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Impact of ICT on Governmental Administrations' Capacity to Combat Corruption: An Analysis of Asian Countries

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ABSTRACT

Technological advancements significantly influence global society, public administration, and the economy. Information and communication technology (ICT) has the potential to enhance government transparency and openness, thereby mitigating corruption. This study examined the use of ICT in the control of corruption. Further examined the economic factors (GDP per capita, cash Expense %GDP & trade openness index) and non-economic (investment & & rule of law) factors to evaluate the impact of ICT on managing corruption within the public sector. The sample of the study is panel data from 46 Asian countries spanning 26 years, from 1996 to 2021, by Pooled Mean Group-Autoregressive Distributed Lag (PMG-ARDL) methodology with STATA software. The findings support the existing body of knowledge regarding the positive impact of ICT on the control of corruption (CR). Further economic and non-economic factors are major contributors to the control of corruption with the use of ICT. The conclusions emphasize the need to accelerate government digitization and develop a comprehensive cloud computing strategy for the executive branch. Additionally, the analysis illustrates how ICT affects government efficiency and economic growth across Asia. A stronger legal framework may also reduce the perception of corruption. This indicates that ICT should be combined with organizational, structural, and pedagogical methods to combat corruption.

Introduction

Asian countries continue to be affected by a serious problem of corruption, while sharp socioeconomic, political divides, the COVID-19 pandemic's severe health and economic ramifications further intensified the situation. Globally, many Asian countries are persistently trapped in the corruption cycle and are considered among the list of most corrupt nations. The widespread of corruption throughout Asia considerably adds fuel to government inefficiencies (World Bank,2010). Furthermore, in accordance with

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Transparency International's report (2016), the most corrupt nations are located in Asia, with weak monitoring, unaccountable administrations, a shrinking space for civil society, and insecurity, all of which marginalize anti-corruption efforts.

The Global Corruption Barometer Asia report (2020) provides the most extensive collection of public opinion statistics regarding perceptions and experiences of corruption in the region. Surveying nearly 20,000 individuals across 17 nations—many of which are classified as authoritarian with limited civil and political rights—the study reveals that nearly three out of four people perceive corruption as a major issue in their countries. Alarmingly, one in five individuals who accessed public services such as healthcare and education reported paying bribes within the previous year. Vote-buying and the use of personal connections to access government services remain pervasive, largely due to legal loopholes. As Delia Ferreira Rubio, Chair of Transparency International, emphasized,

"*Protecting election integrity is essential to preventing corruption from undermining democracy. To combat vote-buying, which undermines public confidence in government, election commissions and anti-corruption organizations across the area must coordinate their efforts."*

Given these persistent governance challenges, integrating Information and Communication Technology (ICT) into government operations has been identified as a promising avenue for mitigating corruption. ICT is defined as various technologies and resources that the government uses to transmit, store, create, and share information (Tiwari et al, 2024). E-government initiatives play a crucial role in streamlining bureaucratic processes, enhancing information access, reducing state budget expenditures, lowering administrative corruption, and strengthening public sector administrative capabilities. In Asia, ICT adoption and infrastructure vary from country to country, which is influenced by economic development, regional digital divides, and government policies. Asian Development Bank's 2030s strategy highlights the need for innovation and technology development aligned UN's Sustainable Development Goals (Mitra, 2024). Most Asian governments have begun automating parts of their operations to increase transparency, lower operating costs, improve service accessibility, and reduce opportunities for corruption. The quality of IT systems in public administration directly influences decision-making processes and institutional effectiveness.

This study seeks to empirically investigate the impact of ICT, in conjunction with governance and development indicators, on corruption across Asian countries over the period 1996–2021. Since 1996, many major Asian countries have adopted the internet in government and public administration, like (Bhatnagar, 2003)Singapore's IT2000 plan was launched in 1996, and India's ICT-driven governance reforms started from the mid-1990s (Bhatnagar,2003). Asia is chosen due to its significant yet troubling economic landscape, where rapid economic growth coexists with pervasive issues such as bribery, vote-buying, a lack of transparency, and systemic legal loopholes. Despite extensive research into the factors contributing to corruption in Asia, there has been no comprehensive empirical analysis of the role of ICT adoption in preventing corruption within the region. Therefore, this study aims to proactively address this gap by rigorously assessing whether widespread ICT diffusion can help Asian countries escape the high-corruption trap.

To further address the impact of ICT on corruption issues, Amari et al. (2020) and Ali and Gasmi (2017) argue that effective e-government initiatives improve public sector accountability, institutional quality, making them valuable tools in the fight against

corruption, particularly in developing economies. Similarly, Merhi and Ahluwalia (2018) also discovered that enhanced access to information and government services through ICT promotes citizen involvement and minimizes the potential for corruption. On the other hand, researchers warn contrary to considering technology as an ultimate solution. Therefore, implementing ICT does not necessarily result in reduced corruption; its effectiveness is dependent on broader governance structures and supportive societal factors (Charoensukmongkol and Moqbel, 2012; Darusalam et al.,2021). Furthermore, Shim and Eom (2009) emphasize the importance of social capital, demonstrating that when citizens are empowered by technology, their active participation considerably strengthens anti-corruption efforts within government institutions. From all this, we need to answer: what is the impact of ICT on corruption control, and what is its role in the economic and non-economic factors?

Understanding these nuanced dynamics is crucial for fully appreciating the impact of ICT on corruption. Thus, this study leverages data from 46 Asian countries to explore the complex interplay between ICT diffusion, governance frameworks, and development indicators. It aims not only to examine the direct relationship between ICT and corruption control but also to investigate the contextual factors that mediate this relationship. The findings will contribute to the broader discourse on public sector reform and offer valuable guidance for policymakers aiming to incorporate ICT into anti-corruption strategies. By doing so, this research aspires to foster more effective governance and sustainable development across Asia in the face of persistent corruption challenges.

The organization of the paper is as follows: Section 2 presents the literature review, theoretical background, and hypothesis development, Section 3 discusses the methodology, while Section 4 explains the results and discussion. Finally, section 5 conclusion of the study.

