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Digital Transformation Corruption and Economic Growth Nexus in Asian Countries

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Abstract

Digital transformation is considered a significant factor to boost economic growth. Corruption, on the other hand, is viewed as a slowing down factor of economic growth. It is well-thought-out that digitisation can generate new corruption opportunities. These opportunities are primarily connected to cyber fraud or the exploitation of well-meaning technology, such as digital public services. Corrupt officials with high IT skills can exploit digital records and public service systems. Digital systems are also vulnerable to cyber-attacks which can interfere with government functions and compromise citizens' privately-owned data, particularly in countries where the administrative capacity is low and security systems are underfunded (IMF 2018; World Bank 2020). This suggests that digitalization has uncertain impacts on corruption. The present study highlights the role of digital transformation in economic growth and its deterrent to corruption in Asian countries. It gives direction and leads economies and organizations to carry out their digital transformation journey. The study would significantly contribute to the literature on economic growth and corruption control. The analysis has been conducted from 1990 to 2019. The study evaluates two different models in which dependent variables are control of corruption and GDP growth. The results divulge that the impact of digital transformation is highly significant and positive on economic growth and deterrence to corruption in Asian countries. This study also suggests policy recommendations towards pro-economic growth and anti-corruption strategy development.

Disciplinary: Digital Economics & Development Economics, Corruption Studies; Information Technology & Economics Crime.

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1 Introduction

Modern theories of economic growth are mainly based on the contribution of technology and R&D. These new theories also suggest that economic growth mainly hinges on digitization and investment in technology. The maximum and authentic empirical test of these theories, however, is an open challenge that has attracted many policymakers' attention over the past few years. Digital technology is bypassing information barriers, growing factors through automation and teamwork, and transforming products through economies of scale. As a result, emerging technologies boost the knowledge economy's integration, competitiveness and creativity (World Bank, 2020).

Digitalization enables the exchange of information between governments and people. This encourages openness, citizenship and transparency (Chêne 2012). Digitalisation's impact on corruption is premeditated by reducing information asymmetries, automating procedures, restricting the discretion of public officers and reducing intermediaries and bureaucracy (Grönlund et al., 2010). Digital transformation can also make a difference by opening a new opportunity for engaging and hiding unethical activity through the use of digital technology.

The ultimate goal of digital transformation is to transmit information. It is important to know that how digitalization affects corruption. It may affect the government information by the supply-side or the citizens' information collecting and engagement demand side (Kossow & Dykes, 2018). These impacts do not make all digital technology uses anti-corruption. Some can affect the supply and demand side or none if they do not require information to be given or demanded, but specifically influence other areas of abuse, such as the discretion of officials.

This study clarifies the idea of digital transformation and its effect on economic growth and the way corruption relations are regulated in Asian countries. First, the study employs the impact of novel Digital Transformation (DT) steps on corruption and growth. Second, a holistic approach is used by taking a broader sample for the entire continent, i.e., Asian economies, which are narrow in reach in comparison to previous studies because they cover only a single country, area, or smaller sample. Thirdly, it explores the less investigated link between digital transformation and control of corruption (CC).

2 Review of Literature

2.1 Studies on Digital Transformation and Economic Growth

Enormous literature is present about socio-economic factors of economic growth but there is a dearth of studies available on links between DT and economic growth. Many empirical studies show the positive contribution of digital transformation investment to economic growth. Some authors, for example, Jorgenson and Stiroh (2000) and Oliner and Sichel (2003) focused on the productivity aspect of digital transformation in the United States and confirmed the positive contribution of digital transformation for growth in the US economy. Levine (1997) expressed that digital transformation reduces barriers to information access and increases investment and growth. One thread of the literature focused only on communication technology. Roller and Waverman

(2001) revealed in their study based on 21 OECD countries, that wireless communications (through phone and internet) cause a positive effect on the GDP. Czernich et al., (2011) used panel data of 20 OECD countries and found similar results that by increasing penetration of broadband connections, the growth rate in GDP per capita also increase (Majeed & Ayub, 2018).

On contrary, some of the researchers found negative effects of digital transformation on economic growth. For example, Stiroh (2002) found adverse output elasticity of digital transformation. Similarly, O'Mahony et al., (2005) found the negative impact of digital transformation on output and growth for UK industries due to lack of human skills but found a positive impact on the U.S economy (Majeed & Ayub, 2018). Niebel (2018) observed the impact of digital transformation on the economic growth of developed, emerging and developing countries. The study findings proved increased ROI on digital transformation investments.

