



Does financial inclusion control corruption in upper-middle and lower-middle income countries?

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Abstract

Presence of corruption in a system is always a path breaker for transparent distribution of public services in the economy. Therefore, controlling corruption is a high priority for progress of a country's growth. The main objective of this study was to empirically examine the impacts of financial inclusion on control of corruption in selected upper-middle and lower-middle income countries. Using cross-country annual data from 2004 to 2018, the study applied fixed effect, random effect, panel corrected standard errors, feasible general least square and 2SLS (two-stage least-squares regression) models to evaluate the impacts of financial inclusion on control of corruption across all samples from upper-middle and lower-middle income countries. The results from the upper-middle income (UMI) countries demonstrated that a basic level of financial inclusion has no impact on the control of corruption, whereas higher intensification of financial inclusion beyond the basic level positively impacts it. Similarly, the findings from lower-middle-income (LMI) countries indicated that financial inclusion up to a certain threshold level helps to control corruption, whereas financial inclusion above the threshold level negatively impacts the control of corruption. These empirical findings suggest that in the overall sample, financial inclusion plays an important role to control corruption.

Keywords Financial inclusion · Corruption · Upper-middle-income · Lower-middle-income · Cross-country

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1 Introduction

Financial inclusion is defined as the easy and affordable access of financial services by the poor and marginalized people (Asian Development Bank 2000; Beck and Demirgüç-Kunt 2008; Rangarajan 2008; Reserve Bank of India 2014). In recent years, the magnitude of financial inclusion has enhanced significantly in both developed and developing countries (Mader and Duvendack 2019). It has been observed that over the years, the accessibility and usability of formal financial products and services among the poor and marginalized sections of people are increasing (Hussain et al. 2021). Like high-income countries, adults from middle-income and low-income countries are also frequently using different modes of formal financial services in their day-to-day lifecycle. The recent adaptability of digital payment technologies across all sections of people has drastically augmented the overall financial transactions. Specifically, the rapid use of digital technologies during the COVID-19 pandemic are well noticed around the globe (see Sahay et al. 2020; Sornaganesh et al. 2020; Ozili 2020a, b). Hence, understanding the rising trend of digital technologies and the high accessibility of financial services among the mass sections of people, it is always a matter of inquisitiveness to demystify the fact how has the wide range of accessibility of basic finance impact corruption practices in the countries.

Corruption is always defined as the misuse of public power for the individual benefits. Hence, the corruptive behavior of the public authority has significant impact on the other socio-economic outcomes. Control of corruption has always been a key factor for the reduction of poverty, inequality (Gupta, et al. 2002), and unemployment (Adjor and Kebalo 2018; Abé Ndjié et al. 2019), and the overall economic development. Hence, comprehending the significance of control of corruption and observing the high accessibility of financial services among all sections of people, a debate has been erupted among the world academicians and policy makers for bringing a clear-cut evidence on the inter-relationship between financial inclusion and corruption. Some economists (like Raghuram Rajan) have argued in favor of financial inclusion and control of corruption. While delivering 20th Lalit Doshi memorial lecture in Mumbai (India), prof. Rajan emphasized that the promotion of financial inclusion and digital finance [like internet/mobile banking, direct benefit transfer (DBT), linking unique biometric identification with a bank account, etc.] can break the corrupt practices in public services. Conversely, a counter argument has been put forward that the high degree of financial inclusion with less financial literacy/awareness, no supervision, and inadequate regulation can enable people to access huge credit and allow them to invest their obtained credit in different unauthorized or illegal activities like insider trading, money laundering, gambling (Ajide 2020), which ultimately enhance the process of corruption in the country.

Understanding the theoretical arguments from both sides of financial inclusion on corruption, this study has endeavored to empirically examine the impact of financial inclusion in controlling corruption between the selected upper-middle- and lower-middle-income countries in the world. While, looking the World Bank

classification of countries on the basis of country's income, it can be understood that unlike low- and higher-income countries, upper-middle- and lower-middle-income countries have less income gap¹ in between them. Hence, it would always be a noteworthy attempt to study how the process of financial inclusion is responding differently to two almost similar kinds of income groups' countries.

This study contributes to the existing literatures of financial inclusion in the following ways. To the best of authors' knowledge, Ajide (2020) is the only empirical study which is depicting the role of financial inclusion in controlling corruption in 13 African countries. Hence, this is the first study which is empirically examining the same relationship in a cross-country level and trying to understand how the process of financial inclusion behaving differently in a cross-country level. Second, unlike Ajide (2020), this study uses principal component analysis (PCA) to construct financial inclusion indexes for both the upper-middle- and lower-middle-income countries. Third, this study examines the non-monotonic relationship between financial inclusion and control of corruption for both the groups of countries. Fourth, identifying the nature of the considered sample countries, it can be said that these countries are having different stages of financial inclusion and its inter-relationship with corruption. Hence, along with the overall sample, this study also endeavored to examine their inter-relationship for lower-middle and upper-middle income countries separately. Fifth, this study applies various panel data models to strengthen the regression results. Finally, this study also make an attempt to provide some valuable policy suggestions to both the groups of countries about the role of financial inclusion in control of corruption.

The rest of the paper is organized in the following manner. Section 2 of this paper describes the theoretical nexus between financial inclusion and corruption. Section 3 provides a brief review of literature. Section 4 gives a detailed explanation of the data and econometric techniques used in this study. Similarly, Sect. 5 presents the empirical findings and intensely discusses the results. Lastly, Sect. 6 delivers a concluding remark and suggests some valuable policy recommendations for the policy makers and governments.

2 Theoretical background

The theoretical foundation of corruption and finance is well described in the 'sand the wheels' hypothesis. This hypothesis depicts that the presence of corruption can adversely affect the financial sector development (see Cooray and Schneider 2018; Ajide 2020). The hypothesis further highlights that because of inadequate supervisory policies, large-scale regulation, insider trading, and the absence of transparency, corruption practices are enhanced, which further hampers the financial sector's development (see Khemani and Meyerman 1998; Song et al. 2021; Weill

¹ As per the 2021 classification of countries, countries' GNI from 1046 to 4096 are classified as lower-middle-income (LMI) countries, whereas GNI from 4096 to 12,695 are classified as upper-middle-income (UMI) countries.

