Information and communications technology development, interorganizational networks, and public sector corruption in Africa

James Danowski[1,4] · Aaron van Klyton[2] · Tai-Quan Winson Peng[1] · Siyuan Ma[1] · Raphaël Nkakleu[3] · Altante Désirée Biboum[3]

Abstract

Studying Information and Communications Technology (ICT) development is increasingly difficult because most advanced countries converge to similar network structures. However, developing countries still manifest meaningful variance in ICT development, affording theoretical elaboration on the nature of societal ICT processes. We examine the relationships between corruption, anti-corruption, interorganizational networks, and ICT development for 48 African countries. Previous studies observed that increased ICT development is associated with lower levels of corruption, although theory to explain this has yet to develop. In the context of interorganizational networks, we theorized that the degree of centralization-decentralization is a key variable in explaining ICT development. We found support for the proposition that there is less ICT development when corruption is high and interorganizational networks are more centralized. In contrast, there is greater ICT development as decentralization increases, coupled with more anti-corruption news. Nevertheless, media freedom was inconsequential regardless of the interorganizational network structure. Lastly, corruption was negatively related to economic growth.

✉ Aaron van Klyton
vanklyton@gmail.com

James Danowski
jdanowski@gmail.com

Tai-Quan Winson Peng
pengtaiq@msu.edu

Siyuan Ma
masiyua1@msu.edu

Raphaël Nkakleu
nkakleur@hotmail.fr

Altante Désirée Biboum
altantebiboum@gmail.com

1   Michigan State University, East Lansing, USA

2   School of Management and Marketing, Kean University, 1000 Morris Ave, Union, NJ 07083, USA

3   University of Douala, Douala, Cameroon

4   University of Illinois at Chicago, Chicago, USA

 Springer

1 Introduction

The distribution of information and communications technology (ICT) development across countries is far from normal, which has implications for ICT theory. The International Telecommunication Union's (ITU) ICT Development Index distribution, shown in Fig. 1, is dense at the top with a long fat tail. While the positive association between ICT and economic development for developed countries is well established (Katz & Callorda, 2019; World Bank Group, 2016), developing countries have varied experiences and outcomes in working towards development goals and thus are a rich data source for theory elaboration regarding ICT development, its antecedents, and effects. Many of the least digitally connected developing countries are in Africa, where Internet users comprise only 28% of the population on the continent (Katz & Callorda, 2019) and government corruption affects ICT development (Adam, 2020; Ben Ali & Gasmi, 2017; Bertot et al., 2010; Lee et al., 2018). Accordingly, we propose a theory of ICT development that seeks to explain this relationship as a function of the structure of interorganizational networks that influences the effects of corruption and anti-corruption efforts.

ICT development projects involve various organizational stakeholders at the national, regional, and local levels, resulting in interorganizational networks with many moving parts. These networks vary in centralization, ranging from a hub-spoke structure with a central node linked to others who are not themselves linked to a decentralized mesh network connecting all nodes. When interorganizational networks are more decentralized, elaborated horizontal linkages occur among local actors, increasing the volume of information exchanged as each additional organizational node exponentially expands potential communication links. As the network size increases, direct contact becomes more limited, leading to increased digitally mediated communication. While the relationship between a more decentralized interorganizational network structure and ICT development is assumed
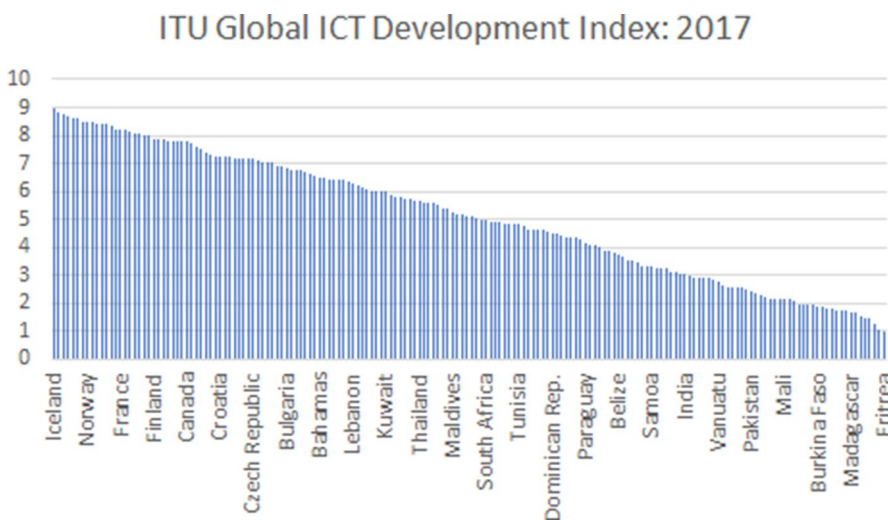
Fig. 1 ITU ICT development index for 2017

to hold over the long term, we expect substantial variation across countries due to the intervening variable of corruption, which can circumvent these macro-level processes in return for agents' gain.

Corruption is behavior that violates laws, rules, or ethical norms. Moreover, public corruption occurs between the private sector and public office holders and includes petty and grand forms (Cuervo-Cazurra, 2016). Bahoo et al. (2020) specified that the personal benefits accrued in this illegal activity are not exclusively financial but include other favors. Even legal activities, such as contributing funds to legislators' campaigns expecting favorable legislation, can constitute corruption (Kaufmann & Vicente, 2011). Although in the countries where this occurs, such practices are not viewed as corruption.

The literature has considered the consequences of corruption in two conflicting ways, as grease or as sand. "Corruption as grease" captures the idea that corruption can reduce transaction costs by circumventing excessively bureaucratic procedures (Cuervo-Cazurra, 2016; Huntington, 1986; Leys, 1965)– a hallmark of institutional voids. As such, corruption becomes the "political glue" that strengthens networks and increases social capital (Martins et al., 2020) or provides access to state-supported projects (Mauro, 2017). Conversely, "corruption as sand" increases transaction costs through uncertainty and opportunism (Méon & Sekkat, 2005; Nur-tegin & Jakee, 2020), disincentivizes market competition, and slows economic growth (Martins et al., 2020). Some studies have suggested that corruption leads to greater economic efficiency and growth of approximately 10% (Ahmad & Brookins, 2007; Barreto, 2001; Mauro, 2017; Méon & Weill, 2010). However, this relationship may be spurious as these studies did not consider the mediating effects of an interorganizational network structure on economic development, particularly when applied to ICT. A preponderance of research found that corruption is associated with less ICT development (Adam, 2020; Bertot et al., 2010; Bhattacherjee & Shrivastava, 2018; Saha & Ben Ali, 2017). Therefore, we theorize that corruption, acting as grease, leads to greater economic growth because of decentralized interorganizational networks. Conversely, when centralization is high, we expect corruption to lead to lower levels of ICT development. ICT's positive association with per capita GDP would account for the simple but spurious relationship between corruption and economic growth.

Many studies confirm that persistent public corruption across Africa hinders economic, political, and social development (Baez-Camargo et al., 2020; Habib et al., 2020; Hsiao et al., 2019; Pring & Vrushi, 2019; Yahaya et al., 2020). For example, the Global Corruption Barometer (GCB) – Africa, published by Transparency International in partnership with Afrobarometer, reported public opinion data on citizens' views on corruption and their experiences of bribery for 34 African countries between 2016 and 2018 (Pring & Vrushi, 2019). More than half of the respondents perceived corruption as worsening in their respective countries and that their government's anti-corruption efforts were weak. One in four people reported paying a bribe in the preceding year, twice as likely for the poorest people, leaving less money for necessities like food, water, and medicine. Furthermore, more than half of the respondents felt that citizens could help stop corruption, an impetus for anti-corruption efforts. Hence, the persistence of corruption in African countries warrants an investigation of its relationship, including anti-corruption initiatives, on ICT development, seen as essential to the continent's economic growth. We mediate this investigation through the concept of decentralizing the interorganizational network.

