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The Effect of Digital Transformation on Corruption: A Global Analysis

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Abstract

Background: *This study investigates the effect of digital transformation on corruption at country level. Very few studies have empirically investigated this phenomenon. The model presented lays the relationships between socio-technical and socio-political factors and their impact on technological factors, which in turn, influence corruption.*

Methods: *Secondary data from 139 countries collected by credible international organizations are used for the empirical analyses. The sample of 139 countries, used in this study, makes the results more robust and generalizable than those published in previous studies. PLS-SEM and multi-group analysis were used to test the hypotheses presented in the research model.*

Results: *The results of the analysis show that digital transformation can significantly lower the corruption. The empirical analysis also demonstrates that socio-technical and socio-political factors are important in supporting the technological factors in reducing corruption. Multi-group analysis based on the GNI categorization of the World Bank revealed fine results for nations of different economic level. The significance of the relationships varies based on the development level of the country.*

Conclusions: *This study contributes to the growing empirical base of literature on digital transformation and corruption by empirically assessing new relationships that have not been explored in the extant literature using a relatively larger sample size. The results suggest that technology plays a critical role in reducing the corruption in any country. Factors such as infrastructure, e-participation, education/human capital, laws relating to ICT, and Importance of ICT to government are found to be vital for fighting corruption.*

Keywords: Corruption, Digital Transformation, Government Efficiency, E-Participation, GNI Categorization.

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Introduction

Countries are increasingly investing in information systems and moving digitally. In addition to convenience, the goal of digital transformation is to deliver services in an efficient and effective way, increase revenue and/or reduce costs, surge transparency and accountability, and diminish corruption (Merhi, 2018; Merhi & Ahluwalia, 2018; Merhi & Koong, 2016; Verhoef et al., 2021). Research shows that effective implementation and use of digital systems enable many benefits such as increased technological innovation, greater self-efficacy of citizens, decreased cost of services etc. (Hassan, 2017; Merhi, 2021; Pérez-Morote et al., 2020). Evidently, digital transformation requires a good IT infrastructure, support, laws, as well as high level of education among the citizens to be able to use the new systems/technologies. Many public organizations and nations cite decreasing corruption as one of the key motives of digital transformation. Very few studies have empirically investigated this phenomenon. This study explores whether this belief of the negative impact of digital transformation and corruption can be empirically validated through rigorous statistical analysis.

During the last two decades, governments of countries around the world have moved to digitization by implementing different systems that fall under the term "e-government." E-government is defined as the use of information and communication technologies (ICTs) to expand the activities of public sector organizations (Ngafeeson & Merhi, 2013). E-government has a positive effect on the nations because the effectiveness yielded from the implementation of these system leads to technological innovations, and employment opportunities, thus increasing economic prosperity within the country (Hassan, 2017; Lee, 2017; Lupu & Lazăr; 2015). E-government, and digitization in general, has also an impact on the corruption level of the nations since these systems help fighting corruption in different agencies (Arayankalam et al., 2021; Merhi & Ahluwalia, 2021).

However, these potential benefits can only be achieved if these systems are implemented properly. For successful implementation, a nation must have a reliable IT infrastructure, solid policies to ICTs, high level of e-participation, online service, and human capital. To our best knowledge, no research has investigated the impact of these specific factors on corruption perception in a country. Merhi and Ahluwalia (2018) investigated the influence of digital maturity and maturity of ICT diffusion on corruption. This paper explores the impact of e-participation and government efficiency on corruption. It also investigates the antecedents of these two factors. Thus, the model presented in this paper demonstrates the process by which different factors, related to digitalization, affect each other to decrease corruption.

To our best knowledge, except for Švarc et al. (2020) that examined digital transformation among the EU members, extant literature on digital transformation has been limited to specific countries or even cities. Datta (2020) studied the Italian Public Administration's digital transformation. Kattel and Mergel (2019) paper focused on the Estonian experience in digital transformation and the success implementation of e-government systems. Ndemo and Weiss (2017) research focused on giving recommendations of changes that need to be done while embracing digital transformation by the Kenyan government. Salem (2016) focused on Dubai's case of digital transformation. This current paper extends the extant literature by examining the antecedents of digital transformation factors as well as their impact on corruption using data collected from 139 countries.

Research focusing on investigating the implementation, diffusion, and adoption of digital solutions indicate that a significant number of these systems are not successful because of a variety of several factors (Ahluwalia & Merhi, 2020; Merhi, 2018). At the same time, Datta (2020) argues that digital transformation is rarely, if ever, a technical solution but a socio-technical and socio-political solution. Švarc et al. (2020) found that human capital is a predictor of digital transformation at the country level. This study builds on these findings by including

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socio-technical and socio-political factors in addition to the techno-related factors and explores their impact on corruption.

