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Does corruption contribute to the rise of the shadow economy? Empirical evidence from Uganda

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Abstract: This paper investigates whether corruption has contributed to the rise of the shadow economy in Uganda. Using autoregressive distributed lag bounds testing approach and granger causality econometric methods we find a positive relationship between corruption and the size of the shadow economy in both the long- and short-run. Additionally, the causality results reveal a bidirectional causal relationship between the shadow economy and corruption, and vice versa. These findings suggest that, for the case of Uganda, an increase in corruption contributes to the rise in the size of the shadow economy and vice versa, all else equal. Given the complementary relationship between corruption and the size of the shadow economy, addressing widespread informality in the country would require; first, reforming the political system to tackle political corruption and go after politicians who use their influence and power to circumvent institutions. Second, carrying out institutional reforms to address political patronage and influence peddling would go a long way into addressing systemic corruption which in turn could help mitigate the spread of informal sector activities. Third, strengthening the enforcement of existing laws to identify and punish culpable public officials who use their offices for private gain would also address the level of informality in the country.

ABOUT THE AUTHOR

Stephen Esaku is a lecturer of Economics in the department of Economics and Statistics Kyambogo University Uganda (Soroti campus). He holds a Phd in Economics specializing in international economics and Development. His research interests are in the areas of international economics (firms in international trade, regional integration, foreign direct investment), and Development economics (focusing on economic growth and development, poverty dynamics, corruption and gender studies) and empirical industrial economics (learning, pricing and market strategies). Stephen has published papers on firm-level investment and Exporting; Export markets and productivity; employment dynamics in Sub-Saharan Africa; Job creation and destruction in an African economy, among others. His teaching experiences spans 8 years.

PUBLIC INTEREST STATEMENT

There is empirical evidence showing the rise and expansion of informal sector activities and corruption in Uganda. Both informality and corruption are detrimental to the growth of a country because they distort the proper functioning of the market mechanism, requiring government's intervention to correct them. Previously, a number of papers have analyzed these variables independently but little is known on how the interaction between these two variables affects each other in Sub-Saharan African context. This paper fills this gap. This paper finds that an increase in corruption increases the size of the shadow economy in both the short- and long-run and a rise in informality results into corruption.

Subjects: African Studies; Introductory Politics; Development Economics; Political Economy; Public Finance; Entrepreneurship

Keywords: Corruption; informal sector; tax evasion and avoidance; country-level studies; shadow economy
GEL classfications: D73; H26; K49; O5; O17

1. Introduction

The existence of corruption[1] and the shadow economy[2] or informal sector has become a recognized fact of everyday life across the world. These vices seem to be common and expanding, especially in countries where the institutional framework is not sufficient to support the proper functioning of the market mechanism (see Elgin & Oztunali, 2014; De Soto, 1989). To curb their expansion, most countries try to institute measures that make it costly to engage in these activities. Such measures include prosecution and punishment, and in some cases sensitization and ensuring improvements in the provision of public services. Corruption and the shadow economy undermine governments' ability to ensure efficient collection of taxes and provision of public services (Esaku, 2021e). Moreover, both corruption and the shadow economy create economic distortions in the efficient allocation of resources that sustain the livelihoods of the population. Additionally, the shadow economy has also been noted to create more pressure on the formal economy by increasing competition for resources that would otherwise be available for firms that are formally registered and paying taxes (Schneider & Enste, 2000). The above distortions create biases in macroeconomic indicators like consumption expenditure, income level, participation rates of the labor force and unemployment level leading to misrepresentation of actual economic reality in the country (Blackburn et al., 2012; Capasso & Jappelli, 2013; Esaku, 2021e). Consequently, policy makers who rely on data with these distortions may find difficulty in crafting effective monetary and fiscal policies to guide economic growth.

