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Article in *Telematics and Informatics* · January 2021

DOI: 10.1016/j.tele.2021.101577

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Do Digital Payment Transactions Reduce Corruption?

Evidence from Developing Countries

Abstract

Extant studies have broadly attributed anti-corruption effects to digitization, although there is a paucity of studies on the role of digital payments in reducing corruption. With the increasing pervasiveness of digital payments and the widespread nature of corruption, particularly in developing countries, it is timely to explore the link between digital payments and corruption. Using a global panel dataset of digital payments and Transparency International's Corruption Perception Index (CPI), the study explores the relationship between digital payment transactions and corruption in 111 developing countries from 2010-2018. Our results, based on a fixed-effects analysis, show that digital transactions reduce corruption. Results remain robust to the use of instrumental variable analysis to alleviate endogeneity concerns. Our finding has implications for curtailing corruption in developing countries.

Keywords: Digital payment, corruption, cross-country analysis; instrumental variable regression

Introduction

Corruption, commonly defined as the abuse of public office for private gain (Lambsdorff 2007; Rose-Ackerman 1999), has been recognized as a global problem by the United Nations because it has economic, political, and social consequences that adversely affect individuals, businesses, and societies (Argandoña 2007). Although it is often associated with government and the public sector (Klitgaard 1991; Rose-Ackerman 1999), and with developing countries (Olken and Pande 2012), corruption also occurs in business, the private sector, as well as in advanced economies. The widespread and systemic nature of corruption (Nielsen 2003), as well as its globalized and cultural dimensions (Davis and Ruhe 2003; Sampath and Rahman 2019; Scholl and Schermuly 2020), make it a formidable ethical issue for businesses and governments around the world.

Multifaceted interventions (for example, simplification of processes, effective management control mechanisms, merit-based recruitment, and incentive pay schemes), as well as broader socio-political change (Hors, 2001; Muno, 2013), have been suggested to have better chances at curtailing corruption than piecemeal or isolated approaches (Rothstein 2011; Sundell 2016). Nonetheless, cross-national observational studies have identified digital technology as an important factor that lowers corruption (Andersen 2009; Ben Ali and Gasmi 2017; Mistry 2012; Mistry and Jalal 2012; Shim and Eom 2008, 2009; Srivastava et al. 2016). The rationale for considering digital technology as a tool for reducing corruption is founded on the tenets of financial transparency (Ben Ali 2020; Corojan and Criado 2012; Relly 2012; Stamati et al. 2015), which address problems of information asymmetry, unchecked monopoly power, uncertainty, and opportunism (Husted 1994; Prasad and Shivarajan 2015). A significant impediment to the fight against corruption in developing countries is the over circulation of physical currency (Singh and Bhattacharya 2017). In developing countries, businesses and individuals make transactions worth billions every day using physical cash.

Such cash payments are often insecure, difficult to trace and inefficient (Singh and Bhattacharya 2017). These attributes of cash payments stimulate illegal activities and foster the growth of shadow economies. With the advent of financial technologies including mobile money, digital payment options offer an opportunity to control corrupt behaviors and activities (Heeks 1998; Ramasoota 1998; Shim and Eom 2008, 2009; Shrivastava and Bhattacharjee 2015). Despite the claims about the potential of digital technologies to reduce corruption, we are not aware of studies that have examined the effects of digital financial technologies and digital payment transactions on corruption reduction in developing countries. This is a surprising omission from the literature, given that in recent decades digital financial schemes such as cards, online, and mobile money payments have spread across the world and gained traction in many developing countries (Capgemini 2017; Hamdan 2019). For example, over 90% of Kenyans now have access to mobile money (CNBC Africa 2017; McGath 2018), and the total value of mobile money transactions now surpasses the national GDP (Vota 2018). Furthermore, as part of inclusion interventions, mobile payments have been integrated into public programs to more effectively deliver entitlements to millions of poor and vulnerable people (Ghosh 2017; Government of India 2015).

