

# The Structural Analysis of Virtual Social Capital for Urban Resilience in a Metropolitan Area: The case of Tokyo and Bangkok

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## ABSTRACT

This study clarified the structure in which virtual social capital (SC) affects the quality of life (QOL) and promotes urban resilience in a metropolitan area. It has been determined that assistance from neighboring residents and acquaintances is essential for community resilience and is considered one of the critical factors in urban systems' resilience. These social ties among residents are called SC. In today's metropolises, social ties with others are shifting from face-to-face relationships to virtual relationships. In this study, virtual SC is defined as a weak virtual network formed among people through social media, email, telephones, letters, which is less overlapped with networks formed in face-to-face networks. Also, direct communication online positively affects psychological and personal well-being (QOL).

The case study in this paper examines the Tokyo metropolitan region and Bangkok metropolitan region. A web-based survey was administered among those in the younger generation who communicate daily using online tools, and 193 valid responses were collected. Structural Equation Modeling was used to analyze. This study's hypothesis model is the structure that virtual SC affects urban resilience through the quality of life. The difference in structure was identified as both ordinary time and the period of emergency declaration.

Virtual SC affected urban resilience through QOL during ordinary times. On the other hand, Virtual SC directly worked towards urban resilience during the period of an emergency declaration. Moreover, the use of media with bridging actors forms rich virtual SC and improves urban resilience. Finally, some recommendations of virtual SC use for urban resilience in a metropolitan area were discussed.

**Keywords:** virtual social capital, urban resilience, disaster, quality of life, metropolitan area.

## INTRODUCTION

In recent years, economic and environmental losses have been increasing due to natural disasters and the global pandemic. But in metropolitan areas, population growth has increased, as vulnerability to natural disasters and pandemics has increased. It is necessary to build on the resilience of urban systems. Resilience refers to the ability to resist impacts, absorb destructive forces, respond effectively, and recover from disasters. Urban system resilience focuses on specific system components; physical, social (Rus et al., 2018), natural, economic, institutions, health or well-being, etc. These system components affect the recovery of the urban system.

Assistance from neighboring residents or acquaintances is essential during and after natural disasters and pandemics. It is considered one of the critical factors for the resilience of urban systems. These social ties among residents are called Social Capital (SC). Many urban residents do not know their neighbors as well in today's metropolises. Social ties with one another are moving away from face-to-face relationships to virtual relationships using social media, email, telephones, letters, etc., and forming more non-face-to-face relationships.

The concept of having social capital by connecting to others using information communication technologies (ICTs) can be viewed as online social capital (Spottswood & Wohn, 2020). Williams (2006) argued that building social capital works differently online than offline and presented measurements that differentiated between online and offline social capital. Distinguishing between offline and online social capital research has mainly focused on people who use ICT platforms to create networks. On the other hand, when we think about SC networks, the networks' strength is also essential. Burt (1995) describes a non-redundant and low-density network that provides an additive network benefit rather than overlapping networks. Non-redundant and low-density networks can access a diversity of information. It also supports decision-making during periods of disasters. Online SC has two types of networks from the redundant concepts; overlapping networks with offline SC (Strong SC) and less overlapping networks with offline SC (weak SC). This study

focuses on the less overlapping networks (weak SC) of offline SC, identifying this as virtual SC. Also, online directed communication positively affects psychological and personal well-being. This well-being is called quality of life (QOL). QOL is highly interconnected with some urban systems.

This study clarifies the structure in which virtual SC affects QOL and promotes urban resilience in a metropolitan area.

## URBAN RESILIENCE

The concept of resilience has evolved from vulnerability assessment (Shiozaki et al., 2015). There are two types of vulnerability assessments: 1) A risk-hazard approach focusing on the physical factors by using engineering measures to manage the risks of natural disasters by controlling the hazard, the exposure, and the sensitivity (Turner II et al., 2003) and 2) Vulnerability assessment focusing on social factors. Moreover, the social factors approach can be classified as a political-economy approach (Wisner et al., 2003) and a coping capacity approach (Anderson & Woodrow, 1998). Coping capacity is the ability to cope with hazards and to recover from the disaster. This research focuses on coping capacities.

Urban resilience discusses the factors affecting the resilience of urban systems. This study defined those factors affecting the resilience of urban systems as "Physical factors," "Economic factors," "Social factors," and "Institutional factors" (Shiozaki et al., 2015).