The theory of institutional voids posits that an economy suffers when there are inadequate network linkages to support transactions (Webb et al., 2020). Networks can overcome corruption when they are more organic, cohesive, decentralized, interconnected, and active. As such, we reason that market effects can override corruption and foster growth.

Centralized networks tend to produce greater levels of corruption and limit ICT development. However, decentralization can disrupt this process and turn ICT networks toward the organic network model. In alignment with Albornoz and Cabrales's (2013) findings that decentralization is positively associated with lower levels of corruption, we theorize that when corruption goes hand in hand with a more efficient, centralized, sparse, and formalistic network, externalities become absorbed and the need for an advanced ICT network is reduced. As a result, development is expected to suffer. Countering this would be a move toward decentralized interorganizational networks, which may increase the prevalence of anti-corruption messages.

Adopting e-government could restructure the principal-agent relationship, reducing opportunism occurrences and enhancing economic growth (Mouna et al., 2020), fitting well within a centralized institutional structure. However, we assert that corruption and interorganizational network centralization would likely reduce ICT infrastructure development across the full spectrum of ICT. Furthermore, decentralization in the interorganizational network is likely to positively influence ICT development. Given the corruption as grease versus sand metaphor and considering anti-corruption efforts and interorganizational network centralization, we form the following research objectives:

1. To examine the relationships between corruption, media freedom, ICT development and economic growth.
2. To explore the influence that interorganizational networks has on this relationship.
3. To elaborate theory on corruption and anti-corruption efforts in developing economies.

The article proceeds with a review of the literature leading to five hypotheses. This section is followed by the methodology, findings and analysis, discussion, and conclusion.

1.1 Literature review

This analysis centers on developing a centralization-decentralization network construct, its relationship to governance, and its effect on ICT development. The literature posits that networks are more centralized when a core of dominant nodes attracts most of the new nodes that enter the network, forming a hub-spoke structure (Barabási & Pósfai, 2016; Yan et al., 2020). More decentralized networks are mesh-like, allowing nodes to link together in a non-hierarchical way. More centralized networks are more hierarchical, sparse, mechanistic, and formal. They remove variation from the periphery, producing uniformity. Tommasi and Weinschelbaum (2007) argued that internalizing negative externalities is an advantage of centralization, particularly for governments with agency problems. However, Boffa et al. (2016, p. 384) presented the counterargument that centralized networks could undermine accountability if they are not accompanied by "a uniformity constraint" that attends to regional heterogeneity. Formalized structures– found in centralized networks– increase the cost and time of information-sharing, impede flexibility, and degrade information as the information travels across multiple layers, ameliorating coordination efforts (Bjørnstad, 2011). Indeed, hierarchical communication systems, similar to those found in centralized networks, were theorized to have a "finite capacity for handling information" (Galbraith, 1973, p. 12). Accordingly, information overload would erode the performance of the centralized structure (Danowski, 1974b). However, given the institutional voids that characterize African economies, actors' reliance on informal relationships would give way to flatter, decentralized networks that are more organic, cohesive, and informal.

In contrast to centralization, decentralized networks are more horizontally elaborated with greater density and are more highly differentiated (Bazzoli et al., 1998; Dubbs et al., 2004; Markovic, 2017) and have links that are dispersed more evenly among members (Provan et al., 2007), except for the network core where links are concentrated. Decentralization reduces decision layers and increases the number of decision-makers, facilitating integration, coordination, and organizational effectiveness (Gulati & Gargiulo, 1999; Provan & Milward, 1995) and greater accountability at the local level (Bjørnstad, 2011).

Provided that local administrators maintain integrity, decentralization could provide more optimal governance outcomes when coordination problems exist across governmental levels (Albornoz & Cabrales, 2013; Tommasi & Weinschelbaum, 2007). These networks are also more locally linked, owing to greater uniformity in attitudes and behavior and greater diversity across the larger landscape (Danowski, 1980). Chen et al. (2020) asserted that decentralization as a form of governance increases the involvement of local entities. Furthermore, Xie and Su (2021) noted a five-fold increase in multiple innovation collaborations resulting from increased decentralization in 297 Chinese cities between 1985 and 2016, which included greater involvement of provincial cities and a significant increase in the relationships between networks (i.e., edges, Blaschke et al., 2012). This period coincided with ICT infrastructure growth in the country.

The information processing capability of organizations is related to their internal structures and their position in interorganizational networks (Danowski, 1974b). Galbraith (1973) conceived organizations as information-processing networks and argued that organizations differ in their capabilities to process information regarding how they receive the information inputs and interact with and manipulate them in executing tasks. Hence, we would expect some variance across African governments. However, as Danowski (1974a) showed, once the diversity and volume of information exceed internal network capacity, performance diminishes, and the overload increases stress. This condition could result in either organizational failure, as information challenges posed by the environment (Aladwani, 2016), or in the network's decentralization (Joseph & Gaba, 2020; van Zandt, 1999). Therefore, we posit that optimal information processing leads to the emergence of more cohesive local and regional networks that process and absorb higher uncertainties, converting them into information.

1.2 Institutional voids

As pointed out in the introduction, African economies have persistent institutional voids that affect the market. Institutional voids are constituted by ineffective contract enforcement, insufficient market intermediaries, and functional governance structures that lead to market failure and interfere with effective transactions (Brenes et al., 2019; Gao et al., 2017; Khanna et al., 2010). As argued above, these deficits lead to decentralization to improve efficiency (Stephan et al., 2015). This line of logic aligns with Gao et al.'s (Gao et al., 2017, p. 2148) assertion that, in the absence of institutional credibility enhancers and adjudicators, a firm's reputation can proxy for trust. However, these same firms face greater risks of opportunism (i.e., corruption) (Martins et al., 2020).

Centralized networks concentrate power by favoring well-connected actors and amplifying the influence of elites (Yan et al., 2020). The networks also marginalize peripheral nodes and lead to institutional voids (DeMarzo et al., 2003; Ibarra, 1993; Mason & Watts, 2012). Centralized networks are more efficient because they reduce intermediary links and, thus, transaction costs. We assert, however, that centralized networks *create* institutional

voids. For example, foreign investors may front-load finances to corrupt central government officials rather than disperse them locally. The sought-after ICT development solutions then become misaligned with local needs. Moreover, the centralized network, coupled with the informal nature of corruption, increases opaqueness (Cuervo-Cazurra, 2016). Such occlusions subject stakeholders to those who control access to resources, constituting a dyadic principal-agent relationship wrought with information asymmetries (Pfeffer & Salancik, 1978), thus facilitating corruption opportunities.

In contrast, decentralized networks could transform the dyad into a larger agency-investor-organizational one. The increased level of social aggregation fits well with the ICT network structure, which links large groups through digital media, fostering new local relationships and altering governance processes to accommodate greater heterogeneity– to some extent, mitigating the effects of institutional voids. Mungiu-Pippidi (2013, p. 103) argued that because state actors as principals are often in the best position to "manipulate anti-corruption bodies or influence policy" to favor particular interests, ordinary citizens should use collective action to impose "normative constraints on elite predatory behavior". In this respect, anti-corruption and accountability would be driven by different stakeholders working together to create mutual benefit (Funaki & Glencorse, 2014). The proposed collective influence reflects an increase in the importance of local nodes in a network, diffusing information processing, promoting the diversity of information emerging from more localism (Xie & Su, 2021), and greater ethnic diversity– theoretically reducing the effects of institutional voids.