2011a, b; Park 2012). That means in the context of financial inclusion, it can be said that because of the problem of adverse selection and moral hazard (Barth et al. 2004; Cooray and Schneider 2018), the financial resources are diverted that leads to inefficient allocation of money. Again due to lack of transparency and supervision in the system, misallocation of financial resources raises the volume of non-performing assets which further damages the financial stability of the country.

Additionally, this study can also borrow its theoretical foundation from the “rational choice theory”, which depicts that the practice of corruption happens because of the existence of asymmetric information between the agent and the principal (Svensson 2005; Kolstad and Søreide 2009; Dupuy and Neset 2018). According to the ‘rational choice theory’, the agent (i.e., government or the public authority) hold the monopoly power over the given information which allows the agent to hide information and to use that information for personal gains. With context to financial inclusion, the agents (i.e., the bank staffs) hold all the banking information and misguide the customers. Generally, in developing and under developed countries, people hold asymmetric information related to banking services because of their low financial literacy (Hussain et al. 2021). It gives an opportunity to the bank agent to hide the key information by misguiding the customers and taking bribe for providing banking services.

3 Review of literature

Much of the earlier research on corruption has focused on the nexus between corruption and economic growth. While studying the inter-relationship between corruption and growth, studies have found mixed results. Some of the studies (like Mauro and Driscoll 1997; Mo 2001; Ahmad et al. 2012; Thach et al. 2017) have found that corruption has a negative impact on economic growth. Whereas some other kind of literatures says that corruption has positive role on growth (Leff 1964; Méon and Weill 2010; Méndez and Sepúlveda 2006; Chakravorty, 2019). Similarly, while narrating the story of corruption and financial sector mismanagement, studies like Kane (1993) have claimed that there were many ways of corruption presented in the Japanese banking system which further led to a big banking crisis that happened in 1990s. Correspondingly, authors like MacFarlane (2001) have put the argument that corruption in the banking system, fraud actives, and loan-sharking by some bankers lead to the bank crisis in Japan. Concerning the Asian financial crisis, researchers like Khemani and Meyerman (1998) have argued that excess corruption, nepotism, and cronyism are the factors behind this crisis. Similar to this kind of results, some other studies (see Cooray and Schneider 2018; Song et al. 2021) have also found that corruption has a significantly negative impact on financial sector development. Similarly, other studies like Weill (2011a, b) and Park (2012) have argued that the presence of corruption in the banking sector promotes bad loans in the system. In another kind of literature (see Ahlin and Pang 2008), financial development and corruption are used for substitutability, and the author’s found that corruption raises the demand for liquidity which brings improvement in the financial system and oppositely financial underdevelopment brings more corruption in the system.

Diverging from these results, other studies by Thornton (2010) and Altunbaş and Thornton (2012) have argued that the development in the financial sector can reduce the corruption level. A recent study by Sharma and Paramati (2020) conducted an empirical study on 140 sample countries to know the impact of financial sector development on the control of corruption. Their empirical findings depicted that the development of the financial sector plays a significant role to control the growth of corruption across the full sample countries, low- and lower-middle-income countries, and upper-middle and high-income countries as well.

Through-out our literature journey, we observed that there are some studies which have depicted the nexus of corruption with economic growth and development. Some other studies have narrated how the presence of corruption in the banking system leads to bad loan and bank crisis. Similarly, while finding the nexus between financial development and corruption, we observed that there are a handful of studies existing on the relationship between financial development and control of corruption and vice-versa. Similar to financial development, we also found that some studies are narrating the inter-relationship between corruption and financial inclusion. The studies depicting the impact of corruption on financial inclusion have found mixed results. For example, one study was conducted by Abu et al. (2015) across the West African states and the study showed that lower level of corruption is increasing the saving rate in the West African states. Similarly, Eldomiaty et al. (2020) conducted another study across the world economics to examine how control of corruption is impacting the process of financial inclusion. In that study, the authors used control of corruption as one of the prominent indicators of good governance (along with other five indicators of good governance), and the study found that control of corruption has a positive significant effect on saving at financial institution, debit and credit card provision (Sha'ban et al. 2020; Ali et al. 2022). Conversely, one recent study by Malik et al. (2022) shows that governance quality (control of corruption is considered as one indicator) is negatively impacting financial inclusion in Asian counties.

From our literature review process, we realized that there are handful of studies depicting the impact of corruption on financial inclusion. However, while looking the literatures from reverse side (i.e., impact of financial inclusion on control of corruption), we found only one study (Ajide 2020) has been conducted in 13 African countries for the period of 2005–2016, to know the impact of financial inclusion on corruption control in African countries. The finding of the paper explains that financial inclusion intensifies the control of corruption. This study further discusses that there is a threshold level up to which financial inclusion will assist to control corruption and after the surpass of the threshold level, financial inclusion will have a negative impact on the control of corruption because of weak institutional factors present in African countries. Hence, from our literature journey, we found that Ajide (2020) is the only study which is showing the impact of financial inclusion on control of corruption in African countries. Looking at the dearth of cross-country evidence in the context of financial inclusion and control of corruption, this current study is an endeavor to find out the impact of financial inclusion on control of corruption considering some selected countries from both the upper-middle- and lower-middle-income groups. The findings of this study will surely help both the

upper- and lower-middle-income countries to redesign their financial inclusion policies, so that it would provide more positive results in controlling corruption.

4 Data and econometrics techniques used

4.1 Variable specification and data sources

This section briefly explains the number of variables used in this paper and its various data sources. To empirically examine the impact of financial inclusion on corruption, this study has collected data from 31 countries from both the upper- and lower-middle-income regions covering the time period of 2004–2018. Depending on the availability of data for all the countries and all the selected variables, this study has chosen 31 countries for its analysis. Out of these total 31 countries, this study has taken 16 countries from the upper-middle-income (UMI) groups and the rest of 15 countries are chosen from lower-middle-income (LMI) categories (see Table 5 in Appendix). For a division of countries on an income basis, this study has relied on the World Bank income-based classification of countries for the 2021 fiscal year.