Recent research has attempted to study the shadow economy and corruption in isolation (independent of each other), with a small number of papers explicitly addressing the connection between these variables (see Buehn & Schneider, 2012a; Choi & Thum, 2005; Dreher & Schneider, 2010; Goel & Saunoris, 2014). Theoretical models have been advanced to show how these variables interact. For example, Choi and Thum (2005) develop a theoretical framework to examine the relationship between the shadow economy and corruption in the presence of entrepreneurial heterogeneity. In their model, they show that entrepreneur's incentive to operate underground constrains the ability of the corrupt official to use public power for private gain thereby enhancing the operations of the formal economy. Viewed from this lens, corruption and the shadow economy are negatively correlated (substitutes) as the latter tempers any distortions introduced by corruption. The above authors conclude that the formal economy and the informal economy should be seen as complements instead of substitutes because of the ability of the latter to enhance economic activities in the former. Similarly, Johnson et al. (1997) present a model in which they consider the allocation of labor between the shadow and the formal economy and present evidence to support a positive relationship (complementary relationship) between corruption and the shadow economy. The above authors show that corruption acts like an additional tax to the entrepreneur so that its presence induces more entrepreneurs to operate underground thereby concealing their production and distribution of goods and services from the "eye" of the public officials.

Correspondingly, Johnson et al. (1998) study how bribes act as a driving force in the growth of the shadow economy and find evidence to support a positive relationship between these variables. The above authors show that in economies where the rule of law is weak, the presence of corruption leads to substantial growth of the informal economy. Their study emphasizes that it is not taxes or regulation in itself that is important but the role governments play in controlling corruption. Friedman et al. (2000) reach similar conclusions in which they show that corruption and

the shadow economy are complements. Similar findings are shown by Hibbs and Piculescu (2005) who emphasize that the "grabbing hands" of the corrupt official may also serve as the "helping hands" that induce entrepreneurs, who see the "grabbing hands" as an extra burden, to operate underground.

On the empirical side, some studies have examined the relationship between corruption and the shadow economy. For example, Buehn and Schneider (2012a) investigate the relationship between the show economy and corruption using a sample of 51 countries around the world and show evidence of a positive relationship between the two variables. In their analysis, the high levels of corruption lead to the growth of the informal economy, as entrepreneurs try to circumvent the "extra cost" imposed by corruption. Moreover, the above authors show that less regulation and lower levels of taxation dampen the ability of corrupt officials to ask for bribes as most entrepreneurs prefer to operate in the formal economy to benefit from government incentives that may be available to formal firms. Additionally, Schneider (2007) presents estimates of the shadow economy across 145 countries and shows that the shadow economy increases corruption in low income countries and reduces corruption in high-income countries. Goel and Saunoris (2014) analyze the relationship between the shadow economy and corruption and find evidence to support a positive relationship between the shadow economy and corruption. Conversely, Dreher and Schneider (2010) use data from a cross-section of 98 countries to study the relationship between corruption and the shadow economy. Their empirical analysis shows no robust link between the shadow economy and corruption when indices of perception of corruption are used, except when the index of corruption from the structural model is used. The use of index of corruption shows that the shadow economy and corruption are positively correlated, especially in low-income countries.

From both the theoretical and empirical literature, there is evidence that the relationship between the shadow economy and corruption is still a contentious issue. Theoretically, the relationship between the shadow economy and corruption could either be a non-reinforcing one (see Choi & Thum, 2005) or a reinforcing one (positive) (see Friedman et al., 2000; Hibbs & Piculescu, 2005; Johnson et al., 1998). This theoretical evidence shows that whether the shadow economy and corruption should be seen as complements or substitutes is still a controversial issue. Furthermore, the empirical examination of the relationship between the shadow economy and corruption has also produced mixed results. For example, the empirical relationship could either be positive (Buehn & Schneider, 2012a) or negative (Dreher et al., 2009; Schneider, 2007), but also it could depend on the income level of the country under investigation (Dreher & Schneider, 2010; Schneider, 2007), and the corruption index used (Dreher & Schneider, 2010).