Our proposed theory suggests that increasing information diversity could increase anti-corruption news, reflecting collective reactions toward corrupt government practices (Asomah, 2020; Mafukata, 2015). Thus, we test the hypotheses that anti-corruption news more likely emerges from decentralized networks and that anti-corruption content may interact with ICT development. We expect that corruption effects will decrease as interorganizational networks decentralize. Suboptimal institutional performance may become more visible and widely discussed, exceeding central information controls as the network becomes more decentralized, with government internship censorship cases as a caveat (Denardis, 2014). Furthermore, the negative information on competing organizations' practices is also likely to emerge, contributing to anti-corruption messages distributed in the network.

1.3 Hypotheses development

The range of informal to formal relationships that represent the institutional contexts in Africa can be captured through an interorganizational network approach and contribute to understanding ICT development. ICT infrastructure projects have become characterized by the emergence of meta-organizations through public–private partnerships (Kociemska, 2019; Palaco et al., 2019) and organizational lending agreements with international financial organizations (van.Klyton et al., 2019). These meta-organizations have both motives and logic as they co-create relationships to form larger entities (Zorina & Dutton, 2020) that regularly come together for a common purpose (Oliver & Ebers, 1998), rendering network building as an iterative process. Gulati and Gargiulo (1999) argued that organizations use cues to identify potential partners for interorganizational alliances. These alliances become interdependent networks that increasingly internalize information about existing and potential partners to co-integrate resources and capabilities to achieve a particular objective.

ICT is more developed when corruption is lower in a country (Adam, 2020). However, two outlier studies found a weak positive relationship between corruption and high ICT development. Andoh-Baidoo et al. (2014) revealed a correlation between corruption and ICT development, explaining less than 10% of the variance. Charoensukmongkol and Moqbel (2014) found a small positive effect with a beta weight of 0.14 between the variables. Notwithstanding, our theorization that corruption reduces ICT development aligns with a preponderance of literature.

This present study proposes an explanation of this relationship that considers the interorganizational network associated with ICT. We reason that corruption occurs more in a centralized network rather than in a decentralized one. Centralization masks the internal information processing of the central node, which exerts maximum control over the information framed for the peripheral nodes. Accordingly, the central node's corrupt practices are less observable, particularly as peripheral nodes communicate exclusively with it and not with each other, potentially impeding ICT development. The following hypothesis reflects this reasoning:

H1: When the interorganizational network is more centralized, corruption is associated with less ICT development.

On the other hand, when the network is decentralized, the increased contact among peripheral nodes facilitates the unmasking of the central node's corrupt behaviors. These participants have multiple vantage points to triangulate corruption, producing increased communication and consensus about its existence and causes and better coordination opportunities to reduce it. Accordingly, messages and actions that seek to root out corruption are more likely to emerge in decentralized interorganizational networks. Hence, anti-corruption efforts may be more effective in reducing corruption where decentralized networks can mitigate the power of the once central nodes. These decentralized actors cascade corrective information and action through the interorganizational network, leading to higher levels of ICT development. This reasoning leads to our second hypothesis:

H2: When the interorganizational network is more decentralized, anti-corruption efforts are associated with more ICT development.

2 Information voids

Centralization is likely to create information voids in news and media freedom with respect to information diversity. Centralization reduces information diversity, impacting news story content about ICT, particularly as the number of themes increases and differentiates into more subthemes. Given that centralization is associated with less heterogeneity, we would expect it to reduce information diversity. Conversely, decentralized interorganizational networks are likely to have higher information diversity. Therefore, we propose the following hypothesis:

H3: Interorganizational network centralization reduces the diversity of news content.

Media freedom is "the ability for journalists to report freely on matters of public importance" (https://freedomhouse.org/issues/media-freedom). The context of media freedom is

dependent on the nature of the government and the extent to which it attempts to control the flow of press information. Brunetti and Weder's (2003) seminal work found a strong inverse relationship between corruption and media freedom, substantiating the logic that a free press is an important check on government corruption. Media freedom would increase the likelihood that corruption news stories would remain highly salient for the public, at least for a longer period than low salience issues (Culpepper, 2010). Bhattacharyya and Hodler (2015) found that media freedom is inversely related to the equilibrium level of corruption. Hence, a causal effect exists for democratization and media freedom on reducing corruption, regardless of income level, suggesting that the theorized relationship should hold even with the variance of African economic development. Therefore, we hypothesize the following:

H4: When corruption is higher, media freedom is lower.

Indeed, as Solis and Antenangeli (2017, p. 1112) pointed out, more corrupt governments are more likely to repress the media and censor the circulation of accurate information to send a "strong message to media personnel" when news reports threaten the government's power base. Tighter restrictions on the information flow in a network can limit corruption detection (Aven, 2015). Furthermore, by the government's introducing a lack of trust in information and its sources (Hanitzsch & Berganza, 2012), press restrictions increase inefficiencies and information becomes misaligned with the organic network of actors and organizations, resulting in compromised decision-making (Rodriguez et al., 2005). Hence, we test the hypothesis that media freedom increases the prevalence of anti-corruption news in the context of ICT development in the following way:

H5: As media freedom increases, anti-corruption efforts increase.

3 Methods

3.1 Interorganizational network data

News reports enable the extraction of network edges among entities (Kenis & Oerlemans, 2008). The edges are dyadic ties derived from their co-mentions across stories and represent networks of individuals such as political actors (Danowski & Cepela, 2010) or organizational departments (Danowski, 2010). Hu et al. (2017) argued that the co-occurrence of concepts in news articles– which we analyze in this study– captures intangible relatedness perceived by people. Using African countries as the unit of analysis, we identify their interorganizational networks based on automated natural language processing of news stories about ICT and examine the extent to which these networks predict ICT network readiness (Dutta & Lanvin, 2019).

Operationalizing a systematic examination of interorganizational networks requires a different approach than survey data. Information is needed on millions of organizational relationships, which was achieved through the automatic mining of news documents. News stories of organizational activity may have considerable correspondence to actual networks in the public sphere because they reflect and engage with "cultures, interests, and public concerns, which only exist in the perception of people" (Hu et al., 2017, p. 2430). Although press releases and journalists' extractions filter these data, most of the errors from these

two processes are, therefore, by omission. What remains are relationships vetted by journalistic norms. Consequently, the data's quality contrasts with the much more significant amounts of error embedded in self-reports of network data, which Bernard et al. (1979) reported bear no resemblance to actual contacts.

The data analyzed for this study are organizational co-mentions in news stories drawn from a global database of online news (GDELT) that captures both formal and informal interorganizational relationships. Informal relationships are publicly expressed locally and manifest a close fit to an informal network. In contrast, more formal alliances in ICT development would likely only be reported from the center of the hierarchical network. We theorize that relationships tend to be more formal when networks are more centralized, albeit with informal corrupt aspects, while more decentralized networks represent informal relationships in society.