4.1.1 Corruption

Country-wise corruption perception index² (CPI) score has been collected for 31 countries from transparency international. The trend of corruption in both the upper- and lower-middle-income countries has been presented in Figs. 3 and 4 in the appendix section of this paper. For both the income groups, periodical trend (i.e., 2004, 2014, and 2018) of corruption has been presented in Figs. 3 and 4 to know the status of corruption in these countries over the years (See Figs. 3 and 4 in Appendix).

4.1.2 Financial inclusion index

Measuring complete financial inclusion is always a challenging task because it cannot be measured in a single dimension. Financial inclusion includes multiple indicators from diverse financial services. In the financial inclusion literature, different indicators have been used by different researchers as per their data availability and suitability. In this present study, we have considered six different financial inclusion

² The CPI has been defined as the ‘misuse of public power for private benefit’ (Hamilton and Hammer, 2018). The CPI score refers to the perceived level of corruption in the public sector. Every individual country is assigned a corruption score which varies from 0 to 10. The score ‘0’ refers to the extreme level of corruption whereas the score ‘10’ refers to no presence of corruption. Each individual country score is developed by aggregating and averaging normalized scores of ‘corruption related data’ collected from various international data sources. Though some methodological limitations have been observed in the calculation of CPI (Álvarez-Díaz et al. 2018), it has been widely used among the researchers to measure the degree of corruption in a given country. Researcher like Ajide (2020) has used the same data for analyzing the impact of financial inclusion on corruption in selected African countries.

indicators covering three major dimensions of financial inclusion (i.e., demographic dimension, geographic dimension, and usage dimension). In the demographic dimension, we have considered the number of bank branches and number of ATMs per 100,000 adult population. Similarly, in the geographic section, we have chosen the number of commercial bank branches and the number of ATMs per 1000 km². Likewise, for measuring usage of financial inclusion, we have taken outstanding deposits and credit as a percentage of GDP. All these indicators are used by Lenka and Barik (2018) in their financial inclusion index calculation. All the indicators of financial inclusion are collected from the financial access survey of the International Monetary Fund (IMF).

4.1.3 Control variables

For control variables, we have used remittance receive as a percentage of county's GDP, GDP per capita, human capital, percentage of unemployment, and the rate of inflation. Some of the control variables like inflation, remittance, and unemployment has been used in earlier studies on financial inclusion and corruption (see Ajide 2020). Data for all the control variables have been collected from World Bank indicators (Table 1).

4.2 Measuring financial inclusion index in both upper- and lower-middle-income countries

Measuring a holistic and unbiased composite financial inclusion index is a challenging assignment for the researchers. Meanwhile, previous studies (Sarma 2008; Arora 2010; Gupte et al. 2012; Chakravarty and Pal 2013) have used different methods [like distance-based approach adopted by UNDP to compute HDI, analytical and hierarchical process (AHP) and axiomatic approach] to compute the index of financial inclusion. Each method has its own merits and demerits for computation of the index. For construction of multidimensional index, weights play a major role in the overall composite indicator. Most of the studies have used AHP method for calculation of weights of the variables in the composite index construction. However, the problem with AHP is that there is no prior information available about the weight of a particular variable (Lenka and Barik 2018). So, it may be messy for a researcher to assign weights for each variable looking the previous literature and expert opinions. Hence, AHP may not be a worthy method to find out the weight of factor included in the multidimensional index. In addition, looking at the volatility nature of financial access variables, AHP and distance-based approach may not solve unbiased index construction.

To overcome these deficiencies, the present study relies on the statistical procedure for the construction of weights of the factors i.e., the principal component analysis (PCA) method. PCA methods always requires the input variable to have a similar scale of measurement, i.e., variables are commonly standardized to zero mean and unit variance (Baxter 1995). This technique is used when the input variables are in different units of measurements. However, Jolliffe (1986) pointed out that if the

Table 1 Description of variables

Variables	Explanation	Data sources
Dependent variable	Measure the perception of corruption in the public sector	Transparency International
Corruption perception index (CPI)		
Independent variable	(a) Number of bank branches per 100,000 adult population	Financial Access Survey of International Monetary Fund
Financial inclusion index (FI)	(b) Number of ATMs per 100,000 adult population	
	(c) Number of bank branches per 1000 km ²	
	(d) Number of ATMs per 1000 km ²	
	(e/f) Outstanding deposit and credit as a percentage of GDP	
Control variables	(a) Received remittance % of GDP	World Bank Indicators
(a) REM (remittance)	(b) Gross domestic product per capita	
(b) GDPPC (GDP per capita)	(c) School enrolment ratio	
(c) HUM (human capital)	(d) Percentage of unemployment	
(d) UNEMP (unemployment)	(e) Rate of inflation	
(e) INF (inflation)		

Source: authors estimation

variables are in same units, standardization amounts to be an arbitrary choice before construction of multidimensional index. Though this study used various variables with different measurement units, the authors used following standardization process of variables before constructing index through PCA method.

$$\text{Standardization} = \frac{X - M}{SD}$$

where X = actual/original value of the variables, M = mean value of the series, and SD = standard deviation of the series.

The study uses six different indicators [automated teller machines (ATMs)] per 1000 km², automated teller machines (ATMs) per 100,000 adults, branches of commercial banks per 1000 km², branches of commercial banks per 100,000 adults, outstanding deposits with commercial banks (% of GDP), and outstanding loans with commercial banks (% of GDP) of financial inclusion for constructing a single index. For measuring the sample adequacy, the authors used Kaiser–Meyer–Olkin (KMO) and Bartlett’s Test of Sphericity test before running to PCA estimation in each of the separate countries. The average score of KMO for FII variables in different countries lies between 0.68 and 0.74 and significant Bartlett test value also (see Table 8 in the appendix section).