Although it has not gained much scholarly attention, the nexus between digital payments and corruption reduction has attracted attention in policy circles. For example, in November 2016, the government of India abruptly embarked on a demonetization intervention, during which over 80% of currency notes were removed from circulation because of the role of cash in enabling corruption and black-market activities (Bose 2019; Lahiri 2020). Although India's demonetization led to a significant and lasting increase in digital payments (Agarwal et al. 2018; Joshi and Desai 2017), it remains unclear how the shift to digital payments affected corruption.

Against this backdrop, the goal of the current study is to examine the link between digital payment transactions and corruption within the context of developing countries. We exploit global panel datasets of digital payments and Transparency International's Corruption Perception Index (CPI) to test the association between digital payments and corruption in 111 developing countries from 2010 - 2018.¹ To strengthen the rigor of results, we alleviate potential endogeneity concerns using an instrumental variable regression. The rest of the paper proceeds as follows: first, we review the literature on digital payments and corruption to derive our research hypothesis. Next, the research methods and results are presented, followed by a discussion of findings and implications.

Background and Hypothesis Development

Digital payment in developing countries

Digital payment, also referred to as electronic or cashless payment is defined as the use of electronic devices and channels to initiate and/or receive money (Staykova and Damsgaard 2015). As an umbrella terminology, digital payment solutions range from debit/credit cards, mobile, and online payment systems (Iman 2018). The value propositions of digital payments include the reduction in cash-related fraud, lowering of transaction costs, increase in financial transparency, and improvements in business record-keeping (Ligon et al. 2019).

Digital payment can be traced to the dot com era, as evident in early payment innovations such as PayPal—a software platform for receiving and paying for goods and services from a linked bank account (Thomas and Morse 2017). As technology advances, new digital payment solutions have emerged, giving rise to a multitude of services and systems conceptualized as financial technologies (Gomber et al. 2017). Although the backend process of digital payment transcends various players and subprocesses, the front end involves three

¹ Developing countries are defined according to the World Bank criteria for low- and middle-income countries

key elements—the payer, payee, and interface or channel (Ligon et al. 2019). Payer refers to the payment initiating actor while payee refers to the receiving actor. Interface refers to the medium through which digital payment is executed. For instance, through digital payment, an individual (payer) can use debit/credit card (interface/channel) to pay a retailer (payee). Compared to cash, digital payment offers speed, convenience, and economical processing with the benefit of verifiable digital trails (Verkijika 2020).

With the widespread diffusion of affordable mobile phones around the world, mobile payment has become a dominant form of digital payment, particularly in developing countries (Maurer 2012). The driving force behind the success of mobile payment in developing countries is the innovative use of mobile phones to provide financial services. As there is low penetration of traditional financial institutions but the majority of the unbanked population in developing countries have access to mobile phones, telecommunication companies developed mobile-based payment solutions to enable digital payment. Mobile payment platforms like Kenya's M-Pesa have grown in scale and scope and offer a wide range of advantages such as convenience, rapid payment processes and reduced transaction costs (Camner and Sjoblom 2009; Hughes and Lonie 2007; Mas and Morawczynski 2009; Mbiti and Weil 2011). Mobile payment was originally developed for money transfer but the success of the technology has led to the development of myriad of solutions such as mobile-based insurance services, micro-loans and savings, as well as daily subscription solar electricity (Shapshak 2016).

Historically, developing countries have operated cash-dominant economies that offer fertile opportunities for untraceable financial transactions. However, many developing countries have now embarked on digital payment initiatives to reduce the use of cash in their economies. Prior studies have focused on adoption and use of digital payment in developing countries for financial inclusion, as well as drivers and barriers to mobile money adoption

(Cobla & Osei-Assibey, 2018; Pal et al., 2020; Patil et al., 2020; Rahman et al., 2017). But despite the contributions from these studies, there is limited understanding of whether the growing popularity and use of digital payment solutions have contributed to lowering the widespread corruption in developing countries.

