Impact of COVID-19 Pandemic on ICT growth in South Korea

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Abstract

We estimate the impact of COVID-19 pandemic using indices derived from in-text measurement on the growth of ICT in South Korea spanning the period between January 2020 and October, 2021. With our OLS and GMM methodologies, we are able to come to term with the following findings. (1) COVID-19 pandemic generally poses negative impact on the growth of ICT in South Korea during the period, (2) the impact is found to be serious with rising reported cases index than with rising death cases index; and lastly (3) the panic generated by the pandemic is limiting the growth of ICT in the region. With our alternative choice of methodology, it could be inferred that the variables under consideration performed better, suggesting the possibility of endogenous problems among the variables and the error terms. We therefore suggest creating an avenue for using ICT in any time like this to serve as a mechanism to combat the diseases rather allowing it to take control in affecting the economy.

Key Words: ICT; COVID-19 pandemic; GMM and Economy
JEL Classification codes: Q55. I15. C26. 053

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1. Introduction

The impact of COVID-19 pandemic on ICT growth has been found to be mixed (see Banga and te Velde, 2020). Viewing it from demand channel in the time of COVID-19, economic activities were put on hold due to lockdown measure to curtail the spread of the pandemic. As a result, many of the economic services were rendered through online channel, which hitherto amount to positive check on the ICT service. However, some other economic activities that involve physical contact with much relation to online service were negatively hit and become responsible for low growth in the ICT provision. These two opposing views account for shortfall arising from COVID-19 pandemic for the ICT services across the globe. According to Hetting (2020), at the time when lockdown measure was in place, it becomes more predictable that a number of connected mobile devices drop while the wi-fi usage rises. For the case of South Korea, number of connected mobile devices in Seoul's MyeongDong shopping district drop by 67% when compared to 4 weeks earlier of March 6, 2020[1]. Also, comparing the pre-COVID-19 era to the period of the pandemic, it was found that the average rate of downloading speed for the country fell by 30.45%[2]. What this suggests is that the impact of COVID-19 pandemic on the growth of ICT, especially for the case of South Korea, cannot be put to one direction.

In making further explanation about the relationship between ICT and economic growth, it has been offered that ICT accelerates economic growth, much more in the area of increasing labour productivity; enhancing output production and improving people's welfare (see Swang *et al*., 2022). In this regard, heavy investment in ICT by both the government and the private personnel can be well justified. For the case of South Korea, investment in ICT has always played dominant roles in enhancing economic growth of the country. In 2019, the contribution of ICT to economic growth was put to 82.89 trillion Korean won which rises to 85.52 trillion Korean won in 2020. That of 2021 was around 9.64 trillion won. Going with this figure, the growth rate for 2020 was 3.17%, lower than both previous and succeeding years (4.59% and 5.99% respectively)[3]. We can possibly attribute this impact of the pandemic to low growth in the ICT in South Korea which was rather more prominent between the first three quarters of year 2020.

However, our concern in this study is to investigate the connectedness between ICT (internet address resources) in South Korea and the COVID-19 pandemic. By implication, we pay attention to the growth rate in these domains in the time of the pandemic. Expectedly, increase in the number of domain is a positive check for the Korean economy, as the resources generated from each domain will benefit the economy. With the presence of COVID-19 pandemic, it may actually become uncertain on the direction of impact of COVID-19 on the growth of these domains. Going with demand channel, the impact should be negative as many economic activities were put on hold during the early part of the period. However, our understanding from the supply channel accurately predicts a positive relationship between the two because ICT gargets are often used in a period like this to carry out economic activities. The actual impact will then relate more on the level of utilization of ICT in the concerned economy and the available number of ICT-inclined industries in such an economy.