## SOCIAL CAPITAL

### General Social Capital Concept

The concept of SC has two dimensions, scope and form (Grootaert & Bastelaer, 2001). Halpern (2005) states that the scope dimension refers to three levels of analysis: micro, meso, and macro. At the micro-level, SC consists of close ties to family and friends; at the meso-level, SC ties to communities and organizations; and at the macro-level, SC consists of connections to the

state and the nation. The form dimension refers to cognitive and structural constructs. Structural refers to the social structure, and cognitive refers to shared understandings (Claridge, 2018). Sanyal and Routray (2016) have found that cognitive and structural SC plays an essential role in disaster risk reduction.

The seminal work on SC written by Putnam (1993) defined “SC refers to features of social organization, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions”. This research identifies this as cognitive SC and is considered a more subjective and intangible concept (Uphoff, 2000).

Aldrich (2012), building on Lin's (2008) research on SC networks, identified three SC networks: bonding, bridging, and linking. Bonding SC emphasizes relationships with and between community members (Frankenberger et al., 2013). In this study, relationships between family members, relatives, and neighbors are defined as bonding SC. Aldrich (2010) defines bridging SC as the connection between members of groups or networks to extra-local networks. In this study, friends, colleagues, and acquaintances who live outside the immediately affected neighborhoods of the disaster are defined as bridging SC. Linking SC is identified by the relationships among community members and governmental, non-governmental organizations (NGOs), and institutional actors (Aldrich, 2012). In this study, relationships with local governmental agencies from the disaster-affected communities, outside governmental agencies from national and local governments, and volunteers from other regions are defined as linking SC.

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## Virtual Social Capital

This study defined virtual SC as a weak virtual network formed among people through social media, email, telephones, letters, etc., which is less overlapped with networks formed in face-to-face networks. Social networks provide support and influence an individual's well-being. Lee et al. (2018) examined an individual's personal

network structure and the intertwined relationships between social networks, social capital, and social support influence over well-being.

The use of social media is shown to have positive effects on behavior during disasters. Kim and Hastak (2018a) showed that using social media after the 2016 Louisiana flood allowed for sharing information, providing updates, and improving communication with the city. There were three entities involved in these communications through social media: individuals, emergency management agencies, and organizations that engaged in sharing vital information during the flood. Because of social media platforms' ubiquitous nature, it is only natural to assume they significantly influence social capital. Kahai and Lei (2019) examined Facebook's influence in building bridging and bonding social capital compared to traditional media networks. According to Kahai and Lei (2019), Facebook was found to promote bonding social capital primarily, but when substituted for conventional media, it could also provide bridging social capital. Twitter is another popular social media platform that is often used during disasters to disseminate valuable information. Kim et al. (2018b) found that in 2017, during Tropical Storm Cindy, most Twitter users were either information sources or information diffusers. The information sources (news outlets and weather agencies) and the diffusers (the public and organizations) governed the information flow within the social network. They illustrated the use of social media during disasters and the importance of social networks in recovering from disasters. Therefore, this study describes the process by which virtual SC affects disaster resilience.

## QUALITY OF LIFE

Past studies demonstrated that engaging in directed communication online positively affects psychological and personal well-being (Burke et al., 2011; Kraut & Burke, 2015). On the other hand, passively using social media does not yield positive effects on one's well-being (Joseph, 2020; Sinclair & Grieve, 2017). The Rockefeller foundation (2015) defined four categories; “health and well-being,” “economy and society,”

“infrastructure and environment,” and “leadership and strategy” as a city resilience framework. The category of “well-being” is called quality of life (QOL). QOL is highly interconnected with some urban systems.

WHO (1996) defines QOL as individuals' perceptions of their position in life in the context of the culture and value systems they live in and concerning their goals, expectations, standards, and concerns. WHO assessed QOL from four domains; physical health, psychological, social relationships, and Environment (WHOQOL-BREF). This study uses these four domains to measure individual QOL.

## STUDY AREA

Two metropolitan areas were chosen as the case studies, and these are; the Tokyo metropolitan region (Tokyo, Kanagawa, Saitama, Chiba, and Southern part of Ibaraki) (population: 37.8 million, 2020) and the Bangkok metropolitan region (Nakhon Pathom, Nonthaburi, Pathum Thani, Bangkok, Samut Sakhon, Samut Prakan) (population:10.9 million, 2018).

## METHODS

### Data Collection

From June to September 2020, a web-based survey was administered among those in the younger adult generations who communicate online daily. The COVID-19 pandemic started at the end of 2019, and each country began resilience policies from the perspective of public health. This survey was conducted during the emergency declaration of COVID-19 to investigate behavioral change before and after the emergency declaration. During the collection periods, one hundred ninety-three (193) valid responses were collected from volunteer respondents. Table 1 shows the data classification. The primary age of samples was in their 20's, and the primary household included two generations.