Literature Review

In addition to the economy, technological advancements have an impact on society and governmental administration around the world. Nations' economy, public administration, and social institutions will suffer if broad digital technology integration is not prioritized. Beyond efficiency, digitalization of public services in developed Central Asian, European, and other nations sends a strong message about the need for change and digital transformation to enter an era of transparency, quality of public services, and anti-corruption efforts at the international, national, and local levels. The continual digital revolution has revolutionized the architecture of contemporary economies, modern enterprises, and public administration by developing and deploying new technology solutions for digitalization (Rymarczyk, 2021). As a result of the integration of information and communication technologies, state governments should continue to be concerned with modernizing public administration and services (Mansell, 2012). They have been proven to be an effective means of eliminating corruption in the countries where these reforms were implemented (Mouna, 2020). The digitalization of public organizations, which increases their efficiency and transparency, should be one of the primary pillars of the creation of any smart community (Sandor, 2018; Vogelsang, 2010). Digitalization streamlines the entire operation of public institutions on all three levels: internally, intra-institutionally, and externally (Afonasova, 2019). Transparency and openness of government institutions are essential in a democratic society (Balzer,2020). Digitalization increases government accountability to citizens. Corruption impedes both good government management and economic growth. Even though certain Asian

countries have recently shown the best performance in the world in terms of reducing corruption, Singapore was ranked fourth out of 180 nations and achieved an 85 out of 100 grade. The Political and Economic Risk Consultancy ranked Singapore as the country with the lowest amount of corruption in its 2022 Report on Perceptions of Corruption in Asia.

Corruption exacerbates socioeconomic inequalities and erodes trust in government, institutions, and the public sector over time (Cera, 2019). Furthermore, corruption can have an impact on how revenue is distributed and lead to a lack of concern for environmental protection. One of the most significant consequences of corruption in state administration is the inability of lawful institutions to deliver effective public services and create an environment conducive to the growth of the private sector (Mircica, 2020). In severe cases, corruption can lead to political and economic instability can also result in an inability to acknowledge the legitimacy of the state (Bilan, 2020; Bilan, 2019; Grayson, 2020).

Despite economic growth, the prevalence of corruption in Asian countries necessitates a thorough examination of the role of Information and Communication Technology (ICT) in improving governance and encouraging development. This study is conceptually grounded in numerous ideas that serve to understand the relationships between the major variables. This study builds on three key theoretical frameworks - the Technology Acceptance Model (TAM) (Davis, 1989), the Diffusion of Innovation Theory (Rogers, 1962), and the Principal-Agent Theory (Jensen & Meckling, 1976) - to provide a solid conceptual foundation for understanding the impact of Information and Communication Technology (ICT) on governmental administrations' capacity to combat corruption. According to TAM, the primary factors influencing technology adoption depend on usefulness and technology adoption. When governments see ICT technologies (e-government portals, automated service platforms, and mobile governance apps) as effective in improving transparency and administrative efficiency, they are more likely to use them. Adoption of such technology improves monitoring, citizen participation, and service delivery, all of which are critical in limiting potential for corruption.

The Diffusion of Innovation Theory outlines how technical improvements permeate through society and institutions. It implies that innovations with clear relative advantages, compatibility with current systems, simple complexity, and visible outcomes are accepted faster. The Principal-Agent Theory conceptualizes governmental administrations' ability to resist corruption, viewing corruption as a result of knowledge asymmetry and insufficient oversight between the "principal" (people) and the "agent" (government personnel). ICT decreases these disparities by improving information flow, enabling real-time monitoring, and producing traceable records of government operations. This increases accountability procedures, reduces public officials' discretion, and limits the potential for rent-seeking behaviour.Overall, these theories emphasize that the strategic adoption and diffusion of ICT not only modernize public administration but also significantly enhance the government's institutional capacity to deter, detect, and reduce corruption. Therefore, the theoretical framework supports the central argument that ICT serves as a transformative tool in strengthening governance and promoting integrity within public sector institutions.

ICT and Digital Transformation:

According to the literature, there are numerous points of view on this concept. Digitization is a major driving force behind the modernization of economies, society, and

the transformation of governmental institutions (Russell, 2020; Bennett, 2013). The use of digitalization as a tool increases predictability (Kliestik, 2020). Using digital technology, digitalization generates new digital streams, according to the findings of empirical research (Kossow, 2020). Digitalization is a strategy that transforms every company and every aspect of society, resulting in a protracted digital transformation process. Digital transformation is determined by digitalization. The process of incorporating digitization is known as "digital transformation," and it helps society and companies adapt to change.

More than anything else, digital transformation involves getting people to embrace and use digital tools and technologies. (Androniceanu A. S., 2022). The process of digital transformation is resulting in significant social, administrative, and legal changes. The digital transformation of the public sector has an impact on many aspects of society, including employment, education, health care, and social security (Karpf, 2012; Gray-Hawkins, 2020)

E-government is made possible by public institutions' digital transformation. According to (Coursey, 2008), E-government is the process of reinventing the public sector through digitalization and innovative information management techniques to boost citizen political participation and streamline the administrative infrastructure (Luzgina, 2017). E-government is a manifestation of the interaction between the state and society (Androniceanu A. K., 2020; Ali et.al, 2021). Increasing the availability of digital public services reduces expenses for government agencies, reduces red tape for businesses and citizens, and reduces corruption (Slusarczyk, 2019; Wescott, 2010). Even though digitization and e-government are intensively investigated topics (Androniceanu, 2021), there is still no consensus on the variables that should be included, how they should be classified, and how to measure them. According to (Mouna, 2020; Ibrahimy et.al, 2023), successful e-government and digital technology adoption will result in increased economic growth while also serving as an anti-corruption tool. (Popescu, 2020; Shkolnyk, 2020) Highlight the effectiveness of digitalization as a tactic for countering corruption as a danger to national security. (Mishchuk, 2020) Investigate methods for calculating losses to the social security and the state financial system. (Shkarlet, 2020; Makowski, 2017) Investigate how digitization and its functions can make public administration less bureaucratic. Adoption of information and digitalization, according to the body of research, improves economic growth and environmental governance.