[1] See www.bloomberg.com/news/articles for more details
[2] See www.cable.co.uk/broadband for further details
[3] for data on this analysis, see www.statisca.com

This research focus becomes necessary owing to very little studies as far as literature in this area is concerned. In fact, studies that have paid attention to ICT behaviour in the time of COVID-19 pandemic are very scarce. While the focus of Swang *et al* (2022) was on causality between ICT and growth for the case of Korea, Ha and Huyen (2022) only considered the utilisation of digitalization for FDI flows among the European countries. In this study, we use the Global Fear Index, constructed by Salisu and Akanni (2020) to proxy COVID-19 pandemic and we also used internet address resources for ICT variable. The indices are in three categories: Reported Cases index, Death Cases Index and Global Fear Index (henceforth, RCI, RDI and GFI respectively). Given the nature of our data as they are all I(0), it becomes suggestive that OLS methodology is sufficient for our analysis. Hence, we used OLS as the benchmark for our estimations while Generalised Method of Moment is used to check for the presence of endogeneity problem.

Our finding from this study can be summarized as follows. One, COVID-19 pandemic generally poses negative impact on the growth of ICT in South Korea during the period; two, the impact is found to be serious with rising reported cases than with rising death cases; and lastly the panic generated by the pandemic is limiting the growth of ICT in the region. With our alternative choice of methodology, it could be inferred that the variables under consideration performed better, suggesting the possibility of endogenous problems among the variables and the error terms. However, this possible indication of endogeneity problem among the series, gives reason for GMM as efficient choice for our analysis.

The remainder of this study is structured as follows: section 2 captures the review of literature and section 3 pays attention on the methodology. In section 4, the focus is rather on the data and preliminary analysis while we present result and discussion in section 5. In section 6, we conclude with policy implications.

2. Brief Literature Review

Studies abound in the literature in explaining the connection between information and communication technology and various sectors of the economy (for recent works, see Owusu-Agye *et al*, 2020; Rehman *et al*., 2021; Sawng *et al*., 2021; Yin and Choi, 2021). Our focus in this section is to briefly review some of the studies relating to ICT in the post COVID-19 era, especially those studies that focus on explaining the impact of COVID-19 pandemic on ICT.

The study by Owusu-Agye *et al* (2020) contributes to the literature by investigating the connection between internet use and financial development in 42 selected sub-Saharan African countries with scope covering the periods between 2000 and 2016. For the variables of financial development, usual proxies such as bank assets (as a percentage of GDP), private credits, credit by financial institution and stock market capitalization are used. Their outcome found evidence of positive impact of internet use on various measures of financial development. In another related work, Rehman *et al* (2021) estimate the connection between ICT and FDI, trade, energy and economic progress for the case of Pakistan. With the data coverage between 1985 and 2017, the study linked ICT, trade and energy to GDP but found a converse relationship with FDI.

Owing to the level of investment in ICT in South Korea, Sawng *et al*, (2021) dabble to account for how investment in ICT for the country has been able to influence South Korean growth. Quarterly data was employed by the study between 1999 and 2016 and the methodology

was Error Correction Model (ECM). According to the outcome of the study, there was evidence of bidirectional relationship between investing in ICT and growth of the country. Also, Yin and Choi (2021) also estimate the role of internet in increasing FDI, trade and economic growth for selected Asian countries using data between 1997 and 2017. However, the causal relationship between internet use and GDP was found to be bidirectional for the south Asia and unidirectional for the west Asian.

More recently, the study by Ha and Huyen (2022) focus on the impact of digitalisation in influencing foreign investment across European region in the time of COVID-19 pandemic. The study uses data for 23 European countries for pre-COVID-19 era (2015 to 2019) and in the time of COVID-19 (2020) to estimate the impact of digitalization for the region. It was found that digititalisation was more critical in promoting FDI flows before the crisis and these roles enhance trading activities through electronic media in the time of COVID-19 pandemics. In the same line, Belloumi and Touati (2022) found evidence on how FDI inflows and ICT have affected economic growth for selected Arab countries using panel ARDL with data spanning from 1995 to 2019. It was revealed that both ICT and FDI inflows have positive and significant effects economic growth in the long runs while ICT indicators have positive impact on FDI inflows in the long run for the selected Arab economies.