**Table 1**

*Data classification*

	Tokyo Metropolitan Region	Bangkok Metropolitan Region
Valid responses	156	37
<b>Age</b>		
19	50	-
20-29	106	34
30-39	-	-
40-49	-	3
<b>Sex</b>		
Male	119	10
Female	35	27
NA	2	-
<b>Household Type</b>		
One generation (ex: Alone, Friends, Siblings or Partner)	54	4
Two generations (ex: Parents, Children or Grandparents)	92	24
Three generations (ex: Grandparents + Parents or Children + Grandchildren)	10	7
Others	-	2

## Measurement of Urban Resilience, Virtual Social Capital and Quality of Life

Table 2 shows the Components of the Survey. Urban resilience was measured by "Physical factors," "Economic factors," "Social factors," and "Institutional factors" (Shiozaki et al., 2015). Virtual SC was measured from two SC viewpoints; cognitive SC and structural SC. Components of cognitive SC was used "Trust," "norms," and "networks" (Putnam, 1993). Components of structural SC was used "Bonding," "Bridging," and "Linking" social capital (Aldrich, 2012). QOL was measured by "Physical health" "Psychological," "Social relationships," and "Environment" domains (WHO, 1996). A 5-level scale was used.

## Analyze of Virtual Social Capital Trend

What are the characteristics of a person with high virtual SC? The method used for this analysis

was an ordered logit model. In this model, the dependent variable is virtual SC, and the independent variables are individuals' behavior (Eq. (1), (2), and (3)). Observed Virtual SC  $y_k$  is considered to correspond to the following continuous latent variable  $y_k^*$ .

$$y_k^* = \sum_{m=1}^M \beta_m x_{km} + \varepsilon_k$$

(1)

$$y_i = \begin{cases} y_1 & \text{if } y_k^* \leq \gamma_1 \\ y_2 & \text{if } \gamma_1 < y_k^* \leq \gamma_2 \\ y_3 & \text{if } \gamma_2 < y_k^* \leq \gamma_3 \\ y_4 & \text{if } \gamma_3 < y_k^* \leq \gamma_4 \\ y_5 & \text{if } \gamma_4 < y_k^* \end{cases}$$

(2)

$$P_{ik} = \frac{1}{1 + \exp(-\gamma_i - y_k^*)} - \frac{1}{1 + \exp(-\gamma_{i-1} - y_k^*)}$$

(3)

Responder  $k$  ( $k = 1, 2, \dots, K$ )

$\beta$  : parameter

$x_1$ : Mobility,

$x_2$ : Media usage (with bonding actors),

$x_3$ : Media usage (with bridging actors),

$x_4$ : Media usage (with linking actors)

The number of individuals' behavior:  $m$  ( $m = 1, \dots, 4$ )

Virtual SC choices:  $i$  ( $i = 1, \dots, 5$ )

$\varepsilon$  : Error term,  $\gamma$  : Threshold,

$P$  : Choice probability

## The Structural Analysis of Virtual Social Capital

The hypothesis model of this study is the structure that virtual SC affects urban resilience through the quality of life. The method used for

this analysis was structural equation modeling (SEM). Multi-group analysis was used to compare the four cases; during ordinary times and during the pandemic's emergency declaration period in the Tokyo metropolitan region and the Bangkok metropolitan region.

**Table 2**

### Components of the survey

**Urban resilience:** Factors affecting the resilience of urban systems are "Physical factors", "Economic factors", "Social factors" and "Institutional factors". (Shiozaki et al., 2015)

**Virtual social capital:** A weak virtual network formed among people through social media, email, telephones, letters, etc, which is less overlapped with networks formed in face to face networks.

Components of cognitive SC: "Trust", "norms" and "networks". (Putnam, 1993)

Components of structural SC: "Bonding", "Bridging" and "Linking" social capital. (Aldrich, 2012)

