

ICTS FOR ANTI-CORRUPTION: INVESTIGATING THE IMPACT OF DIFFERENT ICT TOOLS

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Information and Communication Technologies (ICTs) have been increasingly adopted to improve governance and reduce corruption, yet empirical evidence on their effectiveness remains mixed. This study examines how different ICT tools are associated with corruption across countries at different stages of economic development. Using panel data for 176 countries from 1996 to 2022, we estimate a dynamic panel model through the system generalized method of moments (system GMM). The results indicate substantial heterogeneity across ICT tools and development levels. Mobile penetration is associated with lower perceived corruption, with stronger associations in less developed economies. Broadband adoption is more strongly linked to higher perceived corruption in relatively higher-income contexts, while the relationship between internet usage and corruption is more variable and changes with economic development. Overall, the estimates suggest that ICT-based anti-corruption strategies may be more effective when aligned with a country's development level and institutional environment.

Keywords: Corruption; Digital Infrastructure; Institutional Quality; Dynamic Panel Data
JEL Classification: D73; O33; O11; C23

1. INTRODUCTION

As of 2023, 5.4 billion people, nearly two-thirds (67 percent) of the global population are now online (International Telecommunication Union [ITU], n.d.). We are approaching the UN goal to connect 75 percent of the global population by 2025. Despite this momentum, a digital divide persists. In high-income regions like Europe, North America and the Asia-Pacific, over 90 percent of the population has access to the Internet. In low-income countries, however, only 27 percent of the population can use the Internet, marking a stark 63 percentage point gap between the high-income and low-income countries. Nonetheless, Information and Communication Technologies, or ICTs, have been and continue to be considered one of the driving forces of the 21st century (Brynjolfsson and McAfee, 2011). They hold the promise of revolutionizing and innovating various aspects of our lives and the society, including public services.

One of the aspirations for ICTs is their potential to reduce corruption and support good governance. As defined by Transparency International corruption is “an abuse of entrusted power for private gain.” While the potential for ICTs to reduce corruption is widely recognized, the academic literature presents mixed outcomes regarding their actual impact. In view of the existing research on ICTs and corruption, there remains a lack of consistent empirical evidence regarding the impact of different ICT tools on corruption. This study contributes to the literature by analyzing data from 176 countries over the period from 1996 to 2022, offering one of the most comprehensive and recent assessments of the impact of ICT tools on corruption. Furthermore, unlike many studies that treat ICTs as a single category, this study differentiates between internet usage, mobile subscriptions, and broadband subscriptions across various economic contexts. This study intends to derive policy implications for practitioners in developing countries and serve as empirical evidence in implementing ICT-based measures for anti-corruption measures. Specifically, it addresses the following research questions:

i) Do ICTs influence corruption levels?

ii) If so, how do ICT tools affect corruption at different stages of economic development?

iii) Which ICT tools should developing countries use to combat corruption?

iv)

This paper is structured as follows: Section 2 reviews the existing literature on the impact of ICTs on economic growth and governance, with a specific focus on their role in combating corruption. Section 3 describes the data and methodology used, including the sample of 176 countries and the dynamic panel data model with the System Generalized Method of Moments (GMM) framework. It also discusses the variables considered, including the ICT tools and the components used to measure corruption levels. In Section 4, the findings of the study are presented, highlighting the effects of the individual ICT tools on corruption across various economic contexts. Section 5 provides policy implications based on the study’s findings, emphasizing the need for tailored ICT policies that consider a country's economic development stage and specific local conditions. The policy insights aim to inform policy-makers in developing countries to implement efficient ICT-driven anti-corruption strategies. Finally, Section 6 concludes the paper by summarizing the key insights and suggesting areas for future research.