The contributions offered by this paper are expected to help both researchers and practitioners. To the best of our knowledge, this is the first paper that proposes a model that identifies important macro-level factors related to digital transformation and empirically confirms their influence on corruption. Thus, this paper makes the following specific contributions to research:

1. Empirically explore the relationship between socio-technical and socio-political and corruption level at country level.
2. Analyze and interpret the empirical relationships using data collected from 139 countries, which enhances the generalizability of the results, in the context of research and government policy opportunities.

Governments' decision makers will find in this study a powerful means for identifying fundamental macro-level factors which can lead to fight and reduce corruption. We believe that the findings of this study will illuminate our understanding of the contributions of macro-level related factors at the national level by providing a macro perspective of their influence on corruption. The empirical analysis demonstrates the level of importance and the impact of the factors on each other. The overall model presented in this paper demonstrates the process that should be followed to lessen corruption. Thus, practitioners should follow this process to fight corruption.

The remainder of this paper is organized as follows. We first present the research model and the research hypotheses. We then discuss the methodology and quantitative data analysis that are used to test the hypotheses. Then conclusions and implications are presented. Finally, we discuss the limitations and future research opportunities.

Research Model and Hypotheses

In this section, we present the factors included in the research model. We also present the relationships among the different factors. Figure 1 displays the research model

Corruption

Corruption is defined as the "abuse of public power or authority for private benefit" (Anokhin & Schulze, 2009, p.465). Corruption is demonstrated in different forms such as bribery, clientelism, embezzlement, lobbying, and patronage. Corruption creates distrust in citizens hindering effective delivery of public services (Khan & Krishnan, 2019). Many countries around the world face high levels of perceived corruption and there is a widely held belief that corrupt practices are one of the biggest impediments to the overall public good (Merhi & Ahluwalia, 2018). Transparency International, an international organization that publishes a yearly Corruption Perception Index (CPI), claim that nations with low CPI are plagued by untrustworthy and badly functioning public institutions (transparency.org) and negative government efficiency index whereas nations with high CPI are just the opposite and have high values in the efficiency index. Also, less corrupt nations tend to have higher degrees of information about the public expenditure and stronger standards when it comes to integrity for public officials (transparency.org). Accordingly, we argue that more efficient governments are better able to control corruption. Thus, we postulate that:

Hypothesis 1 (H1): *Government efficiency negatively impacts Corruption.*

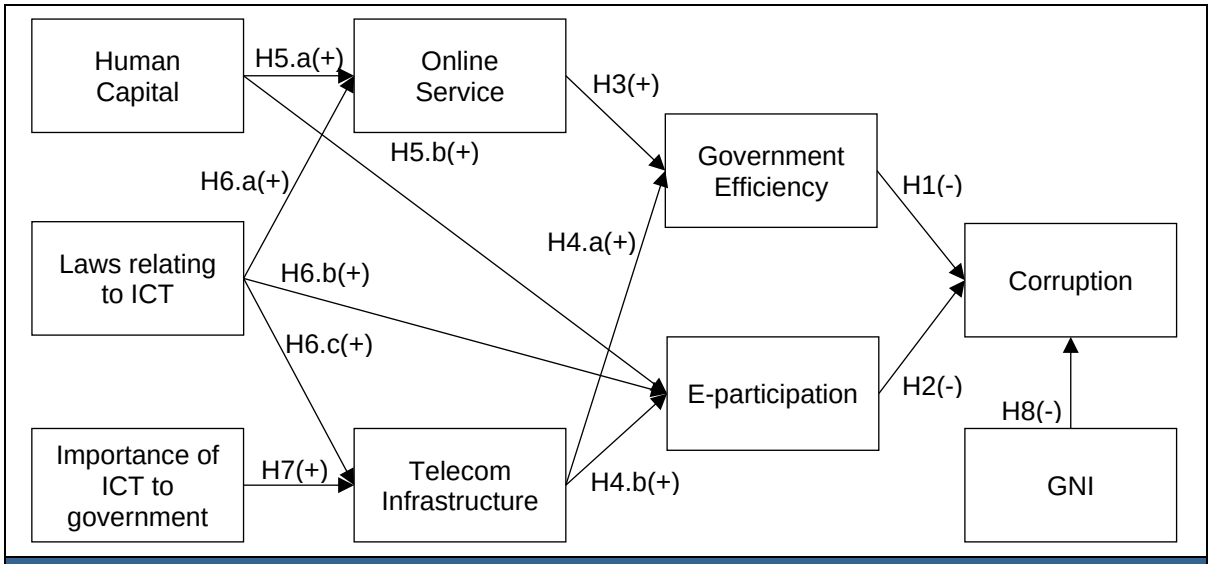

Figure 1 – Research Model

E-participation

E-participation index captures the use of digital technologies by governments to provide information to citizens, interact with stakeholders, and in decision making. It is well known that use of digital technologies increases transparency and accountability (Merhi & Koong, 2013; Ngafeeson & Merhi, 2013; Tai et al., 2020). Computer records can be much easily sifted for fraud or irregular practices (Merhi & Ahluwalia, 2015; Merhi & Ahluwalia, 2017). Also, since e-participation is indicative of both the capacity and the willingness of the government in encouraging the citizen in promoting deliberative, participatory decision-making in public policy, it is understandable that it will affect the corruption in a particular country. For instance, the more governments encourage citizenry to participate, the more likely they are to become less corrupt. Therefore, greater use of digital technologies by the governments are likely to decrease the possibility of corruption. Therefore, we hypothesize:

Hypothesis 2 (H2): E-participation negatively impacts Corruption.

Online Service

The online service index captures a government's capability to provide services to its citizens electronically (United Nations, 2021). Of the advantages of digital transformation and e-government is efficiency and effectiveness (Olumide & Ishola, 2020). By using information systems to provide citizens the needed services, both governments and their citizens become more effective and efficient. Based on this, we postulate that:

Hypothesis 3 (H3): Online service positively impacts government efficiency.

Telecommunication Infrastructure

According to the diffusion of innovation theory (Rogers, 1962), technologies are essential drivers of their widespread use. A robust and reliable telecommunication infrastructure is necessary for large scale diffusion of digital technologies and services (Mbarika et al., 2005). Research shows that the lack of telecommunication infrastructure acts as a barrier in the use of digital services (Kaba et al., 2009). Therefore, we hypothesize that telecommunication infrastructure is an antecedent of e-participation because telecommunication infrastructure includes the essential technologies that enable e-participation by governments. Furthermore, high quality telecom infrastructure helps in electronic service delivery. The better the quality, the faster and smother the delivery is. Hence, we hypothesize that:

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Hypothesis 4.a (H4.a): Telecommunication infrastructure positively impacts government efficiency.
Hypothesis 4.b (H4.b): Telecommunication infrastructure positively impacts e-participation.

Human Capital

Many research and practitioner articles have argued and found that lack of awareness of technology, low level of education and low human resources are major challenge to digital transformation and technology usage in general (e.g., Al Awadhi & Morris, 2009; Shareef et al., 2011; Švarc et al., 2020). Literacy is a prerequisite to technology adoption and usage. As citizens' education rise, citizens are more likely to have greater access to information technologies and to embrace these systems quickly and use them more efficiently. Moreover, citizens who have high skills in the use of emerging technologies are more likely to participate in the decisions and share their ideas. Many research and practitioner articles have cited this as a major challenge to adopt e-participation but cannot do so because of high levels of illiteracy of overall populations (Hakhverdian & Mayne, 2012). Therefore, we postulate:

Hypothesis 5.a (H5.a): Human capital positively impacts online service.
Hypothesis 5.b (H5.b): Human capital positively impacts e-participation.

Laws relating to ICT

In countries where the legal system is well developed and enforcement mechanisms are efficient, citizens (individuals and organizations) will be motivated to engage in digital transactions because they are likely to have the confidence that their interests would be protected, should any conflict arise. As a result, in countries having effective legal systems related to the conduct of digital transactions, citizens are more willing to enter technology-based exchanges with each other. We need to make a distinction between laws related to corrupt practices and those concerning use of digital transactions; we are more focused on the latter. No study has empirically tested the impact of laws relating to ICT on online service, e-participation, and telecom infrastructure. Maharaj and Munyoka (2019) trust and perceived risk impact e-government adoption. Thus, we posit:

Hypothesis 6.a (H6.a): Laws relating to ICT positively impacts online service.
Hypothesis 6.b (H6.b): Laws relating to ICT positively impacts e-participation.
Hypothesis 6.c (H6.c): Laws relating to ICT positively impacts telecom infrastructure.