**QOL:** WHOQOL-BREF domains: "Physical health", "Psychological", "Social relationships" and "Environment". (WHO, 1996)

**Table 2 (Continued)**

	Tokyo Metropolitan Region				Bangkok Metropolitan Region			
	Ordinary time		During emergency declaration		Ordinary time		During emergency declaration	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<b>Urban resilience</b>								
<i>Physical</i>								
Q1: How much preparation of sanitary product stock up have you done in your household for the case of natural disasters or the pandemic?	2.42	0.98	3.07	0.97	2.70	1.31	3.19	1.10
Q2: How many different information sources do you have to access medical information or the potential disaster hazard?	3.06	1.11	2.98	1.10	2.08	0.83	2.14	0.86
<i>Economic</i>								
Q3: Are you able earn an income by working from home even if you cannot go out due to a disaster or infectious disease outbreak?	2.03	1.64	1.80	1.48	2.43	1.66	2.11	1.39
Q4: Are you able to provide a different source of income, when a disaster or infectious disease outbreak continues for a long period of time?	2.82	1.42	2.72	1.39	2.78	1.16	2.43	1.26
<i>Social</i>								
Q5: When you require assistance from others because of a disaster or infectious disease outbreak, are you able to resolve any issues by telephone or online?	3.60	1.23	3.63	1.19	3.54	0.87	3.38	1.01
Q6: If you can't go outside because of a disaster or infectious disease outbreak, how many people would be worrying about your condition?	3.05	1.12	3.22	1.06	3.05	1.15	3.35	1.18
<i>Institutional</i>								
Q7: When you have an opinion on government policies during a disaster or infectious disease epidemic, do you put your views out through the internet or by phone?	1.91	1.07	2.08	1.17	3.24	1.32	3.46	1.32
<b>Virtual social capital</b>								
<i>Trust</i>								
Q8: How much do you trust the following people or organizations?								
1) Family or relatives who live far from you and are only connected by E-mail, Social media or letters.	4.02	0.93	3.90	0.92	3.68	0.85	3.54	0.93
2) Friends or acquaintances who are connected by E-mail, Social media or letters.	3.72	0.89	3.63	0.99	3.70	0.81	3.65	0.79
3) Distant local governments, overseas governmental agencies or NGOs that you know about through their activities on TV, radio and Social media.	3.37	0.98	3.31	1.02	3.03	0.93	3.00	1.05
<i>Networks</i>								
Q9: How much do you associate with the following people?								
1) Family or relatives who live far from you and are only connected by E-mail, Social media or letters.	3.38	1.42	3.36	1.49	3.84	1.17	3.97	1.36
2) Friends or acquaintances who are connected by E-mail, Social media or letters.	4.07	1.13	3.82	1.28	4.08	1.04	4.27	1.02
3) Distant local governments, overseas governmental agencies or NGOs that you know about through their activities on TV, radio and Social media.	1.76	1.20	1.83	1.24	2.14	1.18	2.59	1.36
<i>Norms</i>								
Q10. To what extent would you help the following people or organizations if a major disaster or infectious disease pandemic impacted them?								
1) Family or relatives who live far from you and are only connected by E-mail, Social media or letters.	4.01	1.15	4.01	1.12	3.57	1.09	3.73	1.12
2) Friends or acquaintances who are connected by E-mail, Social media or letters.	3.83	0.91	3.90	0.95	3.57	0.96	3.57	1.04
3) Distant local governments, overseas governmental agencies or NGOs that you know about through their activities on TV, radio and Social media.	2.52	1.03	2.66	1.08	2.76	1.28	2.70	1.29
<b>QOL</b>								
<i>Physical health</i>								
Q11: How satisfied are you with your ability to live your daily life?	3.58	1.04	2.85	1.15	3.97	0.93	3.00	1.13
<i>Psychological</i>								
Q12: Do you think your life is meaningful?	3.35	1.25	2.87	1.21	4.08	0.83	4.11	0.94
<i>Social relationships</i>								
Q13: How satisfied are you with your interactions via e-mail, Social media and letters?	3.82	0.91	3.76	0.99	3.62	0.79	3.62	1.04
<i>Environment</i>								
Q14: How satisfied are you with the medical services (quality and access) in your home location?	3.85	0.87	3.71	0.91	3.49	0.77	3.08	1.04

**Table 2 (Continued)**

<b>Mobility</b>								
Q15: How often do you go shopping or dining out in restaurants during a month?	3.75	1.13	2.46	1.26	4.16	1.19	2.43	1.44
<b>Media usage</b>								
Q16: How often do you use the following during the weekdays to communicate with each other?								
1) E-mail or Social media with family members, relatives, or neighbors.	2.57	1.11	2.79	1.27	4.08	0.89	4.00	0.94
2) E-mail or Social media with friends or acquaintances.	3.67	1.20	3.67	1.28	4.35	0.79	4.19	0.84
3) Email or Social media with local government agencies, police, fire departments or NGOs.	1.56	0.90	1.82	1.07	2.81	1.39	3.00	1.31

## RESULT

### Virtual Social Capital Trend

The estimated parameter for virtual SC is shown in Table 3.