In line with the above controversy, it seems plausible to suggest that the informal economy and corruption may be linked, especially in countries where corruption thrives unabated. In such countries, entrepreneurs who see taxes paid by the formal sector as excessive may be motivated to conceal their operations to avoid detection. These entrepreneurs may pay small bribes to continue operating underground. However, it is also plausible to view corruption and the shadow economy as substitutes especially where institutions are strong and effective, and where informal businesses frustrate rent-seeking avenues for the corrupt government official thereby reducing the ability of the public official to seek bribes and introduce economic distortions to the economy. Whether the relationship between the informal economy and corruption is positive or negative (complementary or substitution), what is clear is that it varies across economies of the world. This implies that there is no established pattern in the relationship between corruption and the shadow economy, and one cannot draw general conclusions that apply across the economies of the world. This is one limitation in the extant literature. Furthermore, most of the theoretical and empirical work on the relationship between corruption and the shadow economy has focused on cross-country analysis with limited attention on how the two variables interact at the sub-national and

country levels. Additionally, the bulk of the papers have studied the above relationship in the context of developed countries with less focus on less developed settings. Given this, it becomes essential to study the above relationship in a country-level framework.

In this paper, we investigate whether corruption has contributed to the rise of the shadow economy in Uganda. The few studies that have investigated this relationship focused on contexts outside of Africa with none examining this relationship in the context of a low-income country like Uganda. It is plausible to suggest that investigating the above relationship in the context of a low-income country like Uganda could provide fresh insights into this relationship that may help in formulation of policies to control the growth and expansion of the two vices (Mugoda et al., 2020). In this paper, we specifically ask, if this relationship is positive (complementary), what policy framework may be needed to control the rise of the two vices? We make two important contributions to the literature; first, we study the relationship between the shadow economy and corruption in the context that is less studied (low-income country). Empirical investigation of this relationship in the above context provides fresh insights that could be generalized to similar contexts. Second, we study an important relationship that has received little examination over the past decades. Corruption and the shadow economy are two factors that retard economic growth and development across many countries. Analyzing how they are intrinsically related would be important in advancing theory and empirical work on how they can be addressed in low-income countries.

Apart from section 1, section 2 reviews related literature with section 3 presenting the data and descriptive statistics. Section 4 presents the methodology while section 5 reports the findings and discussion. Section 6 concludes this paper.

2. Review of related literature

2.1. Theory and empirical evidence

The shadow economy and corruption remain a fact of life around the world but difficult to measure. Part of the reason for this is that activities in the shadow economy and corrupt practices are hidden because they are done underground. Accurate measures of these activities are hard to come by, whatever available evidence that there is, comes from World Bank surveys and other international organizations. A number of papers have examined the shadow economy and corruption separately from each other, with a limited attempt to analyze how they may interact with each other. There is a possibility that activities in the shadow economy and corrupt practices might be interrelated since they are done underground. Consequently, examining them separately could result into overlooking of the possibility that they may be interrelated, and making measures to control them ineffective (see Goel & Saunoris, 2014). Theoretically, some papers have presented different mechanisms showing how the shadow economy may interact with corruption. For example, Choi and Thum (2005) present a simple model to examine the relationship between the shadow economy and corruption and how their interrelationship affects the formal economy. They show that entrepreneurs' activities in the shadow economy limit the ability of corrupt officials to use their regulatory power for private gain, which would otherwise introduce distortions to the economy. Given the above, the shadow economy alleviates "government-induced distortions" leading to increased business activities in the formal economy (Esaku & Watson, 2020b). Thus, the relationship between the shadow economy and corruption is one of substitutes rather than complements, as the shadow economy activities reinforce the formal sector.

The theoretical evidence in Choi and Thum (2005) contradicts that of some studies. For instance, Johnson et al. (1997) examine the shadow economy in transition countries and report evidence of a positive relationship between the shadow economy and corruption. Similar

conclusions are reached in Johnson et al. (1998). In their model, corruption can be seen as imposing an "extra cost" to the entrepreneurs who want to formalize their businesses, thus provides the incentive for these entrepreneurs to conceal their operations from the radar of regulators. Consequently, any increase in the level of corruption leads to a rise in the shadow economy so that they can be taken as complements. Similarly, in Hindricks et al. (1999) model of the shadow economy, the corrupt tax official can reduce the entrepreneur's tax liability in exchange for a bribe, consequently increasing the level of shadow activities in the economy. This is because these entrepreneurs have the incentive to take advantage of profitable opportunities outside of the formal sector. They show that the entrepreneur can collude with the corrupt tax official so he/she (corrupt tax official) under-reports the entrepreneur's tax liability in return for a bribe. Their study provides theoretical evidence that supports a positive relationship between corruption and the shadow economy. In the same vein, Hibbs and Piculescu (2005) emphasize that the "grabbing hands" of the corrupt official could also potentially become the "helping hands" for entrepreneurs who see the "grabbing hands" as an "extra burden" to their business hence inducing these entrepreneurs to conceal their operations from the regulators. In this case, the shadow economy and corruption could be taken as reinforcing each other rather than tempering each other.