Advantages to be Obtained from Utilizing ICT

The implementation of digitalization and digital transformation within the realm of local public administration is instrumental in enhancing accessibility, fostering openness, and optimizing efficiency, all the while mitigating the burdensome bureaucracy and curbing instances of corruption. To optimize performance and meet the needs of public institutions and stakeholders, it is imperative to align efficiency and digitization strategies. While embarking on the journey of digitalization, it is important to acknowledge the initial investment required for government spending on digital investments and civil servant training. However, it is crucial to recognize the potential benefits that lie ahead in the medium and long term. These benefits include improved efficiency through the reduction of government spending on bureaucracy, optimization of employee time, and the enhancement of communication and the quality of public services. The strategic implementation of digitization in public administration not only facilitates the contact between local public administration and citizens but also effectively mitigates

the occurrence of corruption, thereby reducing the risk associated with such unethical practices and ensuring an effective system of transparency and accountability. Similarly,to combat corruption from the system COVID-19 pandemic has further ensured the transparency of the public institutions' operations. Therefore, by leveraging various tools, we can strengthen digitalization in public administration, which has proven to be of utmost importance (Androniceanu, 2020).

Corruption

The term corruption is defined as an inappropriate use of one's authority for personal advantage (Commission, 2020). While in an organizational context, the term "corruption" refers to the lamentable phenomena in which individuals exploit their positions or networks in the public sector for personal gain or to benefit a party unrelated to their official obligations (Bennett, 2020). There is a lower level of corruption in the countries with similar economic structures, while their complexity is influenced by various economic, social, political, and cultural aspects (Yousif, 2020; Gavurova, 2022; Beck's, 2021). However, it is acknowledged that favoritism and conflicts of interest can be perceived as manifestations of corruption in the context of organizational dynamics. Therefore, to effectively address the issue of corruption, a strategic implementation of legislation and formal compliance needs to be ensured. However, to drive substantial structural and mental transformations within public institutions and society as a whole is equally important; thereby, this approach will successfully enable us to combat these various forms of corruption (Luzgina, 2017).

ICT and Corruption

Corruption tends to emerge and proliferate in societies and public administrations that exhibit suboptimal levels of digitization, excessive bureaucratic processes, inadequate institutional transparency, and challenging internal and external communication dynamics. As per existing literature, the implementation of ICT tools can catalyze encouraging openness and facilitate citizen participation and also mitigate the destructive impact of corruption (Adam, 2021). In another study where Andersson (2008) observed the determinants of press freedom and real GDP per capita from the time frame between 1996 and 2006 and found that both emerged as strong influencers of corruption. Followed by another study of Kim, (2013) where the complex interactions between e-government and anti-corruption measures inside the governmental structure is investigated and resulted in four unique models, each meticulously crafted to capture the essence of 200 nations under scrutiny, with the main purpose to understand the connection between these two essential features and their combined impact on governance. Furthermore, for an effective policy response, building a foundation of evidence concerning the issue's prevalence and manifestation within a given country is the need of time. Additionally, to consider the various institutional and other incentives that may either facilitate or hinder progress in addressing this matter is equally important. Many renowned researchers have investigated the various manifestations of corruption prevalent in numerous nations and successfully identified industries and factors that pose a high risk in terms of fostering corrupt practices (Androniceanu, 2020; Remeikienė, 2020; Luzgina, 2017; Osipov, 2018; Tahir et.al, 2022). Followed by Szeiner (2020), who also suggested that it is imperative to address the systemic nature of corruption through comprehensive changes (enhancing management capacity, improving education, strengthening monitoring, and corruption control institutions) across various levels. However, focusing on legislation, implementing specific requirements for individuals seeking public and political office,

promoting digitalization, transparency, and considering other relevant factors is equally crucial.

Corrupt Practices' Drawbacks:

The most common kinds of corruption are related with the misuse of public funds at the municipal level of governance and these corrupt practices (favoring specific private enterprises, bribery to secure preferential allocation of subsidized housing, illicit commissions obtained through the awarding of public contracts to favored companies, misuse of public resources by municipal officials for personal gain, and facilitating expedited acquisition or sale of goods through illicit means. The aforementioned instances in select states serve to illustrate the correlation between corruption within local government and the level of competitiveness. The presence of corruption significantly hampers the capacity of private enterprises to effectively participate in competitive bidding processes for contracts with public entities. In nations characterized by elevated levels of local government corruption, competitive private businesses often face contract losses with public institutions due to their unwillingness to engage in bribery practices. This study investigates the interrelationships among several variables, including control of corruption, ICT, rule of law, government expenses, and trade openness. The findings from Asian countries are compared with those of previous researchers, namely (Balzer, 2020; Andersson, 2008; Luzgina, 2017; Makowski, 2017; Shujaat Abbas, 2022; Osipov, 2018).

Theoretical Background and Hypothesis Development:

According to New Trade Theory by Krugman (1979), trade openness facilitates market access, promotes competitive efficiency, and increases the diffusion of technology and innovation that result in domestic firms' integration into global markets. This integration enhances growth opportunities, productivity, and standards for firms, leading to new avenues for profitability and economic expansion, which facilitates domestic investments. Several studies have shown a positive relationship between trade openness and domestic investment. Diallo (2024) argues that trade liberalization policies significantly impact investment dynamics and productivity growth in developing countries by employing a mixed-methods approach. Similarly, Sabir et al. (2019) showed that trade openness enhances foreign direct investment, resulting in an increase in economic activity, which in turn stimulates domestic investment. The positive impact of trade liberalization and domestic investment is further supported by Gnangnon (2019) and Mudiyanselage and Epuran (2022). Gnangnon emphasizes that multilateral trade liberalization improves the business climate and export performance, which promotes domestic capital accumulation and technological advancement in his country, whereas Mudiyanselage and Epuran (2022) indicate that liberal trade policies across various contexts encourage local economic engagement.

Some studies in the literature highlight that the impact of trade liberalization on domestic investment is dependent on certain contextual factors like institutional quality and economic infrastructure of countries, which might not always lead to a positive relationship. For example, Onifade et al. (2022) argue that the impact of trade on investment is highly dependent on the existing productivity level of local firms and the resilience of domestic financial systems. Mudiyanselage et al. (2021) highlight that the weak institutional structure may lead to the outflow of capital or disinvestment. Also, foreign investors may exploit new market opportunities more swiftly than domestic firms, which can undermine the local investment efforts. Additionally, Mudiyanselage and

Epuran (2022) argue that in the absence of protective measures for local industries, volatile trade agreements or heightened foreign competition erode investor confidence, hence posing a serious threat to domestic investment through

Overall, the above discussion facilitates the notion that trade openness positively influences ICT investment, which in turn enhances governance and economic development. However, certain factors can negatively impact ICT investment, such as corruption. The relationship between corruption and ICT investment can be explored through the lens of Good Governance Theory by Kaufmann et al. (1999). This theory, based on transparency, accountability, and efficiency in public administration, emphasizes that governments that are actively involved in curbing corruption highlight the beneficial role of ICT in governance, i.e., by reducing bureaucratic discretion, enhancing information access, and increasing public oversight. Investment in ICT provides digital tools to governance that facilitate streamlining administrative processes, bolster transparency, and strengthen anti-corruption efforts.