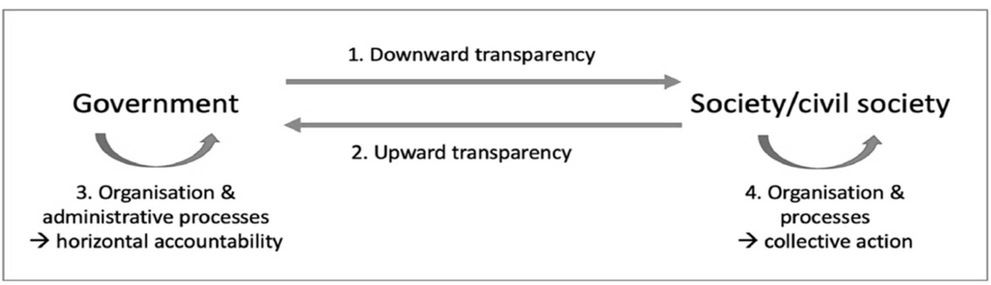
2. LITERATURE REVIEW

ICTs have inspired a steady stream of empirical research that examines their impact on countries' economic growth and governance. The empirical evidence however, remains divided regarding the contribution of ICTs on both developing and developed countries. A fair portion of the academic discourse suggests that ICTs' impact may depend on a country's stage of economic development and other local contexts. Lee et al. (2005) find that ICTs can contribute to growth in developed and newly industrialized countries but not in developing countries. Stanley et al. (2018) suggest that both developed and developing countries benefit from ICTs, though developed countries see more significant benefits. Niebel (2018) identifies that gains from ICT investments are not substantially different between developed and developing countries. On the other hand, Appiah-Otoo and Song (2021) reveal that developing countries benefit more from the ICT revolution than developed countries. When comparing the least developed countries with the Organization for Economic Cooperation and Development (OECD) economies, Myovella et al. (2020) find that basic technologies can create more opportunities for the least developed countries as there is more room for growth. Empirical research also provides implications that ICTs have significant effect on economic growth in transition economies. (Remeikiene et al., 2021; Samoilenko and Ngwenyama, 2011). Lastly, studies with a regional focus on Africa (Adeleye and Eboagu, 2019), the Arab World (Hodrob et al., 2016), Europe (Cioaca et al., 2020; Toader et al., 2018) and Asia (Kurniawati, 2022) also demonstrate varying results.

The literature on ICTs and corruption is equally divergent and demonstrates that the impact of ICTs on corruption is complex and context-dependent. Studies by Andersen (2009), Lio et al. (2011), and Elbahnasawy (2014) show that ICTs such as e-government and the internet can be effective in curbing corruption. Investments in ICTs have also proven to play a role against corruption. (Charoensukmongkol and Moqbel, 2014) Soper (2006) and Sassi and Ben Ali (2017) affirm that in emerging and developing countries, ICT investments contribute to reducing corruption. Mistry and Jalal (2012) suggest that the impact of ICTs in combatting corruption is higher in developing countries than in developed countries. Conversely, many studies depict that ICTs have a non-linear relation to corruption, leading to misuse that worsens corruption. Darusalam et al. (2021) discover that beyond a certain threshold, ICTs no longer support corruption control but instead contribute to corruption. The threshold effect is caused by the potential of ICTs to reinforce existing patterns of corruptive behavior. Charoensukmongkol and Moqbel (2014) demonstrate a u-curve relationship between ICT investments and corruption. Heeks (1998) asserts that ICTs can even create new opportunities for corruption under certain organizational conditions. According to Bhatnagar (2003) corrupt public officials can manipulate e-government systems to develop new corrupt behaviors.

This ambiguity should also be explained by the non-economic determinants of corruption such as the social, political or institutional variables (Park, 2003). Helbig et al. (2009) attribute the success of ICTs' impact to a country's local contexts, cultural background, and technological experience. Nam (2018) and Zhao et al. (2014) find that national culture is an important factor in the anti-corruption effects of ICTs. Bertot et al. (2010) note the transformative nature of ICTs and suggest the potential use of ICTs in influencing cultural attitudes on transparency and openness to reduce corruption. Kossow and Kukutschka (2017) provide quantitative evidence that ICTs may impact the collective action of the citizenry for corruption control. Charoensukmongkol and Moqbel (2014) suggest that the institutional foundations such as supporting policies, should be established in order to reap the full benefits of ICT investments against corruption. Schopf (2019) analyzes that when ICTs are employed in authoritarian regimes, they do not serve as appropriate measures to combat corruption. However, findings on China reveal that despite China's digital censorships, ICTs can break through this control (Lee and Lio, 2016). Lastly, Sassi and Ben Ali (2017) and Bhattacherjee and Shrivastava (2018) demonstrate that for ICTs to curb corruption, it is crucial for a country to have strong levels of rule of law to fully benefit from ICTs' potentials.