Cash and corrupt transactions

Corruption has been classified in various ways, but two common types are grand and petty corruption (Doig and Theobald 1999). Unlike grand corruption that involves large sums embezzled or received as bribes by powerful politicians and elites, petty corruption involves “soliciting or extortion of small payments by low-level officials in order to expedite business by cutting through red tape; or to do what they are supposed to do anyway” (Doig and Theobald 1999, p.5). Although both types of corruption could in principle occur through the physical exchange of cash, grand corruption tends to be sophisticated in its execution and more likely to involve complex schemes that sidestep the physical exchange of cash and allows the flow of illicit gains within and across borders (Lowe 2017; The Center for Public Integrity 2016). Petty corruption on the other hand, is less sophisticated, more opportunistic, and often involves the physical exchange of cash between parties (Syed and Bandara 2019). For example, in many developing countries it is customary to pay cash bribes before receiving entitlements such as an admission spot in public schools, hospital treatments, or critical documents like driving licenses and passports (Riley 1999). Such cash payments are intended to grease the squeaking wheels of administration (Bardhan 1997) but instead act as an ‘arbitrary tax’ on goods and services whose effect is to further oppress the poor and vulnerable in society (Carr and Jago 2014).

In addition to petty corruption, the use of cash has also been associated with illicit activities like money laundering and drug trafficking that thrive under a cloak of secrecy, as well as quasi-legal activities involving tax evasion or concealment of income from authorities

(Schneider 2010; Schneider and Linsbauer 2016). For example, by one estimate, 90% of currency bills in the US have traces of cocaine on them (American Chemical Society (ACS) 2009; Zuo et al. 2008), giving literal expression to the phrase ‘dirty money’. Such concerns about the adverse implications of cash have been broadly discussed in economic circles within a context of efforts to reduce or eliminate cash (Rogoff 2014; Sands 2016). However, although the share of cash payments is highly correlated with the size of the shadow economy in general, the association of cash and levels of corruption, crime, and black market activity is inconclusive (Schneider 2017).

Digital payment potential for anti-corruption

By offering an alternative to cash payments, digital payments obviate the need for physical, face-to-face interactions between transacting parties. The elimination of such face-to-face interactions—suggested to create opportunities for corruption and other offences (Addo 2020)—might, therefore, lead to the decline of black-market, criminal, and corrupt activities. Digital payments might also provide specific modalities in specific functional and social domains to reduce corruption. For example, in the domain of water and sanitation service delivery in Africa where corruption was widespread among a range of actors, and transparency and accountability were found to be lacking (Plummer and Cross 2007), mobile payment methods were found to reduce information asymmetries and petty corruption by making payment data transparent and limiting the availability of economic rents in the billing and payments process (Krolkowski 2014). In India, mobile payments allowed the government to make direct cash transfers to social welfare beneficiaries who previously had to deal with corrupt middlemen (Ghosh 2017; Government of India 2015). For example, in the public distribution system (PDS) where basic food and other entitlements were provided through ration shops, the integration of mobile payment systems with digital identification

allowed recipients to directly access their benefits and to bypass the activities of corrupt actors known as the ‘rice mafia’ (Masiero 2015a, 2015b).

Despite these reported implications of digital payments, research has pointed out that technology by itself does not deterministically drive outcomes (Leonardi and Barley 2008; Orlikowski 1992). The particular organizational and broader context (Avgerou 2001, 2019), as well as enactments in practice (Fountain 2001), are important conditions for the potential anti-corruption outcomes of digital payments. The effects of digital payment technologies are therefore not be taken for granted, and the effort to empirically understand the aggregate effects of digital payments on corruption, particularly in developing countries, becomes salient. Drawing from the foregone discussion, this study proposes the following:

Hypothesis: *Digital payment is negatively associated with corruption in developing countries.*

Methods

The study sample consists of a panel of country-year observations drawn from three databases: (1) the Global Financial Inclusion database (2) the Corruption Perception Index (CPI), and (3) the World Development Indicators (WDI). The World Bank launched the Global Financial Inclusion (Global Findex) database in 2011 by interviewing over 150,000 nationally representative and randomly selected civilians of age 15 and above in more than 140 countries (Demirguc-Kunt and Klapper 2012). The survey is conducted triennially, and the most recent survey round was in 2017 (Hess 2018). The Global Findex database is ideal for the study because it contains financial inclusion indicators that measure how people use financial services to save, borrow and make payments.

