

The Impact of E-government on Corruption Control

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Executive Summary

This study examines while each country has proceeded E-government, how E-government influences on corruption control by using national level panel data. After analyzing the result, both E-government development index and E-participation index showed positive effects on corruption control. However, the comparison analysis of OECD and non-OECD countries on corruption control through E-government shows that it has a great impact on not OECD countries but only non-OECD countries.

This results show that the various goals pursued by E-government have a positive effect on corruption control. However, this research presents that the influence of E-government corruption control on OECD countries, which have already well-developed in all fields, is little. Therefore, the results of this study suggest that corruption control can be made more efficient through the activation of E-government in non-OECD countries where the development level of the country is relatively low compared to the OECD countries.

1. Introduction

In the knowledge and information society, E-government is recognized as very important means of making a competent government with various possibilities of information and communication technology. The importance of E-government is much emphasized since past efficiency-oriented reforms have been criticized for neglecting higher core values that strengthen stability and sustainability in society such as democracy and trust (Wamsley & Wolf 1996).

E-government is seen as a tool to improve productivity and efficiency in internal administration and to increase responsiveness to the public. E-government can be understood as an extension of reforms to improve public sector efficiency. Governments around the world have pursued administrative efficiency and autonomy through New Public Management (NPM) reforms since the 1980s, but in recent years, recognition of the limits of NPM have been widening. In the process of pursuing market-oriented reforms in the public sector, efforts have been made to improve efficiency by mitigating various regulations and introducing competition. However, the concern has been raised that democracy may be impaired and the ultimate administrative goal may be lost. Particularly, improving discretion by granting autonomy to public officials increases efficiency and causes dilemmas such as increased corruption due to reduced control specification (Kim, 2016). E-government is attracting attention as the means of escaping the dilemma of this administrative environment. That is to say, administrative efficiency and democratic values can be improved simultaneously through innovation by fostering public participation and control through web-based interactive service in external administration (Kim, 2016)

As information and communication technology, such as computers and the Internet, has rapidly progressed since the 1980s, many countries have recognized the importance of E-government and begun to materialize their efforts to exploit the information and communication revolution in government innovation. Many countries adopted E-government as a national priority. Especially the United States, Britain and other developed countries have begun to promote E-government as a key strategy for improving national competitiveness and government innovation since the 1990s(2003-2007 The White Paper of

E-government Business The Ministry of Public Administration and Security & Korea Information Society Development Institute, 2008). In other words, many nations in the world today recognize E-government as a means to realize administrative productivity, customer-oriented administrative service systems and democratic values, and are investing in building E-government.

South Korea has been making policy and financial efforts for the last several years to build E-government, and as a result, South Korea is now attracting attention as a global leader in E-government with the high rank record in various E-government evaluations.¹

However, it is still questionable whether the global interest and expectation of such E-government is increasing government efficiency, democracy, and transparency as well as affecting the government's economic performance. In South Korea, which boasts world-class E-government adoption, the government's troublesome management, corruption, and democratic retreat are constantly raising issues.

Started from the awareness of this problem, this research will analyze how E-government affects each country's corruption control². I think this report can help each country to diagnose its own current E-government status.

¹ 13th in 2003, 5th in 2005, 6th in 2008, 1st in 2010-2014, 3rd in 2016

(South Korea's E-government ranking by UN E-Government Survey)

² In my research, Corruption Control refers to reducing corruption by preventing or blocking the possibility of corruption

2. Literature Review

The United States, Britain, and other developed countries have promoted E-government as a key strategy for improving national competitiveness and government innovation since the 1990s. The US used the term "E-government" for the first time in 1993 and the Clinton administration pursued business process reengineering using information technology as part of government reinvention. Under Prime Minister Tony Blair, the UK adopted E-government projects for citizen-centered innovation as part of Modernizing Government (UK Modernising Government White Paper, 1999). The efforts of other developed countries soon began to take shape; Australia promoted On-Line Australia in 1999. Furthermore, political leaders of many countries in international organizations and regional unions, such as the United Nations (UN), the Organization for Economic Cooperation and Development (OECD), and the European Union (EU), made E-government a priority of national agendas and endeavored to improve its use (The Ministry of Public Administration and Security, Korea Information Society Development Institute, 2008).

