

Network and Text Analysis on Digital Trade Agreements

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I. Introduction

The Trade Agreements Provisions on Electronic Commerce and Data (TAPED) database covers over 370 preferential trade agreements (PTAs), with chapters and provisions since 2000. The newly created TAPED dataset provides the title of an agreement, parties, date signed, and in particular, binary information if an agreement includes a digital trade chapter. Texts of specific trade agreements containing digital trade chapters are accessible in pdf format. TAPED and PDF texts enable us to perform quantitative analysis on 94 trade agreements signed between 2000 and 2021, including independent digital trade chapters.

We use TAPED and their corresponding texts to undertake network and text analysis on trade agreements with digital trade chapters to identify which countries are important in the network and how similar or different their texts of digital trade chapters are. In this brief,

we use the terms “digital trade” and “electronic commerce” interchangeably, and refer to digital trade agreements as including both trade agreements with digital trade chapters and an independent agreement such as the Digital Economy Partnership Agreement (DEPA).

In Figure 1, centrality values reflect which countries are influential in the network, while values of similarity assess the level of similarity between the texts of digital trade chapters concluded by these countries. Centrality and similarity are complementary in assessing the relative positions of countries in the network, where the number of linkages between countries is significant in centrality and the quality of digital trade chapters is critical in similarity. We interpret this to mean that a country with a high degree of centrality is likely to be a rule-promoter in the network, whereas a country

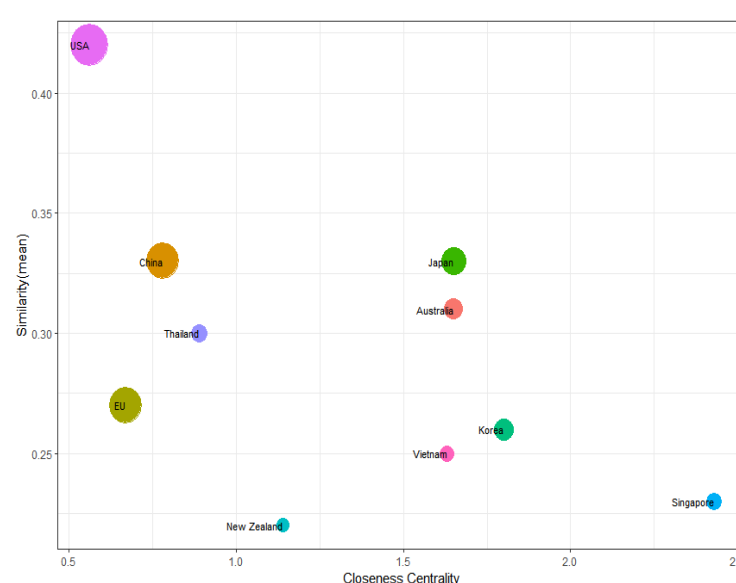
with a high degree of similarity is likely to be a rule-maker. The brief highlights three key findings from network and text analysis of digital trade agreements:

[Finding 1] The U.S. has been the best rule-maker but not the best rule-promoter, whereas Singapore has been the best rule-promoter but not the best rule-maker.

[Finding 2] China is a rule-maker, but to a weaker extent than the U.S., and Korea is a rule-promoter, although it is less active than Singapore.

[Finding 3] Japan and Australia have served as both rule-makers and rule-promoters.

Figure 1. Relative Positions of Countries in the Network



Note: The size of each circle represents the GDP size of the economy.

Source: Authors' illustration based on network analysis of closeness centrality and text analysis of similarity.

II. Network Analysis on Digital Trade Agreements

1. Methodology

We analyze an undirected weighted network of digital trade agreements.¹ Undirected and

weighted are commonly used assumptions in network analysis. An undirected network means that no direction issue arises in the network, due to the nature of agreement reached between the countries in question, based on talks and mutual consent, in accordance with

¹ Among previous studies, Opsahl et al. (2010) identified centrality in an undirected and weighted network by using the idea of a so-called tuning parameter between the number of connected networks (ties) and