In the PCA method, first we calculate the factor scores (weights) through their eigenvalues. Then we calculate the factor score (weights) of each variable and multiply it with the respective original variable. Finally, we add them together to get the single value of the composite index for i th state for a particular time period t . Hence, for constructing a single index of financial inclusion, the formula is expressed as:

$$FII_{it} = W_{i1}X_1 + W_{i2}X_2 + W_{i3}X_3 + \dots \dots + W_{ip}X_p \quad (1)$$

Here, FII_{it} is the financial inclusion index; W_i is the weight of the factor coefficient, X is the respective original value of the component, and p is the number of variables used. Here, the financial inclusion index for all the countries are calculated by adding together the entire factor scores (weights) and their respective original values. FII_{it} is the financial inclusion index of i th state for the time period t and $W_1, W_2, \dots, \dots, W_6$ are the weights of different factor scores. Finally, the financial inclusion index for all the 31 countries (16 countries for UMI and 15 countries for LMI) from both the income groups have been calculated (see Figs. 1 and 2 in Appendix). For both the income groups, periodical trends (i.e., 2004, 2014, and 2018) of financial inclusion have been presented in the figure to know the growth of financial inclusion in these countries over the years.

4.3 Empirical models

The prime objective of this paper is to empirically examine the impact of financial inclusion on control of corruption from the selected upper-middle- and lower-middle-income countries. The following econometric model is specified to materialize our above cited objectives as follows:

$$\begin{aligned} \text{CRP}_{it} = & \alpha_0 + \beta_1 \text{FII}_{it} + \beta_2 \text{REM}_{it} + \beta_3 \text{GDPPC}_{it} \\ & + \beta_4 \text{HUM}_{it} + \beta_5 \text{UEMP}_{it} + \beta_6 \text{INF}_{it} + \mu_{it} \end{aligned} \quad (2)$$

Here, in the above equation, CRP_{it} represents the control of corruption and is used as dependent variable. FII indicates a financial inclusion index and is used in the main independent variable. Along with FII, this study also uses some control variables such as received remittance as a % of GDP (REM), per capita gross domestic product (GDPPC), human capital (HUM), rate of unemployment (UEMP), and rate of inflation (INF) and the μ_{it} refers to the error term. The subscript (i, t) denotes the cross sectional and time dimensions of the panel.

The selected control variables have been well supported with the previous literature. As defined in the Eq. (2), the study uses REM, PGDPC, HUM, UEMP, and INF as its control variables. Previous literatures (like Ajide 2020 and Sharma and Paramati 2020) have used the same variables in their studies. The control variables like REM and GDPPC have important connection with the control of corruption. The inflow of high remittance to the economies and the rise in per capita income can encourage the people to use modern digital technologies for their financial transaction, which may help to reduce corruption in the economies. Correspondingly, the huge inflow of remittance to countries can also help the migrants to have greater political voice and that may bring more transparency in the public administration (Ajide and Olayiwola 2020). Likewise, HUM can also reduce corruption by promoting basic literacy in general and financial literacy in particular among the citizens. The study also chooses UEMP as one of the controls because the presence of high unemployment in the economies may lead to enhance the corruptive practices among the youth. Similarly, the rate of inflation (INF) may increase the corruption behaviors among the citizens by losing their income and encouraging them to be involved in corrupt practices (see Akca et al. 2012).

Furthermore, the study used nonlinear term of financial inclusion (FII^2) to ensure an evaluation of threshold level of financial inclusion (see Ozili 2020a, b; Nizam et al. 2020) in both selected UMI and LMI countries. Because of wide variation in the socio-economic characteristics, financial inclusion is having non-monotonic nature in these two categories of countries. In a simple way, it can be said that there are huge socio-economic and institutional differences existing in between these two categories of nations. These differences can lead to the unequal accessibility of financial services among the peoples of these two groups of countries. Hence, to capture the variability in financial accessibility, the study has taken threshold level of financial inclusion (FII^2) as an independent variable along with the baseline financial inclusion index (FII), especially for the UMI and LMI countries. Therefore, the econometric model can be described in the following manner.

$$\begin{aligned} \text{CRP}_{it} = & \alpha_0 + \beta_1 \text{FII}_{it} + \beta_2 \text{FII}_{it}^2 + \beta_3 \text{REM}_{it} \\ & + \beta_4 \text{GDPPC}_{it} + \beta_5 \text{HUM}_{it} + \beta_6 \text{UEMP}_{it} \\ & + \beta_7 \text{INF}_{it} + \mu_{it} \end{aligned} \quad (3)$$

4.3.1 Estimating techniques

The study uses both fixed effect and random effect models to measure the impact of financial inclusion on the control of corruption. Moreover, the random effect model is chosen for final interpretation of the result based on the Hausman test. Though panel data are mainly based on the two dimensions, i.e., time and cross-sectional dimensions; there might be the issue of autocorrelation and heteroscedasticity in the dataset. To take care of these issues, the study employs panel corrected standard errors (PCSEs) and feasible general least square method (FGLS) for robustness of the results. At the end, both PCSEs and FGLS are not sufficient to solve the issue of endogeneity or any potential problem of variables omission. To overcome these problems, the study relies on the instrument variable techniques (i.e., two-stage least-square-2SLS) and re-estimate the results.

5 Empirical findings and discussion

The motto of this study is to examine the impact of financial inclusion on controlling corruption among the 31 selected upper-middle- and lower-middle-income countries for the period of 2004–2018. To address the above question, the paper estimates three different regressions. First, the study examined the impact of financial inclusion on control of corruption taking the whole 31 countries. This study further segregated the data into two different samples, i.e., upper-middle-income (UMI) countries and lower-middle-income (LMI) countries and examined the same objective differently among these two categories of nations. The main purpose of doing separate regression for two separate categories of nations is to understand if any regional characteristics have impacted the outcomes. Because two categories of nations (i.e., UMI and LMI) have different social, economic, and institutional setup in their respective regions. Moreover, while segregating the whole dataset into two different categories (based on the World Bank classification), we have selected 16 countries for UMI countries and the rest 15 countries are used for LMI countries.

5.1 Results of financial inclusion and control of corruption: for full sample countries

This overall sample includes data from both the UMI and LMI countries. The findings from the overall sample countries depict that financial inclusion have a positive and significant effect on the control of corruption in the overall sample countries (see Table 2). The positive impact of financial inclusion on corruption control indicates that with the rise in the degree of financial inclusion in these selected countries, the basic financial literacy increases among the people, which further restricts the citizens to engage in any form of corrupt financial behavior.