In the literature, several studies have found a positive relationship between corruption control and ICT investment. Amari et al. (2020) highlight that countries with effective corruption control mechanisms are more likely to invest in ICT initiatives and in creating an environment conducive to e-government success to discourage corrupt practices and enhance transparency and accountability. The positive association between control of corruption and ICT is further supported by Campra et al.'s (2023). The study indicates that digitalization in corporate social responsibility (CSR) enhances transparency and prevents corruption by providing real-time access to information. Strand and Hatakka (2019) emphasize that ICT investment can complement anti-corruption efforts by strengthening the mechanisms for corruption control, which results in improving institutional integrity and public trust.

Certain studies highlight the conditional factors that influence the positive impact of ICT investment on corruption control. Darusalam et al. (2021) indicate that ICT effectiveness in reducing corruption depends on the specific policy choices and governance frameworks. Without appropriate institutional structures, investments in ICT may not achieve the desired results regarding corruption control. Donou-Adonsou et al. (2021) found that the existing corruption environment influences e-government initiatives in reducing corruption. Furthermore, Kouladoum (2022) explores the non-linear relationship between ICT and corruption control, suggesting that greater ICT investment does not always lead to improved governance outcomes. The above studies underscore the need for a nuanced approach to ICT deployment that considers the specific corruption dynamics within different governmental contexts.

Furthermore, the adverse impact of corruption on investment can be explained by Public Choice Theory (Buchanan & Tullock, 1962). According to this theory, public officials as self-interested actors may engage in rent-seeking behavior, which results in increased costs of doing business and unpredictability in the economy, discouraging both domestic and foreign investors. Therefore, Investors often perceive corrupt environments as high-risk and unstable. Numerous studies have provided empirical evidence of the negative effect of corruption on investment. Mazaraki et al. (2023) argue that corruption significantly affects economic security by decreasing investment returns. Zakharov (2019) showed that corruption hinders domestic investment in physical capital, which deters both local and foreign investors, ultimately reducing economic growth. Similarly, Alfada (2019) highlights that corruption acts as a significant barrier to economic development in

the context of Indonesia by diminishing investor confidence and reducing the attractiveness of the investment climate. Luu et al. (2019) further confirm that corruption negatively impacts foreign direct investment (FDI), with investors often reducing their engagement in economies perceived as corrupt. Ndiaye (2019) similarly finds that corruption reduces the efficiency of public investment, discouraging private sector investment, subsequently hampering overall economic growth.

Contrasting evidence has also suggested that the relationship between corruption and investment can vary across contexts. Burböck et al. (2018) discuss that due to the OECD Anti-Bribery Convention, the multinational enterprises (MNEs) have become less sensitive to corruption, as investors might adapt to corrupt environments without changing their investment behavior. Similarly, Belgibayeva & Plekhanov (2019) argue that corruption may be perceived as a manageable risk in informal investment environments where short-term opportunities can offset the costs associated with corruption. Cieślik and Goczek (2018) demonstrate that stronger institutional controls over corruption are directly related to improved investment outcomes, as firms are more likely to avoid highly corrupt markets to minimize inefficiencies and potential financial losses. These mixed discussions surrounding the corruption and investment relationship lead to the "sand and grease" paradox. According to this paradox, while corruption may occasionally facilitate transactions in rigid regulatory environments, the "grabbing hand" perspective asserts that corruption creates unpredictability and inefficiency, which deters both domestic and foreign investment (Urbina, 2020; Yuan et al., 2021). Based on the above discussion, the current study hypothesizes:

H_1: Greater corruption control is positively correlated with government investments in ICT.

In the literature, a bidirectional negative causal relationship exists between corruption and economic development, whereby rising per capita GDP suppresses corruption, and high corruption simultaneously hampers economic development. The Endogenous Growth Theory (Romer, 1986) and Modernization theory (Lipset, 1959) provide theoretical ground for this bidirectional negative causal relationship. The modernisation theory explains that developed economies and high living standards increase the societal demands for transparency, institutional quality, and democratic governance, which in turn leads to lower corruption levels. In contrast, Endogenous growth theory suggests that a high level of corruption acts as a barrier to economic growth by distorting resource allocation, discouraging investment, and undermining institutional trust. Numerous studies have examined the relationship between corruption and economic growth. Purwanto (2025) indicates that countries with lower corruption levels experience higher economic growth rates. Moreover, Sofuoğlu et al. (2017) highlight that corruption influences economic growth negatively in newly industrialized countries.

The complexity of the relationship between corruption and economic growth also depends on contextual factors. Khalid (2024) highlights the role of the rule of law in moderating the effects of corruption on economic growth. The study proposed that while corruption reduces economic growth, the legal frameworks facilitate the growth, which in turn reduces corruption, supporting the modernization theory perspective. Densumite's (2023) findings also supported the modernization perspective that economic growth strengthened the resources and institutional capacity needed for effective anti-corruption measures.

In the literature, some studies have also found the positive impact of corruption on economic growth under certain political or institutional contexts. Khalid (2024) indicates that in emerging economies, in the presence of informal economic practices, corruption increases economic growth in the short term. However, in the long term, such practices have a detrimental impact on economic growth. These findings are supported by Ahmad et al. (2012). By employing panel data analysis, the study showed a significant long-term negative impact of corruption on growth. Similarly, Hussain et al. (2023) employed causal inference analysis across diverse national contexts, showing that corruption might offer short-term economic benefits, whereas in the long term, it undermines economic growth. To summarize, the literature overwhelmingly supports the view that corruption negatively influences growth, and it also acknowledges the existence of a bidirectional relationship where an increase in economic development reduces corruption. Based on this argument, the study hypothesizes:

H_2: There is a negative causal relationship between economic factors (GDP, expense % of GDP, and trade Openness) and corruption.

