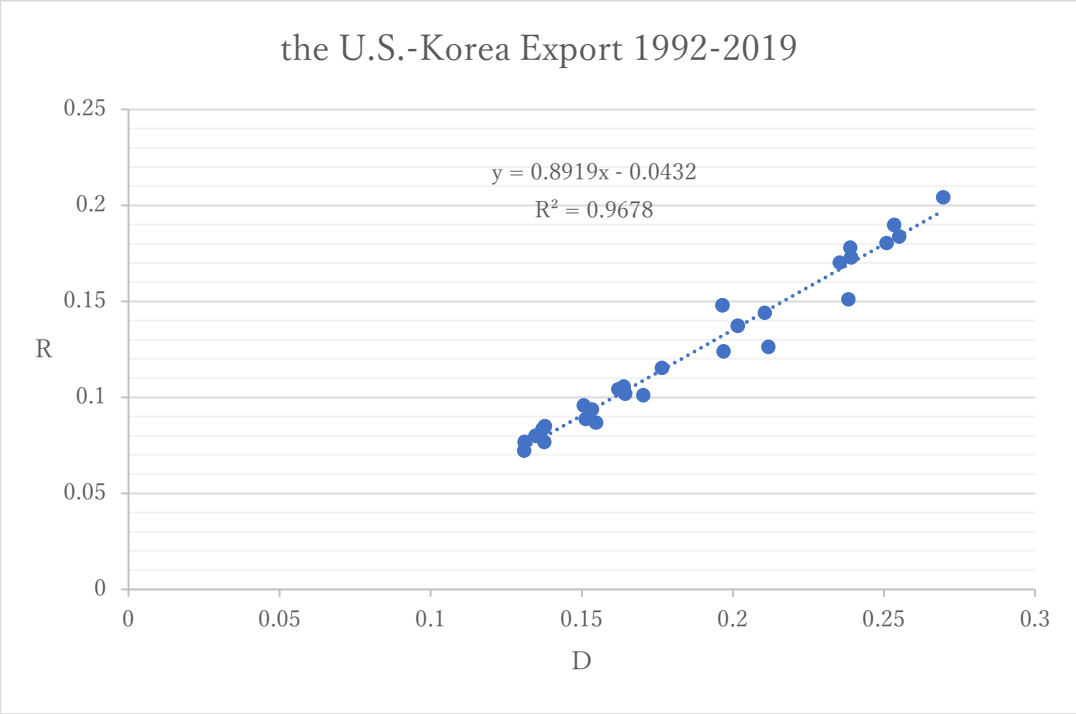

FIGURE X X

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

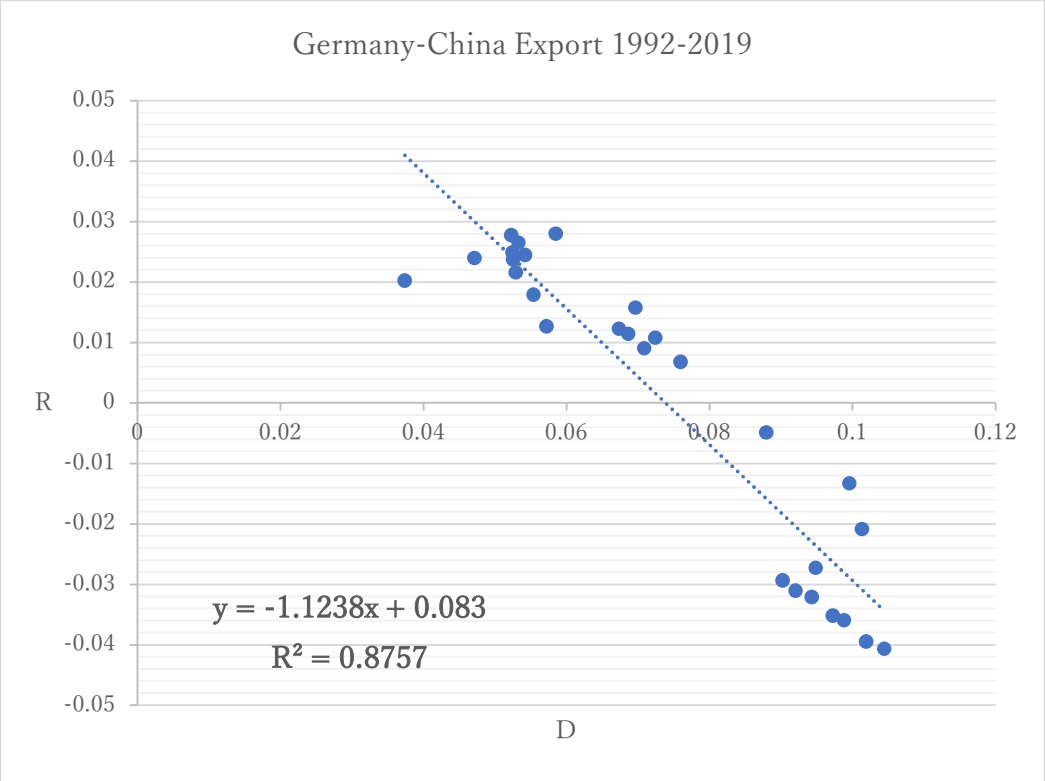

FIGURE X XI

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