Table 2 Impact of financial inclusion on corruption for full sample countries from 2004 to 2018

Variables	FE Model-1	RE Model-2	PCSEs Model-3	FGLS Model-4	IV-2SLS Model-5
FI	- 0.0013 (0.0020)	0.0004 (0.0018)	0.0038*** (0.0009)	0.0038*** (0.0014)	0.0562** (0.0282)
REM	- 0.0205* (0.0096)	- 0.0182* (0.0091)	- 0.0154*** (0.0032)	- 0.0154*** (0.0065)	- 0.0439** (0.0199)
GDPPC	3.0305*** (0.2990)	2.5211*** (0.2616)	0.8537*** (0.0718)	0.8537*** (0.1428)	2.1764 (1.6503)
HUM	1.6774* (0.7515)	1.8307* (0.7422)	1.6411*** (0.5289)	1.6411* (0.9111)	8.5296** (4.1033)
UEMP	- 0.0021 (0.0054)	- 0.0004 (0.0054)	- 0.0376*** (0.0047)	- 0.0376*** (0.0055)	- 0.0718*** (0.0212)
INF	- 0.0138*** (0.0035)	- 0.0145*** (0.0035)	- 0.0160*** (0.0049)	- 0.0160*** (0.0060)	- 0.0118 (0.0189)
C	- 11.813*** (1.8512)	- 10.2043*** (1.7454)	- 3.5518*** (1.2657)	- 3.5518* (1.9065)	- 8.1793* (4.4744)
Observation	465	465	465	465	465
R-square	0.3664	0.3641	0.3341		0.4357
F-statistics	41.25				
Prob. (F-statistics)	0.0000				
Wald χ^2		236.82	818.91	233.34	63.36
Prob > χ^2		0.0000	0.0000	0.0000	0.0000
Hausman test		- 7.39			
Log likelihood				- 467.5802	
Durbin(score) $\chi^2(1)$					13.2216 ***
Wu-Hausman F(1,457)					13.3744***
No. of countries	31	31	31	31	31

Source: authors estimation

Dependent variable: corruption

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

On the other side, with rising financial consciousness, it becomes difficult for financial fraudsters to cheat the people or to illegally engage them in any corrupt practices.

Furthermore, the overall increment of financial inclusion helps to reduce poverty (see Lal 2018; Inoue 2019; Zhang and Posso 2019; Churchill and Marisetty 2020; Ahamed and Gutiérrez-Romero 2020) and enhances the basic standard of living among the national citizens. The improvement in basic standard of living allows individuals to use digital technology in their day-to-day financial transactions. The frequent use of digital payment technologies helps to check the corrupt financial transaction and brings more transparency within the system. Hence, the overall increment of financial inclusion has a positive and significant effect on the control of corruption among the overall sample countries.

The result of the control variables depicts that remittance inflow (REM), unemployment rate (UEMP), and inflation (INF) have negatively impacted the process of corruption control in the overall sample countries. The huge inflow of remittance can have negative impact on the control of corruption because the huge inflow of remittance to the economies can divert the public goods provision and because of higher income, migrants can obtain more favor from the public authorities by providing them with more bribes (see Berdiev et al. 2013). Similarly, the presence of unemployment in the economies can also promote the corruptive behavior among the national citizens. This is because, the persistence of high unemployment can provide an opportunity to the youth to give bribe to the public authority to obtain a job in the public sectors. Likewise, the presence of price instability in the economies due to high inflation rate can hinder the process of corruption control in the economies. However, other control variables like GDP per capita (GDPPC) and human capital (HUM) have positively impacted the control of corruption. On one side, the increment of individual income allows the individual to access basic amenities and can encourage the individual to less involve in corrupt practices. Similarly, with rise in income level, the individuals can opt to use modern mode of digital payment in their day-to-day financial transaction, which ultimately decay the corruptive behavior within the system. Likewise, the improvement in human capital by enhancing basic literacy level can augment the social consciousness of the negative consequence of corruption, which may enforce the individuals to less engage in corruptive practices.

5.2 Results of financial inclusion and control of corruption: for upper-middle-income (UMI) countries

The impacts of financial inclusion on control of corruption among the UMI countries are presented in the following table (Table 3). Here, in Table 3, we have used two levels of financial inclusion. One is the baseline level and another one is the threshold level. The reasons for leveling the financial inclusion data are to verify the impact of financial inclusion on control of corruption at the primary level and with the extensive level of financial inclusion. Here, the table has shown the impact of both baseline and threshold level financial inclusion on control of corruption. The

Table 3 Impact of financial inclusion on corruption for upper-middle-income countries from 2004 to 2018

Variables	FE Model-1	RE Model-2	PCSEs Model-3	FGLS Model-4	IV-2SLS Model-5
FI	-0.01647*** (0.0057)	-0.0158*** (0.0055)	-0.0319*** (0.0087)	-0.0319*** (0.0053)	-0.0733*** (0.0204)
FI ²	0.0001*** (0.0003)	0.0001*** (0.0003)	.0003*** (0.0007)	0.0003*** (0.0004)	0.0007*** (0.0001)
REM	-0.0973*** (0.0342)	-0.0606* (0.0280)	-0.0450*** (0.0067)	-0.0450*** (0.0150)	-0.0591*** (0.0188)
GDPPC	1.8454*** (0.4929)	1.6337*** (0.4509)	0.4213* (0.2242)	0.4213 (0.3302)	0.3364 (0.5921)
HUM	1.4706 (1.2389)	1.5198 (1.2571)	0.9240 (0.8563)	0.9240 (1.4086)	0.2451 (1.6884)
UEMP	-0.0093 (0.0071)	-0.0014 (0.0068)	-0.0556*** (0.0079)	-0.0556*** (0.0060)	-0.0680*** (0.0095)
INF	-0.0365*** (0.0076)	-0.0374*** (0.0078)	-0.0468*** (0.0113)	-0.0468*** (0.0126)	-0.0167 (0.0225)
C	-6.8750* (3.5477)	-6.2562 (3.4452)	0.4949 (2.1931)	0.4950 (3.4360)	6.5620 (4.9530)
Observation	240	240	240	240	240
R-square	0.3857	0.3788	0.4317		0.498
F-statistics	19.46				
Prob. (F-statistics)	0.0000				
Wald χ^2		116.67	302.50	182.31	107.27
Prob > χ^2		0.0000	0.0000	0.0000	0.0000
Hausman test		-7.05			
Log likelihood				-228.1258	
Durbin(score) $\chi^2(1)$					40.8487***
Wu-Hausman F (1.457)					23.5881***
No. of countries	16	16	16	16	16