#### 1. In the case of ordinary time:

A high virtual SC (Networks) person was identified as a high media user with bonding and bridging actors in the Tokyo metropolitan region. A high virtual SC (Norms) person was identified as a high mobility user and media user with bonding actors. In the Bangkok metropolitan region, a high virtual SC (Trust) person was identified as a high media user with bridging actors.

**Table 3**

*Estimated parameters for virtual SC*

	Tokyo Metropolitan Region				Bangkok Metropolitan Region			
	Ordinary time		During Emergency Declaration		Ordinary time		During Emergency Declaration	
	Estimate value	P value	Estimate value	P value	Estimate value	P value	Estimate value	P value
<b>Virtual SC (Trust)</b>								
Mobility	0.153	0.266	-0.155	0.200	-0.497	0.114	-0.558	0.013 **
Media Usage (with bonding actors)	0.122	0.441	0.001	0.992	0.120	0.821	-0.105	0.809
Media Usage (with bridging actors)	0.039	0.783	0.194	0.125	1.454	0.027 **	0.925	0.074 *
Media Usage (with linking actors)	-0.042	0.820	0.130	0.382	0.130	0.594	0.326	0.173
<b>Virtual SC (Networks)</b>								
Mobility	0.017	0.903	0.409	0.001 ***	0.298	0.306	0.467	0.044 **
Media Usage (with bonding actors)	0.372	0.014 **	0.241	0.059 *	-0.127	0.800	-0.292	0.477
Media Usage (with bridging actors)	0.323	0.016 **	0.400	0.001 ***	0.253	0.664	0.672	0.145
Media Usage (with linking actors)	0.153	0.386	0.221	0.128	-0.103	0.664	0.148	0.544
<b>Virtual SC (Norms)</b>								
Mobility	0.502	0.001 ***	-0.054	0.666	0.091	0.755	0.120	0.586
Media Usage (with bonding actors)	0.340	0.031 **	0.268	0.042 **	-0.467	0.376	1.082	0.031 **
Media Usage (with bridging actors)	0.061	0.674	0.429	0.001 ***	0.737	0.194	-0.819	0.107
Media Usage (with linking actors)	-0.015	0.936	0.092	0.541	0.151	0.543	0.133	0.568

## 2. In the case of during emergency declaration:

A high virtual SC (Networks) person was identified as a high mobility user and media user with bonding and bridging actors in the Tokyo metropolitan region. A high virtual SC (Norms) person was identified as a high media user with bonding and bridging actors. In the Bangkok metropolitan region, high virtual SC (Trust) persons were identified as low mobility users and high media users with bridging actors. Moreover, a high virtual SC (Networks) person was identified as a high mobility user. A high virtual SC (Norms) person was identified as a high media user with bonding actors. In particular, the use of media with bridging actors forms rich virtual SC and improves urban resilience.

## Influence structure of virtual SC

The result is shown in Fig. 1, 2, 3, and 4. The goodness of fit was GFI = 0.891, AGFI = 0.835, CFI = 0.881, and RMSEA = 0.039. Unstandardized estimates were used because the path values were comparable among the four cases.

### 1. In the case of the Tokyo metropolitan region:

In the case of during ordinary times (Fig.1), the determinant factors were Virtual SC (Trust) (Norms), QOL, and Urban Resilience (Social and Institutional) (Economic). The structure of Virtual SC (Trust) affects QOL (0.10,  $p < 0.01$ ), and QOL affects Urban Resilience (Social and Institutional) (0.77,  $p < 0.05$ ). Trust in virtual space increases life satisfaction and improves the ability to problem-solving. Virtual SC (Norms) directly affects Urban Resilience (Economic) (-0.71,  $p < 0.1$ ). People who are low mutual helping in the virtual space try to prepare various sources of income on their own. Virtual SC (Trust) affects Virtual SC (Norms) (0.15,  $p < 0.05$ ). Trust in virtual space also forms mutual help in virtual space. Urban Resilience (Social and Institution) affects Urban Resilience (Economic) (0.80,  $p < 0.05$ ).

In the case of emergency declaration (Fig. 2), the determinant factors were Virtual SC (Networks) (Norms), QOL, and Urban Resilience (Social and Institutional). Especially, people use norms to create social and institutional urban resilience. It was assumed that the strengthening social and institution is expecting resilience during the emergency period. Virtual SC (Networks) affects QOL (0.11,  $p < 0.05$ ). During the emergency declaration, QOL decreased compared with during the ordinary times (Table 2), while the virtual space interaction improved the QOL. Virtual SC (Norms) directly affects Urban Resilience (Social and Institutional) (0.50,  $p < 0.1$ ). Mutual help in virtual space creates the ability of an informal support network. Virtual SC (Networks) affects Virtual SC (Norms) (0.22,  $p < 0.01$ ). Increasing communication in virtual space leads to improved mutual help in virtual space.