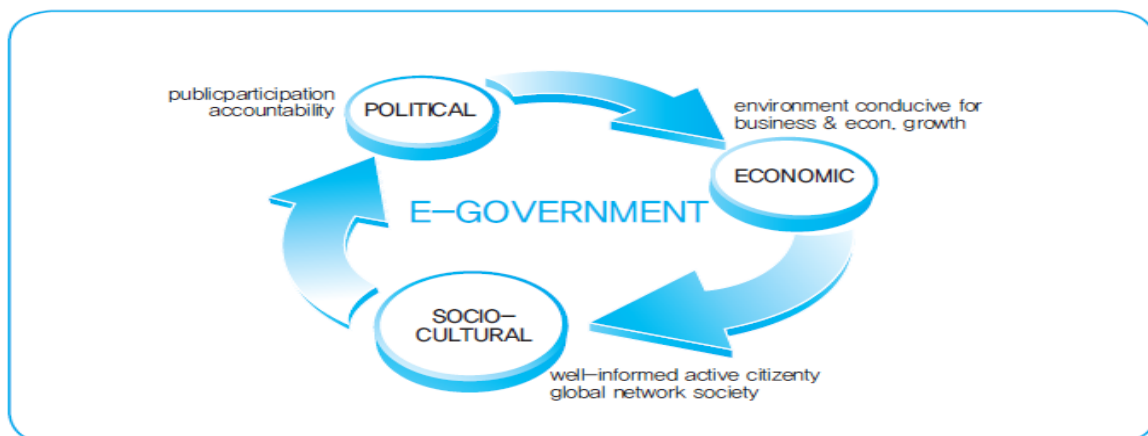
What is E-government? It is difficult to define in one word, but in general, E-government means utilizing Information and Communications Technologies (ICT) actively in administrative activities of the government. And the ultimate value that E-government pursues is to recreate the government of the industrial society into the government suited for the knowledge and information society. More specifically, the focus of E-government has been on government recreation through improvements to service for citizens, government efficiency, and accountability (Choi & Lee 2004). In general, the philosophy of E-government is to provide as many services as possible via the Internet. That is to say E-government may be approached from the narrow definition that emphasizes the use of the Internet in providing administrative services, or the broad definition where local information-related government functions enable infrastructure, living, and industry, and each administrative sector works more harmoniously as a system.

In the US, E-government means that the government enables citizens to access information and services more broadly and quickly, and provides citizens with various administrative

services on the basis of common information and communication at any time anywhere through efficient and citizen-centered processes. In the UK, E-government means that when government provides the client (the general public and companies) with services, it enhances the efficiency of administrative information by supplying services for the citizen with both more-developed information technology and traditional communication means. In South Korea, E-government means that by innovating all public administration processes with IT utilization, government clients, citizens, and companies are able to use various services and information provided by the government easily (The Ministry of Public Administration and Security 1998). Although the concept of E-government in three countries may have a difference between laudatory goals and actual functioning, the goal they pursue through E-government is not very different.

E-government was started to improve governance and administrative efficiency, but the shift has a ripple effect on politics, economics and social and cultural fields beyond the government sector. Figure 1 below shows ideal conditions for E-government to pursue. E-government can form a more participatory political culture, and act as a mechanism to strengthen the accountability of politicians to the people. E-government may create a favorable environment for business activities and economic development by streamlining administrative services and contributing to national economic growth (Kim 2009).

<Figure 1, Political, economic and social impact of E-government>



(Source: 2011 Economic Development modular business, MOGAHA & KAPS, 2012)

Consequently, it goes without saying that the development of E-government is very important in the information age. In light of the importance of E-government, The United

Nations surveys the 193 United Nations member states every two years to assess their E-government development status. The E-government Development Index (EGDI) evaluates online services, telecommunication connectivity, and human capital. In particular, human capital focuses on citizens' acceptance of E-government. The E-Participation Index (EPI) deals with the citizen's access to public information and services related to participation in public decision-making (UN E-government Survey 2016). Each index has a value from 0 to 1, and the higher the score, the higher the level of E-government. (Detailed description in independent variable)

Information and communication technology (ICT) itself is considered to be a tool with the potential to achieve efficiency of organization operation, cost reduction, improvement of service quality, convenience, and innovation in that it can eliminate time and space constraints and connect various subjects through various communication channels organically (Ndou 2004).

Before analyzing the impact of E-government on corruption control, it is necessary to examine corruption theories.

The concept of corruption is difficult to define uniformly, and various concepts are presented depending on the state or society or the person who discusses it. South Korea's Corruption Prevention Act tackles corruption in a broad sense, including the following three items.

- (a) "The act of any public official's abusing his position or authority or violating Acts and subordinate statutes in connection with his duties to seek gains for himself or any third party;"
- (b) "The act of causing damages to the property of any public institution in violation of Acts and subordinate statutes in the process of executing the budget or executing a contract"
- (c) "The act of coercing, urging, proposing and inducing the act referred to in (a) and (b) or its covering up." < Source: South Korea's the Corruption Prevention Act Article 2 >

Transparency International (TR) defines corruption as "abusing public power for private interests" in a broad sense (TR webpage). Choi Yong-hoon (2003) defines the concept of corruption in relation to Red tape as "an act that violates the public interest by pursuing private benefits or by unfairly exercising the authority related to the job in the administrative

sector". Klitgaard (1998) also defines corruption as escapes or violations of public duty from public positions for income on a privately held monetary position. Cho, Jae Hyun (2015) argues that the cause of corruption can be variously interpreted according to the viewpoint on corruption and that in particular it is difficult to say the cause of corruption in a word by the comprehensive viewpoint on corruption. In other words, in the analysis of attribution between cause and effect in corruption phenomenon, it is often necessary to fundamentally solve the problem in the institution itself and the other environmental causes besides the corrupt actor.