The Transaction Cost Theory developed by Williamson (1975) provides a conceptual foundation to the perspective that ICT adoption increases domestic investment by reducing transaction costs, improving information availability, minimizing bureaucratic inefficiencies, and fostering trust through greater transparency. It further streamlines government-business interactions, decreases uncertainties associated with regulatory compliance, lowers operational risks and administrative burden, creating a suitable environment for domestic investors. Several studies have shown a positive relationship between ICT adoption and domestic investment. Hammed and Ademosu (2023) examine the spillover effects of ICT innovations in BRICS countries. The findings indicate that investments in ICT infrastructure attract foreign direct investment (FDI), which subsequently encourages domestic investment activities. Similarly, Hanim et al. (2022) suggested that improvements in the ICT index in Indonesia have significantly improved the economic growth, which ultimately results in creating favorable conditions for domestic investment. Furthermore, Fitriady et al. (2022) reinforce this relationship by arguing that ICT enhances communication and operational efficiency, which provides a technological backbone for business operations and decision-making, hence increasing domestic investment and other macroeconomic factors. Pradhan et al. (2021) suggested ICT development as a crucial contributor to sustainable economic growth, by impacting domestic investment through improved financial inclusion and expanded economic activities. Jiang et al. (2022) similarly emphasize the positive relationship between ICT investments and economic growth, indicating that technological advancement enhances the investment across multiple sectors.

Despite this positive relationship, contradictory perspectives also exist in the literature. Mondal and Chakrabarti (2021) highlight that younger firms often face challenges in adopting ICT, which can lead to negative outcomes, suggesting that the benefits of ICT for investment may depend on firm maturity and sectoral characteristics. Additionally, Chancellor (2023) cautions that while ICT investment generally enhances productivity and investment activities, the benefits may take time to materialize, indicating that immediate positive impacts are not guaranteed and transitional challenges may exist.

Furthermore, the interaction between foreign investment and domestic entrepreneurship is critical in understanding ICT's broader impact on domestic

investment. Dung et al. (2024) propose that effectively integrating FDI with ICT development can foster domestic entrepreneurship, reinforcing ICT's role as a catalyst for stimulating local investment activities.

H_3: There is a negative marginal causal relationship between non-economic factors (investment and rule of law) and corruption.

Methodology

The study sample consists of 46 Asian countries from 1996 to 2021, using the Pooled Mean Group-Autoregressive Distributed Lag (PMG-ARDL), which is employed to analyze the short- and long-term relationships between the independent variables (IVs) and dependent variable (DV) in heterogeneous panels. To improve the data quality, missing data were addressed with gap ≤3 Years through linear interpolation. The potential recognition of structural breaks across our 25 years (1997 Asian Financial Crisis, 2008 Financial Crisis, and COVID-19 2020 pandemic) is addressed by incorporating dummy variables in our model. Further, ICT reforms may take time to influence corruption, a model explicitly addressed by adding a lagged term of ICT. Before estimation, this study used panel-unit root tests that confirmed that all variables were either I (0) or I (1), satisfying the requirement of PMG-ARDL. Cointegration Pedroni and Westerlund test ($p<0.01$) further confirmed the long-term relationship among variables, and the Hausman test was applied to confirm PMG estimation over alternative. Robustness test applied system GMM techniques further confirmed the results.

Table 1: Variables & Data Source

Variables	Indicators	Abbreviation	Source
Control of corruption (Dependent Variable)	The effectiveness of governance in preventing and combating corruption	CR	World Bank
ICT employment as a whole (Independent Variable)	Quantifies the government's utilization of information technology in its public relations efforts, as well as its impact on mitigating corruption. This metric is expressed as a percentage of all ICT employment within the domain of service experts.	ICT	World Bank
Economic-Factor			
GDP per capita	The natural log of the Purchasing power parity rate, the gross domestic product was translated to foreign currency. It takes into consideration the economic structural differences across regions and provides an estimation of the median income level, as indicated by real GDP per capita.	GDP	World Bank
Expense %GDP	Cash payments for the government's operational costs of providing goods and services	EXG	World Bank
TOPEN	Trade openness index	TI	Word Bank
Non-Economic Factor			
Investment INV	Gross fixed capital	INV	World Bank
Rule of Law	Global Governance Indices. The former quantifies the influence of investment opportunities, while the latter measures the degree to which a nation's citizens comply with its legal framework.	RL	World Bank

Empirical Model

$$\Delta CR_{it} = \emptyset_i \, (CR_{i,t-1} - \theta_1 ICT_{i,t-1} - \theta_2 \sum_{k=1}^{3} Economic_{k,i,t-1} - \theta_3 \sum_{m=1}^{2} Control_{m,i,t-1}) + \beta_0 + \beta_1 \Delta ICT_{i,t-1} + \beta_2 \sum_{q=0}^{1} Economic_{i.t-q} + \beta_3 \sum_{r=0}^{1} Control_{i,t-r} + \gamma_1 D_{1997} + \gamma_2 D_{2008} + \gamma_3 D_{2020} + \varepsilon_{it}$$

Where;

To capture the short-term dynamics used β_0 is used, while a long-term equilibrium relationship is captured with an error correction term (ϕ_i). CR is a dependent variable representing the year-to-year change in control of corruption. ICT is the independent variable that represents Information and Communication Technology. The economicit represents the three economic control variables (GDP, EXG, TI) potential impact of corruption. The Control represents the two non-economic control variables (Investment INV, Rule of Law Index). Error correction term (ECT), θ_1, captured the long-term effect with the lagged value of ICT, and θ_2 and θ_3 captured the control variables' long-term effects. γ_1, γ_2, and γ_3 captured the structural breaks as dummy variables, where i represents the country and t represents the time. The error term, denoted as ε, accounts for the presence of white noise.

Results and Discussion

Table 2 illustrates the presence of notable disparities in income among Asian nations, which can be attributed to the considerable standard deviation observed in GDP per capita (Georgescu, 2020). The presence of a digital divide among Asian countries is evident from the observation that the standard deviation of Information and Communication Technology (ICT) is relatively small compared to the mean value of 49.0. This indicates a high degree of proximity among the data points, suggesting a clustering effect. The IPS unit root test is subsequently employed to ascertain the stationarity of the variables. To ensure that the integration order of the variables does not exceed a specified threshold, it is necessary to conduct panel unit root tests.