### 2. In the case of the Bangkok metropolitan region:

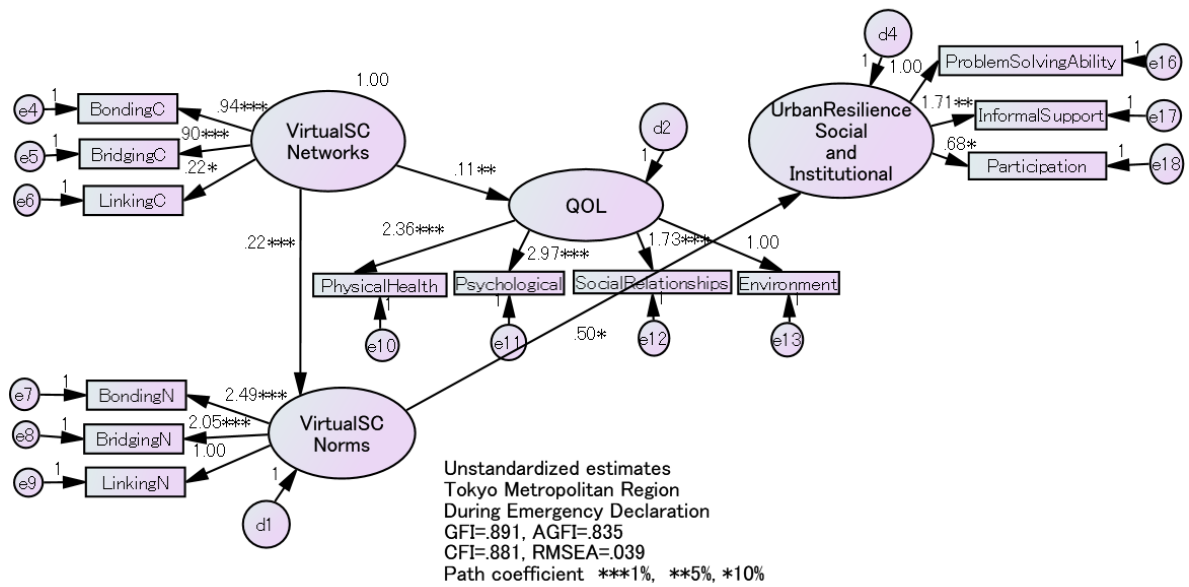
In ordinary times (Fig.3), the determinant factors were Virtual SC (Norms), QOL, and Urban Resilience (Economic). The structure of virtual SC (Norms) affects QOL (0.21,  $p < 0.05$ ), and QOL affects Urban Resilience (Economic) (1.86,  $p < 0.05$ ). Mutual assistance in virtual space increases life satisfaction and improves the ability to prepare diverse economic resources.

In the case of emergency declaration (Fig.4), the determinant factors were Virtual SC (Trust) (Networks) and Urban Resilience (Social and Institutional) (Economic). Especially, people use trust and networks to create urban economic resilience. It was assumed that the strengthening economy is expecting resilience during the emergency period. Virtual SC (Trust) directly affects Urban Resilience (Economic) (0.66,  $p < 0.01$ ). Trust in virtual space supports the ability to prepare diverse economic resources. Virtual SC (Networks) also directly affects Urban Resilience (Economic) (-0.67,  $p < 0.05$ ). If people do not communicate with others in the virtual space, they prepare economic resources by themselves.