In a related work, Tamannum (2021) had examined the impact of COVID-19 pandemic on digital intensity and digital maturity in the ICT sectors for the Nordic countries. These countries are Finland, Denmark, Norway and Sweden. By the outcome of the analysis from the study in relation to the performance of each of the countries during the pandemic, it was found that despite the negative impact posed by the COVID-19 pandemic, the Nordic countries did better in using their level of digital transformation, digital innovation and financial capability of ICT to handle the COVID-19 situation. However, the study found variation among the country as regard degree of digital integration, level of digital maturity and capacity of digital innovation, with Sweden having better performance among them. Earlier before this time, Nagel (2020) had examined the impact of COVID-19 pandemic on changing the transformation of works among people using primary data that was gathered between March and April, 2020 via crowdsourcing platform of Amazing Mechanical Turk. The outcome found evidence of higher number of people working from home offices and having a belief that the step is a direct response to COVID-19 pandemic. The study further informed that people are now loosing focus on the efficacy of traditional means of generating income, putting more emphasis on the prospect of ICT-based income generation, especially in any situation relating to the experience of COVID-19 pandemic.

However, our focus in this study is to investigate possible connection between growth rates in ICT resource domain in South Korea during the time of COVID-19 pandemic. The novelty of this study becomes much more obvious given the usage of recently constructed global fear index by Salisu and Akanni (2020). We further align suggested methodology of OLS with GMM as alternative choice and as way to correct for the problem of endogeneity. All these explain the necessity of our findings given the available literature on the subject matter.

3. Methodology

The features exhibited by the series of our variables necessitate the choice of our methodology in this study. In the section as presented under preliminary analysis, we found our

variables as all I(0) variables. When this situation arises, the methodology to accurately capture the analysis is Ordinary Least Square method. OLS as a methodology is sufficient for variables that are stationary at levels. Without much ado, we represent the functional form of our analysis using the following equations:

$$ICTG = f(GFI, RCI, RDI) \quad (1)$$

Where ICTG is growth rate in ICT, GFI is global fear index, RCI is the reported case index and RDI is reported death index. We can further have the following by categorizing our model into three, expressing ICT growth rate as a function of each of the indices of the pandemic. In doing so, we express them in log form. However, the growth rate of ICT is not logged because it is in rate form and the series has combination of both positive and negative numbers:

$$\text{ICTG} = \beta_1 \log(GFI) + \varepsilon_t \quad (2)$$
$$\text{ICTG} = \beta_2 \log(RCI) + \varepsilon_t \quad (3)$$
$$\text{ICTG} = \beta_3 \log(RDI) + \varepsilon_t \quad (4)$$

We cannot make a specific expectation about the behaviour of $\beta's$ owing to mixed observations from the submission of the previous studies on the subject matter. Hence, following the demand channel, the $\beta's$ could assume negative value or otherwise if we accounted for supply channel.

4. Data and Preliminary Analysis

This study essentially aims at investigating the connection between the growth rate of information and communication technology in the South Korea in the period of COVID-19 pandemic. By implication, various data on ICT and COVID-19 indices are used for the estimation. For the ICT, we use data on growth rate of aggregate ICT domain in the country and this data covers the periods between February, 2020 and October, 2021. This data could be found in the statistics department, ministry of information, South Korea. The indices of COVID-19 are text-based measures, which were developed by Salisu and Akanni (2020) to measure the amount of fear posed by the pandemics. The indices were categorized into three, namely: cases index, death index and fear index. Cases and death indices are respectively measure of report cases and death toll while Global Fear Index combined the two to capture the total measure of the pandemic. We pay close attention to each of these measures with respect to ICT growth rate of the republic of South Korea during the pandemic which runs between aforementioned periods.