Data were obtained from the GDELT GKG Global Knowledge 2.0, January 2017-through July 2020 for 48 African countries and combined to match the time frames for the other data. GDELT captures the world's online news items, translates them into English, and enables searches. We searched the online news from each country filtered by the World Bank code, WB 133, which corresponds to the theme of Information and Communication Technologies (World Bank Group, 2016). The leading ICT themes co-occurring with information and communication technologies were ICT infrastructure, digital government, network management, telecommunications access, broadband access, access and connectivity, ICT security, satellites, and social media. Non-ICT themes ranged widely across governance, population characteristics, economy, trade, security, social issues, and so on. The average number of themes per country was 4,301.

We extracted the names of organizations co-mentioned for these ICT stories, producing an edge list for each country. After dropping edges occurring five or fewer times, there was a median of 10,389 vertices (i.e., actors in a network or nodes) and 4.79 million edges per country, which were network analyzed with iGraph in R. The network indicators for this analysis included the number of vertices, the number of edges, the average edge frequency, density, number of groups, and eigenvector centrality.

3.2 Corruption perceptions index

We obtained public sector corruption scores for 2019 from The Corruption Transparency Index (CPI) (https://www.transparency.org/en/cpi), a composite of other surveys. Though not without criticisms (de Maria, 2008; Nur-tegin & Jakee, 2020), the CPI is widely used across multiple academic disciplines (Gilman, 2018). Because the scores are scaled as "transparency", we inverted the values to represent corruption. Prior research found that the extremes in countries with the CPI's behavior vary over time, with greater stability in the middle (Zouaoui et al., 2017), a pattern suggesting that meaningful variation is available for analysis.

3.3 Anti-corruption

The frequency with which anti-corruption themes are mentioned in online news, tabulated by GDELT, was used as an index of anti-corruption efforts. Although the news does not capture GDP per all such efforts, those reported are assumed to be significant.

3.4 Information diversity

Because we expect centralization to be associated with less information diversity, we extracted the themes co-occurring with ICT news from the same stories that mentioned the interorganizational networks. We examined the size of the news network in terms of the number of vertices, average edge frequency, number of groups, density, and betweenness centrality. More extensive networks are more differentiated into groups, denser, and less centralized; hence we consider information diversity higher.

3.5 Media freedom

We examined the significance of media freedom for a corruption, centralization, and ICT development context, assuming that media freedom is associated with anti-corruption efforts, based on Starke et al. (2016) and Žuffová (2020). Examining the validity of different media freedom scales, Becker et al. (2007) studied four measures of media freedom, Freedom House, Reporters sans frontières, IREX, and the Committee to Protect Journalists, finding considerable consistency, but that Freedom House scores vary in meaningful ways over time. Therefore, we used the Freedom House data for 2019 (https://freedomhouse.org/freedom-and-media-research-methodology) where a country or territory is awarded 0 (least free) to 4 (most free) points for media freedom.

3.6 Networked ICT infrastructure

We represented ICT Infrastructure by the Networked Readiness Index (NRI), published annually since 2002 (Dutta & Lanvin, 2019). The 2019 Index consists of four pillars (technology, people, governance, and impact), 12 sub-pillars, and 62 items. The NRI selects indicators based on data availability from at least 50% of the countries. Therefore, only countries with at least 70% of all indicators are included in the index, with at least 40% of the sub-pillar level data (Dutta & Lanvin, 2019). As such, 121 economies, including some 23 African countries, are included in the 2019 ranking.

The NRI is considered as an "international assessment of a country's capacity to exploit the opportunities offered by ICT and ICT impact" (Pratipatti & Gomaa, 2019, p. 18) and a critical "resource in unfolding the situation in global scale of the ICTs that feed innovation" (Değerli et al., 2015, p. 1556). Moreover, the NRI affords countries tools in identifying "areas of priority to more leverage ICTs for development" (Vidruska, 2016, p. 902) to participate in the global digital economy.

3.7 Economic growth

We used the index for economic growth rate by The World Bank from 2017–2019 (https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG). This time frame closely matched the news data extracted from 2017 to 2020.

Table 1 Descriptive statistics

	Minimum	Maximum	Mean	Std. Dev
Vertices	1016.00	36,092.00	8212.16	8303.86
Edges	203,431.00	19,467,875.00	4,425,633.43	4,034,658.94
Frequency	15.18	216.15	48.20	36.74
Density	0.02	0.94	0.20	0.19
Groups	171.00	8480.00	1462.06	1708.44
Eigen centrality	0.78	0.99	0.96	0.03
Centralization	0.00	1.00	0.50	0.51
Network size	− 34.09	22.92	0.12	9.67
corruption	1.00	58.00	34.23	12.58
Anti-corruption	3711.00	214,686.00	39,784.90	49,849.17
Info. Diversity	− 59.75	30.54	−2.79	17.49
Media freedom	− 2.00	92.00	42.12	24.78
ICT development	0.00	640.76	198.00	212.62
Economic growth	− 10.80	9.40	3.00	4.14

Table 2 Correlations

	1	2	3	4	5	6	7	8
1. Corruption	–							
2. Anti-corruption	0.223	–						
3. Info.Diversity	−.313[*]	−0.158	–					
4. MediaFreedom	−.688[**]	−0.154	0.250	–				
5. Centralization	.387[**]	.660[**]	−.379[**]	−0.264	–			
6. NetworkSize	−0.202	0.003	.908[**]	0.225	− 0.244	–		
7. ICTDevel	−.399[**]	.419[**]	0.050	.285[*]	0.008	0.060	–	
8. Econ.Growth	−.406[**]	−0.080	0.080	0.219	−.305[*]	0.075	0.173	–

*Correlation is significant at the 0.05 level (2-tailed)

**Correlation is significant at the 0.01 level (2-tailed)

4 Results

Table 1 lists the descriptive statistics, while Table 2 presents the correlations among the variables.

4.1 Index construction

The institutional void variable was constructed by examining the interorganizational network variables. A factor analysis with varimax rotation was done to identify the components of an institutional void. The variables included the number of vertices, mean frequency of edges, density, groups, and eigenvector centrality. Table 3 shows the loadings on the two dimensions identified. Corruption and media freedom data were already indices.

Table 3 Factor analysis of network variables

Components		
	1	2
Edges	0.965	0.094
Vertices	0.947	− 0.294
Groups	0.930	− 0.266
Frequency	0.073	0.937
Density	− 0.249	0.836
Eigen centrality	0.178	− 0.669

The first factor represents the network size, which is not as substantively crucial as its structure, so we consider size a control variable. The second factor represents the structure of the network, including mean edge frequency and density, but a negative loading for eigenvector centrality, indicating decentralization rather than centralization. This includes more active interorganizational links with greater density and less centralization. Variable distributions have extreme values, so median splits are coded on a normalized scale of 0 or 1. These were then combined to form the two network indices. Centralization is the sum of eigenvector centrality, minus average link frequency, and minus density. Finally, a median split resulted in scores of 1 for centralized and 0 for decentralized networks. Network size was the sum of the normalized number of vertices, edges, and groups, followed by the media split to create a score of 1 for large and 0 for small. These are independent of the interorganizational network centralization indicators.

The twelve NRI sub pillars were factor analyzed for the ICT infrastructure variable. They formed a single dimension, so we summed the values to create the ICT Infrastructure index. Next, we operationalized Information Diversity based on network analysis of theme co-occurrences in the news about ICT, which we performed using iGraph in R to compute the number of vertices, the mean frequency of edges, the number of groups, density, and betweenness centrality. Again, factor analysis found a single component, so we summed the normalized variables to create the Information Diversity index. Lastly, to control for country size (because larger countries would have more news), this variable by the normalized population value.