2.2 Studies on Digital Transformation and Corruption

Corruption is a very complex and unexplored topic. The link between corruption and digital transformation has not been studied extensively. Since battling corruption needs accessing information that is tough to find, ICT and digital transformation tools may help in the acquisition and storage of information which helps in identification, reduction, and combatting corruption. In this way, digital transformation tools may help a lot in the enquiry and prosecution of corruption (Bhattacherjee & Shrivastava, 2018).

Although many studies observed that investments in digital transformation have decreased corruption (Bertot et al., 2010; Kim and Kang 2017), but the exploration of reasons how digital transformation causes a reduction in corruption is still a question mark for researchers (Charoensukmongkol & Moqbel 2012; Garcia-Murillo 2013). One reason for the inability of digital transformation to resolve and prosecute corruption can be the lack of specific laws for ICT and cyber-crimes (Bhattacherjee & Shrivastava, 2018).

3 Model, Data, and Methodology

To observe the impact of digital transformation on economic growth and corruption control in Asian countries, two models have been specified and the fixed effects method has been used.

Model 1: Digital Transformation and Economic Growth Model

The econometric equation is given as

$$GDPG_{it} = \delta_0 + \delta_1 LFPR_{it} + \delta_2 GFCF_{it} + \delta_3 SSE_{it} + \delta_4 DTI_{it} + \delta_5 CC_{it} + \delta_6 MRent_{it} + \delta_7 TRADE_{it} + \delta_8 ODA_{it} + \varepsilon_{it} \quad \textbf{(1).}$$

Model 2: Digital Transformation and Control of Corruption Model

$$CC_{it} = \gamma_0 + \gamma_1 DTI_{it} + \gamma_2 GDPG_{it} + \gamma_3 GINI_{it} + \gamma_4 SSE_{it} + \gamma_5 TRADE_{it} + \gamma_6 ODA_{it} + \varepsilon_{it} \quad \textbf{(2).}$$

The term ε is the model error. The data have been collected from 1990-2019. Table 1 gives the list of the explanatory variables describing their anticipated signs.

Table 1: List of Variables with their anticipated signs (Source: World Development Indicators (WDI))

Variables	Description	Expected Sign
GDPG	Gross Domestic Product Growth (Percentage Annual)	Negative
CC	Control of Corruption estimate	Positive
DTI	Digital Transformation Index constructed by Principal Component Analysis (PCI)	Positive
GFCF	Gross Fixed-Capital Formation (% of GDP)	Positive
LFPR	Labour-Force Participation Rate (Percentage Annual)	Positive
SSE	Secondary School Enrollment	Positive
TRADE	Trade as Percentage of GDP (% of GDP)	Positive
MRent	Mineral Rent (% of GDP)	Positive
ODA	Official Development Assistance (% of GDP)	Positive
GINI	Income Inequality (Gini Index)	Negative

4 Results and Discussions

4.1 Descriptive Statistics and Correlation Analysis

The descriptive statistics for the main variables are given in Table 2. Table 3 shows the correlation matrix of the key variables.

Table 2: Descriptive Statistics of Main Variables for Asian Countries

	GDPG	LFPR	GFCF	DTI	SSE	TRADE	MRENT	ODA	CC	GINI
Mean	5.27	64.89	22.56	35.71	50.09	88.22	1.09	0.01	-0.31	11.39
Median	5.31	67.51	23.30	5.59	60.15	80.95	0.01	0.00	-0.51	0.00
Max.	54.16	88.51	69.67	41.08	120.65	437.33	29.83	0.76	2.33	47.20
Min.	-33.10	37.96	0.00	0.00	0.00	0.00	0.00	0.00	-1.67	0.00
SD	5.24	12.19	11.91	259.50	41.82	61.32	3.25	0.05	0.87	16.92
Skewness	0.66	-0.28	0.18	17.35	-0.13	2.25	5.34	8.02	0.81	0.87
Kurtosis	21.03	2.26	4.64	335.06	1.35	11.90	37.05	84.79	3.06	1.87
J.B	105.15	27.09	87.64	347.00	87.18	308.18	394.64	211.70	82.23	133.62
Prob.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Table 3: Correlation Matrix of Key Variables for Asian Countries