The Corruption Perception Index (CPI) database has been annually published by Transparency International since 1995 (Transparency International 2020). The CPI measures the perceived level of public sector corruption in 180 countries and territories using opinion

surveys of businesspeople and experts. We favour the CPI data over other indices because the CPI is a composite index, which incorporates information from 16 different surveys and assessments from 12 independent institutions including the African Development Bank, Economist Intelligence Unit, World Economic Forum and the Political and Economic Risk Consultancy.

The World Development Indicators (WDI) database contains data related to global development collected from the UN specialized agencies, national statistical offices and other reputable institutions (The World Bank 2020). The database is compiled by the World Bank and provides access to time series data (1960-2018) containing over 1600 development indices of 217 economies. The indices capture development progress made in a wide range of areas including agriculture and rural development, education, health, infrastructure, social and urban development.

Data and sample

Countries in the three datasets were matched to construct our sample, and the sample restricted to low and middle-income economies for further analysis. The assignment of low to middle-income economies was based on the World Bank's classification that designates economies with a gross national income per capita of less than \$12,475 as low-to-middle income (World Bank Data Team 2012). To ensure that findings are driven by a causal effect of digital payment transaction on corruption, the sample was restricted to one-year time lags of our explanatory variables. Lagged explanatory variables are commonly used in econometrics to mitigate simultaneity bias in observational data (Singer and Willett 1991). The final sample consisted of 111 countries (see Appendix A Table 5 for list of countries) matched in the Global Findex, CPI, and WDI databases. The total number of country-year observations for the 111 countries in our sample was 198 after excluding missing data.

Measures

Measuring Corruption. We used the corruption perception index to measure corruption. Transparency International's corruption perception index (*CPI*) measures public sector corruption on a 0-100 scale, where 0 is very corrupt and 100 is very clean. Prior to 2012, Transparency International published the CPI on a 0-10 scale. We transformed the 0-10 scale to 0-100 scale to be consistent with the 2012-2018 CPI data. To facilitate an intuitive interpretation of our results, we inverted the 0-100 scale by subtracting each countries CPI score from 100, thus making 100 the most corrupt and 0 the least corrupt.

Measuring Digital Payment Transaction. Our dependent variable is digital payment transaction (*digitalpay*). We use the Global Findex indicators to measure digital payment transaction. Specifically, we operationalized digital payment transaction as the proportion of the population who have sent or received digital payment in the past year.

Control Variables. Whereas the existing literature has examined numerous determinants of cross-country corruption, the determinants can be largely categorized as political, sociocultural and economic (Elbahnasawy and Revier 2012; Treisman 2007). Accordingly, to account for alternative explanations of corruption, we controlled for the potential effects of gross domestic product per capita, the strength of the legal system and the extent of internet access. Research suggests a link between economic output and corruption (Brown and Shackman 2007). It is conceivable that higher levels of economic development bring greater willingness to combat corruption (Blackburn et al. 2006). Accordingly, we controlled for the potential influence of economic output on corruption. Economic output is measured as the gross domestic product per capita (*GDPcap*).