Some other studies have examined the empirical relationship between the shadow economy and corruption and find evidence suggesting that their relationship could be either negative or positive. And in some cases it depends on the income level of the economies under investigation. The extent to which the shadow economy and corruption are either substitutes or complements could possibly vary between low and high-income countries and the type of corruption index used (see Dreher & Schneider, 2010). Thus, Buehn and Schneider (2012a) analyze the link between corruption and the show economy in a sample of 51 countries and find evidence that supports a positive relationship between corruption and the shadow economy. They show that high levels of corruption also create high levels of shadow activities as businesses try to overcome the "extra burden" imposed by corruption. In this sense, less regulation and lower levels of taxation reduce the ability of corrupt officials to extort money from entrepreneurs since these businesses can conceal their operations from government regulators. Furthermore, Friedman et al. (2000) find evidence showing that entrepreneurs operate in the shadow economy because of discretion in the application of regulations and the existence of corruption. They emphasize that high levels of corruption and the existence of a weak institutional framework induce entrepreneurs to abandon the formal sector for the shadow economy. Similarly, Goel and Saunoris (2014) investigate the relationship between corruption and the shadow economy and find evidence in support of a positive relationship.

Conversely, Dreher and Schneider (2010) use data from a cross-section of 98 countries to study the relationship between corruption and the shadow economy. They challenge results that support a positive (complementary) relationship between the shadow economy and corruption. They provide evidence of a positive relationship only when the index of corruption from the structural model is used. However, when perception-based index is used, they find no robust relationship between the shadow economy and corruption suggesting that they substitute for one another. The use of index of corruption shows that the shadow economy and corruption are complements, especially in low-income countries. Correspondingly, Dreher et al. (2009) analyze the relationship between corruption and the shadow economy in samples of 78 and 135 countries and find evidence of a negative relationship. Their empirical evidence shows that the informal economy can alleviate government-induced economic distortions arising from corrupt practices so that the shadow economy and corruption could be considered substitutes rather than complements. The above conjecture could possibly mirror a picture of a developed economy where soliciting for bribes may result in prosecution because of a strong institutional framework in those countries.

However, this might not be the case for low-income countries given the weak nature of institutions in these countries.

While one could expect some anecdotal evidence of the relationship between the shadow economy and corruption in other contexts, a formal evaluation of this relationship is required in a less developed setting to provide further evidence. This paper attempts to provide evidence for the less developed context, Uganda. There is a possibility that the two activities (corruption and informality) could be related and need to be examined simultaneously in different contexts as evidence suggests that the geography of corruption and informal economy matters (Dreher & Schneider, 2010). Furthermore, the relationship between the shadow economy and corruption has rarely been studied in a single-country context (to the best of our knowledge), especially in a low-income country like Uganda. This could possibly be the first attempt to unravel the mystery in the relationship between the shadow economy and corruption. In sum, both theory and empirical evidence do not seem to provide a definitive answer to the relationship between corruption and the shadow economy, as emphasized by Buehn and Schneider (2012b).