Correlation	GDPG	LFPR	GFCF	DT I	SSE	TRADE	MRENT	ODA	CC	GINI
GDPG	1									
LFPR	0.10	1								
GFCF	0.12	0.13	1							
DTI	-0.04	0.10	0.01	1						
SSE	-0.07	-0.03	0.10	0.01	1					
TRADE	0.06	0.33	0.13	0.24	-0.06	1				
MRENT	0.08	-0.02	0.16	-0.02	0.03	0.03	1			
ODA	-0.06	-0.02	0.05	0.01	0.01	-0.13	-0.05	1		
CC	-0.11	0.37	0.12	0.23	0.12	0.50	-0.16	0.18	1	
GINI	0.04	0.06	0.20	-0.03	0.21	-0.04	0.14	0.15	-0.03	1

4.2 Unit Root Analysis

Table 4 demonstrates the outcomes of Fisher-ADF, LLC, IPS, and Fisher-PP tests. Results display that all variables are stationary at the level.

Table 4: Unit Root Test Results

	Intercept and Trend				None			
Variable	LLC test	IPS Test	Fisher-ADF Chi-square	Fisher-PP Chi-square	LLC test	Fisher-ADF Chi-square	Fisher-PP Chi-square	Results
GDPG	-11.14 (0.00)	-6.57 (0.00)	184.21 (0.00)	290.46 (0.00)	-3.94 (0.00)	167.47 (0.00)	209.50 (0.00)	I(0)
LFPR	-9.83 (0.00)	-1.89 (0.02)	119.92 (0.01)	67.57 (0.94)	2.04 (0.97)	43.39 (1.00)	88.60 (0.46)	I(0)
GFCF	-0.13 (0.05)	-2.41 (0.09)	-67.47 (0.03)	36.01 (1.00)	-1.27 (0.09)	-68.72 (0.01)	58.26 (0.06)	I(0)
DT	-12.83 (0.00)	-12.72 (1.00)	-46.36 (0.00)	54.44 (0.00)	-7.83 (0.00)	-26.73 (0.00)	23.22 (0.00)	I(0)
SSE	3.72 (0.99)	-1.89 (0.97)	-101.75 (0.06)	150.35 (0.00)	-6.46 (0.00)	139.23 (0.00)	154.54 (0.00)	I(0)
TRADE	-3.12 (0.00)	-0.37 (0.04)	97.03 (0.09)	80.60 (0.04)	-1.27 (0.10)	83.69 (0.05)	84.13 (0.03)	I(0)
MRENT	-1.27 (0.10)	-0.83 (0.20)	74.66 (0.13)	20.84 (1.00)	-5.67 (0.00)	116.83 (0.00)	112.04 (0.00)	I(0)
ODA	0.03 (0.01)	-0.63 (0.03)	-2.84 (0.02)	-4.87 (0.06)	-1.83 (0.03)	-10.32 (0.01)	-13.97 (0.02)	I(0)
CC	-2.02 (0.02)	-0.09 (0.06)	92.28 (0.05)	131.25 (0.00)	-1.00 (0.05)	78.96 (0.04)	116.41 (0.02)	I(0)
GINI	6.90 (1.00)	-3.02 (0.00)	128.59 (0.00)	332.42 (0.00)	-361.97 (0.00)	112.28 (0.00)	265.05 (0.00)	I(0)

4.3 Fixed Vs Random Effect Determination

In Table 5, the probability values of random effect tests for both models are less than 0.10, therefore, null hypotheses are rejected.

Table 5: Hausman Test

Test - Summary	Chi-Sq. Statistic	Chi-Sq. D.F	Prob.
Correlated Random Effect Test Digital Transformation and Growth Model	4.74	9	<0.01
Correlated Random Effect Test for Digital Transformation and Corruption Model	6.89	7	<0.01

4.4 Fixed Effect based Results of Digital Transformation and Economic Growth

Table 6 discusses the fixed effects-based estimates of digital transformation and economic growth. The labor force participation rate (LFPR) shows a significant and positive effect on GDP Growth. This depicts that as employment increases proportionately with the growth of the working-age group, productivity and overall economic growth rate increase. Another fact is that an efficient labor force promotes economic development. Various studies indicate the positive connection between labour force participation and economic development (e.g. Shahid, 2014).

Gross Fixed Capital Formation (GFCF) indicates that GDP growth has a positive and significant effect on GDPG. Capital formation boosts investments and economic growth. Economic theories have highlighted the significance of capital formation in economic growth models (Ghura and Hadjimichael 1996, Beddies 1999; Ghura, 1997). Capital plays a vital part in the production and

development process. Bakare (2011), Orji and Mba (2010) also point out that capital has a positive link with GDP.