Source: authors estimation

Dependent variable: corruption

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

baseline result in Table 3 depicts that financial inclusion has a negative and significant impact on the control of corruption across the models presented in columns 1–5. However, the threshold result of financial inclusion demonstrates that financial inclusion has a positive and significant effect on the control of corruption in UMI countries. That means, in UMI countries, financial inclusion has no impact on the control of corruption up to a certain threshold level, while a further increase in financial inclusion beyond the threshold level helps significantly to control corruption in these selected countries. These results can further describe as that in the UMI countries, majority of citizens can access basic financial services at an easy and affordable cost and this basic accessibility of financial services does not have any impact on the control of corruption. Whereas, after the surpass of a threshold level, financial inclusion has a positive impact on the control of corruption. This is happening because the upsurge of financial inclusion beyond the threshold level helps to spur economic growth in the counties (see Sharma 2016; Lenka and Sharma 2017; Sethi and Acharya 2018), which ultimately assists to increase the government expenditure on the provision of public goods. Because of the provision of more public goods from the government, the citizens would not be involved in any corrupt practices to access their basic amenities. Correspondingly, the rise of financial inclusion above the threshold level would allow the individuals to access more credit from the formal financial system and that obtained credit will be invested in the market by the individuals, which will bring more income to the individuals. The escalation of an individual's income through financial inclusion would allow the government to have more tax collections based on the citizen's income (Mitchell and Scott 2019). Again, the collection of more tax revenue would support the government to spend more on the provision of public goods, which would further restrict the citizens to engage in any corrupt practices. Moreover, the rise in government revenue would also spur digital innovation through the government expenditure on research and development (R&D). In the UMI countries, with a strong bureaucratic system, the use of digital technologies would help to bring more transparency in the organizations and reduce the corruptive behavior among the citizens. Therefore, after a threshold level, financial inclusion has a very positive and significant impact on the control of corruption in UMI countries.

With regard to the control variables used for UMI countries, we found that remittance has a negative and significant impact on the control of corruption. The inflow of more remittance to the economies can hinder the process of corruption control. Similarly, the findings illustrate that the degree of economic development which is proxied by per capita GDP (GDPPC) has a positive and significant impact on the control of corruption (An and Kweon 2017). This result depicts that the process of economic development helps to control corruption in the UMI countries. With the rise in GDP per capita, the citizens opt to use more modern digital technologies (like mobile/internet banking, automated teller machine, credit cards, etc.) in their financial transactions which bring more transparency in their financial transactions and reduce corruption by removing the middlemen participation. Additionally, with more economic development, countries endeavor to strengthen their public institutions and bureaucratic structure, which support to convey more transparency and accountability within the system. A similar kind of study was conducted by Sharma

and Paramati (2020) showing the impact of financial development on controlling corruption in 140 countries across the globe. The results of that study show that per capita income positively impacts the control of corruption across selected countries. As expected, human capital (HUM) which is proxied by primary school enrollment ratio, has a positive and significant impact on the control of corruption. Likewise, the impact of unemployment on control of corruption describes that unemployment (UEMP) has a negative and significant impact on the control of corruption. That means the presence of high unemployment in the economies can hamper the drive of corruption control. This is because the incidence of high unemployment in the countries can provoke the youths to engage in corrupt practices to obtain a job. Similarly, this can also encourage the fake employment agencies and companies to involve in corrupt practices by taking money and providing false employment assurance to the youths. However, it is found that the rate of inflation (INF) in the countries has a negative and significant impact on the control of corruption in the UMI countries. That means the rise in the inflation rate creates price instability in the economies, which negatively influences the control of corruption in the studied countries (Akca et al. 2012).

5.3 Results of financial inclusion and control of corruption: for lower-middle-income (LMI) countries

Here, the present section demonstrates the results of financial inclusion and control of corruption in lower-middle-income (LMI) countries. Like the previous section (i.e., UMI countries), here also we have depicted the threshold level impact of financial inclusion on control of corruption along with its baseline results. However, unlike the UMI countries, here we have found a contrast result for LMI countries. The baseline result of financial inclusion indicates that financial inclusion has a positive effect on the control of corruption across the five models (see Table 4). Whereas the threshold result depicts that after the surpass of a threshold level, financial inclusion has a negative impact on the control of corruption in the LMI countries. That means in LMI countries, up to a certain threshold level, financial inclusion significantly helps to control corruption. However, a further enhancement of financial inclusion beyond that threshold level hinders the control of corruption in these countries. These findings further indicate that the accessibility of basic formal financial services plays a pioneering role to reduce corruption in the LMI countries. Whereas, the greater intensification of financial accessibility among the LMI countries' people can have a downside impact on the corruption reduction process. This result clearly illustrates that beyond the threshold level, more intensification of financial inclusion can produce financial risk for the LMI countries people. This is quite possible because, in LMI countries with the poor institutional quality and weak organizational structure, it would be fairly difficult to supervise and regulate the financial accessibility service. It can further be argued that the more intensification of financial inclusion allows low-income individuals to access financial services (including formal credit) without proper scrutiny and risk measure. This kind of financial accessibility sometimes encourages criminals, hackers, and fraudsters

Table 4 Impact of financial inclusion on corruption for lower-middle-income countries from 2004 to 2018