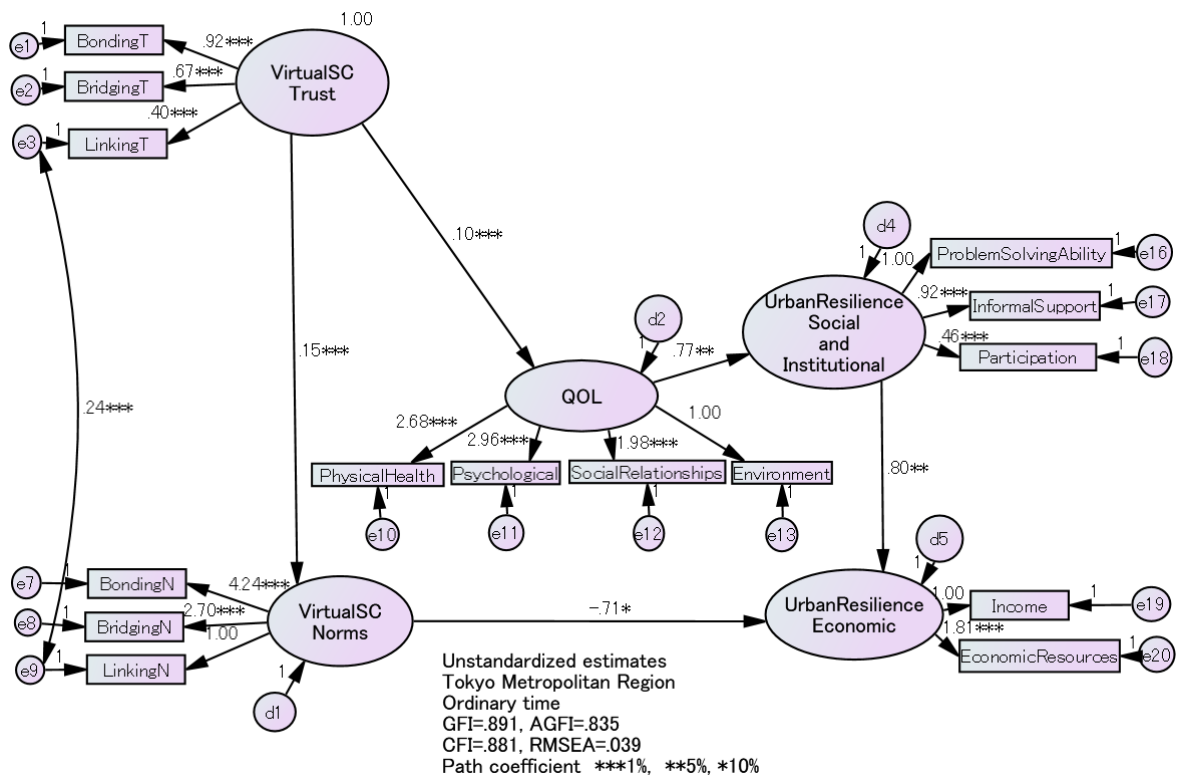
**Figure 1**

Result of SEM (Ordinary time, Tokyo Metropolitan Region)



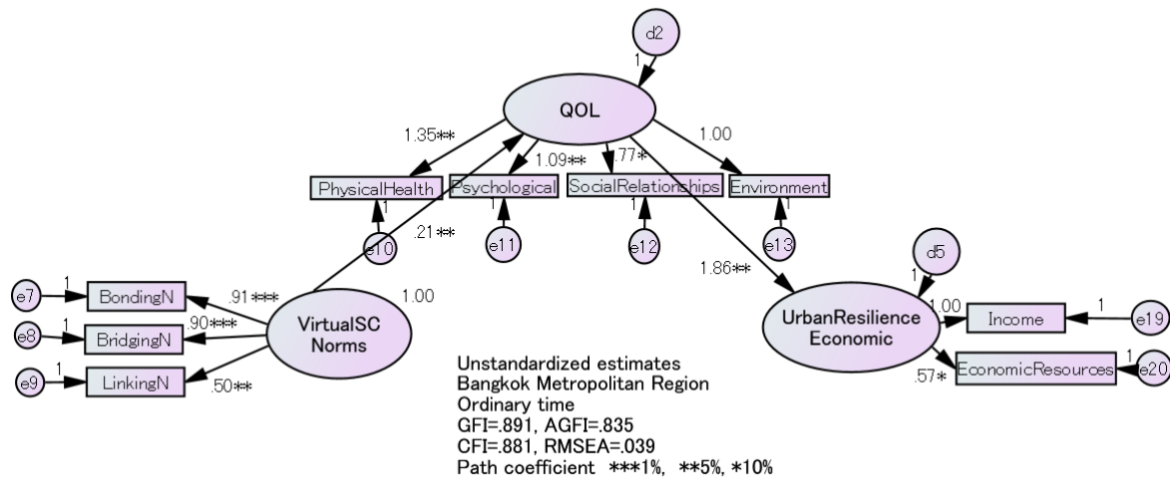
**Figure 2**

Result of SEM (During Emergency Declaration, Tokyo Metropolitan Region)