Importance of ICT to Government

In an increasingly interconnected world, countries are constantly competing and trying to lead in different domains. In the last decade, digital technologies and transformation have spurred growth in several countries (Szeles, 2018). Therefore, instruments of states are likely to benefit from applications of new technologies to increase or improve their economic status. While the extent and nature of involvement of state in economic activity is a separate topic, all schools of economic policies require the states to develop and articulate their vision in respect of development and implementation of information technology and associated technologies in their respective countries. The infrastructure development should be among the strategies of any country especially if high level of development is desired, whether at the technological or the economical domain. Governments are also concerned about digital divide, which is a major barrier facing many countries, both developing and developed. Therefore, we argue that a clear and long-term vision of any government on ICT infrastructure clearly affects the development and implementation of the IT infrastructure. This reasoning leads us to postulate:

Hypothesis 7 (H7): Importance of ICT to government positively impacts telecom infrastructure.

GNI

Many studies examined the relationship between economic growth and corruption and found a significant relationship (e.g., Gründler & Potrafke. 2019). Like these studies, we hypothesis:

Hypothesis 8 (H8): GNI negatively impacts Corruption.

Since this study is at the global level and includes countries from different economic level, we aim to explore the above listed hypotheses in different countries of different classification. The World Bank categorizes the countries in four categories: Low-income; lower-middle; upper-middle; and high-income.

Methodology

We used secondary data comprising of 139 countries in this research to test the hypotheses and to conduct the empirical analysis. The data were drawn from credible international organizations that have the resources to collect data at a global level and are known for their integrity. The datasets used for analysis are drawn from the Transparency International and the United Nations. The variables of interest are now described.

The corruption index is calculated by Transparency international (transparency.org). Transparency international aggregates data about perceptions of businesspeople and country experts of the level of corruption in the public sector then calculates this index. The scale of the index ranges from 0 to 100 where 0 signifies the highest level of perceived corruption and 100 equals the lowest of corruption. Since we are examining the factors impacting corruption, we flipped the scale of the index so 100 means the highest level of perceived corruption and 0 indicates the lowest perceived corruption.

E-participation was collected from the World Bank database (worldbank.org). This index assesses the quality, relevance, and usefulness of government websites in providing online information and participatory tools and services to their citizens. The index ranges from 0 to 1, where 1 is the best.

Human capital is an index calculated by the World Bank based on data they collect. This index measures how much capital each country loses through lack of education and health. The index ranges between 0 and 1, with 1 meaning maximum potential is reached.

Importance of ICT to government is collected by the World economic forum (weforum.org). This factor is measured using a question: “To what extent does the government have a clear implementation plan for utilizing ICTs to improve your country’s overall competitiveness?” The scale ranges from 1 to 7 where 1 is “not at all, there is no plan” to 7: “to a great extent, there is a clear plan.”

Laws relating to ICT is another factor collected by the World economic forum (weforum.org). This factor is measured using a question: “How developed are your country’s laws relating to the use of ICTs (e.g., e-commerce, digital signatures, consumer protection)?” The scale ranges from 1 “not developed at all” to 7 “extremely well developed.”

Online service is an index calculated by the United Nations and published in the World Economic Forum report. This index assesses the quality of government’s delivery of online services to their citizens. The index ranges from 0 to 1 (best).

Telecommunication infrastructure is another index calculated by the United Nations. This index measures the countries’ telecommunication infrastructure readiness to adopt the

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opportunities offered by ICT as to enhance their competitiveness. The index is calculated based on five indicators: active mobile broadband subscriptions/ 100 population; fixed broadband Internet subscriptions/ 100 population; fixed telephone lines; Internet users; and mobile telephone subscriptions.

Government efficiency is another index calculated by the United Nations. This index captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The index ranges 0 to 1 (highly effective).

Finally, GNI per capita represents the value produced by a nation's economy in a year. Data for GNI per capita were collected from World Bank.

Analysis and Results

The first step in statistical analyses is descriptive analysis because it helps in providing useful information about the data. The results of the descriptive statistics are presented in Table 1. By checking the range value of corruption, one can see that the value is big enough to show disparities among the countries included in this study. That is true since the data are composed from different countries that have different levels of corruption. One can also see the disparities in other factors. Moreover, from Table 1, the skewness and kurtosis measures show that the data are normally distributed. Normality is one of the assumptions that should be tested before running multivariate analysis. The results yielded in this table, ensure that other multivariate tests could be executed later. Besides, more information about the shape of the distribution could be found in the results. Half of the skewness values are positive which means that the mass of the distribution is concentrated to the left. At the same time, all the kurtosis values are negative which means that the shape of the distribution is not peaked.