Table 2: Descriptive Statistics

	CR	*ICT*	*GDP*	*EXG*	*TI*	*INV*	*RL*
Mean	39.695	49.004	18923.1	21.946	90.474	25.637	40.849
Std. Dev.	27.061	17.098	24242.1	10.176	55.901	8.855	25.867
Min	0.474	11.5	443.116	3.227	0.027	0.734	0.469
Max	99.038	85.03	163220	83.616	437.327	70.105	98.558
Obs	1,196	1,196	1,196	1,196	1,196	1,196	1,196

Based on the findings presented in Table 3, the variable INV is significant at 5% and exhibits a stationary behavior of order zero (I (0)), whereas the variables CR, GDP, and ICT display a non-stationary behavior of order one (I (1)). The integration orders I (0) and I (1) are combined in the context of the dependent variable, CR, which is integrated of order one. Hence, the PMG-ARDL method emerges as the most optimal approach for estimation.

Table 3: Unit Root Test

Variable	P-value	1st P-value	Order of integration
CR	0.484	0.000	I (1)
ICT	0.568	0.000	I (1)
GDP	1	0.000	I (1)
EXG	0.212	0.000	I (1)
TI	0.137	0.000	I (1)
INV	0	0.000	I (0)
RL	0.073	0.000	I (1)

In this study, we also focused on implementing robust measures to ensure the prevention of corruption. The focus of the analysis lies on the dependent variable, CR, while the independent variables encompass total ICT employment, GDP per capita, government spending, investment, rule of law, and trade openness. In Table 4, the Kao test confirmed the long-term persistence of cointegration.

Table 4: Cointegration Test

Kao Test	3.12**
	(0.002)

To ascertain the optimal model, the study employed a comprehensive range of methodologies, including the long-run Hausman test, PMG, and MG approaches. In the context of the long-run Hausman test, it is important to note that the PMG estimator is considered to be the preferred choice due to its superior efficiency compared to the alternative MG estimator. Based on the results of the long-run Hausman test, it is evident from Table 5 that the study is unable to reject the null hypothesis. This is because the p-value, which stands at 0.1758, is greater than the predetermined significance level of 0.05.

Table 5: Hausman Test

Hausman Test	8.96
	(0.1758)

Henceforth, the study solely elucidates the outcomes derived from the PMG estimator. To effectively address the long-term ICT-control of corruption nexus at the Asian level, it is crucial to adopt a uniform approach. However, when conducting short-term analyses of individual nations, it is important to maintain independence and embrace heterogeneity. In this regard, the PMG estimator emerges as a valuable tool that can aid in achieving the objectives. To optimize efficiency and foster a harmonious environment, it is imperative for each country to proactively devise and implement a comprehensive

strategy to combat corruption within its respective jurisdictions. However, it is equally crucial to adopt a broader perspective and envision a collective vision for the entire Asian region. By aligning policies and objectives, we collectively strive towards the common objective of reducing corruption in the long run (Saadaoui, 2020). Table 6 presents the esteemed figures of the long-term elasticities, short-term coefficients, and the pace at which adjustments are made towards achieving long-term equilibrium.

The PMG long-term effects of ICT adoption on corruption control, with a 1-year lagged value, have a significant coefficient, 0.53% reduction in corruption over time with a 1% increase in ICT implementation. The error correction term exhibits a negative coefficient of -0.77, which is both greater than 2 and statistically significant at the 1% level. Based on the analysis, it has been observed that the annual rate of adjustment towards the long-term equilibrium stands at an impressive 77%. The deduction of joint causation of the variables, specifically the collective long-term effect on the dependent variable CR, can be derived from the error correction term. The long-term elasticity of GDP per capita with CR is nearly negligible, but it gains significance at a 1% level. The positive and significant coefficients of TI and RL, along with the long-term elasticity of ICT compared to CR, demonstrate a strong and promising outlook for the organization. The coefficient of governmental expenses exhibits a small magnitude, indicating a conservative approach towards spending. On the other hand, the investment elasticity showcases a noteworthy negative value, signifying its significance at a confidence level of 1%. Regarding the short-term component outlined in Table 6, it is worth noting that the coefficients displayed lack significance. This suggests that neither of the independent variables under consideration exerts any discernible impact on the control of corruption within a limited timeframe. In the grand scheme of things, it has been observed that a mere 1% alteration in GDP per capita would yield an inconsequential upsurge in CR, approximately amounting to a minuscule 0.00007%. The data presented in Figure 2 illustrate a consistent and encouraging upward trend in the relationship between GDP per capita and corruption control from 2010 to 2019. According to Lučić's (2016) study, a comprehensive analysis was conducted on a diverse sample of 40 nations spanning from 1995 to 2011. The findings revealed a noteworthy correlation between alterations in GDP and fluctuations in corruption levels. Notably, it was observed that changes in GDP tend to manifest approximately six to eight years after shifts in corruption levels, and vice versa. In the long run, it is anticipated that a 1% growth in ICT will yield a corresponding rise in CR of approximately 0.87%.

Table 6. The PMG and MG Estimators

	PMG		**MG**	
Variables	**Long Run**	**Short Run**	**Long Run**	**Short Run**
Error correction term (ECT)		-.31738* (0.000)		-.77514* (0.000)
ICT	0.530* (0.000)	-0.280 (0.570)	0.030 (0.949)	-0.166 (0.643)
ΔICT	–	-0.166 (0.643)	–	-0.280 (0.570)
GDP	0.0002 (0.711)	-0.001 (0.468)	0.00007 (0.192)	0.0015 (0.286)
ΔGDP	–	-0.001 (0.468)	–	0.0015 (0.286)
EXG	-0.214 (0.108)	0.054 (0.703)	0.147* (0.062)	-0.907 (0.169)
ΔEXG	–	0.054 (0.703)	–	-0.907 (0.169)
TI	-0.024 (0.345)	-0.042 (0.253)	0.054* (0.000)	0.099 (0.371)
ΔTI	–	-0.042 (0.253)	–	0.099 (0.371)
INV	-0.053 (0.526)	0.046 (0.759)	-0.096 (0.013)	-0.420 (0.262)
ΔINV	–	0.046 (0.759)	–	-0.420 (0.262)
RL	0.140* (0.010)	0.048 (0.421)	0.886* (0.000)	0.431* (0.001)
ΔRL	–	0.048 (0.421)	–	0.431* (0.001)
Constant	–	–	–	35.98 (0.026)