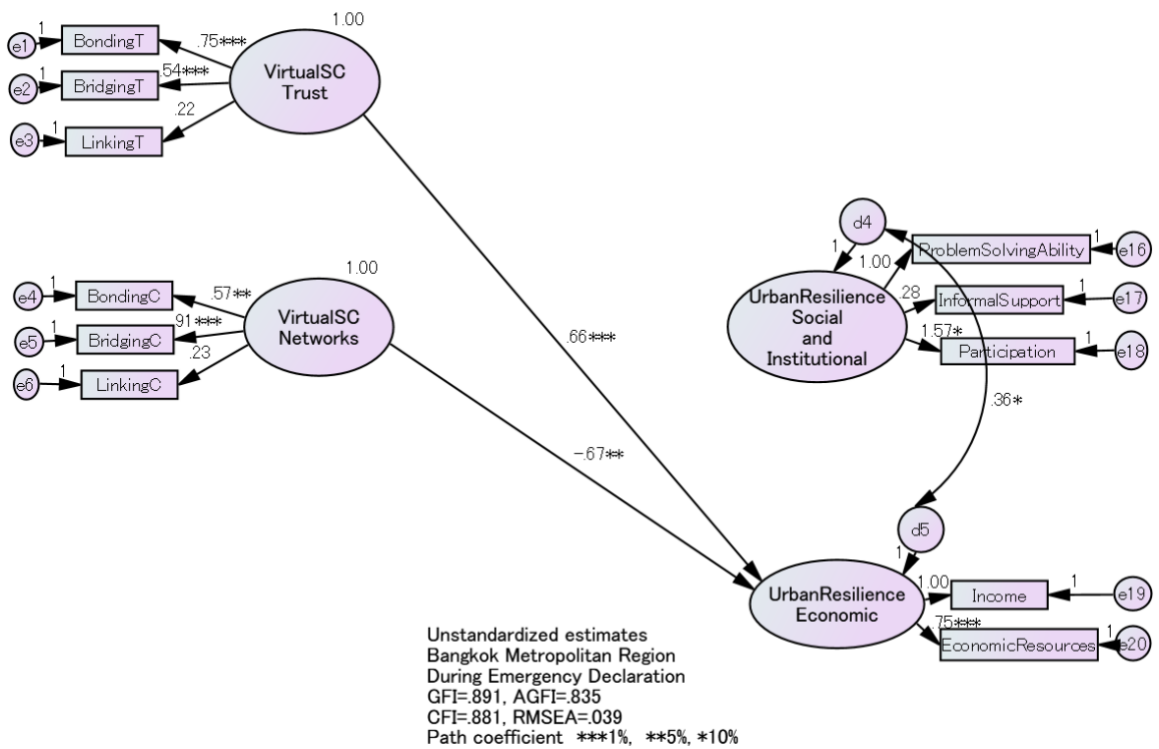
**Figure 3**

Result of SEM (Ordinary time, Bangkok Metropolitan Region)



**Figure 4**

Result of SEM (During the Emergency Declaration, Bangkok Metropolitan Region)



## CONCLUSION

This study clarified the structure in which virtual SC affects QOL and promotes urban resilience in a metropolitan area. Also, this study determined the structural difference between during ordinary times and during periods of emergency declaration.

Virtual SC affects urban resilience through QOL during ordinary times. On the other hand, the structure of Virtual SC works directly towards improving urban resilience during the period of an emergency declaration, and QOL is not the determinant of urban resilience. Especially, the role of virtual SC in promoting urban resilience in emergency times has been clarified.

During ordinary times for the Tokyo metropolitan region, trust in virtual space increases life satisfaction and improves problem-solving. Trust in the virtual space also forms mutual assistance in the virtual space. During the emergency declaration, QOL decreases compared with during ordinary times, and mutual assistance in virtual space creates the ability to form informal support networks. In the Bangkok metropolitan region during ordinary times, mutual assistance in the virtual space increases life satisfaction and improves the ability to prepare diverse economic resources. But during the emergency declaration period, trust in virtual space supports the ability to prepare various economic resources.

During the emergency declaration, the important virtual SC is Norms for the Tokyo metropolitan region and Trust and Networks for the Bangkok metropolitan region. A high virtual SC (Norms) person is a high media user with bonding and bridging actors in the Tokyo metropolitan region. A high virtual SC (Trust) person is a low mobility user and high media user with bridging actors in the Bangkok metropolitan region. Moreover, a high virtual SC (networks) person was a high mobility user. How can we improve urban resilience that will be useful during emergency declaration? Communication by email or Social media with friends, colleagues, and acquaintances who live outside the immediately affected neighborhoods forms rich virtual SC, and these virtual SC directly improves urban resilience.

It is essential to raise the awareness of mutual assistance in the virtual space to improve bottom-

up urban resilience. There must be interaction through social media, email, and telephone conversations during ordinary times to improve trust in the virtual space and be prepared to secure income in an emergency. Also, information is needed to increase trust in governments and public institutions to ensure diverse economic resources. Selecting reliable information while communicating in the virtual space and mutual utilization of offline SC and Virtual SC will be conducted in future studies.

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