There is also government transparency as a concept considered in corruption control research. Transparency generally refers to accessibility, which means the acquisition and availability of data and public information, the completeness of how much information is provided and the quality of information provided, and accountability, which means that people should explain to others the reasons for their individual behavior transparently as a member of society living together (Chang & Song, 2007). According to this definition of transparency, government transparency is defined as a government status equipped with access to public information for citizens, citizen participation in political decisions, and accountability for legal treatment, etc. (Cotterrell, 1999). In addition, government transparency plays a direct role in decreasing the possibility of corruption by strengthening direct control over government organizations while the public actively participates in the right to know and policy making process (Lee, 2003). For this reason, in many studies, transparency and corruption are discussed in a similar framework, and corruption indices such as the corruption index and the bribery index are used when investigating transparency (Park, 2004). This is because if the corruption index or the bribery index is high, the transparency index may be lowered to the contrary, so these indexes can be considered together when transparency in each country is studied.

2.1 Theoretical Analysis of E-Government's Corruption Control Effect³

The anti-corruption effect of E-government is centered on the disclosure and monitoring of the administrative government using Information and Communications Technologies (ICT).

According to one set of observers, "The opening of administrative information → Surveillance by the public, Digital records and Evidence, Introduction of competition → Reduction of free discretion → Reduction of corruption" (Nam & Gwon & Park & Jeon, 2002)

According to Park Heung-sik (2002), the introduction of E-government is about improvement of the work structure, and the e-government's anti-corruption effects can be explained in four ways

1) Increasing the volume of opened information - Controlling discretionary information confidentiality

Strategies to prevent corruption by strengthening administrative oversight and control systems have been difficult to realize because of the problem of increased administrative costs. In the past, it was technically impossible to increase transparency by disclosing all information. However, with the development of information and communication technology (ICT), it is now possible to provide administrative information to a large number of people at a low cost. The advantage of E-government lies in the communication technology of distributing and sharing information that transfers lots of information to a large number of people at a time with low cost

Today, the government pursuit of transparency as a result of this information disclosure provides the opportunity to prevent abuse of power and corruption in addition to satisfying people's right to know and improving trust between government and citizens. In other words,

³ Nam, Gung-geun & Gwon, Hae-su & Park, Heung-sik & Jeon, Tae-yeong 2002 Controlling Corruption through E-Government in Korea- Theory and Cases Gyeongsang National University Social Science Research Institute

E-Government can reduce the need for citizens to use bribes to obtain information by publicizing many areas that have been prohibited from external control according to public officials' own arbitrary judgment.

2) Control of discretionary work

According to Klitgaard (1988), the possibility of corruption is proportional to the monopoly of power and exercise of discretion. On the other hand, higher accountability reduces corruption. The discretion appears when the content of the statute is inconsistent with reality or in its ambiguous expression. This extends the scope of discretionary interpretation when the officer in charge applies statutes or standards. The discretion of administrative officials improves work efficiency by enhancing responsiveness and flexibility, but at the same time, if it is not supported by high professional or ethical standards, it may result in increased corruption. The E-government reduces the possibility of public officials to decide and interpret disagreements or ambiguous expressions between laws and realities through free discretion by attracting the attention of information disclosure and public scrutiny.

3) Reduction of face-to-face opportunities

E-government makes face-to-face interactions between government and citizens unnecessary through online communication. The contents and procedures of all work are disclosed, and the administrative agency responds to questions and inquiries of the complainants through online channels, thereby reducing the opportunity to face the citizens directly. Therefore, the possibility of unfair treatment by public officials and citizens through direct meeting, that is to say, the possibility of corruption, can be reduced.

4) Expansion of competition

Corruption is often caused by competition restrictions and information monopolies.

The effects of corruption control through competition appear especially in specific areas such as government procurement. The E-government's disclosure of information makes it possible to compete fairly. The E-government technologically implements an environment in which all private operators can participate in open competition in procurement contracts between government and citizens for public works, goods purchases, etc. through information and communication technology (ICT). For example, the E-bidding system in the E-government precludes competition restriction through fair distribution of information and suppresses corruption by eliminating opportunities for officials in charge to provide beneficial information to specific operators or to apply special criteria.

As mentioned above, there are earlier studies that positively evaluate the effects of E-government on the control of corruption, but as Bac (2001) pointed out, there are negatively effective research that public officials' information may be exposed to complainants and public officials may collide with the civilians.

In addition to research related to corruption control and transparency, there are also studies on efficiency, democracy and other effects of E-government.

Lee (2010) found that Gyeonggi Provincial Office of Education's administrative information system in Korea had a positive effect on work productivity (efficiency and effectiveness).