4.2 Hypothesis tests

The first two hypotheses posited that corruption is negatively associated with ICT development as an interorganizational network becomes more centralized, and greater decentralized anti-corruption efforts are associated with increased ICT development. We tested hypotheses using OLS regression, with ICT development as the dependent variable. Robustness checks found heteroskedasticity, so we ran weighted least squares (WLS) regressions. There were no outliers, and the Variance Inflation Factor (VIF) was below 8, indicating no substantial multicollinearity (Thompson et al., 2017).

Table 4 shows regression results for Model 1, without interaction terms, and Model 2, where there are interaction terms for corruption and centralization and anti-corruption and centralization. The interaction effects were significant, supporting the hypothesis that corruption and anti-corruption are negatively associated with ICT development when

Table 4 Regressions on ICT development

	Model 1		Model 2
Corruption	−0.428**	Corruption	−0.326*
	(0.167)		(0.168)
Anti-corruption	0.762***	Anti-Corruption	1.300***
	(0.160)		(0.304)
Info. Diversity	0.037	Info. Diversity	0.029
	(0.306)		(0.287)
Media Freedom	0.042	Media Freedom	−0.003
	(0.156)		(0.152)
Network size	−0.152	Network Size	−0.094
	(0.295)		(0.280)
Centralization	−0.653*	Centralization	−0.734*
	(0.328)		(0.323)
Constant	0.299	CorruptionXCentralization	−0.441*
	(0.195)		(0.251)
R^2	0.485***	AntiCorrupt.XCentralization	−0.766*
			(0.354)
		Constant	0.663**
			(0.237)
		R^2	0.574***

With robust standard errors shown in parenthesis

*$p < .05$ (one-tailed). Unstandardized coefficients

**$p < .01$

***$p < .001$

centralization is high. On the other hand, media freedom, information diversity, and network size were not significant. The results show support for H1 and H2.

Our third hypothesis is supported regarding the association of centralization with less information diversity (see Table 2). Furthermore, we find support for H4, that media freedom is negatively correlated with corruption, an $r = -0.69$, $p < 0.01$.

The fifth hypothesis that media freedom is associated with more anti-corruption news was supported by the significant correlation between these two variables with $r = 0.42$, $p < 0.01$, as seen in Table 2. Nevertheless, the regression shows that H5 was not supported. Neither media freedom nor information diversity is a significant predictor. Given the negative zero-order correlation, the effects disappear when corruption, anti-corruption, and centralization are included.

The correlations show a moderate negative relationship regarding the research objective about economic growth, $r = -0.41$, $p < 0.01$. Nevertheless, OLS regression with the same predictors as in Table 4 found no significant F value for the equation, suggesting no evidence for corruption's association with economic growth among variables in the equation.

5 Discussion

The exercise of testing theory requires sufficient variation in observed phenomena, and developing countries show the greatest variability in ICT development. We illustrated the value of examining 48 African developing countries to advance a theory about ICT development processes. The prevalence of corruption in Africa led us to examine its relationships to ICT development. The literature has found that corruption is associated with less developed ICT. In seeking to explain this relationship, we focused on the structure of the interorganizational networks as a mediator of this process, positing that centralized networks facilitate corruption's dampening of development, while decentralized networks enhance anti-corruption efforts and greater development. This adds some rationale to the institutional void theory as to why centralization limits ICT development. Centralized networks create not only institutional voids but also information voids. These voids mask corruption which further stifles development, while decentralized networks foster anti-corruption efforts and greater ICT development. We found that anti-corruption leads to more developed ICT infrastructure only when a network is decentralized.

While we found that media freedom was negatively associated with corruption, we were surprised to find no relationship between it and ICT development when the model included corruption, anti-corruption, and the interorganizational network structure. Furthermore, media freedom is inconsequential regardless of network structure and does not appear necessary for anti-corruption efforts to increase ICT development. Anti-corruption efforts with network decentralization are more important.

Perhaps the Western liberal democratic concept of media freedom is less relevant across the wide range of governmental systems in Africa. Perhaps more relevant is that anti-corruption reform efforts are rooted in social movement networks, whose main form of communication is social media, which embodies decentralization. The freedom to organize reform is a different kind of freedom than journalistic freedom. How journalists treat anti-corruption stories is perhaps less important than mere coverage, given the agenda-setting effect of frequency of mention on shaping public opinion (McCombs et al., 2014). The social movement network dynamics associated with anti-corruption themes are likely the driving influence in reducing corruption's negative effects on ICT development, more so than news alone.

Decentralization increased information diversity, which may be the main reason why anti-corruption messages increase through multiple means, weakening corruption's harmful effects on ICT development. This is congruent with arguments put forth by Funaki and Glencorse (2014) and Jha and Sarangi (2017), who called for a broader array of actors to enhance anti-corruption efforts through a collective voice.

So, does corruption promote growth? Our findings show that corruption has a negative relationship with economic growth in Africa, which raises questions about the earlier research that finds that corruption greases the growth curve (Ahmad & Brookins, 2007; Barreto, 2001; Mauro, 1995; Méon & Weill, 2010). However, our findings support the findings of Nur-tegin and Jakee (2020) that while both sand and grease were significant, corruption as sand had a stronger effect. These studies looked across the range of countries with a distribution heavy at the top with a long fat tail. In that area, we find that developing African countries' corruption acts more like sand, abrading growth by 17%, lending support to Cooray and Schneider's (2018) assertion that decentralization mitigates the negative effects of corruption.

We further contribute to scholarship by articulating institutional void theory in inter-organizational network terms to argue that more centralized interorganizational networks create higher institutional voids and limit effective functioning as information volumes increase. We also conceptualized how information voids emerge due to centralization, leading to lower ICT development. We found that centralized interorganizational networks work together to yield more corruption, which dampens ICT development. This finding may also apply to developed countries.

Concerning methods, the algorithms appear to have produced reliable data– representative of interorganizational networks– and have predictive validity. Another effective variable automatically extracted from the news was counts of anti-corruption, a predictor of improved ICT infrastructure. Automatic network data extraction resolves data collection problems that have plagued interorganizational network research using traditional survey data or other means.

Although the cross-sectional data do not enable evidence for the causal nature of this association, if the causal arrow flows from the interorganizational network to ICT development, then this has implications for practice. Countries can include more diverse stakeholders, forming more decentralized interorganizational networks, leading to improved development. Anti-corruption advocates have a path to reduce corruption by including more diverse and local stakeholder organizations in the ICT policy process. Such an indirect strategy may be more effective than directly confronting corruption.

6 Conclusion

Studying ICT in developing African countries helped form a general theory of ICT processes encompassing interorganizational networks and their effects on corruption and anti-corruption on ICT infrastructure development. This study found that interorganizational network centralization/decentralization is an important mediator between corruption and ICT development. Corruption's effect on ICT development decreases only when the network is decentralized. In contrast, corruption is the dominant factor associated with less ICT development when the network is centralized. Moreover, when the interorganizational network centralization is lower, anti-corruption messages lead to more developed ICT, suggesting a spurious relationship in extant research that finds corruption positively associated with economic growth.

Decentralization, as conceptualized in this study, occurs as an organic response to institutional voids and the incapacity of the centralized network to process information. As theorized, we find empirical support that decentralization mitigates corruption through the affordance of increased anti-corruption efforts and results in greater ICT infrastructure development. Decentralized networks are theorized to mitigate corruption's effects as anti-corruption information increases. Therefore, the recommendation would be to develop and implement policies that foster greater ICT development based on the rationale that this leads to improved economic growth. Furthermore, encouraging organizations to develop increased alliances would increase decentralization and, in turn, increase ICT development. We expect, however, that governments that are highly centralized (and manifest higher levels of corruption) would resist such policies as they would disrupt corrupt practices. The longer-term effects of regular ICT upgrades would contribute to decentralization and anti-corruption efforts. Greater utilization of the infrastructure by individual and organizational users at the local levels would enhance decentralization and, in theory, reduce corruption.