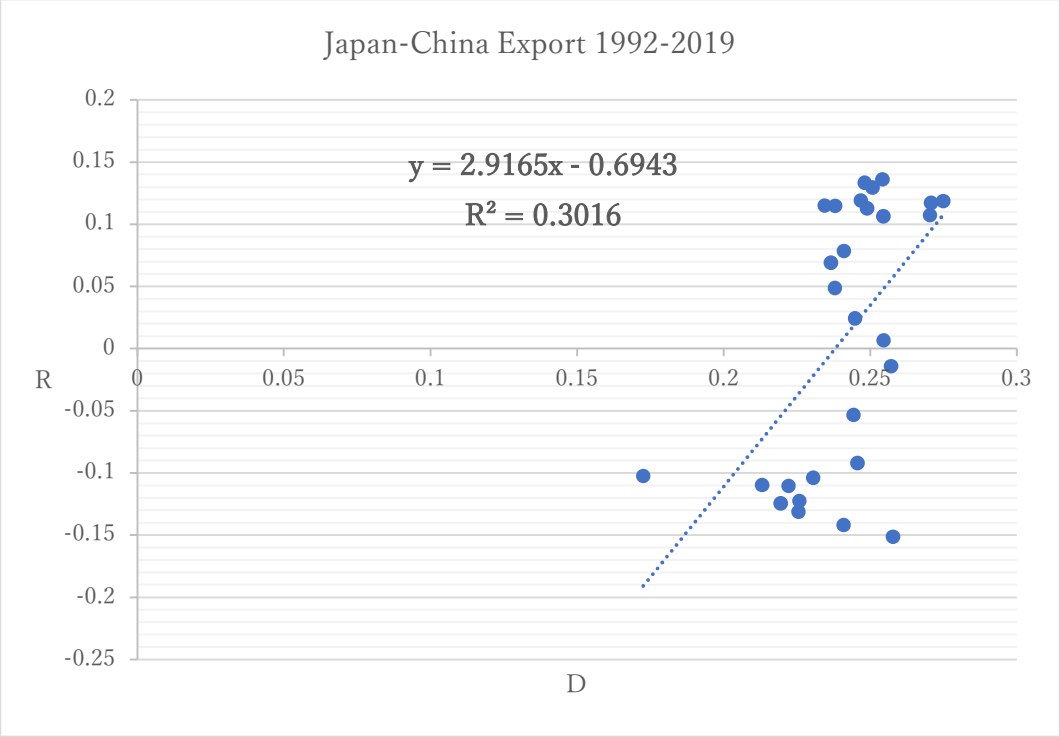

FIGURE XXII

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

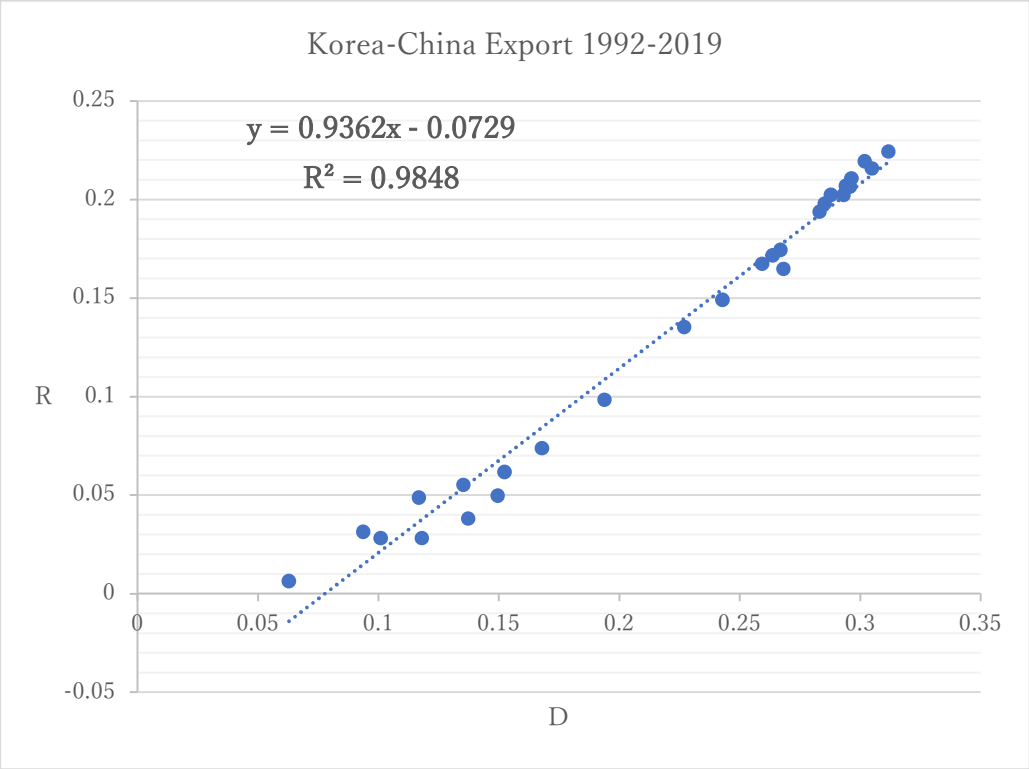

FIGURE X X Ⅲ