However, Bertot, John Carlo, Jaeger & Paul T.(2008) argue that for citizen-centered E-government operations, repeated evaluations and feedback on citizen's needs, citizen's and government's ability, citizen participation and quality of service should be continuously carried out. They emphasize that E-government does not inevitably reduce the cost of government. The publication(title : In the service of democracy, 2002) pressed by the e-Envoy Cabinet Office of the UK, which shows that E-government has a positive effect on democracy, suggests that the level of information system service affects not only citizen participation but also the scope and quality of that participation. However, Netchaeva (2002) compares levels of E-government between developing countries and developed countries, and argues that society, government, and social systems cannot be changed by the existence of electronic technology. Democracy can be only realized when Information and communication technology (ICT) can expand the accessibility of information to more people

and encourage more citizen participation through active public debate.

Yand and Rho (2007) investigated the impact of E-government on government accessibility, efficiency, economics, and effectiveness (participation, trust, and transparency) through various programs. As a result, although E-government has improved the efficiency of many programs, it has been relatively difficult to elicit effectiveness, citizen satisfaction, transparency, and citizen participation.

As we have seen, there have been many empirical studies on E-government effects as well as on its theoretical impacts. Research on the effectiveness of E-government produces varied results.

I would like to focus on corruption control among various effects of E-government

This research will examine how E-government has affected corruption control and transparency when the current level of E-government⁴ is much more advanced than it was in previous research.

It examines the difference in the impact of E-government on corruption between OECD countries which are already well established and relatively less-equipped and non-OECD countries.

⁴ UN (2008) E-government development stage

(1.Emerging 2.Enhanced 3.Interactive 4.Transactionnal 5.Networked, Connected)

3. Research design

The purpose of this study is to analyze the impact of E - government on corruption control at a multi-year and a multi-national level.

For this study, the E-government development index and the E-participation index announced by the UN every two years were set as independent variables to compare the level of E-government development (UN E-Government Survey, 2016, 2012, 2008)

In more detail, the E-government development index (EGDI) consists of three sub-indices such as Online Service Index, Telecommunication Infrastructure Index and Human Capital Index and a weighted average of normalized scores on the three sub-indices. “The E-participation index (EPI) is derived as a supplementary index to the UN E-Government Survey.” It is composed of E-information sharing, E-consultation and E-decision-making (UN E-Government Survey 2016). Each index has a value from 0 to 1, and the higher the score, the higher the level of E-government.

Moon et al. (2005) argue that there are some problems with validity, claiming that the UN E-government survey is a supplier-centered evaluation. Namely, it focuses on the government's output rather than actual use by citizens. However, the UN E-government survey is a commonly used indicator when evaluating the level of E-government in each country.

Corruption Perceptions Index (CPI) by Transparency International was used as a dependent variable to understand the degree of corruption in each country. “The Corruption Perceptions Index (CPI) scores are based on how corrupt a country's public sector is perceived to be. It is a composite index, a combination of surveys and assessments of corruption, collected by a variety of reputable institutions. The score of Corruption Perception Index (CPI) ranges from 0 to 100, where 0 means that a country is perceived as highly corrupt and a 100 means that a country is perceived as very clean. The reason why the Corruption Perception Index(CPI) is based on perceptions is that there is no meaningful way to assess absolute levels of corruption in countries on the basis of hard empirical data” (Transparency International 2016 Corruption perception index).

Daniel Treisman (2007) argues that corruption indices, which indicate the degree of

corruption in each country, are data based on perceptions rather than empirical data. Therefore, most elements of corruption are not related to measures of actual corruption experience when controlling income in each country. In other words, he was skeptical of the validity and credibility of corruption indices, including the corruption perception index (CPI), and he said future research should focus on experience-based indicators.

However, Anastasiia Shukhova (2017) in the article of Measurement of Validity of Corruption Indices said that “Corruption is an intrinsically latent phenomenon, which makes it a challenging task to measure it and requires the use of indirect indicators.” The study analyzed 5 the most widely used indices on corruption – “The Corruption Perceptions Index (Transparency International), The Control of Corruption Index (World Government Indicators), The Bribing and Corruption Index (The International Institute for Management Development), The Corruption Index (International Country Risk Guide), and The Rule of Law: Absence of Corruption (World Justice Project)”. According to the analysis result, Corruption Perception Index by Transparency International and Control of Corruption Index by World Government Indicators is the most reliable among the five representative corruption indices currently used. Therefore, although Corruption Perception Index has a few problems in reliability and validity, this research used it because it is the index that shows the degree of corruption in countries most at present (Anastasiia Shukhova, 2017).

In previous studies, there have been some studies on the effectiveness of e-government's corruption control but the results from the studies were different. For example, while Andersen (2008) argues that E-government has a positive impact on corruption control, Wang (2013) has published a study that E-government has no significant effect on corruption control.