The quality of the legal systems within which economic actors and businesses operate in is a potential determinant of the levels of corruption. Apergis and Cooray (2017) find a significant effect of legal systems and property rights on corruption. Accordingly, we

accounted for the influence a country's strength of legal rights have on corruption by using the World Bank's strength of legal system index (*legalStrength*). Access to the internet enhances access to information which results in greater corruption awareness and transparency (Kock and Gaskins 2014). Therefore, we controlled for internet access effect on corruption by using a measure of the percentage of households in a country that have access to the internet (*internetAccess*). We acknowledge that digital payment transactions and internet access may be correlated. But our rationale for including internet access as a control stems from the fact that the modes of digital payment predominant in developing countries e.g., mobile money do not necessarily require widespread internet access.

Model specification

To test the relationship between digital payment transaction and corruption, the linear unobserved effects model specification was as follows:

$$\text{Corruption}_{it} = \beta_0 + \beta_1 \text{digitalpay}_{it} + \lambda \text{Controls}_{it} + \mu_i + \varepsilon_{it} \quad [1]$$

Corruption_{it} denotes the level of corruption of country i at time t ; digitalpay_{it} is the proportion of the population of country i who have sent or received digital payment at time t ; $\lambda \text{Controls}_{it}$ is the vector of country i control variables at time t ; μ_i and ε_{it} are the unobserved time-invariant country-specific effects and idiosyncratic error term respectively.

Estimation approach

To estimate our model, we conducted a Hausman test to evaluate which panel data estimation approach – fixed or random-effects model – was appropriate for our analysis (Wooldridge 2013). The Hausman test checks whether the unique errors (μ_i) are correlated with each explanatory variable. The null hypothesis of the test was that the unique errors and the explanatory variables are uncorrelated. The Hausman test rejected the null hypothesis ($\chi^2 = 217.47$; $df = 3$; $p < 0.001$). Hence, we estimated our model using fixed effects regression

with clustered standard errors, at the country level, to account for heteroskedasticity across observations.

Results

Table 1 presents descriptive characteristics and correlations. We log-transform the corruption and GDP per capita data to reduce skewness and improve the interpretability of the analysis. Table 2 presents the results of the fixed effects regression. Recall that we predicted that digital payment transactions are associated with lower levels of corruption. This prediction was supported. As results from Table 2 show, digital payment transaction is negatively associated with corruption ($\beta = -0.251$, $t = -2.711$, $p < 0.01$).

Table 1: Descriptive Statistics and Correlations

	Mean	SD	1	2	3	4
1 Log Corruption Perception	1.756	0.452				
2 Digital payment transaction	0.521	0.319	-0.766***			
3 Strength of legal system	5.112	2.893	-0.215***	0.161**		
4 Log GDP per capita	3.573	3.499	-0.731***	0.782***	0.074	
5 Internet access	0.550	0.289	-0.744***	0.855***	0.139**	0.752***

*** $p < 0.001$; ** $p < 0.01$

Table 2: Results of Fixed Effects Regression

Dependent Variable: Corruption Perception			
	β	se	t value
Constant	3.580**	1.217	2.940
Digital payment transaction	-0.251**	0.093	-2.711
Strength of legal system	-0.221*	0.110	-2.009
Log GDP per capital	-0.213*	0.102	-2.088
Internet access	-0.202	0.113	-1.772
Country fixed effects		Included	
Year fixed effects		Included	
R-Sq.		0.485	

** $p < 0.01$; * $p < 0.05$

Robustness Checks

A concern in our primary analysis is that our results may be sensitive to alternative measures of corruption although we include several control variables theorized to influence

corruption. We used the World Bank's Worldwide Governance project's control of corruption indicator as the alternative measure of corruption to test the sensitivity of our results (Kaufmann et al. 2011). The control of corruption indicator captures both grand and petty forms of corruption and measures the perception of the extent to which public power is exercised for private gain. The indicator aggregates data from over 30 underlying sources including survey institutes, think-tanks, non-governmental organizations, international organizations and private sector firms. The indicator is reported in percentile rank terms from 0-100, with higher values corresponding to better outcomes. We reverse coded the 0-100 percentile rank scale to facilitate an easier interpretation of the data i.e., making 100 the most corrupt and 0 the least corrupt.