Numerous studies discuss the direct and indirect effects of ICTs on corruption. Adam and Fazekas (2021) present a comprehensive framework that elucidates its impact mechanisms (see Figure 1). They identify two primary sets of actors: public actors, which include the government, public institutions and public officials, and private actors such as citizens and non-governmental organizations. This model delineates four dynamics within the horizontal and vertical impact mechanisms of ICTs in enhancing transparency and improving public processes. The vertical dynamics represent the information channels enabled by ICTs, where governments provide downward information to citizens and citizens provide upward information to the government. The horizontal dynamics represent administration and processes of the government and the collective actions of citizens.



Source: Adam and Fazekas (2021)

Figure 1. Four Impact Mechanisms for the Effect of ICTs on Corruption

ICTs facilitate the downward flow of information creating transparency on government activities and reducing opportunities for corruption. Downward government transparency makes public activities and procedures visible and scrutinize-able. It provides citizens with information on their rights. ICTs can also foster upward transparency from the civil society to the government. Governments can receive input from citizens on public initiatives and services. ICTs can also be used as an effective tool to control and monitor public officials' behaviors (Shim and Eom, 2008). Furthermore, they may enable reporting and whistleblowing actions against corruption.

The horizontal dynamics demonstrate how ICTs can foster horizontal accountability for public actors and collective action for private actors. ICTs can digitalize and automate public administration processes and reduce citizens' contact with corrupt public officials. (Andersen, 2009) This limits public officials thus increasing horizontal accountability and discouraging corruption. ICTs can also build avenues of collective action for citizens through digital platforms, including information sharing and crowdsourcing. Heightened public awareness can build a social and political culture proactively condemning corruption making it difficult for public officials to engage in corruptive activities.

3. METHODOLOGY AND DATA

In this study, we examine the effects of three different ICT tools on corruption for a comprehensive sample of 176 countries spanning the period from 1996 to 2022. The countries included in this analysis are detailed in Appendix A. Summary statistics, which provide an overview of the data distributions, can be found in Appendix Table A3. The following regression models, adapted from Sassi and Ben Ali (2017) are considered for analysis, where i indexes countries and t indexes years:

$$CPI_{it} = \alpha + \rho CPI_{i,t-1} + \beta_1 Broadband_{it} + \beta_2 Internet_{it} + \beta_3 Mobile_{it} + \theta' X_{it} + \epsilon_{it} , \tag{1}$$

$$\begin{aligned} CPI_{it} = \alpha + \rho CPI_{i,t-1} + \beta_B Broadband_{it} + \beta_I Internet_{it} + \beta_M Mobile_{it} \\ + \phi_B\left(Broadband_{it} \times \ln GDPpc_{i,t-1}\right) + \phi_I\left(Internet_{it} \times \ln GDPpc_{i,t-1}\right) \\ + \phi_M\left(Mobile_{\mathrm{it}} \times \ln GDPpc_{i,t-1}\right) + \theta' X_{it} + \epsilon_{it}. \end{aligned} \tag{2}$$

The dependent variable in this study is corruption, measured by the Corruption Perception Index (CPI), denoted CPI_{it}. The CPI is developed by Transparency International, a global nonprofit organization with the mission to stop corruption. The CPI is a widely available, reliable measure of the overall level of corruption based on composite subjective indicators (Hamilton and Hammer, 2018). It compiles the assessments of the level of perceived corruption in 180 countries, ranking them annually on a scale from 0, which indicates 'highly corrupt,' to 100 denoting 'very clean.'

Perceived corruption levels are determined by expert assessments and opinion surveys from a variety of sources such as the World Bank, Freedom House, the African Development Bank, and Bertelsmann Stiftung among others (Transparency International, 2023). A one-year lagged value of the corruption indicator, $CPI_{i,t-1}$ is included to control for potential persistence of corruption and unobserved historical factors affecting the current level of corruption.