Variables	FE Model-1	RE Model-2	PCSEs Model-3	FGLS Model-4	IV-2SLS Model-5
FI	0.0095 (0.0111)	0.0081 (0.0106)	0.0072 (0.0070)	0.0072 (0.0105)	0.0475** (0.0263)
FI ²	-0.0001 (0.0001)	-0.0009 (0.0001)	-0.0002*** (0.0009)	-0.0002** (0.0001)	-0.0008** (0.0004)
REM	-0.0282*** (0.0096)	-0.0203** (0.0090)	-0.0088** (0.0041)	-0.0088 (0.0070)	-0.0080 (0.0075)
GDPPC	3.0927*** (0.4629)	2.8805*** (0.4216)	2.1870*** (0.2338)	2.1870*** (0.2794)	2.0085*** (0.3098)
HUM	1.4237 (0.9920)	2.0223** (0.9584)	2.7160*** (0.6292)	2.7160*** (0.9846)	3.0348*** (1.0618)
UEMP	-0.0152 (0.0101)	-0.0120 (0.0098)	-0.0046 (0.0099)	-0.0046 (0.0106)	-0.0036 (0.0121)
INF	-0.0070** (0.0037)	-0.0067** (0.0037)	-0.0015 (0.0057)	-0.0015 (0.0059)	-0.0070 (0.0071)
C	-11.3743*** (2.1241)	-11.7328*** (2.0377)	-10.2532*** (1.6760)	-10.2531*** (2.1430)	-0.8784*** (2.3316)
Observation	225	225	225	225	225
R-square	0.4861	0.4838	0.4011		0.3218
F-statistics	27.43				
Prob. (F-statistics)	0.0000				
Wald χ^2		184.61	375.61	150.72	125.45
Prob > χ^2		0.0000	0.0000	0.0000	0.0000
Hausman test		8.66			
Log likelihood				-178.5791	
Durbin(score) $\chi^2(1)$					4.81295**
Wu-Hausman F(1,457)					2.34978**
No. of countries	15	15	15	15	15

Source: authors estimation

Dependent variable: corruption

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

to access formal loans by giving money to the bank staffs or by providing fake documents. Similarly, greater accessibility of bank credits can provoke individuals to engage themselves in other financial crimes like insider trading, money laundering, gambling, etc. Because people from LMI countries normally have less financial literacy and low investment skills, which would further mislead them in their financial investment. Additionally, the greater intensification of financial inclusion would enhance the use of digital transaction technologies in the LMI countries. The frequent use of digital transaction technologies without proper digital training and institutional supervision can also promote cyber hacking and financial crimes in the LMI countries.

Similarly, the LMI counties generally have a very low presence of bank branches in rural and remote areas; hence, it is quite difficult for the rural people to access banking services at an easy and affordable charge. This incidence provokes the middlemen to provide banking services (like proving bank credits, ATM and other digital technology services) by taking some amount of money from the customers. Even sometimes, the bank staffs may take some amount of bribe for extending the banking services. As a result of all these reasons, financial inclusion after a threshold level has a negative effect on the control of corruption in the selected LMI countries. The finding of this study is relatively associated with the finding of Ajide (2020), where the author conducted a cross-country study considering 13 African countries. The finding of that paper depicts that after the surpass of a threshold level, financial inclusion has a negative impact on the control of corruption in the selected African countries (see Ajide 2020).

Except for the main variable (i.e., FI), the results of control variables for LMI are quite similar to the control variables findings of UMI countries. Like the UMI countries, we found that remittance (REM), unemployment (UNMP), and inflation rate (INF) have a negative impact on the control of corruption. Whereas the other two variables, i.e., per capita GDP (GDPPC) and human capital (HUM) have a positive and significant effect on the control of corruption in LMI countries. The analysis of the control variables for LMI countries follows the same arguments as UMI countries.

6 Concluding remarks

The practice of corruption severely affects the social, economic, and political behavior of the nation. Most specifically, corruption affects the process of economic development, issues of unemployment, social and political stability, and more importantly the everyday lives of the general people. Understanding the gravity of the issue, policy makers and academicians across the globe have taken their interest to study the various aspects of corruption (Goel and Nelson 2010; Corrado and Rossetti 2018). Correspondingly, the beginning of the twenty-first century has also witnessed rapid progress in the process of financial inclusion among the developing and lower developed countries. The rise in basic financial inclusion has also witnessed the corresponding rise in digital payment technologies across the globe. Hence, given this background, this study is an endeavor to empirically examine the role of

financial inclusion in the process of corruption control. Furthermore, to understand the dynamic relationship between these variables, we further segregated our analysis into two categories of nations, i.e., upper-middle-income (UMI) and lower-middle-income (LMI) countries.

The empirical finding of this study illustrates that, in the overall sample countries, financial inclusion is playing a pioneering role in the control of corruption. Furthermore, while empirically examining the same objective by considering the baseline and threshold level of financial inclusion among the UMI and LMI countries, our findings show very interesting relationship between these two variables. The findings from UMI countries demonstrate that at the basic level, financial inclusion does not affect the control of corruption. While the more intensification of the financial inclusion process significantly plays a positive role to control corruption in the selected UMI countries. Likewise, the results from LMI countries suggest pure contrast answers. The results show that the basic level of financial inclusion is having a significant role to play in the process of corruption control. Whereas, the surpass of financial inclusion beyond the threshold level is having a downside impact on the control of corruption in the selected LMI countries. Concerning to the control variables, the result depicts that across the three categories of nation, the sign of all the control variables remains the same. The control variables like remittance (REM), unemployment (UNMP), and inflation rate (INF) are having a negative impact on the control of corruption, whereas other two control variables such as per capita GDP (GDPPC) and human capital (HUM) are having a positive and significant effect on the control of corruption across the three categories of nations.

6.1 Policy implications

Based on our empirical findings, this study takes an opportunity to propose some valuable policy suggestions to the policy makers. The findings show that the overall sample of financial inclusion is positively impacting to the control of corruption. Similarly, in the case of UMI countries, an extension of financial inclusion beyond the basic financial accessibility significantly impacts the control of corruption. Based on this result, it can be suggested that the UMI countries should give more priority to the intensification of financial inclusion process as it is more beneficial for controlling corruption. However, in the case of LMI countries, the empirical findings suggest that, up to a certain threshold level, financial inclusion can play a pivotal role to control corruption, whereas the extension of financial inclusion beyond the threshold level can increase the level of corruption. From this result, it can be said that in case of LMI countries, because of less financial literacy/awareness, low financial supervision, and weak institutional structure, more intensification of financial inclusion after a certain level can enhance the process of corruption. This kind of result does not discourage more intensification of financial inclusion in LMI countries. Rather, it suggests, along with the enhancement of financial inclusion, LMI countries should also give equal importance to financial literacy/awareness, stringent

financial supervision policy, and strong institutional structure to reduce the level of corruption in their countries.