Results of the analysis using the alternative measure of corruption are reported in Table 3. The results from Table 3 show that the relationship between digital payment transaction and control of corruption is negative and significant ($\beta = -0.198$, $t = -2.245$, $p < 0.01$). Thus, our results from the primary analysis are robust to an alternative measure of corruption.

Table 3: Results of Fixed Effects Regression (Alternative Measure of Corruption)

Dependent Variable: Control of Corruption			
	β	se	t value
Constant	8.145***	1.311	6.213
Digital payment transaction	-0.198*	0.088	-2.245
Strength of legal system	-0.217*	0.103	-2.107
Log GDP per capital	-0.311**	0.122	-2.549
Internet access	-0.182	0.152	-1.197
Country fixed effects		Included	
Year fixed effects		Included	
R-Sq.		0.389	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Addressing endogeneity concerns

The analysis in the previous section shows a significant and negative relationship between digital payment transactions and corruption. However, one of the empirical

challenges in our primary analysis is endogeneity resulting from the possibility of time-variant and time-invariant omitted variables. The inclusion of country-fixed effects in our primary analysis will control for any time-invariant unobservable characteristics.

Concerns remain that time-varying unobservable characteristics that are correlated with digital payment transactions will bias the coefficient estimates of the fixed effects analysis. For example, in our model the unobserved time-variant omitted variable, technocratic political leadership is likely to bias the results of our primary analysis. The level of technocratic leadership of incumbent governments could result in a national push for cashless economies via digital payment transactions (Bátiz-Lazo et al. 2014; Putter 2016), and at the same time, the level of technocratic leadership might be correlated with corruption (Bertsou and Pastorella 2017). This omitted variable may bias our inference regarding the effect of digital payment transaction on corruption.

Instrumental variable analysis

A common approach to address endogeneity concerns arising from time-variant omitted variables is instrumental variables (IVs) (Chintrakarn et al. 2020; Lu et al. 2018). To account for the endogeneity of digital payment transaction, we conducted an IV analysis (Fixed Effects 2 Stage Least Square – FE 2SLS – estimation) using the average annual precipitation of the countries as the instrument. We obtained precipitation data from Ashouri et al. (2015) and Nguyen et al. (2017, 2019). Keeping with our notation in Equation [1] of the observations of country i at time t , the first and second stages of the 2SLS are summarized by Equations [2] and [3] respectively. For the IV analysis to provide an unbiased estimate, both the relevance condition and exclusion condition must be satisfied (Wooldridge 2013).

$$\text{Digitalpay}_{it} = \Pi_0 + \Pi_1 \text{Precipitation}_{it} + \Pi \text{Controls}_{it} + \omega_{it} \quad [2]$$

$$\text{Corruption}_{it} = \Phi_0 + \Phi_1 \text{digitalpay}_{it} + \Phi \text{Controls}_{it} + \psi_{it} \quad [3]$$

Relevance Condition. The instrument must be relevant in that it is correlated with the endogenous variable. Our instrument measures the average rainfall depth (in mm) of a country in a given year. The underlying rationale is consistent with the finding that weather shocks in low-income countries can serve as exogenous positive shocks to digital payment transactions (Jack and Suri 2014). A study of digital remittances in Tanzania found that households with mobile money users were more likely to receive digital payments after rainfall shocks (E. Riley 2018). Therefore, we expect our instrument – the average annual precipitation variable – to be relevant i.e., positively correlated with digital payment transactions.

A commonly used approach to evaluate IV relevance is to report the F statistic in the first stage of the 2SLS estimation procedure. The first stage F statistic tests the null hypothesis that the first stage coefficient Π in Equation [2] is zero (Wooldridge 2013). In Table 4, we report the K-P Wald $rk F$ statistic and the p value of the under-identification test (Kleibergen and Paap 2006). The results of Table 3 indicate that we can reject the null hypothesis although the F statistic is less than the recommended weak instrument threshold of 10 (Stock et al. 2002), which indicates our instrument is only weakly correlated with the endogenous regressor. With weak instruments, the IV or 2SLS estimator is biased and inconsistent in small samples (Staiger and Stock 1997). Accordingly, we use weak IV robust inference and report the Anderson and Rubin (1949) test in Table 4. The AR statistic is significant ($\chi^2 = 5.532, p < 0.05$), confirming that the coefficient estimate is robust to the weak instrument.