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

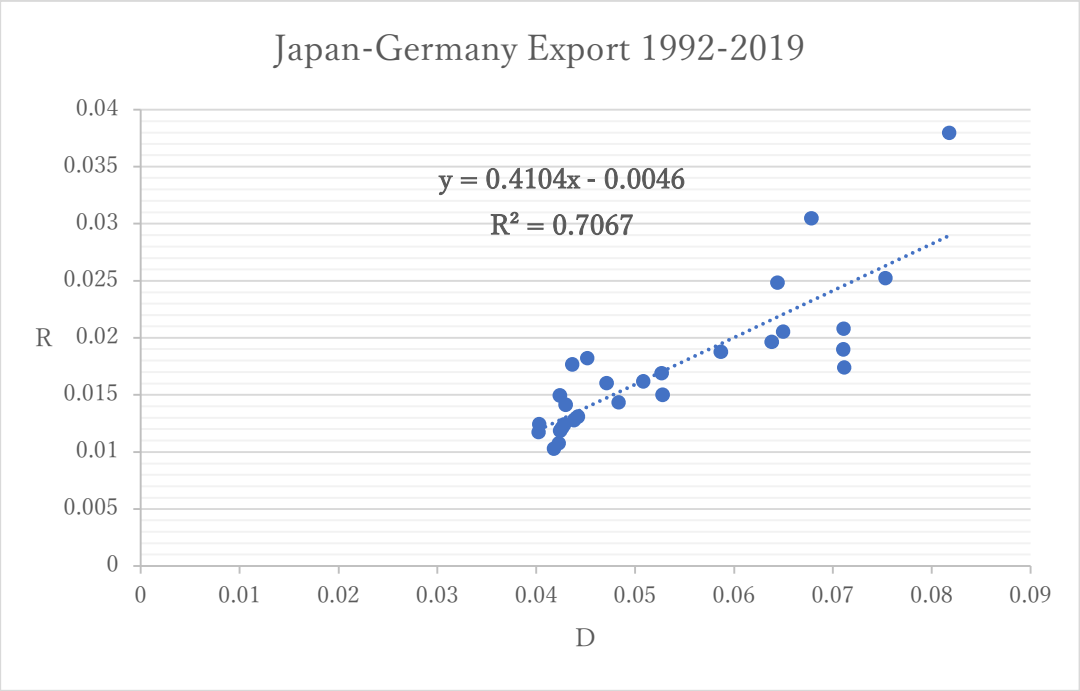

FIGURE X X IV

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

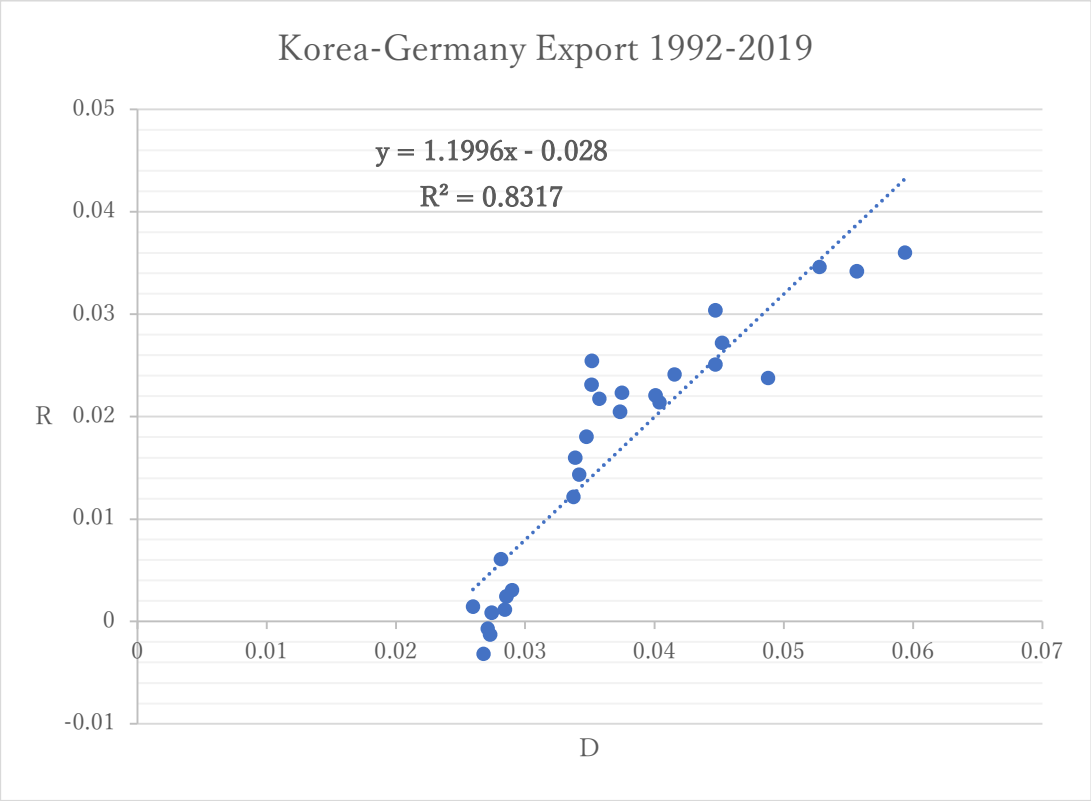