This study defines three ICT tools: internet usage, mobile subscriptions, and broadband subscriptions, denoted $Internet_{it}$, $Mobile_{it}$ and $Broadband_{it}$, respectively. Internet usage is defined as the percentage of individuals who have used the Internet in the last three months. Mobile subscriptions measure the number of public mobile telephone service subscriptions per 100 people. Broadband subscriptions indicate the number of fixed subscriptions to high-speed Internet access per 100 people. Existing literature on ICTs and corruption examines a wide range of ICT indicators, from ICT development and use, e-government development and effectiveness (Shim and Eom, 2008; Andersen, 2009), and investments (Charoensukmongkol and Moqbel, 2014). Though few, some studies differentiate between these individual ICT tools, allowing for comparisons of each ICT tool's impact on corruption (Shabbir et al., 2021; Kanyam et al., 2017; Ben Ali and Gasmi, 2017; Sassi and Ben Ali, 2017; Koyuncu and Unver, 2017; Lee and Lio, 2016).

This study includes several economic determinants and control variables, adapted from Sassi and Ben Ali (2017). The economic determinants analyzed are GDP per capita, inflation, and trade. GDP per capita, denoted $GDPpc_{it}$, measured in constant 2015 US dollars, represents the economic output per person. Inflation reflects the annual percentage increase in the consumer price index. Trade represents the sum of exports and imports of goods and services as a percentage of GDP. Control variables include the rule of law and population. To reduce skewness, GDP per capita, trade, and population enter the regression models in natural logarithms. The rule of law variable captures perceptions of the quality of legal and political institutions on a scale of -2.5 (bad) to 2.5 (good). X_{it} is a vector of controls including $\ln GDPpc_{it}$, $Inflation_{it}$, $\ln Trade_{it}$, $RuleLaw_{it}$ and $\ln Population_{it}$. The data has been retrieved from Transparency International, the World Bank's World Development Indicators and World Governance Indicators database, and the International Telecommunication Union.

For analysis, a dynamic panel data model with System Generalized Method of Moments (GMM) framework was used in this study (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998). The GMM framework has been used to derive empirical results in the research on ICTs and corruption as it can effectively address issues of endogeneity (Elbahnasawy, 2014; Lee and Lio, 2016; Sassi and Ben Ali, 2017; Kanyam et al., 2017; Shabbir et al., 2021). By using lagged values of CPI as instruments, the GMM framework captures the persistence of corruption over time and controls for unobserved country-specific effects. Additionally, robust standard errors are used to adjust for heteroscedasticity (Windmeijer, 2005).

4. ESTIMATION RESULTS

The results are presented in Table 1. Column (1) presents a baseline model, including GDP per capita, rule of law, and the three ICT variables. Column (2) adds inflation, trade and population. Interaction effects between GDP per capita and broadband subscriptions, internet usage, and mobile subscriptions can be found in Columns (3), (4), and (5), respectively. Lastly, Column (6) presents the interaction effect of GDP per capita and all three of the ICT variables.

The coefficient of lagged perceived corruption is statistically significant in all models, indicating that corruption is present and persists over time. *GDP per capita* shows positive significance in the first three models and *the rule of law* remains significantly positive throughout all models. Higher income levels and better governance appear to be effective tools associated with corruption control. *Broadband* presents mixed results. It is significantly negative in Columns (1) and (2), but significantly positive in interaction terms in Columns (3) and (6), while its interaction term is significantly negative. *Internet* is significantly positive in Columns (1), (2), (4), (5) and *Mobile* is significantly positive across most models. Unlike findings from previous studies however, inflation, trade and population are not consistently significant across the models. The following explains each major finding in more detail.

Finding 1: Income level and strong institutional frameworks are fundamental in reducing corruption.

The coefficient for GDP per capita is positive and significant in the first three models, indicating that higher economic development is associated with lower corruption levels. This may also signify that while GDP per capita is generally a strong predictor of lower corruption, its effect may diminish when considering the interaction effects with ICT variables. It can be inferred that policies to develop and invest in ICTs against corruption can be more impactful when combined with policies promoting economic growth.

This concurs with the empirical results that show that it is developing economies or transition economies that benefit the most from ICTs in combatting corruption (Remeikiene et al., 2021; Stanley et al., 2018; Samoilenko and Ngwenyama, 2011; Gholami et al., 2005; See Finding 3 for related marginal effects). Furthermore, the rule of law has a consistently strong positive relationship, emphasizing that stronger institutions are crucial in reducing corruption. This finding affirms the findings of Bhattacherjee and Shrivastava (2018), Schopf (2019), Sassi and Ben Ali (2017), and Charoensukmongkol and Moqbel (2014), wherein supporting policies for ICTs should accompany efforts to reduce corruption. Therefore, strengthening the rule of law may be a key policy focus to combat corruption effectively.