Table 4: Results of IV Estimation

	First stage		Second stage	
	Digital payment transaction		Corruption Perception	
	β	se	β	se
Constant	-3.135***	0.133	4.222***	1.129
Strength of legal system	0.112	0.093	-0.128	0.101
Log GDP per capital	0.323**	0.113	-0.236*	0.117

Internet access	0.434***	0.132	-0.099	0.222
Precipitation	0.023*	0.011		
Digital payment transaction			-0.236*	0.119
Country fixed effects		Included		
Year fixed effects		Included		
R-Sq.	0.427		0.299	
Weak id. (K-P Wald rk F stat)	5.722		-	
Under id. (K-P rk LM p value)	$p < 0.05$		-	
Anderson-Rubin statistic	5.532*			

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Exclusion Condition. To satisfy the exclusion condition, the instrument needs to be uncorrelated with the error term in the structural equation; which in our case means that precipitation does not directly influence corruption. This exclusion condition cannot be directly tested because the condition involves an unobservable residual. Therefore, our argument that precipitation does not directly influence corruption remains a reasonable intuitive assumption.

IV results

To summarize, the precipitation variable is a weak instrument, but a further weak IV inference test suggests the estimate is robust. In addition, the instrument has no direct effect on corruption and results from Table 4 shows that precipitation is significantly positively related to digital payment transaction ($\beta = 0.023$, $se = 0.011$, $p < 0.05$). Results of the second stage estimation in Table 4 are consistent with results from primary analysis (Table 2), thereby mitigating the possible endogeneity concerns in our fixed-effects analysis.

Discussion and Conclusion

Although digital payment has been touted as curtailing corrupt behaviors (Shrivastava and Bhattacharjee 2015) and increasing transparency in financial transactions (Coroan and Criado 2012; Relly 2012; Stamati et al. 2015), it still remains unclear if it can attenuate corruption in developing countries where corruption remains widespread. To address this knowledge gap, we draw on a global panel dataset of digital payments and CPI to investigate

the relationship between digital payment and corruption in 111 developing countries. The results of our analysis confirm our hypothesis that there is a negative relationship between digital payment and corruption. Moreover, this result still holds while controlling for country-level characteristics and using the instrumental variable analysis to address endogeneity concerns. While there is an expectation that digital payment might attenuate corruption in developing countries (e.g., Heeks, 1998; Ramasoota, 1998; Shim & Eom, 2008, 2009; Shrivastava & Bhattacharjee, 2015), this study is arguably the first to establish this relationship. We, however, caution that the results of the study should be interpreted within the context of developing countries.

Through our result, the study offers a number of salient implications. First, this result asserts that digital payment is a viable tool to reduce corruption in developing countries, implying that if developing countries become cashless economies with high levels of digital payment, there is a high likelihood that corruption will reduce. However, for this to materialize, developing countries must address socio-technical issues such as limited digital payment infrastructure, poverty, digital illiteracy, and cultural beliefs that work against wide adoption and use of digital payment (Suri 2017). At the moment, cash remains “king” in many developing countries despite digital payment efforts as people mainly use digital payment to send money to others, or to pay for certain products and services (Senyo and Osabutey 2020). As a result, large volumes of corrupt financial transactions still occur through cash (Syed and Bandara 2019). Thus, developing countries need to provide fertile conditions to normalize digital payment in everyday life in order to reap the attendant anti-corruption benefits.