Appendix

See appendix Tables 5, 6, 7, 8.

Table 5 List of countries considered for this study

Sl. No.	WB classification	Country	Sl. no.	WB classification	Country
1	UMIC	Brazil	17	LMIC	Moldova
2	UMIC	Bulgaria	18	LMIC	Egypt
3	UMIC	China	19	LMIC	India
4	UMIC	Costa Rica	20	LMIC	Kenya
5	UMIC	Ecuador	21	LMIC	Morocco
6	UMIC	Guatemala	22	LMIC	Pakistan
7	UMIC	Kazakhstan	23	LMIC	Philippines
8	UMIC	Malaysia	24	LMIC	Tunisia
9	UMIC	Mexico	25	LMIC	Ukraine
10	UMIC	Peru	26	LMIC	Vietnam
11	UMIC	Russia	27	LMIC	Zambia
12	UMIC	Serbia	28	LMIC	Zimbabwe
13	UMIC	South Africa	29	LMIC	Bangladesh
14	UMIC	Indonesia	30	LMIC	Ghana
15	UMIC	Thailand	31	LMIC	Sri Lanka
16	UMIC	Turkey			

Source: authors estimation

Table 6 Descriptive statistics for all 31 countries

	Mean	Standard deviation	Minimum	Maximum
CPI	3.373118	0.8114137	1.5	5.9
FI	43.6712	27.37524	3.716863	100
REM	4.650598	5.23452	0.0932936	34.499
LGDPPC	3.915394	0.2964055	3.168833	4.450265
LHUM	2.018941	0.0357658	1.887118	2.128788
UEMP	7.332232	5.836214	- 10.4974	30.91959
INF	6.419217	5.359475	- 2.4095	48.69986

Source: authors estimation

Table 7 Correlation matrix for all 31 countries

	CPI	FI	REM	LGDPCC	LHUM	UEMP	INF
CPI	1.0000						
FI	0.3047	1.0000					
REM	- 0.2897	0.1185	1.0000				
LGDPCC	0.4841	0.5739	- 0.4078	1.0000			
LHUM	0.1124	0.1652	- 0.1209	0.0129	1.0000		
UEMP	- 0.3248	- 0.0718	- 0.1246	0.1562	0.0827	1.0000	
INF	- 0.1795	- 0.1505	0.0521	- 0.1361	- 0.2183	0.0329	1.0000

Source: authors estimation

Table 8 KMO and Bartlett’s test

Kaiser–Meyer–Olkin measure of sampling adequacy	0.682
Bartlett’s test of sphericity	
Approx. χ^2	234.293
df	15
Sig.	0.000

See appendix Figs. 1, 2, 3, 4.

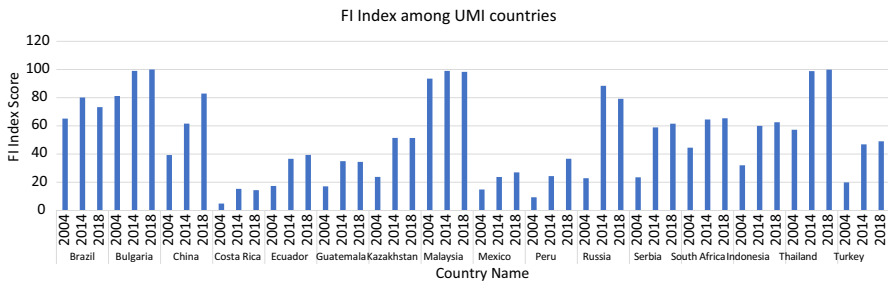


Fig. 1 Status of financial inclusion in UMI countries

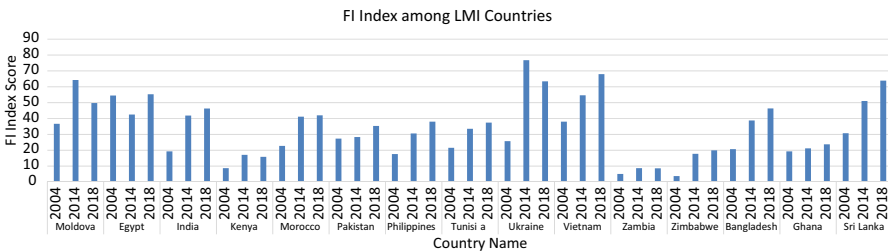


Fig. 2 Status of financial inclusion in LMI countries

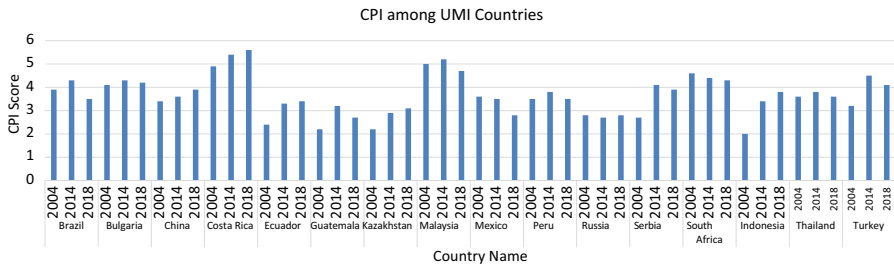


Fig. 3 Status of corruption in UMI countries

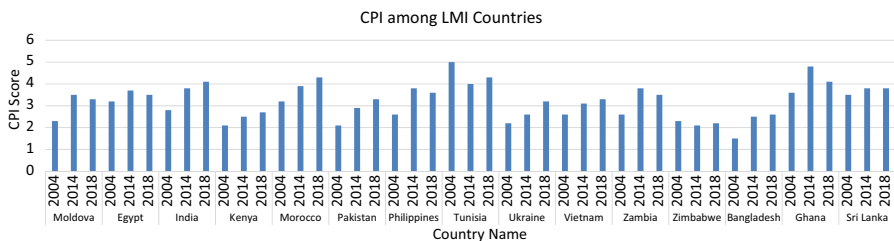


Fig. 4 Status of corruption in LMI countries

Data availability All the data used in this study is available in the public domain. The Individual sources of data availability is mentioned in the data description Table 1.

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