Declarations

Competing interests We have declared that there is no competing interest in the publication of this article.

References

Adam, I.O.: Examining E-Government development effects on corruption in Africa: The mediating effects of ICT development and institutional quality. Technol. Soc. **61**, 101245 (2020). https://doi.org/10.1016/j.techsoc.2020.101245

Ahmad, N., Brookins, O.T.: The impact of corruption on efficiency in developing economies. Int. Econ. Perspect. **1**(2), 64–73 (2007)

Aladwani, A.M.: Corruption as a source of e-Government projects failure in developing countries: A theoretical exposition. Int. J. Inf. Manage. **36**(1), 105–112 (2016). https://doi.org/10.1016/j.ijinfomgt.2015.10.005

Albornoz, F., & Cabrales, A. (2013). Decentralization, political competition and corruption. J. Dev. Econ. 105(C), 103–111. https://econpapers.repec.org/article/eeedeveco/v_3a105_3ay_3a2013_3ai_3ac_3ap_3a103-111.htm

Andoh-Baidoo, F.K., Osatuyi, B., Kunene, K.N.: ICT Capacity as the Investment and use of ICT: Exploring its antecedents in Africa. Inf. Technol. Dev. **20**(1), 44–59 (2014). https://doi.org/10.1080/02681102.2013.804399

Asomah, J.Y.: Can private media contribute to fighting political corruption in sub-Saharan Africa? Lessons from Ghana. Third World Q. **41**(12), 2011–2029 (2020). https://doi.org/10.1080/01436597.2020.1806707

Aven, B.L.: The paradox of corrupt networks: An analysis of organizational crime at enron. Organ. Sci. **26**(4), 980–996 (2015). https://doi.org/10.1287/orsc.2015.0983

Baez-Camargo, C., Bukuluki, P., Sambaiga, R., Gatwa, T., Kassa, S., Stahl, C.: Petty corruption in the public sector: A comparative study of three East African countries through a behavioural lens. Afr. Stud. **79**(2), 232–249 (2020). https://doi.org/10.1080/00020184.2020.1803729

Bahoo, S., Alon, I., Paltrinieri, A.: Corruption in international business: A review and research agenda. Int. Bus. Rev. **29**(4), 101660 (2020). https://doi.org/10.1016/j.ibusrev.2019.101660

Barabási, A.-L., Pósfai, M.: Network Science (Illustrated edition). Cambridge University Press (2016)

Barreto, R. (2001). Endogenous corruption, Inequality and growth: econometric evidence (School of Economics Working Paper No. 2001–02). University of Adelaide, School of Economics. https://econpapers.repec.org/paper/adlwpaper/2001-02.htm

Bazzoli, G.J., Harmata, R., Chan, C.: Community-based trauma systems in the United States: An examination of structural development (1982). Soc. Sci. Med. **46**(9), 1137–1149 (1998)

Becker, L.B., Vlad, T., Nusser, N.: An evaluation of press freedom indicators. Int. Commun. Gaz. **69**(1), 5–28 (2007)

Ben Ali, M.S., Gasmi, A.: Does ICT diffusion matter for corruption? An economic development perspective. Telemat. Inform. **34**(8), 1445–1453 (2017). https://doi.org/10.1016/j.tele.2017.06.008

Bernard, H.R., Killworth, P.D., Sailer, L.: Informant accuracy in social network data IV: A comparison of clique-level structure in behavioral and cognitive network data. Soc. Netw. **2**(3), 191–218 (1979). https://doi.org/10.1016/0378-8733(79)90014-5

Bertot, J.C., Jaeger, P.T., Grimes, J.M.: Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies. Gov. Inf. Q. **27**(3), 264–271 (2010). https://doi.org/10.1016/j.giq.2010.03.001

Bhattacharyya, S., Hodler, R.: Media freedom and democracy in the fight against corruption. Eur. J. Polit. Econ. **39**, 13–24 (2015). https://doi.org/10.1016/j.ejpoleco.2015.03.004

Bhattacherjee, A., Shrivastava, U.: The effects of ICT use and ICT Laws on corruption: A general deterrence theory perspective. Gov. Inf. Q. **35**(4), 703–712 (2018). https://doi.org/10.1016/j.giq.2018.07.006

Bjørnstad, A.L.: Exploring network organization in military contexts: Effects of flatter structure and more decentralized processes. Mil. Psychol. **23**(3), 315–331 (2011). https://doi.org/10.1080/08995605.2011.570595

Blaschke, S., Schoeneborn, D., Seidl, D.: Organizations as networks of communication episodes: Turning the network perspective inside out. Organ. Stud. **33**(7), 879–906 (2012). https://doi.org/10.1177/0170840612443459

Boffa, F., Piolatto, A., Ponzetto, G., a. M.: Political centralization and government accountability. Quart. J. Econ. **131**(1), 381–422 (2016). https://doi.org/10.1093/qje/qjv035

Brenes, E.R., Ciravegna, L., Pichardo, C.A.: Managing institutional voids: A configurational approach to understanding high performance antecedents. J. Bus. Res. **105**, 345–358 (2019). https://doi.org/10.1016/j.jbusres.2018.03.022

Brunetti, A., Weder, B.: A free press is bad news for corruption. J. Public Econ. **87**(7), 1801–1824 (2003). https://doi.org/10.1016/S0047-2727(01)00186-4

Charoensukmongkol, P., Moqbel, M.: Does investment in ICT curb or create more corruption? A cross-country analysis. Public. Organiz Rev. **14**(1), 51–63 (2014). https://doi.org/10.1007/s11115-012-0205-8

Chen, S., Gao, Q., Peng, Q., Yang, H.: Government-decentralized power: Measurement and effects. Emerg. Mark. Rev. (2020). https://doi.org/10.1016/j.ememar.2020.100769

Cooray, A., Schneider, F.: Does corruption throw sand into or grease the wheels of financial sector development? Public Choice **177**(1), 111–133 (2018). https://doi.org/10.1007/s11127-018-0592-7

Cuervo-Cazurra, A.: Corruption in international business. J. World Bus. **51**(1), 35–49 (2016). https://doi.org/10.1016/j.jwb.2015.08.015

Culpepper, P. D. Quiet Politics and Business Power: Corporate Control in Europe and Japan. Cambridge University Press. (2010)

Danowski, J. A. Environmental uncertainty, group communication structure and stress. (1974a)

Danowski, J. A. (1974b). An information processing model of organizations: A Focus on Environmental Uncertainty and Communication Network Structuring. https://www.researchgate.net/publication/234716021_An_Information_Processing_Model_of_Organizations_A_Focus_on_Environmental_Uncertainty_and_Communication_Network_Structuring

Danowski, J.A.: Group attitude uniformity and connectivity of organizational communication networks for production, innovation, and maintenance content. Hum. Commun. Res. **6**(4), 299–308 (1980). https://doi.org/10.1111/j.1468-2958.1980.tb00151.x

Danowski, J.A.: Identifying collaborative innovation networks: At the inter-departmental level. Procedia. Soc. Behav. Sci. **2**(4), 6404–6417 (2010). https://doi.org/10.1016/j.sbspro.2010.04.050