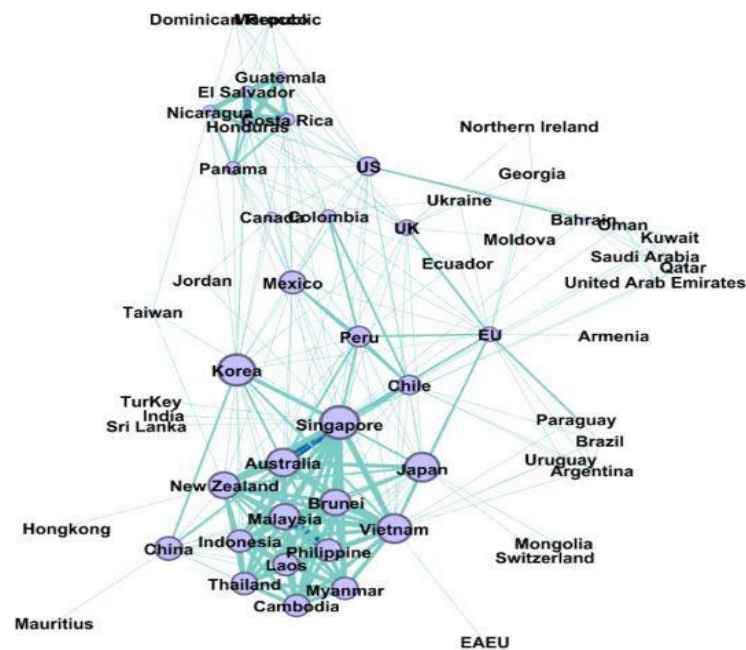
the strength of connected networks (tie weights). In calculating centrality measures, we use a tuning parameter value of 1.5 and GDP as tie weights.

their bilateral partnerships.² A weighted network means that the number of signed digital trade agreements is reflected as a weight in the network. It can be argued that the greater the number of digital trade agreements signed by any country, the greater their trust or the possibility of being important partners in digital economic cooperation becomes. Australia and Singapore, for example, are essential partners because they have signed six digital trade agreements.

2. Main Results

We begin by visualizing the network of digital trade agreements, which include 57 countries and 286 links (see Figure 2). Each node's size is proportional to the country's eigenvector centrality. It represents the significance of partner countries that have signed agreements with countries that have major influence over the network.

Figure 2. The Network of Free Trade Agreements with Digital Trade Chapters



Note: The size of each node is proportional to the size of the country's eigenvector centrality.
Source: Authors' own calculations based on TAPED (2022.1)

In addition to eigenvector centrality, we examine two other centrality measures: closeness and betweenness. Closeness centrality indicates the proximity of connected countries

within the network and determines if a country is at the center of this network. It assesses the impact of the ability of a country to quickly spread information to all the other countries in

² Technically, undirected means that the network's adjacency matrix is assumed to be symmetric.

the network. Betweenness centrality measures how far a country is “between” other countries in the network, i.e., how far it can act as an intermediate via digital trade agreements.

For each of the 57 countries in the network, we compute the indices of eigenvector centrality, closeness centrality (weighted), and betweenness centrality (weighted). Table 1 clearly shows that Singapore ranks first in all

centrality measures. This result shows that Singapore has played a central role in promoting digital trade rules, influencing the network of digital trade agreements.

Centrality measures can tell how influential a country is in the network, but they cannot show the extent to which a country has been self-interested and hence influential through texts of digital trade agreements.

Table 1. Centralities in the Network of Digital Trade Agreements: Top ten countries

Eigenvector centrality		Closeness centrality (weighted)		Betweenness centrality (weighted)	
Singapore	1.00	Singapore	2.43	Singapore	5.72
Korea	0.95	Korea	1.80	EU	2.08
Japan	0.88	Japan	1.65	Japan	1.75
Vietnam	0.88	Australia	1.65	US	1.35
Australia	0.85	Vietnam	1.63	Vietnam	1.25
New Zealand	0.80	New Zealand	1.14	UK	0.89
Malaysia	0.79	Malaysia	1.12	Australia	0.48
Brunei	0.79	Peru	1.07	Korea	0.43
Mexico	0.71	Brunei	1.05	China	0.23
Thailand	0.69	Mexico	0.93	New Zealand	0.21

Notes: Standardization yields closeness and betweenness centrality. Weighted average refers to the average value of each centrality, computed by weighting the number of digital trade agreements concluded and the contracting countries' economic scale (GDP).