Secondary School Enrollment (SSE) is used as a proxy of human capital. The SSE coefficient has a significantly positive relationship with GDP growth. Countries with high school enrolment rates are considered to achieve more per capita income growth. The high rate of enrolment in education induces rapid productivity. Advances in education quality increase efficiency and long-term growth. Bils and Klenow (2000), Agiomirgianakis et al. (2002) examine the role of human capital in economic growth also explore that higher education levels have a stronger influence on economic growth.

Digital Transformation Index (DTI) is the main variable in this study. The result shows that DTI has a positive and substantial effect on GDP growth. As digital revolution enhances diverse education, skills and the maturity of the user. The increasing use of technology increases the productivity of labor, thus increasing economic growth. The Internet increases the workforce's efficiency resulting in acceleration in production and economic growth. The studies by Kim and Kang (2017), Albiman and Sulong (2016), and Majeed & Ayub, 2018 have highlighted that digitalization increases labor productivity and thereby augments economic growth. The neoclassical theories underline an important positive relationship between digital transformation and economic growth. These theories show that DT enters into economic supply in the form of capital and contributes by deepening capital, advancing technology, and efficiency to increase the production process. DT thus provides value-addition at the business and sector level and therefore contributes to economic growth (Aghaei and Rezagholizadeh, 2017). Some studies do not support the positive relationship between DT and growth, for example, Yousefi (2011) has found no significant link between investment in digital technology and economic growth.

Table 6: Fixed Effect Estimates of Digital Transformation-Growth Model

Dependent Variable: GDPG				
Variables	Coefficient	Std. Errors	t-Statistics	Prob.
C	0.28	1.21	0.23	0.81
LFPR	5.31	1.68	3.15	<0.01
GFCF	5.22	1.62	3.22	<0.01
SSE	2.38	0.53	4.51	<0.01
DTI	7.27	4.18	1.74	0.08
CC	1.25	0.27	4.50	<0.01
MRENT	2.93	1.28	2.29	0.02
TRADE	9.48	3.78	2.50	0.01
ODA	3.87	1.92	2.02	0.04

Control of Corruption (CC) shows a positive impact on GDP growth. Control of corruption increases economic performance by removing problems caused by malfunctioning institutions. Efforts to control corruption, such as regulatory changes and policy reforms increase popular awareness, and improve the institutional standards would contribute to economic growth. Mallik and Saha (2016); Pulok and Ahmed (2017) have also found the same results.

Mineral Rent demonstrates a positive and significant impact on GDP growth. Most nations have been blessed by natural resources. Many studies have shown that resource-rich countries often exceed in economic growth than resource-poor countries. Sachs & Warner (1995) Mehlum et al., (2006) point out that the positive relationship between the abundance of natural resources with high-quality institutions and growth.

Trade shows a positive relationship between GDP growth. An increase in international trade contributes to economic growth through the promotion of information and technology dissemination and direct imports of high-tech goods. Trade fosters the convergence of creative sources and raises foreign direct investment income. An increase in the market size helps economies to better reap the potential advantages of rising scale and specialization (Sala, 1997).

Official Development Assistance (ODA) has a positive and significant impact on GDP growth. It is widely acknowledged that if the country has a good policy setting, ODA helps to develop as it boosts investment in a country leading to economic growth. Aid to develop an industry has a greater effect on economic growth since industrialization is referred to as a "growth engine" that creates employment opportunities and equitable economic growth. The significant influence of ODA on economic growth has also been found by Shimeles (2015), Burnside and Dollar (2000).

4.5 Fixed Effect based Results of Digital Transformation and Control of Corruption

Table 7 discusses the fixed effects-based estimates of control of corruption. Digital Transformation (DT) exhibits a positive and significant effect on corruption control. Digital transformation influences corruption through improved accountability and transparency in public institutions. Digital penetration may help to reduce the misuse of administrative control at a low cost. Digitalization improves the digital trace, which in turn can contribute to a greater risk of being caught by unethical practice. On the other hand, it can also build a transparent atmosphere for public information and grow social capital through increase interactions in an individual area. For example, e-government is linked to digitalization innovations that trigger cost savings and offer an important solution to corruption problems in many countries. This study is centred on the potential of digital transformation to eliminate corruption. The use of digital technology has been successful in eliminating corruption in the public sector by changing both the internal working processes of the government and external ties with its people. Andersen et al., (2011) find that the Internet is a good technology against corruption. Furthermore, Chawla and Bhatnagar (2001); Im (2001), Bhattacherjee & Shrivastava (2018) have found the same results.