Danowski, J.A., Cepela, N.: Automatic Mapping of Social Networks of Actors from Text Corpora: Time Series Analysis. In: Memon, N., Jennifer Jie, X., Hicks, D.L., Chen, H. (eds.) Data Mining for Social Network Data, pp. 31–46. Springer US, Boston, MA (2010). https://doi.org/10.1007/978-1-4419-6287-4_3

de Maria, B.: Neo-colonialism through measurement: A critique of the corruption perception index. Crit. Perspect. Int. Bus. **4**(2/3), 184–202 (2008). https://doi.org/10.1108/17422040810870079

Değerli, A., Aytekin, Ç., Değerli, B.: Analyzing information technology status and networked readiness index in context of diffusion of innovations theory. Procedia. Soc. Behav. Sci. **195**, 1553–1562 (2015). https://doi.org/10.1016/j.sbspro.2015.06.190

DeMarzo, P., Vayanos, D., & Zwiebel, J. Persuasion Bias, Social Influence, and Unidimensional Opinions. Q. J. Econ., 118(3), 909–968. (2003) https://econpapers.repec.org/article/oupqjecon/v_3a118_3ay_3a2003_3ai_3a3_3ap_3a909-968..htm

Denardis, L.: The Global War for Internet Governance. Yale University Press (2014)

Dubbs, N.L., Bazzoli, G.J., Shortell, S.M., Kralovec, P.D.: Reexamining organizational configurations: An update, validation, and expansion of the taxonomy of health networks and systems. Health Serv. Res. **39**(1), 207–220 (2004). https://doi.org/10.1111/j.1475-6773.2004.00222.x

Dutta, S., & Lanvin, B. The Network Readiness Index 2019: Towards a Future-Ready Society (p. 310). (2019) Portulans Institute. https://networkreadinessindex.org/wp-content/uploads/2020/03/The-Network-Readiness-Index-2019-New-version-March-2020.pdf

Funaki, Y., Glencorse, B.: Anti-corruption or accountability? International efforts in post-conflict Liberia. Third World Q. **35**(5), 836–854 (2014). https://doi.org/10.1080/01436597.2014.921433

Galbraith, J.R.: Designing Complex Organizations. Addison Wesley (1973)

Gao, C., Zuzul, T., Jones, G., Khanna, T.: Overcoming institutional voids: A reputation-based view of long-run survival. Strateg. Manag. J. **38**(11), 2147–2167 (2017). https://doi.org/10.1002/smj.2649

Gilman, S.C.: To understand and to misunderstand how corruption is measured: Academic research and the corruption perception index. Public Integrity **20**(sup1), S74–S88 (2018). https://doi.org/10.1080/10999922.2018.1472974

Gulati, R., Gargiulo, M.: Where do interorganizational networks come from? Am. J. Soc. **104**, 1439–1493 (1999). https://doi.org/10.1086/210179

Habib, S., Abdelmonen, S., Khaled, M.: The effect of corruption on the environmental quality in African Countries: A panel quantile regression analysis. J. Knowl. Econ. **11**(2), 788–804 (2020). https://doi.org/10.1007/s13132-018-0571-8

Hanitzsch, T., Berganza, R.: Explaining journalists' trust in public institutions across 20 countries: Media freedom, corruption, and ownership matter most. J. Commun. **62**(5), 794–814 (2012). https://doi.org/10.1111/j.1460-2466.2012.01663.x

Hsiao, A., Vogt, V., Quentin, W.: Effect of corruption on perceived difficulties in healthcare access in sub-Saharan Africa. PLoS ONE **14**(8), e0220583 (2019). https://doi.org/10.1371/journal.pone.0220583

Hu, Y., Ye, X., Shaw, S.-L.: Extracting and analyzing semantic relatedness between cities using news articles. Int. J. Geogr. Inf. Sci. **31**(12), 2427–2451 (2017). https://doi.org/10.1080/13658816.2017.1367797

Huntington, S.P.: Political Order in Changing Societies (The Henry L Stimson Lectures Series edition). Yale University Press (1986)

Ibarra, H.: Personal networks of women and minorities in management: A conceptual framework. Acad. Manag. Rev. **18**(1), 56–87 (1993). https://doi.org/10.2307/258823

Jha, C.K., Sarangi, S.: Does social media reduce corruption? Inf. Econ. Policy **39**, 60–71 (2017). https://doi.org/10.1016/j.infoecopol.2017.04.001

Joseph, J., Gaba, V.: Organizational structure, information processing, and decision-making: A retrospective and road map for research. Acad. Manag. Ann. **14**(1), 267–302 (2020). https://doi.org/10.5465/annals.2017.0103

Katz, R., & Callorda, F. Economic contribution of broadband, digitization and ICT regulation: Econometric modelling for Africa (p. 34). ITU Publications. (2019) https://www.itu.int/dms_pub/itu-d/opb/pref/D-PREF-EF.BDT_AFR-2019-PDF-E.pdf

Kaufmann, D., Vicente, P.C.: Legal corruption. Econ. Polit. **23**(2), 195–219 (2011). https://doi.org/10.1111/j.1468-0343.2010.00377.x

Kenis, P., & Oerlemans, L. The Social Network Perspective: Understanding the Structure of Cooperation. In S. Cropper, C. Huxman, M. Ebers, & P. Smith Ring (Eds.), The Oxford Handbook of Inter-Organizational Relations (pp. 289–312). Oxford University Press. (2008). htttps://doi.org/https://doi.org/10.1093/oxfordhb/9780199282944.003.0011

Khanna, T., Palepu, K. G., & Bullock, R. J. Winning in Emerging Markets: A Road Map for Strategy and Execution. Harvard Business Press. (2010)

Kociemska, H. Public–Private partnership for Sub-Saharan Africa (1st ed. 2019 Edition). Springer. (2019)

Lee, K., Choi, S. O., Kim, J., Jung, M. A study on the factors affecting decrease in the government corruption and mediating effects of the development of ict and e-government—a cross-country analysis. J. Open Innov.: Technol., Market, Complex, 4(3), 1–20. (2018). https://ideas.repec.org/a/gam/joitmc/v4y2018i3p41-d167411.html

Leys, C.: What is the problem about corruption? J. Mod. Afr. Stud. **3**(2), 215–230 (1965). https://doi.org/10.1017/S0022278X00023636

Mafukata, M.A.: Evolution of corruption in Sub-Saharan Africa - from Nkruma to Mutharika The 2nd: Case study of South Africa (2147–4478). Int. J. Res. Bus. Soc. Sci. **4**(1), 87–112 (2015). https://doi.org/10.20525/ijrbs.v4i1.32

Markovic, J.: Contingencies and organizing principles in public networks. Public Manag. Rev. **19**(3), 361–380 (2017). https://doi.org/10.1080/14719037.2016.1209237

Martins, L., Cerdeira, J., Teixeira, A.A.C.: Does corruption boost or harm firms' performance in developing and emerging economies? A Firm-Level Study World Econ. **43**(8), 2119–2152 (2020). https://doi.org/10.1111/twec.12966

Mason, W., Watts, D.J.: Collaborative learning in networks. Proc. Natl. Acad. Sci. **109**(3), 764–769 (2012). https://doi.org/10.1073/pnas.1110069108

Mauro, P.: Corruption and growth. Q. J. Econ. **110**(3), 681–712 (1995). https://doi.org/10.2307/2946696