As there are few cases that have been studied by a long-term basis at present, it seems to be necessary to analyze the long-term effects from 2008 to 2016, which is current E-government development stage.⁵

⁵ The country that is implementing E-government well at the present can be regarded as the fifth stage (Connected) by UN classification.

My other research is that E-government's impact on corruption control compares between OECD and non-OECD countries.

Since GDP Per Capita in each country is considered to influence on E-government level in each and the impact of E-government level on corruption control can be difficult to know precisely, it is used as a control variable.

<Hypothesis setting and Operational definition of variables>

1. Hypothesis setting

1) E-government and corruption control (government transparency)

The root cause of corruption in the public sector can be found in information asymmetry between the government and the people. Information asymmetry between the government and the public allows the bureaucrats to exercise strong discretion, and bureaucrats can avoid or transfer their responsibilities by setting up complex procedures or ambiguous standards with their discretion. In this process, bureaucrats can reveal tokens that require indirect bribery through secret contact with the public, and it is highly likely that the public respond to the deal. (Kim. 2016)

E-government provides a lot of administrative information to a large number of people at a low cost, thereby providing a clue to solve the information asymmetry problem between the government and the people, which is the root cause of corruption.

The introduction of e-government has resulted in disclosing the areas and information for which officials have limited external control in accordance with their own discretion, thereby enabling the public to gain a better understanding of the administrative domain covered by the veil. The possibility of corruption in the public sector is expected to be reduced because E-government can strengthen monitoring and control on governments. Therefore, the following hypothesis setting is possible.

Hypothesis 1> the level of E-government development in each country will have a positive impact on corruption control

Hypothesis 2> the level of E-participation in each country will have a positive impact on corruption control

2) OECD and Non OECD Countries

The effects of e-government can vary depending on the social, economic, and democratic environment of each country. In particular, it is necessary to focus on whether a country is OECD as a means to collectively distinguish government environment. In other words, it can be expected that the impacts of E-government on corruption control will be different between OECD countries and non-OECD countries in that OECD countries are more socially and economically developed with stronger pursuit of more open market economy and plural values.

Hypothesis 3> the impact of E-government on corruption control in each country will be different between OECD countries and non-OECD countries.

2. Operational definition and measurement of variables

1) Independent Variable

The United Nations conducts E-Government Survey to assess the E-government development status of the 193 United Nations Member States every two years. The E-Government Development Index evaluates online service, telecommunication connectivity and human capital. E-Participation Index deals with the citizen's access to public information and services to participate in public decision-making (UN E-government Survey 2016). Independent variables were measured by E-government development index (EGDI) and E-participation 1 index (EPI). Each index has a value from 0 to 1, and the higher the score, the higher the level of e-government.

“E-Government Development Index (EGDI) is a weighted average of normalized scores on the three most important dimensions of e-government” (UN E-Government Survey, 2016)

(1) E-Government Development Index

a) Online Service Index

- Measuring government's general ability to provide services to the public
- Survey on the provision of services required by the e-government development stage in each government's homepage

b) Telecommunication Infrastructure Index

- Measuring the level of infrastructure related to basic information and communication, which is a prerequisite for E-government
- “an arithmetic average composite of five indicators: (i) estimated internet users per 100 inhabitants; (ii) number of main fixed telephone lines per 100 inhabitants; (iii) number of mobile subscribers per 100 inhabitants; (iv) number of wireless broadband subscriptions per 100 inhabitants; and (v) number of fixed broadband subscriptions per 100 inhabitants.”(UN E-Government Survey, 2016)

c) Human Capital Index

- It reflects the acceptance of people's e-government service through general intellectual ability measurement of people who can use e-government
- “The Human Capital Index (HCI) consists of four components, namely: (i) adult literacy rate; (ii) the combined primary, secondary and tertiary gross enrolment ratio, etc.; (iii) expected years of schooling; and (iv) average years of schooling.” (UN E-Government Survey, 2016)

(2) E-Participation Index

The online participation index is one that evaluates how many services and how much

information are provided to E-government websites so that citizens can participate in public policy formation through E-government websites. This evaluates the level of government's information provision (E-information) that enables citizens to easily access the information they want through the website, Government counters and functions to communicate directly with the people (E-Consultation) and the level and effort of the government to Converge on and reflect the opinions of the people in the policy making process (E-Decision Making) through Government websites respectively. (UN E-Government Survey, 2016)

2) Dependent Variable

Corruption Control (Government transparency)

The Measurement of Corruption Control uses the Corruption Perceptions Index (CPI) provided by Transparency International. The Corruption Perceptions Index is a composite index derived from the corruption-related indexes surveyed by over 10 well-known international institutions and represents a degree of corruption in the public sector from 0 to 100 points.⁶ The higher the score, the lower the degree of corruption (Transparency International, 2016 Corruption Perception Index)

3) Control variable

As a control variable, GDP per capita, which is considered to affect E-government level, is utilized. This data expressed in US \$ and published by the World Bank.