FIGURE X X V

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 15 March 2022 doi:10.20944/preprints202203.0207.v1

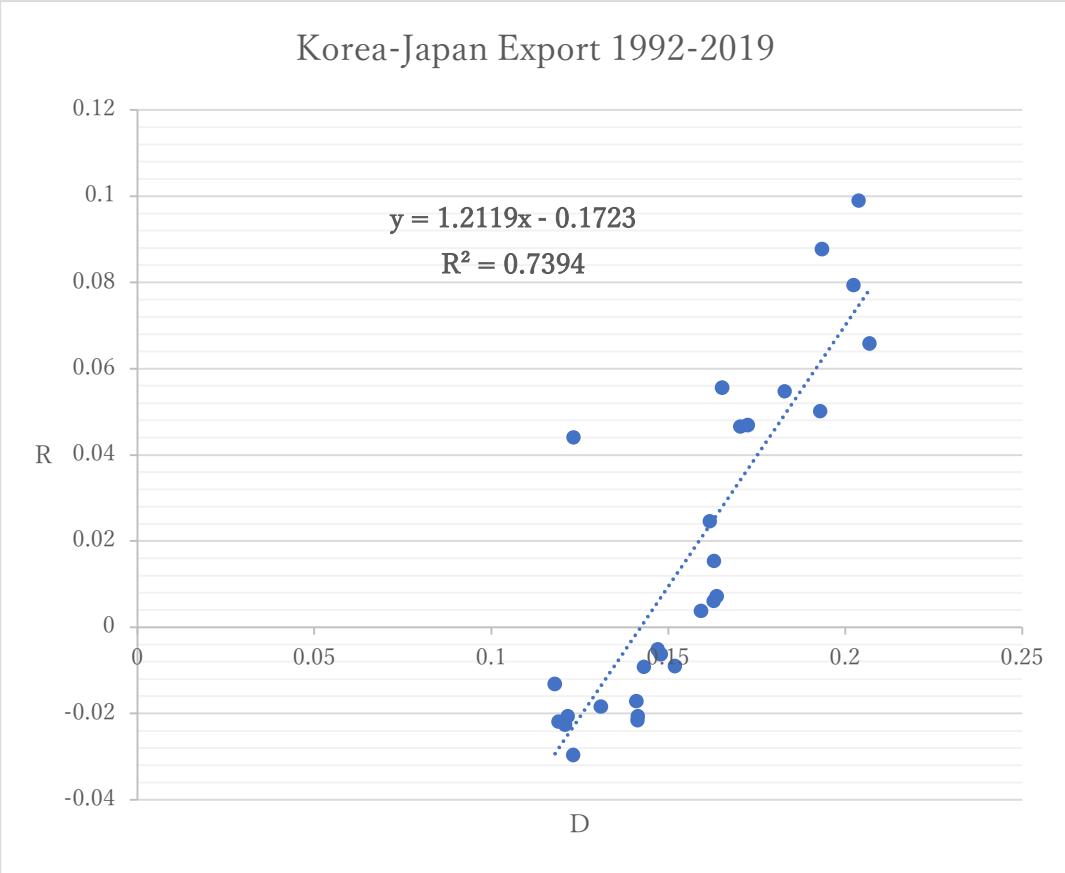

FIGURE X X VI