Mauro, P. The effects of corruption on growth and public expenditure. In: A. Heidenheimer & M. Iohnston (Eds.), Political Corruption- Concepts & Contexts (p. 14). Routledge. (2017). https://doi.org/10.4324/9781315126647-31

McCombs, M.E., Shaw, D.L., Weaver, D.H.: New directions in agenda-setting theory and research. Mass Commun. Soc. **17**(6), 781–802 (2014). https://doi.org/10.1080/15205436.2014.964871

Méon, P.-G., Sekkat, K. Does corruption grease or sand the wheels of growth? Public Choice, 122(1), 69–97. (2005). https://econpapers.repec.org/article/kappubcho/v_3a122_3ay_3a2005_3ai_3a1_3ap_3a69-97.htm

Méon, P.-G., & Weill, L. Is corruption an efficient grease? World Development, 38(3), 244–259. (2010). https://ideas.repec.org/a/eee/wdevel/v38y2010i3p244-259.html

Mouna, A., Nedra, B., Khaireddine, M.: International comparative evidence of e-government success and economic growth: Technology adoption as an anti-corruption tool. Transform. Gov.: People, Process Policy **14**(5), 713–736 (2020). https://doi.org/10.1108/TG-03-2020-0040

Mungiu-Pippidi, A.: Controlling corruption through collective action. J. Democr. **24**(1), 101–115 (2013). https://doi.org/10.1353/jod.2013.0020

Nur-tegin, K., Jakee, K.: Does corruption grease or sand the wheels of development? New results based on disaggregated data. Q. Rev. Econ. Finance **75**, 19–30 (2020). https://doi.org/10.1016/j.qref.2019.02.001

Oliver, A.L., Ebers, M.: Networking network studies: An analysis of conceptual configurations in the study of inter-organizational relationships. Organiz. Stud. (1998). https://doi.org/10.1177/017084069801900402

Palaco, I., Park, M.J., Kim, S.K., Rho, J.J.: Public–private partnerships for e-government in developing countries: An early stage assessment framework. Eval. Program Plann. **72**, 205–218 (2019). https://doi.org/10.1016/j.evalprogplan.2018.10.015

Pfeffer, J., Salancik, G.R.: The External Control of Organizations: A Resource Dependence Perspective, 1st edn. Stanford Business Books, USA (1978)

Pratipatti, S., Gomaa, A. A longitudinal analysis of the impact of the indicators in the networked readiness index (NRI). J. Int. Technol. Inform. Manag. 28(2), 17–50. (2019) https://scholarworks.lib.csusb.edu/jitim/vol28/iss2/2

Pring, C., Vrushi, J. Global Corruption Barometer: Africa 2019. Transparency International. (2019) https://www.transparency.org/files/content/pages/GCB_Africa_2019_Full_report_spread.pdf

Provan, K.G., Fish, A., Sydow, J.: Interorganizational networks at the network level: A review of the empirical literature on whole networks. J. Manag. **33**(3), 479–516 (2007). https://doi.org/10.1177/0149206307302554

Provan, K.G., Milward, H.B.: A preliminary theory of interorganizational network effectiveness: A comparative study of four community mental health systems. Adm. Sci. Q. **40**(1), 1–33 (1995). https://doi.org/10.2307/2393698

Rodriguez, P., Uhlenbruck, K., Eden, L.: Government corruption and the entry strategies of multinationals. Acad. Manag. Rev. **30**(2), 383–396 (2005). https://doi.org/10.5465/amr.2005.16387894

Saha, S., Ben Ali, M.S.: Corruption and economic development: New evidence from the Middle Eastern and North African countries. Economic Analysis and Policy **54**, 83–95 (2017). https://doi.org/10.1016/j.eap.2017.02.001

Solis, J.A., Antenangeli, L.: Corruption is bad news for a free press: Reassessing the relationship between media freedom and corruption. Soc. Sci. Q. **98**(3), 1112–1137 (2017). https://doi.org/10.1111/ssqu.12438

Starke, C., Naab, T. K., Scherer, H. Free to expose corruption: The impact of media freedom, internet access and governmental online service delivery on corruption. Int. J. Commun. 10(0), 21 (2016). https://ijoc.org/index.php/ijoc/article/view/5712

Stephan, U., Uhlaner, L.M., Stride, C.: Institutions and social entrepreneurship: The role of institutional voids, institutional support, and institutional configurations. J. Int. Bus. Stud. **46**(3), 308–331 (2015). https://doi.org/10.1057/jibs.2014.38

Thompson, C.G., Kim, R.S., Aloe, A.M., Becker, B.J.: Extracting the variance inflation factor and other multicollinearity diagnostics from typical regression results. Basic Appl. Soc. Psychol. **39**(2), 81–90 (2017). https://doi.org/10.1080/01973533.2016.1277529

Tommasi, M., Weinschelbaum, F.: Centralization vs. Decentralization: A Principal-agent analysis. J. Public Econ. Theory **9**(2), 369–389 (2007). https://doi.org/10.1111/j.1467-9779.2007.00311.x

Van Zandt, T.: Decentralized Information Processing in the Theory of Organizations. In: Sertel, M.R. (ed.) Contemporary Economic Issues, pp. 125–160. Palgrave Macmillan UK, London (1999). https://doi.org/10.1007/978-1-349-14540-9_7

van Klyton, A.C., Rutabayiro-Ngoga, S., Liyanage, L.: Chinese investment in the Sierra Leone telecommunications industry: International financial institutions, neoliberalism, and organizational fields. Rev. Afr. Polit. Econ. **47**(164), 220–237 (2019). https://doi.org/10.1080/03056244.2019.1605591

Vidruska, R.: The digital economy and society index and network readiness index: Performance of latvia on European Union Arena. New Chall. Econ. Bus. Dev. **2016**, 901–916 (2016)

Webb, J.W., Khoury, T.A., Hitt, M.A.: The influence of formal and informal institutional voids on entrepreneurship. Entrep. Theory Pract. **44**(3), 504–526 (2020). https://doi.org/10.1177/1042258719830310

World Bank Group. The World Bank Development Report- Digital Dividends (A World Bank Group Flagship Report, p. 359). The World Bank. worldbank.org/en/publication/wdr2016. (2016)

Xie, Q., Su, J.: The spatial-temporal complexity and dynamics of research collaboration: Evidence from 297 cities in China (1985–2016). Technol. Forecast. Soc. Chang. **162**, 120390 (2021). https://doi.org/10.1016/j.techfore.2020.120390

Yahaya, N.S., Mohd-Jali, M.R., Raji, J.O.: The role of financial development and corruption in environmental degradation of Sub-Saharan African countries. Manag. Environ. Qual.: an Int. J. **31**(4), 895–913 (2020). https://doi.org/10.1108/MEQ-09-2019-0190

Yan, B., Jian, L., Ren, R., Sidnam-Mauch, E., Monge, P. The paradox of interaction: Communication network centralization, shared task experience, and the wisdom of crowds in online crowdsourcing communities. Communication Research. (2020)

Zorina, A., Dutton, W.H.: Theorizing actor interactions shaping innovation in digital infrastructures: The case of residential internet development in Belarus. Organ. Sci. (2020). https://doi.org/10.1287/orsc.2020.1389

Zouaoui, A., Al Qudah, A., Ben Arab, M.: World corruption perception index analysis. Res. J. Financ. Account. **8**(24), 85–91 (2017)

Žuffová, M.: Do FOI laws and open government data deliver as anti-corruption policies? Evidence from a cross-country study. Gov. Inf. Q. **37**(3), 101480 (2020). https://doi.org/10.1016/j.giq.2020.101480