For reference, the United Nations E-government Survey in 2014 shows that income is correlated with E-government (online service delivery). As you can see in the following table1, even in high, middle and low income countries, high income countries ranked higher than low income countries.

⁶ From 2012, the standard of score is changed from 10points to 100 points. The data before 2012 in this research is converted to from 10points to 100 points (total score).

Table 1

<Top Countries in Online Service Delivery, by Income Group>

Global rank	Rank within income group	High income	Global rank	Rank within income group	Middle income	Global rank	Rank within income group	Lowincome
1	1	France	17	1	Colombia	63	1	Rwanda
2	2	Singapore	23	2	Kazakhstan	72	2	Ethiopia
3	3	Republic of Korea	30	3	Morocco	79	3	Kenya
4	4	Japan	31	4	Malaysia	98	4	Bangladesh
5	5	Spain	35	5	Mexico	107	5	Mozambique
6	6	United States	37	6	Sri Lanks	110	6	Zimbabwe
7	7	Bahrain	39	7	Tunisia	115	7	Burkina Faso
8	8	Australia	41	8	Peru	115	8	Tanzania
9	9	Netherlands	43	9	Armenia	123	9	Madagascar
10	10	Canada	43	9	Costa Rica	135	10	Gambia
			43	9	Mongolia			

(Source: UN E-government Survey, 2014)

In this study, I tried to include the democratization index considering the political situation and the globalization index of the Swiss Economic Research Institute, which seeks to improve the efficiency and transparency of government as control variables. However, the validity and reliability of the democratization index data are questionable, and for the globalization index, the correlation between globalization index and E-government is so large that it is not appropriate to use it as a control variable.

In addition, Research on the relevance of corruption to the economy on very diverse and there is little controversy about its relevance. For example, there is a research like that corruption and economic development have strong causality (Juraj Dobrila University 2016). Because the level of economy (GDP per capita) can affect corruption, the economic factor is a variable that must be controlled to understand the impact of E-government on corruption control.

Finally, Fixed effects analysis can greatly reduce (but do not completely eliminate) the chance that a relationship is driven by an omitted variable. (Allison 2009) so, I analyzed my data through Fixed effects analysis to minimize the omitted variable effect.

As a result, my research set GDP per capita as a control variable to examine the impact of only E-government on Corruption Control

<Analysis method>

This study investigates impact of E - government on corruption control in 172 countries. In addition, it examines the difference of E- government impact on corruption control between the OECD and non - OECD countries. For this study, fixed effect analysis will be conducted using Panel data based on the time difference of about 4 years in 2008, 2012 and 2016 (but, GDP Per Capita is used 2015 data because of no 2016 official data released).

4. Analysis and Findings

Descriptive Statistics

Table 2 shows the descriptive statistics of the variables included in the study. The Corruption Perception Index (CPI) provides a score on the scale of 0 (highly corrupt) to 100 (very clean). The average Corruption Perception Index (CPI) score is 41.4, ranging from 0 to 93. The E-Government Development Index (EGDI) and E-Participation Index (EPI) are weighted average scores on the scale of 0 to 1. Their average scores are 0.480 and 0.312 respectively. The average adjusted GDP Per Capita is \$13.562, ranging from \$0.183 to \$112.852 per \$1000.

Table2. Descriptive Statistics

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std.Dev.</i>	<i>Min</i>	<i>Max</i>
Corruption Perception Index(CPI)	512	41.441	20.478	0	93
E-Government Development Index(EGDI)	515	0.480	0.213	0	0.928
E-Participation Index(EPI)	515	0.312	0.282	0	1
GDP per capita	499	13.562	19.516	0.183	112.852

Table 3 presents a pairwise correlation matrix for 172 countries. The correlation between average Corruption Perception Index (CPI) and E-Government Development Index (EGDI) (0.766), between average Corruption Perception Index (CPI) and GDP Per Capita (0.767), between E-Government Development Index (EGDI) and E-Participation Index (EPI) (0.734), and between E-Government Development Index (EGDI) and GDP Per Capita (0.715) turns out to be relatively strong. However, all values of the variance inflation factor (VIF) were less than 5, ranging between 2.17 and 3.72. While multicollinearity does exist, VIF* scores of less than 5 indicate that it will not significantly influence the stability of the parameter estimates (Belsley et al., 1980). Also, there are no significant correlations among independent variables to remedy a potential collinearity problem. For instance, I might need to drop one of the independent variables if correlation coefficients were greater than 0.8 which is evidence of severe collinearity. Accordingly, multicollinearity problems do not influence the results.