Table 1 – Descriptive Analysis

	Mean	Std. Deviation	Kurtosis	Skewness
Corruption	54.007	18.249	-0.568	-0.721
E-participation	0.562	0.245	-0.749	-0.337
Human Capital	0.675	0.184	-0.148	-0.675
Importance of ICT to gov	3.962	0.781	-0.188	0.385
Laws relating to ICT	3.921	0.908	-0.665	0.115
Online Service	0.562	0.247	-0.854	-0.265
Telecom infrastructure	0.417	0.226	-1.066	0.181
Government-efficiency	4.055	0.832	-0.45	0.292

We next conducted a correlation analysis to take a general idea about the strength and the magnitude of the relationships between and among the variables. The results of the correlation analysis are displayed in Table 2. All the coefficients of the correlation range from moderate to very strong and are in the same direction as expected.

Table 2 – Correlation Analysis

	Corruption	E-particip	GNI	Human Capital	Importance of ICT to gov	Laws relating to ICT	Online Service	Telecom infrastruc
E-participation	-0.622							
GNI	-0.835	0.58						
Human Capital	-0.647	0.735	0.647					
Import of ICT to gov	-0.596	0.473	0.531	0.329				
Laws relating to ICT	-0.783	0.713	0.739	0.676	0.825			
Online Service	-0.658	0.964	0.623	0.739	0.515	0.746		
Telecom infrastr	-0.766	0.756	0.805	0.856	0.487	0.769	0.787	
Gov efficiency	-0.682	0.583	0.620	0.514	0.935	0.914	0.634	0.644

We then used SmartPLS to assess the hypotheses presented in the research model. The results are displayed in Figure 2. The results of PLS analysis show that all the hypotheses of the research model are supported. All the coefficients and their statistical significance levels are displayed on the arrows. The R-squared parameter, which measures the variance of endogenous latent variable that is explained by the independent latent variables, are all included in Figure 2.

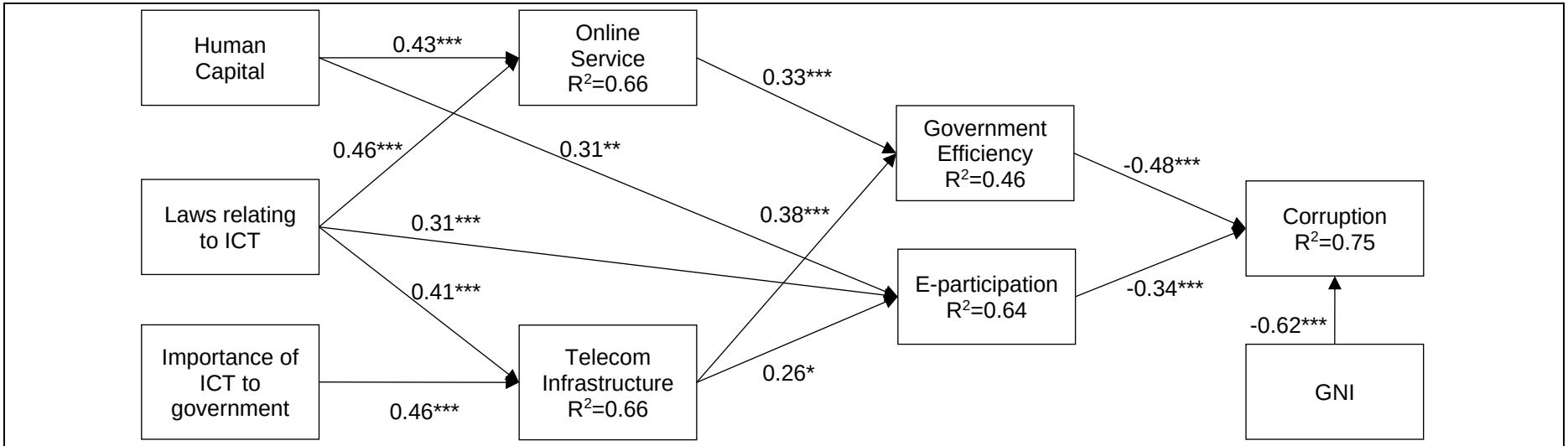

Figure 2 – PLS Results

Finally, we executed a multi-group analysis based on the GNI categorization of the world Bank. The results are displayed in Table 3 below. Interestingly and although all the hypotheses were significant when using the data collected from 139 countries, different results were found for each category. For low-income countries, the following hypotheses were found to be significant:

Hypothesis 1 (H1): *Government efficiency negatively impacts Corruption.*
Hypothesis 3 (H3): *Online service positively impacts government efficiency.*
Hypothesis 4.a (H4.a): *Telecommunication infrastructure positively impacts government efficiency.*
Hypothesis 4.b (H4.b): *Telecommunication infrastructure positively impacts e-participation.*
Hypothesis 6.a (H6.a): *Laws relating to ICT positively impacts online service.*
Hypothesis 6.b (H6.b): *Laws relating to ICT positively impacts e-participation.*

For lower-middle countries, the following hypotheses were found to be significant:

Hypothesis 1 (H1): *Government efficiency negatively impacts Corruption.*
Hypothesis 3 (H3): *Online service positively impacts government efficiency.*
Hypothesis 5.a (H5.a): *Human capital positively impacts online service.*
Hypothesis 6.a (H6.a): *Laws relating to ICT positively impacts online service.*
Hypothesis 6.c (H6.c): *Laws relating to ICT positively impacts telecom infrastructure.*
Hypothesis 7 (H7): *Importance of ICT to government positively impacts telecom infrastructure.*

For upper-middle countries, the following hypotheses were found to be significant:

Hypothesis 3 (H3): *Online service positively impacts government efficiency.*
Hypothesis 5.a (H5.a): *Human capital positively impacts online service.*
Hypothesis 6.a (H6.a): *Laws relating to ICT positively impacts online service.*
Hypothesis 6.c (H6.c): *Laws relating to ICT positively impacts telecom infrastructure.*

For high-middle countries, the following hypotheses were found to be significant:

Hypothesis 1 (H1): *Government efficiency negatively impacts Corruption.*
Hypothesis 2 (H2): *E-participation negatively impacts Corruption.*
Hypothesis 3 (H3): *Online service positively impacts government efficiency.*
Hypothesis 4.a (H4.a): *Telecommunication infrastructure positively impacts government efficiency.*
Hypothesis 5.a (H5.a): *Human capital positively impacts online service.*
Hypothesis 5.b (H5.b): *Human capital positively impacts e-participation.*
Hypothesis 6.a (H6.a): *Laws relating to ICT positively impacts online service.*
Hypothesis 6.c (H6.c): *Laws relating to ICT positively impacts telecom infrastructure.*

Table 3 includes all the coefficients and the significant level of each of the hypotheses. The list of the countries of each category is found in the Appendix.

Table 3 – Analysis Based on GNI

	Low-income	Lower-middle	Upper-middle	High-income
Gov efficiency -> Corruption	-0.654*	-0.545***	-0.232 NS	-0.365***
E-participation -> Corruption	-0.198 NS	0.026 NS	0.1 NS	-0.392***
Online Service -> Gov efficiency	0.704***	0.384**	0.266*	0.268*
Telecom infrastructure -> Gov efficiency	0.615**	0.075 NS	0.158 NS	0.268*
Telecom infrastructure -> E-participation	0.705*	0.253 NS	0.313 NS	0.268 NS
Human Capital -> Online Service	-0.16 NS	0.293*	0.389***	0.318***
Human Capital -> E-participation	-0.093 NS	0.268 NS	0.165 NS	0.239*
Laws relating to ICT -> Online Service	0.579**	0.444***	0.326***	0.45***
Laws relating to ICT -> e-participation	0.705*	0.253 NS	0.313 NS	0.268 NS
Laws relating to ICT -> Telecom infrastructure	0.995 NS	0.807***	0.649***	0.589***
Importance of ICT to gov -> Telecom infrastructure	0.508 NS	0.526*	0.383 NS	0.112 NS

*** significant at 0.001 level; ** significant at 0.01 level; * significant at 0.05 level; NS not significant

Discussion

The ever-increasing interest in digital transformation by governments of nations from around the globe has led to many studies that measure the effect of digital transformation on multitude aspects of our societies. Previous research (Datta, 2020; Švarc et al., 2020) argued and found that digital transformation is rarely, if ever, a technical solution but a socio-technical and socio-political solution. This research constructs a model that depicts the relationships between socio-technical and socio-political factors relevant to digital transformation and corruption, and empirically test it using secondary data of 139 nations.

We applied two stages of analysis on the data collected. We started by analyzing the data of 139 nations collectively. The data supported all our hypotheses. The results indicated that high levels of efficiency in government (H1) and e-participation (H2) diminish corruption. This finding is in line with the results of Zheng (2016) who found that nations with a higher level of e-participation are more likely to have a lower level of corruption. Of the advantages of e-government systems are efficiency, effectiveness, transparency, and accountability (Merhi & Koong, 2013; Ngafeeson & Merhi, 2013; Tai et al., 2020). Thus, digital transformation increases the level of e-participation and government efficiency in governmental agencies. Because digital records help regulate fraud or irregular practices, it is understandable that it will affect the corruption in a particular country.