Table 1 below gives information about the descriptive statistics of the variables of our study. The information covers basic descriptive statistics such average value, dispersion, kurtosis (a measure of peakness of the variables) and skewness (a measure of flatness). According to this statistics, average growth rate of domain is found on average to fall in the period of the pandemic as the value is -0.116. Its level of dispersion is very low with value of 0.3113. It however skews moderately to the left (-1.225) and was fairly peaked, which make it to exceed the threshold by just 0.54 rate. The probability with Jacque Bera (0.06) supports the normality of the data. The information on Global Fear Indices indicates that the average values for the three indices are relatively the same (about 52.3 points). All of them have standard deviation that ranges between 6.8 and 7.8, very high and suggests some sort of greater dispersion in the data. Aside being

normal, they are equally skewed positively (with the least value being 1.95 and the highest, 2.60), and by Kurtosis, they are highly peaked (the least value being 7.15 and the highest, 11.14).

Figures 1 to 3 account for the trend analysis between the variables measuring the pandemic and that of the ICT growth rate in Korea. One common observation becomes obvious about the relationship between them. In the month of March, 2020 when the COVID-19 pandemic reached its peak of 82.5, 75.04 and 78.23 respectively for the reported, death and fear cases respectively, the growth rate of ICT for the represented country remains very low (in fact, one of the highest fall ever, about -5.5 growth rate). At this period, COVID -19 was rather tensed in the whole world, given the high levels of cases and deaths that occur at this period.

Table 1: Summary Statistics

Item	ICT_GR	GFI	RCI	RDI
Mean	-0.1163	52.309	52.310	52.309
Std. Dev.	0.3113	6.8267	7.8532	6.8149
Skewness	-1.2250	2.6803	2.3296	1.9453
Kurtosis	3.5339	11.136	10.095	7.1531
Jarque-Bera	5.5019	83.066	63.042	28.338
Probability	0.0638	0.0000	0.0000	0.0000
Observations	21	21	21	21