3. The data and descriptive statistics

In this section, we present the data and descriptive statistics of the main variable under this study. This paper uses annual time series data obtained from various internationally recognized sources, from 1984 to 2008. We report the summary statistics for the data in Table 1. The data for our outcome variable, the shadow economy, are drawn from Elgin and Oztunali (2012), who provide the estimates of the size of shadow economy based on two-sector dynamic model. Next, the first explanatory variable, corruption, is from the International Country Risk Guide (International Country Risk Guide (ICGR) Researchers Dataset, 2017) that measures corruption for an extended period of time. This corruption index ranges from 0, denoting the highest level of corruption, to 6, representing no corruption (Dreher et al., 2009). This implies that lower scores indicate the high likelihood of government officials demanding special and illicit payments, in form of bribes, likely throughout lower levels of government (Knack & Keefer, 1995). For robustness checks, we also use perception-based indices of corruption, in an alternative specification, drawn from Transparency International (TI). The subsequent control variables include gross domestic product (GDP) growth annual percent, general government final consumption expenditure as (% of GDP), polity2 and institutional quality. The first two variables, that is, gross domestic product (GDP) growth annual percent, and general government final consumption expenditure as (% of GDP), are all drawn from Africa development indicators of the World Bank ("World bank," 2014). Polity2, our proxy measure of democracy is from polity IV project (Marshall & Gur, 2018), while institutional quality (inst.qual) is simple average of three indices: (i) rule of law, (ii) democratic accountability, and (iii) bureaucratic quality. All these three variables are from ICGR published by Political Risk Services (PRS), and widely used indices to measure the quality of institution (International Country Risk Guide (ICGR) Researchers Dataset, 2017).

In Table 1, we can observe that the average values of the key variables are shadow economy (shadow E) is 44.22, corruption (corr) 2.26, institutional quality (inst.qual.) is 2.38, growth is 2.93, government spending (GOV/GDP) is 11.9, polity2 and corruption-based indices (Corp), are -3.92 and 24.47, respectively. Apart from summary statistics, we also include the correlation matrix in Table 2. From Table 2, we can observe that there is a positive correlation between the size of the shadow economy and measure of corruption. However, one can argue that positive correlation does not necessarily imply causation. We should embark on a formal analysis of the relationship between corruption and the size of the shadow economy.

4. Methodology

In this section we present the methodology used to examine the relationship between the shadow economy and corruption. We conduct empirical analysis in four basic steps; first, we specify our

Table 1. Summary statistics of the key variables

	Obs	Mean	Std.Dev.	Min	Max	Data source
Shadow E.	25	48.22	5.01	39.38	54.80	Elgin and Oztunali (2012)
Corruption	25	2.26	0.64	1.00	3.00	International Country Risk Guide (International Country Risk Guide (ICGR) Researchers Dataset, 2017)
Inst.Quality	25	2.38	0.56	1.33	3.00	International Country Risk Guide (International Country Risk Guide (ICGR) Researchers Dataset, 2017)
Growth	25	2.93	3.34	−6.48	8.11	*"Africa development indicators, World Bank" (2014)*
GOV/GDP	25	11.90	2.77	6.97	16.79	*"Africa development indicators, World Bank" (2014)*
Polity2	25	−3.92	2.61	−7.00	3.00	Center for Systemic Peace (CSP), Polity V (Marshall et al. 2018)
Corp	13	24.47	2.77	19.00	28.00	Transparency International (2019)

Source: Author's calculation.

Table 2. Correlation matrix of the core variables

	Shadow	Corr	Inst. Qual	Growth	GOV/GDP	Polity2	Corp
Shadow	1.000						
Corr	0.485	1.000					
Inst.Qual	−0.381	0.366	1.000				
Growth	−0.357	0.308	0.475	1.000			
GOV/GDP	−0.020	−0.392	−0.172	−0.246	1.000		
Polity2	−0.506	−0.192	0.466	0.464	−0.291	1.000	
Corp	−0.187	0.286	0.520	0.344	−0.600	0.510	1.00

Source: Author's calculation.

estimation model. We specify our estimation techniques in step two and determine the cointegration relationship (whether variables are I(0) or I(1)) in step three. In step four, we conduct the empirical analysis and perform diagnostic tests to confirm the robustness of the results.