Finding 2: The impact of ICTs against corruption is mixed.

The second major finding reveals that ICTs have mixed impact on corruption depending on the type of ICT tool and contextual factors. For broadband subscriptions, the coefficient is negative in models without interaction terms, implying that broadband subscriptions may not be effective in controlling corruption. For internet usage as well, the coefficient is inconsistent across all models. These initial inconsistent results for broadband and internet suggest that the impact of internet usage on corruption varies by context. However, unlike broadband and internet, mobile shows a positive and significant relationship across all models. This consistent positive relationship highlights the potential of mobile technology as a reliable tool associating with reducing corruption. The variability of the impacts of each ICT tool highlights the importance of considering contextual factors when applying ICTs in anti-corruption policies and initiatives.

Finding 3: The economic thresholds at which ICTs can be impactful vary for each ICT tool, which should be prioritized depending on the level of economic development.

The marginal effects analysis reveals how the estimated marginal association of each ICT tool changes across different GDP per capita levels. This finding is concurrent with previous studies that demonstrate a non-linear relationship with ICTs and corruption (Darusalam et al., 2021; Charoensukmongkol and Moqbel, 2014). In the case of mobile subscriptions, its coefficient showed a consistently positive and significant association with higher CPI across models without interaction terms. However, the interaction term with GDP per capita is negative and significant. This indicates that the marginal benefit of mobile subscriptions for corruption control diminishes as GDP per capita rises, with the estimated effect becoming statistically indistinguishable from zero at approximately \$8,955 (see the left graph of Figure 2). Internet usage similarly shows higher effectiveness in reducing corruption at lower GDP levels, with the positive impact diminishing as GDP per capita increases, with the turning point at around \$12,088 (see the middle graph of Figure 2), suggests a threshold effect whereby the relative contribution of internet usage to anti-corruption efforts is most pronounced in lower-income contexts than high-income contexts. Lastly, for broadband, the interaction term with GDP per capita is negative and significant. This suggests that broadband's association with reducing perceived corruption may become less pronounced as in higher-income countries. The estimated threshold for broadband stands at \$29,732 (see the right graph of Figure 2).

Given the lowest turning point, in less developed countries, policies should prioritize mobiles for anti-corruption efforts. Mobiles can be particularly helpful in lower GDP contexts with its relative impact decreasing in developed countries. As a country becomes more developed and in more developed countries, the focus might need to shift towards integrating the other ICT tools with economic growth and existing institutional frameworks.