Source: Authors' own calculations based on TAPED (2022.1).

III. Text Analysis on Digital Trade Agreements

1. Methodology

Despite certain limitations, text analysis has

grown in popularity because of its capacity to analyze a large number of texts from any agreements in a short period of time. Following previous studies, we investigate the pairwise similarity between digital trade agreement texts.³ We interpret that higher similar-

³ Among previous studies, Seiermann (2018) investigates the similarities of trade agreements. He shows

that large countries' signed trade agreements have a high degree of similarity and suggests that larger

ity (on average) points to a stronger role in setting the text of a digital trade chapter. This means that a country with high similarity (on average) has played a significant role as a rule-maker in the network.

2. Main Results

We choose Korea and the U.S. as examples and report their similarities in texts of digital trade agreements.⁴ Korea (the U.S) has signed 13 digital trade agreements in total, resulting in a 13 by 13 symmetric matrix with pairwise similarity values in cells. The diagonal of the matrix has no number because its value is meaningless (its original value becomes 1 due to the fact that pairwise similarity is calculated between identical agreements).

The first row on the top panel compares the Korea-Singapore FTA to the other agreements in Table 2. The similarity value between digital trade chapters in the Korea-Singapore FTA and the Korea-U.S. FTA is 0.37 in the second column of the first row. The similarity value between the digital trade chapters in the Korea-Singapore FTA and the Korea-EU FTA is 0.15

in the third column of the first row.

The average degree of agreement similarity for Korea and the U.S. is 0.26 and 0.42, respectively. It is simple to compare color differences between Korea and the U.S. as shown in Table 2. The U.S. has more red and blue cells than Korea. The U.S. has the highest degree of similarity among the countries in our sample. We understand this outcome to mean that the U.S. has taken the lead as a rule-maker through digital trade agreements.

In terms of centrality and similarity, we may also argue that Japan, Australia, China and other countries are placed in between the U.S. and Singapore, as shown in Figure 1. We contend that Japan and Australia, in particular, have played dual roles as both rule-makers and rule-promoters. China has also played a role as a rule-maker, necessitating additional research to understand how the U.S. and China differ in their roles as rule-makers in the network. This avenue of research links to the international trade and law literature with provision comparisons, although it is outside of the scope of this brief.

countries can form self-interested trade agreements based on large economic scales and effects over the world. He also shows, using a gravity model, that export gains increase with increased similarity between countries. Seo et al. (2019) study Korea's finalized RTAs using text mining. They use the same degree of Jaccard Similarity to determine which RTA has played

a vital role in the history of RTAs signed by Korea. According to Seo and Roh (2021), the average similarity of a country's signed agreements can be used to measure how consistently the country respects its trade principles.

⁴ We also look at the degree of similarities for Singapore, China, the EU, and (nearly) all countries participating in the Indo-Pacific Economic Framework (IPEF).

Table 2. Similarities in Texts of Digital Trade Agreements: Korea and the U.S.

Korea

SGP06		0.37	0.15	0.26	0.19	0.23	0.24	0.17	0.18	0.37	0.17	0.10	0.29
USA07	0.37		0.14	0.35	0.29	0.34	0.28	0.27	0.31	0.45	0.27	0.20	0.53
EU10	0.15	0.14		0.16	0.29	0.20	0.16	0.17	0.20	0.19	0.12	0.06	0.19
PER11	0.26	0.35	0.16		0.41	0.32	0.55	0.32	0.32	0.45	0.26	0.16	0.40
COL13	0.19	0.29	0.29	0.41		0.36	0.37	0.38	0.34	0.53	0.24	0.13	0.49
AUS14	0.23	0.34	0.20	0.32	0.36		0.27	0.32	0.32	0.34	0.27	0.15	0.40
CAN14	0.24	0.28	0.16	0.55	0.37	0.27		0.30	0.27	0.37	0.25	0.16	0.34
VNM15	0.17	0.27	0.17	0.32	0.38	0.32	0.30		0.35	0.34	0.25	0.13	0.36
CHN15	0.18	0.31	0.20	0.32	0.34	0.32	0.27	0.35		0.32	0.25	0.13	0.34
CA18	0.37	0.45	0.19	0.45	0.53	0.34	0.37	0.34	0.32		0.26	0.15	0.54
RCEP20	0.17	0.27	0.12	0.26	0.24	0.27	0.25	0.25	0.25	0.26		0.28	0.29
SGDP21	0.10	0.20	0.06	0.16	0.13	0.15	0.16	0.13	0.13	0.15	0.28		0.19
ISR21	0.29	0.53	0.19	0.40	0.49	0.40	0.34	0.36	0.34	0.54	0.29	0.19	
	SGP06	USA07	EU10	PER11	COL13	AUS14	CAN14	VNM15	CHN15	CA18	RCEP20	SGDP21	ISR21