4.1. Model specification

The empirical model that we use for testing the relationship between corruption and the shadow economy is in line with the literature reviewed above. Consequently, we adapt the framework of Dreher and Schneider (2010). Since the interest of this paper is to investigate whether corruption contributes to the rise in the shadow economy (and not whether the shadow economy promotes corrupt activities), we express our empirical model as follows:

$$se_i = \beta_0 + \beta_1 cor_i + \beta_2 Z_i + \mu_i \tag{1}$$

Where se_i denotes the shadow economy, cor_i is the measure of corruption, cop_i is corruption perception measure, Z_i is the vector of variables that control for fiscal, macroeconomic and institutional environment. These variables include GDP growth per capita (annual percent), government final consumption expenditure as a ratio of GDP, measure of democracy (polity2) and institutional quality. Additionally, μ_i denotes the error term. The rationale for the inclusion of the above variables in eq. (1) is well documented in the extant literature on the shadow economy and corruption (see Buehn &

Schneider, 2012a; Dreher et al., 2009; Dreher & Schneider, 2010; Esaku, 2021c; Johnson et al., 1997, 1998). For example, empirical evidence has shown that higher taxes have a positive and statistically significant impact on the shadow economy (Dreher et al. 2009). However, data on the tax burden is scarce so analysts have used government consumption expenditure to proxy for the tax burden since higher government expenditure implies an increase in taxes to fund public goods and services like security. An increase in taxes provides incentives for entrepreneurs to operate underground to avoid paying taxes. Furthermore, when entrepreneurs go underground this means that governments cannot raise adequate revenue to provide public goods and services. Funding for infrastructure projects, law and order, security, and education among others, will be affected which leads to low level of economic growth and development (Esaku, 2021b). Consequently, one can argue that the rise of the size of the shadow economy affects the level of development in a country (Esaku, 2021b). In sum, the above variables broadly reflect the level of institutional framework and macroeconomic conditions that likely determine the size of the shadow economy.

4.2. Estimation technique

This paper follows three steps for estimating the relationship between corruption and the shadow economy. First, we conduct unit root tests to determine whether the main variables are integrated of order zero and or order one, that is, I(0)s or I(1)s. Second, we conduct tests of the presence of long-run relationships (cointegration tests) between the variables, and third, we implement the empirical tests and conduct model diagnostics. Thus, we follow the autoregressive distributed lag (ARDL) bounds testing approach to cointegration of Pesaran et al. (2001), which has a number of merits over traditional cointegration techniques. This approach is robust for determining long-run and short-run relationships in the presence of small sample size (Tang, 2004). Further, this approach can be carried out regardless of whether the variables are I(0)s and or I(1)s (Pesaran et al., 2001). To analyze the relationship between the shadow economy and corruption, this study uses the autoregressive distributed lag (ARDL) bounds testing method to cointegration in line with Pesaran et al. (2001). Thus, the ARDL specification can be expressed as:

$$\Delta se = \beta_0 + \sum_{i=1}^{n}\beta_{1i}\Delta se_{t-i} + \sum_{i=0}^{n}\beta_{2i}\Delta corr_{t-i} + \sum_{i=0}^{n}\beta_{3i}\Delta iq_{t-i} + \sum_{i=0}^{n}\beta_{4i}\Delta growth_{t-i} + \sum_{i=0}^{n}\beta_{5i}\Delta gov/gdp_{t-i} + \sum_{i=0}^{n}\beta_{6i}\Delta pol2_{t-i} + \gamma_1 se_{t-i} + \gamma_2 corr_{t-1} + \gamma_3 iq_{t-1} + \gamma_4 growth_{t-i} + \gamma_5 gov/gdp_{t-1} + \gamma_6 pol2_{t-i} + \varepsilon_t \quad (3)$$

Where $\beta_0$is the constant term while $\beta_1, \ldots, \beta_6$denote the short-run coefficients, while $\gamma_1, \ldots, \gamma_6$, denote long-run coefficients, and finally, $\varepsilon_t$is the error term.

The ARDL bounds testing technique in this paper follows two steps. First, we test for cointegration among variables with the purpose of determining whether there exists a long-run relationship. The existence of the long-run relationship among variables is tested using the F-statistic and t-statistic. From the calculated F-statistic, the null hypothesis of no cointegration, that is,$(H_0 = \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 0)$, against the alternative hypothesis of cointegration, that, $(H_1 \neq \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq \alpha_6 \neq 0)$. The results of the calculated F-statistic are compared with the critical values in Pesaran et al. (2001). The decision rule is that, if the calculated values of the F-statistic exceed the upper critical bound values, the H_0 (the null hypothesis) is rejected and vice versa. On the other hand, if the calculated values of F-statistic fall within the bounds, then the test results are inconclusive. In the second step, we employ ARDL bounds testing procedure to test for relationships. During this step, the optimal lag length for the ARDL model is chosen using appropriate lag selection criteria based on the Schwartz-Bayesian criterion (SBC).