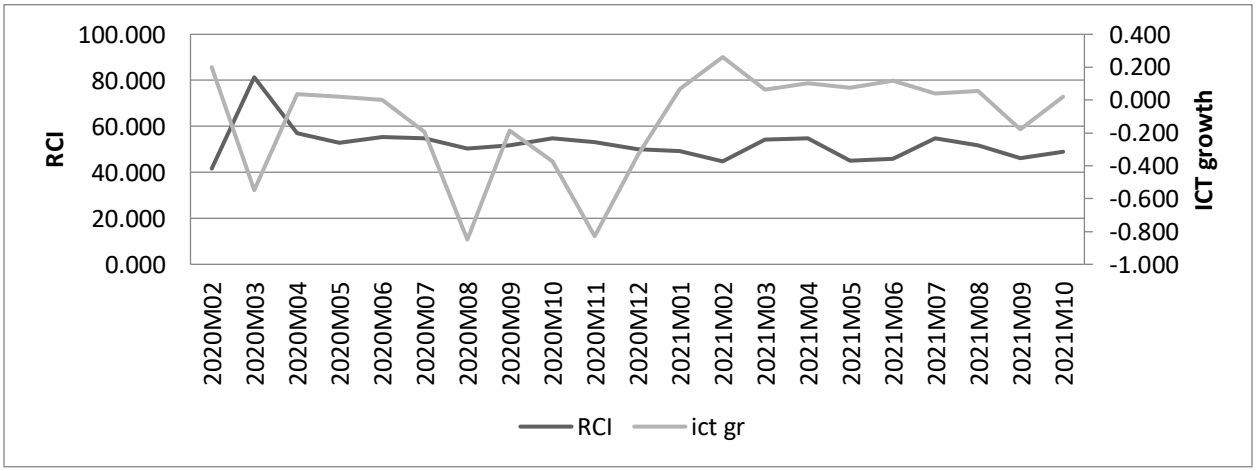

Figure 1: co-movement between RCI and ICT Growth

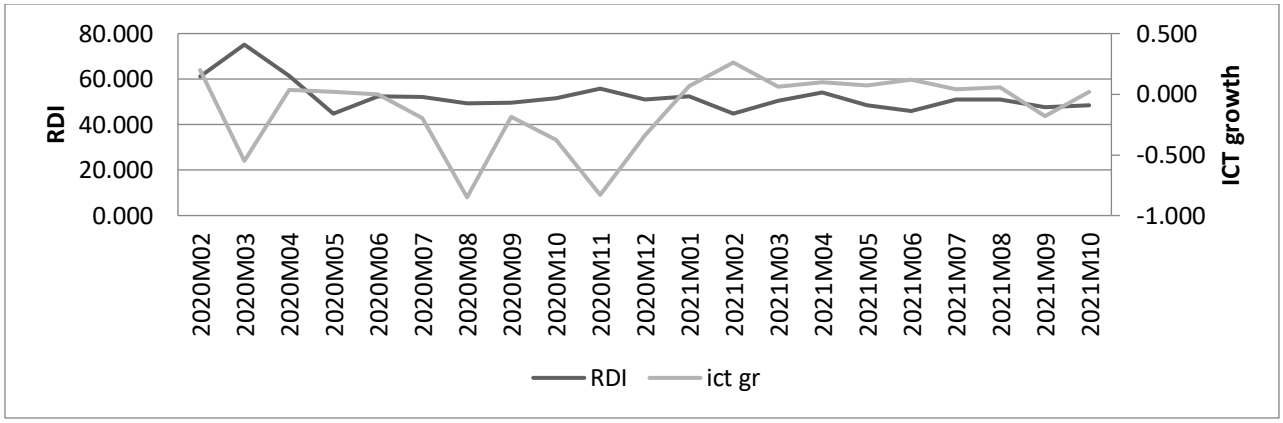

Figure 2: co-movement between RDI and ICT Growth

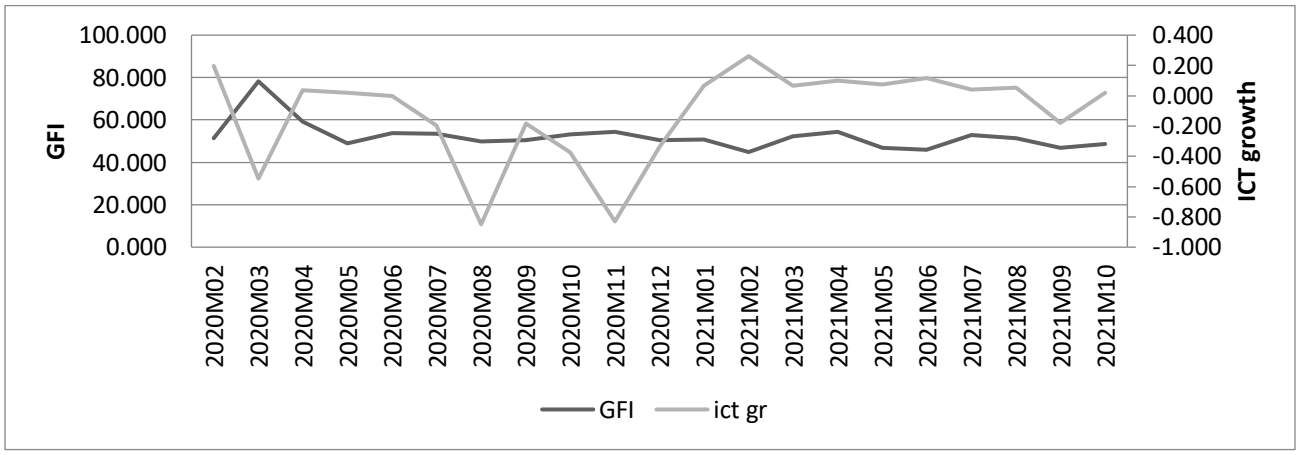

Figure 3: co-movement between GFI and ICT Growth

5. Results

Unit Root

We subject our variables to the test of unit root. This is necessary for any time series analysis. When series are not stationary, it becomes difficult to account for the long-run relationship and the result from such an analysis may be spurious. Table 2 presents the result of unit root analysis for our variables. All the variables are I(0). This indicates that OLS will be sufficient for our analysis. They are significant at either 1% or 5% respectively. However, for robustness checking, we further account for endogeneity problem in the series by hedging our analysis with Generalised Method of Moment which is known to take into consideration the possibility of endogeneity problem in the series.