The U.S.

SGP06		0.37	0.43	0.69	0.52	0.72	0.65	0.52	0.52	0.50	0.35	0.16	0.11
CHL09	0.37		0.30	0.38	0.54	0.39	0.36	0.35	0.35	0.55	0.27	0.21	0.14
AUS14	0.43	0.30		0.45	0.39	0.50	0.50	0.57	0.57	0.40	0.47	0.25	0.16
MAP_24	0.69	0.38	0.45		0.54	0.60	0.61	0.54	0.54	0.55	0.33	0.16	0.10
Central4	0.52	0.54	0.39	0.54		0.55	0.52	0.51	0.51	0.69	0.32	0.22	0.14
DIR14	0.72	0.39	0.50	0.60	0.55		0.76	0.54	0.54	0.56	0.34	0.16	0.11
CHN15	0.65	0.36	0.50	0.61	0.52	0.76		0.61	0.61	0.55	0.38	0.17	0.11
PER15	0.52	0.35	0.57	0.54	0.51	0.54	0.61		1.00	0.54	0.54	0.26	0.16
COL16	0.52	0.35	0.57	0.54	0.51	0.54	0.61	1.00		0.54	0.54	0.26	0.16
PAN17	0.50	0.55	0.40	0.55	0.55	0.55	0.54	0.54	0.54		0.35	0.23	0.15
KOR17	0.35	0.27	0.47	0.33	0.32	0.34	0.36	0.54	0.54	0.35		0.34	0.23
MCA18	0.16	0.21	0.25	0.16	0.22	0.16	0.17	0.26	0.26	0.23	0.34		0.46
JPN19	0.11	0.14	0.16	0.10	0.14	0.11	0.11	0.16	0.16	0.15	0.23	0.46	
	SGP06	CHL09	AUS14	MAP_24	Central4	DIR14	CHN15	PER15	COL16	PAN17	KOR17	MCA18	JPN19

Notes The similarity on the diagonal indicates self-similarity, and the original value 1, but it is set as a missing value since self-similarity is meaningless. The counterpart country that signed an agreement with Korea is indicated based on ISO3. CA means an agreement with the five Central American countries.

Source: Authors' calculation.

IV. Concluding Remarks

Thirteen countries have participated in the U.S.-led Indo-Pacific Economic Framework (IPEF) to seek new opportunities by establishing new digital trade rules and cooperating with one another to boost their digital trade and economy in the region. If the IPEF establishes

an agreement on digital trade rules in Pillar 1, its impact on the network of digital trade agreements will be significant, depending on the number of signatory countries and the quality of the text.

We do not know and cannot predict how the negotiations with 12 countries (India is an obs-

erver in Pillar 1) will progress up to the end of this year. Many countries may need to amend or expand their bilateral or regional digital trade agreements. The U.K., Singapore, and Australia have been particularly active and influential in the network of digital trade agreements.

Korea also implemented the Korea-Singapore Digital Partnership Agreement in January 2023 and has tried to conclude the process for joining the Digital Economy Partnership Agreement, which China and Canada have yet to begin negotiation on. It is time for Korea (and other countries) to develop a well-structured strategy to move forward with digital trade agreements in the near future. Identification of countries' relative positions in the network of digital trade agreements would be useful at the start of talks on digital trade policy. **KIEP**