Second, our results point to how achieving a cashless economy through digital payment can offer added benefits such as increasing government revenue and ultimately alleviating poverty (through corruption reduction and leakage of public funds). For instance, the

Christian Aid report (Christian Aid 2008) estimates that corruption accounts for about \$160 billion revenue losses to developing countries each year due to tax evasion alone. Hence, if developing countries advance digital payment to curtail corruption, government revenue could increase as a result of blocking corruption loopholes. Aside the revenue losses, corruption also contributes to non-financial impacts that are detrimental to developing countries. Corruption remains a challenge to ending severe poverty and disproportionate ownership of resources in developing countries (World Bank 2018). However, should digital payment become the *modus operandi* in developing countries, previously unaffordable critical products and services might become more accessible to the poor (Rahman et al. 2017). Consequently, this could produce a positive rippling effect in other areas to propel development in emerging economies (World Bank 2018).

Third, our study advances corruption research in developing countries. The corruption literature is replete with studies that recognize that institutional approaches such as legal reforms, financial disclosures, and anti-corruption laws are potent tools to fight corruption (Gokcekus and Ranjana 2006; Vargas and Schlutz 2016). While these *distal* tools have enhanced our understanding of anti-corruption efforts, our study extends the corruption literature by advancing an alternative argument that proposes digital payment technologies to have a *proximal* effect on corruption. More broadly, our study points to a need for deeper understanding of the mechanisms through which digital payment technologies exert a negative influence on corruption. The literature on financial technologies hints that digitalization enables financial transparency by improving business record keeping and lowering transaction cost (Ameen and Ahmad 2012; Husted 1994; Kshetri 2017). We thus call on future research to examine the mediating effect of business transparency in the relationship between digital payment transactions and corruption at the national level.

Fourthly, our study opens avenues for future research in financial technologies. There are different modes of digital payment systems such as card, online, and mobile (Yu et al. 2002), and future research should examine how specific modalities of digital payment influence corruption. Finally, our study is not without limitations. It focuses on corruption in developing countries from a public sector perspective (using the CPI and CCI) as there is limited data on private sector corruption. Thus, we were unable to directly compare the effect of digital payment on private and government corruption, although government corruption undoubtedly affects business as well as citizens. Therefore, when this data becomes available, future studies may find it important to investigate the effect of digital payment on both government and private sector corruption in developing countries.

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Appendix A

Table 5: List of Countries

Afghanistan	Ghana	Panama
Albania	Guatemala	Papua New Guinea
Algeria	Guinea	Paraguay
Angola	Guinea-Bissau	Peru
Argentina	Haiti	Philippines
Armenia	Honduras	Romania
Azerbaijan	India	Rwanda
Bahamas	Indonesia	Sao Tome and Principe
Bangladesh	Iran	Senegal
Benin	Iraq	Serbia
Botswana	Jamaica	Seychelles
Brazil	Jordan	Sierra Leone
Brunei	Kazakhstan	Slovakia
Bulgaria	Kenya	Somalia
Burkina Faso	Kosovo	South Africa
Burundi	Kyrgyzstan	Sri Lanka
Cambodia	Laos	Sudan
Cameroon	Latvia	Swaziland
Cape Verde	Lebanon	Syria
Central African Republic	Lesotho	Tajikistan
Chad	Liberia	Tanzania
China	Libya	Thailand
Colombia	Macedonia	Timor-Leste
Congo Republic	Madagascar	Togo
Costa Rica	Malawi	Tunisia
Cote d'Ivoire	Malaysia	Turkey
Democratic Republic of the Congo	Mali	Turkmenistan
Djibouti	Mauritania	Ukraine
Dominican Republic	Mauritius	Uzbekistan
Ecuador	Mexico	Vietnam
Egypt	Morocco	Uganda
El Salvador	Mozambique	Zambia
Equatorial Guinea	Myanmar	Zimbabwe
Eritrea	Namibia	
Ethiopia	Nepal	
Yemen	Nicaragua	
Gabon	Niger	
Gambia	Nigeria	
Georgia	Pakistan	