Table 2: Unit Root

Variable	ADF		PP	
	Level	**status**	**level**	**Status**
Dom_gr	-3.2237[b]	I(0)	-3.2237[b]	I(0)
Gfi	-6.7608[a]	I(0)	-3.4186[b]	I(0)
Rci	-6.1387[a]	I(0)	-6.7470[a]	I(0)
Rdi	-6.2789[a]	I(0)	-2.5663	I(1)

Note: [a] and [b] indicate significance at 1% and 5% respectively

As previously mentioned, the study uses both OLS and GMM for estimation of variables of concerned. Our OLS estimation is presented in table 3. The table contains three independent regression models. The one which uses Global Fear Index (GFI) for prediction of growth rate in the ICT domain, the Reported Cases Index (RCI) and Reported Death cases (RDI). For the OLS estimation, each of the GFI, RCI and RDI in their different models has negative relationship with the growth rate in ICT domain and they are significance except for the case of RDI which is not significance at any levels. Going further, when GFI increases by 1%, growth rate in ICT domain falls by 1.0145% while the same rise in RCI and RDI reduces growth in ICT by 0.9440 and 0.7437 respectively. The R-squared and adjusted R-squared are positive as expected and ranges from 3% to 12% for all our models. For all our models, we found no evidence for the presence of serial correlation and heteroscasticity. The probability from serial correlation test and ARCH LM indicate non-significance for the two. However, we are worry about the non-significance of RDI in their respective model. Thus, we further subject our estimation to further methodology using Generalised Method of Moment (GMM).

Table 3: Results of the Regression Dependent variable: ICT domain

Variable	OLS				
	value	t-test	Adj_R^2	Ser_Cor	ARCH LM
Gfi	-1.0145	-1.755[c]	0.094	1.3210*	0.3264*
Rci	-0.9440	-1.9287[c]	0.120	1.4701*	0.3260*
Rdi	-0.7437	-1.2867*	0.032	1.0632*	0.3172*

*Note: [c] indicates significance at 10 while * indicates non-significance*

Table 4 presents the outcome from GMM estimations. We find significant variation with respect to the performance of our model when compared the output from OLS methodology. All the independent variables are now significant in explaining the behaviour of the growth rate in ICT during the time of COVID-19 for the period under consideration. The J-stats from the model (which is equivalent to Sargan test statistics) indicates that the instruments are valid and endogenously related to the error term in all the models. This is evident from the associated P-Values that are more than the minimum value of 0.25 [0.8969, 0.8832 and 0.8887, all greater than 0.25].

Table 4: Results of the Regression Dependent variable: ICT domain

Variable	GMM				
	Value	t-test	Adj_R^2	D_W	J_Stats (p-value)
GFI	-0.9556	-4.1783[a]	0.091	1.223	0.2177 (0.8969)*[4]
RCI	-0.8901	-4.1735[a]	0.069	1.218	0.2484 (0.8832)*
RDI	-1.0235	-4.0359[a]	0.098	1.254	0.2361 (0.8887)*

*Note: [a] indicates significance at 1 while * indicates non-significance*

6. Conclusion

Essentially, this study pays attention to investigating the implication of COVID-19 pandemic on the growth of ICT domain in South Korea in the time of the pandemic. The study uses both OLS and GMM for estimation which uses monthly data running from the 31st December, 2019 to 28th December, 2021. Our measures of COVID-19 pandemic was the indices constructed by Salisu and Akanni (2020) which comprises global index, reported cases index and reported death index. Our findings indicate that COVID-19 pandemic generally poses negative impact on the growth of ICT in South Korea during the period. Also, the impact is found to be serious with rising reported cases than with rising death cases; and lastly, the panic generated by the pandemic is limiting the growth of ICT in the region. With our alternative choice of methodology, it could be inferred that the variables under consideration performed better, suggesting the possibility of endogenous problems among the variables and the error terms in the model. We therefore suggest the possibility of using ICT in any situation like this as mechanism to combat diseases rather than allowing it to take control in affecting the economy.

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