The data also suggest that online services (H3) and telecom infrastructure (H4.a) are antecedents to governments efficiency. Both these factors increase the efficiency of governments. Olumide and Ishola (2020) argue that of the advantages of digital transformation are efficiency and effectiveness. Digitized services offer more convenience to citizens and employees to finish their transactions. Thus, by using IT to provide citizens the needed services, both governments and their citizens become more effective and efficient. At the same time the online service requires a solid IT infrastructure.

Human capital (H5a) and laws relating to ICT (H6.a) can also increase the online service in a country. Education is a pre-requisite for any technology adoption and usage. Several studies have examined the role of efficacy/education in promoting use of different information systems (e.g., Ahmed et al., 2019; Hassandoust et al., 2016). A higher index of computer efficacy, education etc. have yielded significant positive relationships with IT use. This study also finds positive relationship between human capital and online service.

Another finding is that human capital (H5b), laws relating to ICT (H6b), and telecom infrastructure (H4.b) improve the level of e-participation in a nation. Researchers who

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examined corruption in developing countries have reported that illiteracy is a major challenge (e.g., Hakhverdian & Mayne, 2012). At the same time, nations that are more educated and richer tend to have less corruption (Glaeser & Saks, 2006). In this paper, we confirmed that human capital has a positive relationship with e-participation. Thus, it is essential for the government to focus on education and skill development of citizens for making effective use of e-services to its citizens. At the same, it is critical for governments to develop solid telecommunication infrastructure and laws relating to ICTs to improve the level of e-participation. Citizens need to feel safe while transacting online and sending their personal information electronically.

The data also indicate that having sound laws relating to ICTs (H6c) and plans to improve and invest in technologies (H7) improve the telecommunication infrastructure. It is reasonable to expect that all governments would pay attention to the IT infrastructure in their countries. Just like most infrastructure areas, implementation of IT infrastructure is also expensive, require planning (Merhi & Ahluwalia, 2015). Thus, government's role in framing policies towards IT and even directly participating as a provider is common. This paper argues and the results indicate that sound laws relating to ICT and higher level of government's role in IT result in better telecom infrastructure.

Our last hypothesis (H8) was also supported by the data. We postulated that nations with high GNI per capita have lower level of corruption. Researchers (Glaeser & Saks, 2006; Gründler & Potrafke, 2019) found that income level impacts the level of corruption in a nation. Our results confirm their findings.

After we found that GNI per capita is a significant predictor of corruption, we moved to the second stage of analysis to deeply understand and assess the hypotheses presented based on GNI. In the second stage of the analysis, we executed a multi-group analysis based on the GNI categorization of the world Bank. Interestingly only two hypotheses (H3 and H6a) are significant for all four categories. None of the hypotheses is insignificant for all categories. The analysis indicated that government efficiency reduces corruption in low-income, lower-middle, and high-income nations. The data also showed that e-participation has a negative impact on corruption in high-income nations only. Telecom infrastructure positively impact government efficiency in low-income and high-income countries. The impact of telecom infrastructure on e-participation is only significant in low-income counties. Human capital positively impacts online service in lower-middle, upper-middle, and high-income countries. On the other hand, human capital only impacts e-participation in high-income nations. Laws relating to ICT influences e-participation in countries of high-income and impacts telecom infrastructure in lower-middle, upper-middle, and high countries. Finally, importance of ICT to government effects telecommunication infrastructure in lower-middle countries. To our best knowledge, no study has yet empirically the hypothesis presented in this paper in this way. Thus, these results can not be compared to findings of previous research.

Conclusion, Implications, Limitations, and Future Directions

The motivation of this study was the lack of empirical evidence regarding the relationship between technical and socio-political factors and corruption. This paper explored empirical validation of widely reported assertion that digital transformation can diminish corruption. Although many factors may directly or indirectly influence corruption at a country level, we examined the stated hypotheses in the research model by drawing from secondary data published by reputable international organizations namely the United Nations and Transparency International. The data collected supported all the hypotheses presented in our research model.

The findings suggest that technology plays an important role in reducing the corruption in any country. Factors such as infrastructure, e-participation, education/human capital, laws relating to ICT, and Importance of ICT to government are found to be important for fighting corruption. Thus, when governments make greater use of digital technologies in their decision making, in providing information to its citizens, and to interact with various stakeholders, they help in strengthening the perceptions that their practices are free of corruption.