Table3. Correlation matrix

	Corruption Perception Index(CPI)	E-Government Development Index(EGDI)	E-Participation Index(EPI)	GDP
Corruption Perception Index(CPI)	1			
E-Government Development Index(EGDI)	0.766	1		
E-Participation Index(EPI)	0.545	0.734	1	
GDP per capita	0.767	0.715	0.482	1

* Variance Inflation Factor (VIF) results

	Variance Inflation Factor(VIF)	1/Variance Inflation Factor(VIF)
E-Government Development Index(EGDI)	3.72	0.269
GDP per capita	2.4	0.416
E-Participation Index(EPI)	2.17	0.460
OECD	2.13	0.469
Mean Variance Inflation Factor(VIF)	<i>2.61</i>	

Selecting the Fit Model

Panel data analysis provides regression analysis with both a spatial and temporal dimension, and thus my model using this approach can control for cross-sectional properties like attributes of individual countries. The model investigates the ceteris paribus effect of each of the national level factors presented in Table 2 on average Corruption Perception Index (CPI). The corresponding econometric model is given b (1).

$$CPI_{it} = \alpha + \beta_1 EGDI_{it} + \beta_2 EPI_{it} + \beta_3 GDP_{it} + u_i + \epsilon_{it} \quad (1)$$

In equation (1), average Corruption Perception Index (CPI) is the dependent variable, while the right hand side variables are its explanatory variables. There are two types of errors

in panel data. One is the individual specific effect u_i that can capture unobserved and time-constant factors which affect the dependent variable. The other is the idiosyncratic error ϵ_{it} of the equation.

Before analyzing the data using a fixed effects approach, I examined if the approach is appropriate for the data. Panel data analysis needs the selection of the best fit model between random and fixed effects models. Therefore, specification tests were conducted using the Hausman specification test. The result of the Hausman test enables me to decide whether or not to reject the null hypothesis that the difference in coefficients of both fixed and random models is not systematic. The result ($\chi^2(2) = 242.54, p < 0.05$) indicates that the fixed effects estimator is appropriate. In addition, the Breusch and Pagan Lagrangian multiplier test for random effects (Breusch and Pagan, 1980) indicates that the variance of the individual country specific effect, u_i is significantly different from zero ($\chi^2(1) = 242.54, p < 0.01$). As a result, I used heteroscedasticity-robust standard errors for consistent and unbiased estimators. A serial correlation problem is another issue that occurs when conducting panel analysis. The result of the Wooldridge test ($\beta = -.1616, p > 0.1$) for autocorrelation in panel data revealed no serial correlation problems in the model.

In order to see if time fixed effects were required when employing a fixed effects model, I ran a joint hypothesis test to examine if the dummies for all years are equal to zero. The result indicates that the F -statistic ($F = 2.23, p > 0.1$) is insignificant, and thereby time fixed effects are not appropriate in my model.

Findings from the Model

Table 4 depicts the fixed effects panel regression estimates for Corruption Perception Index (CPI). More specifically, model 1 introduces initial effects with a control variable, model 2 includes main explanatory variables, and model 3 is fully specified, including control variables, main effects, and interaction effects.

According to hypothesis 1, E-government development Index (EGDI)s are expected to positively influence average Corruption Perception Index (CPI)s. Thus, I expected the

coefficient estimate for E-Government Development Index (EGDI) to be positive and significant. The fully specified model 3 in Table 4 supports this expectation ($\beta = 27.17, p < 0.01$) as high E-Government Development Index (EGDI) scores are found to relatively increase the likelihood of better average Corruption Perception Index (CPI) scores. More specifically, the increase of 1% in E-Government Development Index (EGDI) leads to 27.17 Corruption Perception Index (CPI) scores, holding all other explanatory variables constant. Therefore, hypothesis 1 is fully supported.

Hypothesis 2 suggested that a high level of E-Participation Index (EPI) plays a key role in explaining variations in average Corruption Perception Index (CPI). I thus expected the coefficient estimate for E-Participation Index (EPI) to be positive and statistically significant. The main effect model 2 ($\beta = 2.662, p < 0.05$) and fully specified model 3 ($\beta = 3.12, p < 0.1$) in Table 4 support this expectation. Hypothesis 2 is supported.

Table4. Fixed Effects Panel Regression Estimates for average Corruption Perception Index

VARIABLES	Model1: Initial Effects Coefficient(SE)	Model2: Main Effects Coefficient(SE)	Model 3: Interaction Effects Coefficient(SE)
E-Government Development Index(EGDI)		21.27*** (7.994)	27.17*** (9.22)
E-Participation Index(EPI)		2.662** (1.333)	3.120* (1.689)
E-Government Development Index(EGDI)#OECD			-41.65*** (14.86)
E-Participation Index(EPI)#OECD			-0.653 (2.747)
GDP per capita	0.1723537*** (0.000065)	0.214155** (0.000083)	0.1765556** (0.000078)
Constant	39.86*** (0.894)	28.12*** (4.01)	32.42*** (3.575)
Observations	495	494	494
R-squared	0.007	0.066	0.083
Number of state	170	170	170
Country Fixed Effect	YES	YES	YES

Robust standard errors in parentheses OECD (OECD countries = 1, non-OECD = 0). *** p<0.01, ** p<0.05, * p<0.1