In the short run, no immediate anti-corruption effects are shown on ICT as a change in ICT coefficient value -0.166, with P>0.10 supporting the hypothesis that ICT requires improvements over time for institutionalization. Based on the findings supported by the research conducted by Darusalam (2021), it can be inferred that the utilization of ICT has the potential to yield advantageous outcomes in terms of mitigating corruption. In light of the aforementioned, it is worth considering that ICT has the potential to serve as a strategic instrument in the ongoing battle against corruption, as highlighted by Ben Ali (2017). Furthermore, it is imperative to note that a modification in the Investment metric would lead to a commendable 5% growth in Total Openings (TI) and a substantial 88% surge in Customer Conversion Rate. Based on the findings presented in (Shrivastava, 2018), it is imperative to consider implementing legislative measures to ensure that information and communication technology effectively reduces carbon dioxide emissions

once the specified threshold has been attained. To optimize the impact of ICT investments, it is imperative to ensure their alignment with comprehensive ICT laws. Enhancing the efficacy and robustness of legal systems leads to a reduction in the perception of corruption. Based on the extensive research, it has been identified that law enforcement plays a pivotal role in determining the magnitude of the rule of law. Lagged ICT, RL, and TI have a long-run significant positive effect control of corruption, and INV has a significant negative impact on CR. GDP and EXG have a weak effect on the control of corruption. Over 25 years, structural breaks (not shown in the coefficient) were controlled for major crises like 1997, 2008, and COVID-19, to ensure the results from temporary disruptions.

Table 7. Robustness Test System GMM

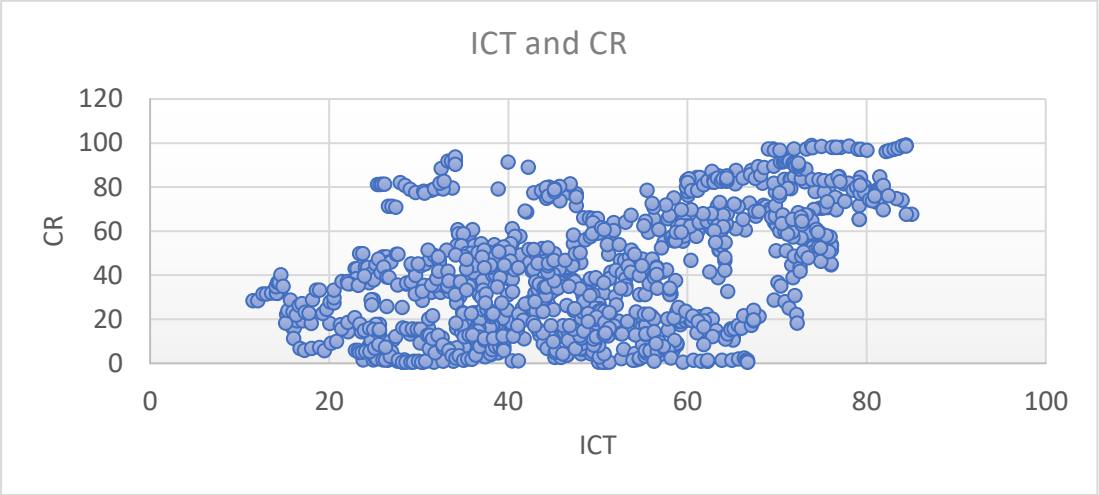
Variables	**Coefficient**
ICT (t-1)	0.302**
	-0.023
ICT	0.462***
	0.000
GDP	0.0004
	-0.152
EXG	-0.181*
	-0.047
TI	-0.018
	-0.455
INV	-0.049
	-0.327
RL	0.203***
	-0.003
Constant	11.24**
	-0.013
Hansen J-test	0.387
AR (1)	0.010
AR (2)	0.732

Table 7 reports the GMM robustness test results, aligning with PMG and MG results and confirming the endogeneity issue. The coefficients of ICT and lagged ICT, 0.48 and 0.32, respectively, confirmed the ICT adoption's long-term impact on corruption. In the short run, results show a more pronounced appearance. The Hansen test p-value of 0.421 confirmed the instrument's validity, and the autocorrelation issue was resolved at the AR (2) level.

The relationship between ICT and CR can be effectively demonstrated through the utilization of a two-way scatter plot. Based on the findings presented in Figure 4.1, it is

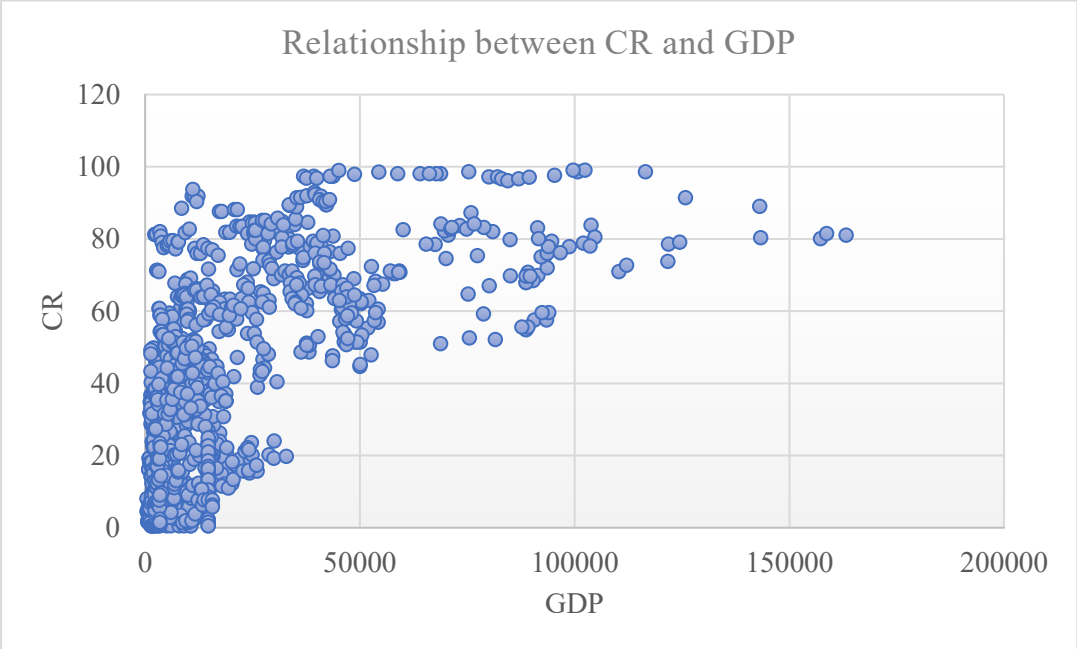
evident that there exists a positive correlation between ICT and CR, which aligns with the expectations.