This study makes two important contributions to the literature. Even as most studies in literature examined the impact of digital transformation on societies, no study has yet investigated the research model postulated in this study. Thus, this research adds to the literature and the body of knowledge. Second, by empirically investigating the hypothesized relationships using a data set with a greater sample size lends greater generalizability to the results. To our best knowledge, studies that examined digital transformation and corruption have used smaller sample size except Merhi and Ahluwlia (2018) who used a sample size of sixty-nine countries. This study uses data collected from 139 countries.

A multitude of people are expected to find this paper useful and interesting. In addition to its contribution to the growing empirical base of literature on digital transformation and corruption, the results found in this study have significant implications for policy makers and people working with governments' technologies. The results of this study do not only assess the relationships at the global level, but also split the countries based on the income categorization of the World Bank. Thus, the results are more meaningful for practitioners of countries. Practitioners of a certain category can know specifically the factors impacting corruption in their countries.

During the last decade, it is witnessed that governments from all over the world are trying to develop efficient as well as effective government services and delivery systems by using technologies. Despite their attempt to achieve success, unfortunately some governments fail to accomplish their goals. The results obtained in this research suggests that effective government is a significant antecedent to corruption, and that the efficiency and quality of governments' delivery of public services can be significantly improved by effective laws and plans to ICT.

It is important to know that effective implementation of telecom infrastructure can play an important role in increasing e-participation and efficiency by lending themselves to ease of search and reporting. All these factors facilitate transparency which is considered to be the strongest anti-dote of corruption. Thus, when governments make greater use of digital technologies in their decision making, in providing information to its citizens, and to interact with various stakeholders, they help in strengthening the perceptions that their practices are free of corruption.

While this paper makes important contributions to theory and practice, it is necessary to acknowledge its limitations which may offer opportunities for further research on this important topic. Firstly, the findings of the paper are based of statistical analysis of secondary data collected by the United Nations and Transparency International. It is practically impossible to collect global level data by individuals or even group of researchers. Therefore, most studies that examine cross-country level phenomena are dependent on secondary data. This also means that the studies can only assess the indexes that have been published by the international organizations and cannot access the original raw data. Second, this study examines the relationships of few macro-level factors that represent digital transformation. Many other determinants may also fall under the umbrella of digital transformation. Thus, future studies might explore other macro-level factors that may impact corruption. Factors such as cultural dimensions will also add to the body of knowledge.

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Appendix A

Low-income	Lower-middle	Upper-middle	High-income
Burundi	Algeria	Albania	Australia
Chad	Bangladesh	Argentina	Austria
Ethiopia	Benin	Armenia	Bahrain
Gambia	Bhutan	Azerbaijan	Belgium
Guinea	Bolivia	Bosnia	Canada
Haiti	Cambodia	Botswana	Chile
Liberia	Cameroon	Brazil	Croatia
Madagascar	Cape verde	Bulgaria	Cyprus
Malawi	Cote D'ivoire	China	Czech Republic
Mali	Egypt	Colombia	Denmark
Mozambique	El Salvador	Costa Rica	Estonia
Rwanda	Ghana	Dominican Republic	Finland
Tajikistan	Honduras	Ecuador	France
Uganda	India	Gabon	Germany
	Kenya	Georgia	Greece
	Kyrgyz Republic	Guatemala	Hong Kong
	Lao PDR	Guyana	Hungary
	Lesotho	Indonesia	Iceland
	Mauritania	Iran	Ireland
	Moldova	Jamaica	Israel
	Mongolia	Jordan	Italy
	Morocco	Kazakhstan	Japan
	Myanmar	Lebanon	Korea (South)
	Nepal	Macedonia	Kuwait
	Nicaragua	Malaysia	Latvia
	Nigeria	Mexico	Lithuania
	Pakistan	Montenegro	Luxemburg
	Philippines	Namibia	Malta
	Senegal	Paraguay	Mauritius
	Sri Lanka	Peru	Netherlands
	Tanzania	Romania	New Zealand
	Tunisia	Russia	Norway
	Ukraine	Serbia	Oman
	Vietnam	South Africa	Panama
	Zambia	Swaziland	Poland
	Zimbabwe	Thailand	Portugal
		Turkey	Qatar
		Venezuela	Saudi Arabia
			Seychelles
			Singapore
			Slovak Republic
			Slovenia
			Spain
			Sweden
			Switzerland
			Taiwan
			Trinidad
			United Arab Emirates
			United Kingdom
			United States
			Uruguay

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