GDP growth shows a negative and significant impact on the control of corruption. In modern society, corruption is widespread. Millions of dollars are paid in bribes per year (UNODC, 2007). Economic growth enhances the chances of corruption, raises inflation, and increases economic uncertainty particularly in less developed countries but in developed countries, economic growth decreases the chances of corruption due to institutional changes. Higher economic growth increases the rent-seeking behaviour, makes corruption more lucrative and requires more amount

of money that can be used to regulate it (Sheikh, 2017). So, if economic growth rises, more investment and development will take place, and there will be more space for corruption. The study by Ahmad et al., (2012) highlighted the same relationship between GDP growth and control of corruption.

Table 7: Fixed Effect Estimates of Digital Transformation-Corruption Model.

Dependent Variable: CC				
Variables	Coefficients	Std. Errors	t-Statistics	Prob.
C	-1.04	0.06	-16.44	0.00
DTI	3.45	1.02	3.37	0.00
GDPG	-1.84	0.49	-3.72	0.00
GINI	-3.64	1.57	-2.30	0.02
SSE	3.28	0.63	5.18	0.00
TRADE	7.37	0.43	16.86	0.00
ODA	4.16	0.50	8.24	0.00

Income inequality shows that GINI affects the control of corruption negatively and significantly If income inequality grows, equitable political, administrative and judicial systems would have to lose more. As inequality grows, the rich would also have greater capital, both legally and illegally, to gain influence. As a class or interest group, richer people can use legal lobbying, political contributions or bribery to influence legislative processes. Moreover, to secure basic services, people in developing countries rely on small bribing or are aimed at bureaucratic corruption. Although the number of their kickback payments may be small due to their limited ability to pay, corruption at an extremely low level is perceived by the poor as an acceptable type of conduct.

Secondary School Enrollment (SSE) shows a positive and significant relationship with Control of Corruption. Many studies support the role of education in promoting the control of corruption through the channels of legal behavior, increase social cohesion and social responsibility. Training may have a huge effect on attempts to prevent corruption. Providing anti-corruption education and developing a culture of anti-corruption are very important steps in the prevention of corruption.

Trade exhibits a positive and highly significant relationship with control of corruption. Trade openness can reduce corruption, but additional policy reforms can lead to corruption being reduced. Government economic restrictions create rents in a wide variety of forms in market-oriented economies, including bribery, smuggling, and black markets. Bureaucrats can give customers legitimate or unlawful advantages. It is well admitted that limited trade transfers capital from productive to rental. These findings are consistent with Ades & Tella (1997).

Official Development Assistance (ODA) displays that aid has a positive and significant impact on the control of corruption. Several studies have shown that international aid is eliminating corruption by raising government and institutional standards. These studies suggest that aid donors should lay down guidelines for recipient countries to make meaningful reforms to boost the quality of government and reduce corruption before they get assistance packages.

Another result is that foreign aid can reduce public-income shortages and lead to higher salaries, by providing additional funding to poor cash-strapped governments, thus reducing the incidence of corruption. Studies by Tavares (2003); Ali and Isse (2003); Charron (2011) Okada and Samreth (2012); and Asongu (2013) have found the same results.

5 Conclusion and Policy Implications

This study investigates the nexus between digital transformation, corruption and economic growth in Asian countries. The analysis has been conducted for 1990-2019 using the fixed-effect estimation technique. The results exhibit that the impact of digital transformation is highly significant and positive on economic growth and deterrence to corruption in Asian countries.

The following policies are suggested to increase economic growth:

- Strategies may concentrate on improving productivity; encouraging research and development in the digital world.
- In the digital transformation process, continuing education and lifelong learning programs can be used to overcome job losses as employees and job seekers aspire to strengthen and develop competitive skills and promote human capital.
- The government needs to encourage the gross formation of fixed capital through monetary policy.

The following policies are suggested to control corruption.

- Policymakers need to consider their country's institutional and resource environments to mitigate the effect of low trust of the people and organization toward technology adaptation and digital transformation.
- Another important step is the provision of anti-corruption education/training and the development of an anti-corruption culture are very important steps in the prevention of Corruption.
- Trade-oriented economies may change internal conditions, such as financial reforms, to benefit from trade as a means of controlling corruption.

6 Availability of Data And Material

Data can be made available by contacting the corresponding author.

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