OECD as Moderator

Concerning hypothesis 3, social, economic, and political environment of each country are expected to differently influence Corruption Perception Index (CPI). This difference can offset or intensify the effects of other explanatory variables such as E-Government Development Index (EGDI) and E-Participation Index (EPI) on average Corruption Perception Index (CPI). In the study, I used OECD membership as the level and stability of social, economic and political development. To investigate this moderating role of the level and stability of social, economic and political development, I introduced interaction terms of OECD membership on E-Government Development Index (EGDI) and E-participation Index (EPI). As the fully specified model 3 indicates, the coefficient estimate of E-Government Development Index (EGDI) and OECD membership interaction is negative and significant ($\beta = -41.65, p < 0.01$). However, the coefficient estimate of E-Participation Index (EPI) and OECD membership ($\beta = -0.653, p > 0.1$) is not statistically significant. This finding suggests that E-Government Development Index (EGDI) is likely to positively influence average Corruption Perception Index (CPI) in non-OECD countries not in OECD. In OECD countries, the level of E-Government Development Index (EGDI) scores is negatively associated with average Corruption Perception Index (CPI).

As shown as table 5, the effect of E-Government Development Index (EGDI) is to reduce corruption in non-OECD countries. For OECD countries, the model's interaction term cancels out the effect. That means that E-Government Development Index (EGDI) is a force against corruption, but in the OECD there is no evidence of any effect.

Table5. The impact of E-government on Corruption Perception Index in OECD and Non-OECD

Corruption Perception Index (CPI)	Robust					
	Coef.	Std.Err.	t	P> t	[95% Conf.Interval]	
E-Government Development Index(EGDI)	27.165	9.220	2.95	0.004	8.965	45.377
E-Participation Index(EPI)	3.120	1.689	1.85	0.066	-0.214	6.454
E-Government Development Index(EGDI)#OECD	-41.652	14.862	-2.8	0.006	-70.992	-12.312
E-Participation Index(EPI)#OECD	-0.653	2.747	-0.24	0.812	-6.076	4.769
GDP per capita_000	0.176	0.0787	2.24	0.026	0.021	0.339
_Cons	32.425	3.575	9.07	0	25.367	39.482
Rho	0.937					

The model has only GDP as control variable, and the effect is 0.176 on the Corruption Perception Index (CPI) per \$1,000 per capita GDP. The standard deviation of the Corruption Perception Index (CPI) is about 20 (table 2), so the effect is not large, but it does show that an increase in GDP Per Capita reduces corruption.

There are no other control variables, but the fixed effects include all time-invariant country characteristics, which greatly reduces concerns about omitted factors. Time-invariant characteristics include ethnolinguistic fractionalization (how many ethnic groups are in the country), neighboring countries, and for most countries, the degree of democracy and resource dependency. Some omitted factors that change over time are omitted, but 93.7% of the variance of the Corruption Perception Index (CPI) is predictable just knowing what country it is (estimated by the fixed effects model), so the model with GDP Per Capita controls for much more than is apparent.

5. Conclusion and Implication

The impact of E-government on corruption control in each country is analyzed through using the E-government Survey conducted by the UN and the corruption perception index (CPI) by Transparency international at a multi-national and a multi-year level.

The results are as follows.

First, the level of E- government development positively affects corruption control in each country. In other words, the construction of information and communication infrastructure such as 'Online Service Index', 'Telecommunication Infrastructure Index', etc., seems to contribute to building transparent government.

Second, it showed that the degree of E-participation also has a positive effect on corruption control in each country. The level of public policy information provided to citizens by E-government as the form of online information provision, E-consultation, online policy decision making, etc. affects the formation of transparent government positively by reducing the possibility of corruption.

Finally, the impact of corruption control through E-government is strong in non-OECD countries but it is not in OECD countries. This suggests that in OECD countries which have already been developed socially and economically and equipped with all the bases for a transparent government, have little effect on corruption management through E-government. Whereas it implies that in non OECD countries, which are currently developing in all fields, E-government development can contribute more effectively to creating a transparent government.

In conclusion, E-government development is not an omnipotent tool for controlling corruption. It suggests that the role of social, political, economic and cultural factors may be more important after E-government has reached a specific level.

However, as E-government has a positive effect on corruption control in each country, E-government's strategic approach considering the reality of each country will help to manage corruption more effectively.

6. Limitations

The purpose of this study is to analyze the impact of E-government on corruption control by using indicators developed by accredited international organizations.

However, this study has the following limitations.

First is the limitation of data. Although international indicators were used, it was not possible to completely overcome the problems of reliability and validity that could arise in the process of collecting data and deriving indicators in each international organization.

Second is the limit of variable control. In addition to the economic situation (GDP per capita), there are factors influencing corruption control such as political situation and globalization level, etc. However, this research does not include other control variables because it is difficult to solve problems like whether the data is reliable or valid enough for analysis and the strong correlation with independent variables, etc.

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