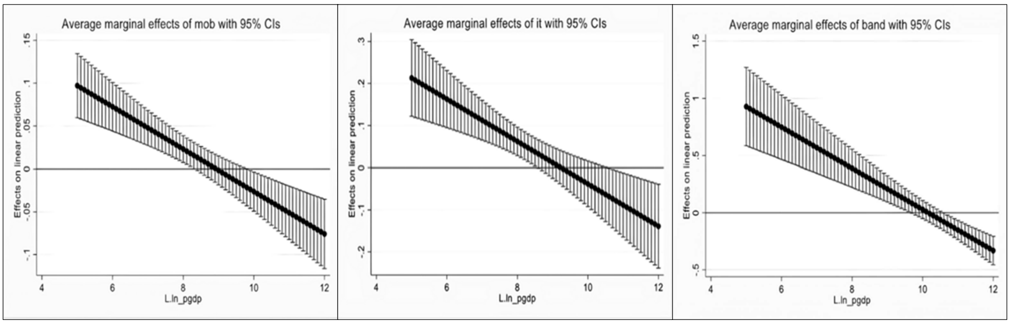
Table 1. System GMM Estimates

Dependent Variable: Corruption Perception Index (CPI)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Lagged CPI	0.225*** (0.030)	0.260*** (0.032)	0.207*** (0.028)	0.216*** (0.030)	0.228*** (0.029)	0.191*** (0.028)
GDP per capita	4.006** (1.804)	3.200* (1.929)	3.718** (1.872)	2.984 (1.945)	2.436 (1.952)	2.992 (1.848)
Rule of Law	5.232*** (0.919)	4.641*** (0.881)	3.858*** (0.833)	4.233*** (0.904)	4.652*** (0.888)	3.976*** (0.840)
Broadband	-0.143*** (0.045)	-0.159*** (0.042)	1.814*** (0.405)	0.013 (0.050)	-0.047 (0.045)	1.357*** (0.450)
Internet	0.030** (0.015)	0.041** (0.019)	-0.025 (0.018)	0.465*** (0.124)	0.038** (0.018)	0.157 (0.127)
Mobile	0.015* (0.009)	0.025*** (0.009)	0.015* (0.009)	0.019** (0.009)	0.251*** (0.061)	0.132** (0.062)
Inflation		0.001 (0.004)	0.001 (0.003)	-0.002 (0.005)	0.001 (0.004)	-0.001 (0.004)
lnTrade		0.441 (0.700)	0.696 (0.702)	1.243* (0.683)	0.677 (0.671)	1.082 (0.661)
lnPopulation		-4.056 (3.155)	2.670 (3.053)	-1.048 (3.123)	-5.442 (3.468)	1.208 (3.449)
lnGDP per capita * Broadband			-0.182*** (0.039)			-0.128*** (0.045)
lnGDP per capita * Internet				-0.052*** (0.014)		-0.020 (0.014)
lnGDP per capita * Mobile					-0.027*** (0.007)	-0.014* (0.007)
Constant	-1.526 (15.420)	66.98 (52.030)	-43.10 (49.740)	20.42 (50.210)	96.98* (54.880)	-13.67 (52.940)
N	2,698	2,382	2,382	2,382	2,382	2,382
Countries	176	157	157	157	157	157

Note: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively. Higher CPI values indicate lower perceived corruption.

Figure 2. Marginal Effects of Mobile, Internet, and Broadband Subscriptions



Turning Point: Mobile	*Turning Point: Internet*	*Turning Point: Broadband*
ln(GDPpc) = 9.100;	*ln(GDPpc) = 9.400;*	*ln(GDPpc) = 10.300*
GDPpc = $8,955	*GDPpc = $12,088*	*GDPpc = $29,732*

Notes: The figure shows average marginal effects of mobile subscriptions, internet usage, and broadband subscriptions on corruption. Solid lines indicate estimated marginal effects, and vertical bars represent 95% confidence intervals. The horizontal axis reports the natural logarithm of GDP per capita, and the horizontal line denotes zero effect.

5. CONCLUSION

The evidence suggests that developing countries should prioritize mobile and internet technologies for their anti-corruption efforts due to their accessibility and cost-effectiveness at lower GDP levels. The relatively lower turning points for mobile and internet indicate that ICT tools may offer the highest marginal utility for anti-corruption efforts in countries at earlier stages of development with lower GDP per capita levels. Furthermore, mobile networks generally require less infrastructure and can reach high penetration rates more rapidly and at lower costs. Governments in developing countries should therefore focus on expanding mobile network coverage and ensuring that mobile services are affordable and accessible to the broader population.

As countries' GDP grows, they should gradually expand to broadband-based measures. Higher turning points for broadband suggest that broadband's correlation with corruption reduction varies with countries' economic levels, likely due to complementary infrastructure requirements. As broadband typically requires significant infrastructure investments, including fiber optic networks and reliable electricity, investments in broadband may become more feasible as countries move towards higher GDP levels. Lastly, policymakers are encouraged to consider implementing supportive policies that strengthen the rule of law and institutional frameworks. Strong legal and political institutions are crucial for maximizing the benefits of ICT investments against corruption.

Our findings indicate that the impact of ICT tools is non-linear and varies with the level of economic development. Mobile phones are the most widely accessible and used ICT tool due to their widespread penetration, particularly in developing countries. The availability of phones allows for effective leverage of mobile connectivity for reporting corruption, disseminating public information, and enhancing transparency. While internet access is growing, though not as pervasive as mobile access, it still provides citizens with access to public information, increasing transparency and accountability of government officials. Broadband access, however, remains limited in many developing countries. Broadband's benefits in reducing corruption become significant at higher GDP levels. Policies aimed at reducing corruption through broadband must focus on strengthening broadband infrastructure.