Figure:4.1



To effectively analyze the relationship between GDP and CR, it is recommended to utilize a two-way scatter plot. This visual representation will allow for a comprehensive understanding of the correlation between these two variables. Based on Figure 4.2, it is evident that there exists a positive correlation between GDP and CR, aligning with the expectations.

Figure:4.2



4.2 Hypotheses Summary

Hypothesis	Statement	Accepted/Rejected
H_1	Greater levels of corruption control are positively correlated with government investments in ICT.	Accepted
H_2	There is a negative marginal causal relationship between economic factors (GDP, expense % of GDP, and trade Openness) and corruption.	Accepted
H_3	There is a negative marginal causal relationship between non-economic factors (investment and rule of law) and corruption.	Accepted

Conclusion and Discussion

The presence of significant corruption challenges in Asian nations hinders their developmental progress, necessitating a fresh approach to address this issue. Despite previous attempts to combat corruption, it is evident that alternative strategies are required to effectively mitigate criminal activities in the region. The objective of this study was to assess the potential of ICT diffusion in aiding Asian nations to overcome the challenges posed by persistent corruption, thereby paving the way for progress and development. The study meticulously constructed an econometric model, focusing on panel data encompassing 46 Asian countries from the period of 1996 to 2021. The outcomes we derived from this rigorous analysis are undeniably captivating, particularly from a scientific perspective. The analysis encompassed an examination of both the direct impacts of ICT diffusion as well as economic and non-economic factors.

One fascinating discovery that has come to light is the positive impact of openness on domestic investment. Additionally, it has been observed that higher trade intensity in Asia has the potential to mitigate corruption. The findings clearly indicate a robust and significant correlation between ICT, TI, and INV. Moreover, it is evident that governmental allocation of resources towards the ICT sector positively influences the level of corruption control. The observed increase in corruption has regrettably resulted in a detrimental effect on investment. The error correction term suggests that the variables collectively contribute to the long-term impact on the dependent variable CR. Upon careful examination of the explanatory variables in isolation, it is evident that the long-term elasticity of GDP per capita about CR showcases a positive trend, gradually approaching zero, and holds significant importance at the 1% level. In analyzing Figure 2, we observe a clear and encouraging correlation between CR and GDP, indicating a promising connection between these two variables.

Based on the research, it has been determined that a strategic allocation of resources towards Information and Communication Technology (ICT) has the potential to effectively mitigate corruption. According to additional research, it is imperative to

acknowledge that the anticipated reduction in corruption, resulting from the increased dissemination of ICT, will heavily rely on the effectiveness of the legal system, political institutions, and courts within Asian countries. The aforementioned conclusion highlights the imperative for ICT to efficiently mitigate corruption, emphasizing the necessity of robust law enforcement within a nation. The findings indicate that the implementation of a robust and efficient legal framework has a direct impact on reducing the perception of corruption. Based on the comprehensive analysis, it has been determined that the non-economic factor rule-of-law index holds utmost significance in shaping corruption levels across Asia. The validity of this outcome remains consistent across subsamples of varying developmental levels. Law enforcement stands as a pivotal pillar within Africa's anti-corruption endeavors.

This research reveals that the use of ICT significantly reduces the corruption level in the long run. On the other hand, GDP has a limited direct impact, but trade openness plays a vital role for reduction in reducing corruption and fostering investment and stability. The COVID-19 pandemic has presented a unique opportunity for public institutions to embrace digitalization as a powerful tool in combating corruption. Androniceanu (2020) highlights the importance of this special setting, as it offers various tools that can effectively transform operations within public administration. The practical implications for the government should prioritize the adoption of ICT and align with digital governance reforms to control corruption. Evidence from the rule of law there are robust judicial systems to control corruption, like anti-corruption laws, with the adoption of ICT. One other way policymakers promote trade openness which can directly mitigating corruption and boosting investment.

Public managers and elected politicians are instrumental in proactively mitigating and reducing instances of corruption within public institutions. There is the existence of various internal and external anti-corruption measures that can be effectively implemented by civil employees and politicians within public organizations. To foster a culture of honesty and effectiveness in the organization, it is imperative to establish fundamental principles and integrity standards. One such measure would involve the formulation of civil servant conduct codes as a mandatory component of employment. Additionally, internal commissions should be established to proactively identify instances of official misconduct and ensure that those accountable are held responsible for their actions. To ensure the integrity of public contracts, it is within the purview of politicians and public administrators to exercise their authority and take proactive measures to prevent the participation of corrupt organizations in the bidding process.

Future study may include conducting comprehensive training sessions for government employees, aimed at fostering a deep understanding of the ramifications associated with corruption, as well as equipping them with the necessary tools and strategies to effectively make them fully aware of unethical practices. The moral conduct and actions of public managers and politicians discourage the prevalence of corruption within public institutions. However, ensuring access to public information is equally important, as it fosters transparency and accountability. It is imperative to prioritize the publication of relevant data, as it empowers stakeholders and facilitates informed decision-making (Lewis, 2020; Lima, 2020). It is critical to prioritise and solve the pressing needs of integrating ICT and encouraging the creation of cutting-edge IT applications designed expressly for efficient administration inside the government cloud environment in the Member States, while the degree of ICT absorption in the

administration may vary, according to a study. It is noteworthy that even states that have made substantial progress in the computerization process encounter challenges related to transparency and corruption in the public sector. These challenges necessitate a management approach characterized by professionalism and inventiveness.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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