It is important to note however that the existing academic literature suggests that impact of ICTs on corruption is greatly dependent on local conditions and time periods, which may not be fully captured in a global dataset such as that used in this study (Helbig et al., 2009). The variability in local socio-economic, political, and cultural contexts means that the effectiveness of ICT tools can differ significantly across regions. Future research should focus on region-specific studies to provide a more nuanced understanding of how ICTs can be effectively leveraged to combat corruption in different countries, accounting for those local conditions.

APPENDIX

Table A1. List of Countries Included in the Sample

High-income	Australia, Austria, Bahamas, Bahrain, Barbados, Belgium, Brunei Darussalam, Canada, Chile, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Guyana, Hong Kong, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Kuwait, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Oman, Panama, Poland, Portugal, Qatar, Romania, Saudi Arabia, Seychelles, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Arab Emirates, United Kingdom, United States, Uruguay

Table A1. List of Countries Included in the Sample (cont')

Middle-income	Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Belarus, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Cabo Verde, Cambodia, Cameroon, China, Colombia, Comoros, Republic of the Congo, Costa Rica, Côte-d'Ivoire, Cuba, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eswatini, Fiji, Gabon, Georgia, Ghana, Grenada, Guatemala, Guinea, Haiti, Honduras, India, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kosovo, Kyrgyzstan, Laos, Lebanon, Lesotho, Libya, Malaysia, Maldives, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Montenegro, Morocco, Myanmar, Namibia, Nepal, Nicaragua, Nigeria, North Macedonia, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, Russia, Saint Lucia, Saint Vincent and the Grenadines, Sao Tome and Principe, Senegal, Serbia and Montenegro, Solomon Islands, South Africa, Sri Lanka, Suriname, Tajikistan, Tanzania, Thailand, Timor-Leste, Tunisia, Turkey, Turkmenistan, Ukraine, Uzbekistan, Vanuatu, Vietnam, Zambia, Zimbabwe
Low-income	Afghanistan, Burkina Faso, Burundi, Central African Republic, Chad, Democratic Republic of Congo, Eritrea, Ethiopia, Gambia, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, South Sudan, Sudan, Syria, Togo, Uganda, Venezuela, Yemen

Table A2. Data Sources and Descriptive Statistics

Variables	Definition	Source
Corruption Perception Index (CPI)	Perceived level of corruption by experts and opinion surveys (Scale of 0, highly corrupt to 100 clean)	Transparency International
GDP per capita	GDP per capita (constant 2015 US$)	WDI)
ICT		
Broadband	Fixed subscriptions to high-speed access to the public internet (per 100 people)	WDI / ITU
Internet	Individuals who have used the internet in the last 3 months (% of population)	WDI / ITU
Mobile	Subscriptions to a public mobile telephone service (per 100 people)	WDI / ITU
Economic		
Inflation	Annual % change in consumer price index (CPI)	WDI
Trade	Sum of exports and imports of goods and services (% of GDP)	WDI
Control		
Rule of Law	Perceptions on quality of legal and political institutions (Scale of -2.5 to 2.5)	World Governance Indicators (WGI)
Population	Total number of residents	WDI

Note: WDI: World Development Indicators; ITU: International Telecommunications Union.

Table A3. Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
CPI (0-100)	3,893	43.224	21.045	4.000	100.000
GDP per capita (constant 2015 US$)	4,683	12,149.860	17,405.180	221.303	112,417.900
Rule of Law (-2.5 to 2.5)	4,233	−0.106	0.987	−2.591	2.125
Broadband (per 100 people)	3,440	9.914	12.412	0.000	49.549
Internet (% of population)	4,476	31.203	31.383	0.000	100.000
Mobile (per 100 people)	4,677	68.005	52.782	0.000	319.426
Inflation (annual %)	4,412	8.770	68.175	−16.860	4,145.106
Trade (% of GDP)	4,216	86.253	54.448	0.027	442.620
Population (persons)	4,779	38,445,520	139,572,900	68,153	1,417,173,000

Note: Descriptive statistics are reported for raw variables. In regressions, GDP per capita, trade, and population enter in natural logarithms.

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