If the results of the cointegration test on equation (3) indicate cointegration among variables, then we can proceed to express the error correction model (ECM) as:

$$\Delta se_t = \beta_0 + \sum_{i=1}^{n}\beta_{1i}\Delta se_{t-i} + \sum_{i=0}^{n}\beta_{2i}\Delta corr_{t-i} + \sum_{i=0}^{n}\beta_{3i}\Delta iq_{t-i} + \sum_{i=0}^{n}\beta_{4i}\Delta growth_{t-i} + \sum_{i=0}^{n}\beta_{5i}\Delta gov/gdp_{t-i} + \sum_{i=0}^{n}\beta_{6i}\Delta pol2_{t-i} + \lambda ECT_{t-1} + \varepsilon_t \quad (4)$$

where ECT represents the error correction term, whileλdenotes the coefficient of the error correction term which captures long-run adjustments and $\varepsilon_t$being the residual error term. The size and sign of the error correction term determines the economic significance of the estimates, and speed of adjustment. This implies that the coefficient of the error correction term λ should be negative, less than one and statistically significant (Enders, 2004).

5. Results and discussion

5.1. Stationarity tests

In this section, we report the findings of the pre-requisite tests before conducting empirical analysis. Before conducting the analysis, we first tested the variables for the existence of unit roots to determine whether they are integrated of order zero, I(0), or order one, I(1) to enable a valid estimation process. This paper uses two varying tests to conduct unit root tests. Accordingly, we use Augmented-Dickey-Fuller test (ADF), and Phillip-Perron (PP) test. The results of these tests are presented in Table 3. The test results in Table 3 show that the variables are stationary after first differencing. Moreover, our results vary depending on the type of test employed. This study then proceeded to implement ARDL bounds testing after the stationarity test was conducted. In Table 4 we report the results of the ARDL bounds test for cointegration to establish whether there exists a long-run relationship. In Table 4 we can note that the calculated F-statistic is higher than the asymptotic critical value bounds. This leads to the rejection of the null hypothesis of no cointegration and the conclusion that the variables are cointegrated. Once the cointegration test was carried out, this study proceeded to estimate the long- and short-run coefficients for the model. Consequently, this study determined the optimal lag length using the Schwartz information criterion (SIC), which selected ARDL (1,2,2,0,0,2) for model (1), and ARDL (1,0,0,0,0,0) for model (2). Models (1) and (2) denote control of corruption, and perception-based indices of corruption respectively.

5.2. The long-run relationship between the shadow economy and corruption

Having determined the optimal lag length for the respective models we then conducted the empirical estimation of the long- and short-run relationship between corruption and the shadow economy. We report the results of the empirical analysis of the long-run relationship between the shadow economy and corruption, using ARDL, DOLS (dynamic ordinary least squares) and FMOLS (fully modified ordinary least squares) in Table 5, columns 2, 4 and 6, respectively. In Table 5, column 2, this study establishes a positive and statistically significant long-run relationship between the shadow economy and corruption. Thus, the coefficient on corruption is positive and statistically significant at 1% level. The above findings are not surprising given that Uganda is a low-income country with institutions that exist but unable to enforce measures aimed at curbing corruption. These results seem to bode well with the findings of Buehn and Schneider (2012a). According to Buehn and Schneider (2012a), the level of corruption and the size of the shadow economy exhibit a positive relationship. Additionally, Dreher and Schneider (2010) study suggests that the relationship between corruption and the shadow economy exhibits a stronger positive relationship in low income countries than high income countries. This appears to be the case with our results. Given than Uganda is a low income country, these results are consistent with the findings in Dreher and Schneider (2010). Similarly, Hindricks et al. (1999) suggest that the presence of corruption induces the corrupt tax official to collude with the entrepreneur for his/her private gain, by reducing the tax liability of the entrepreneur in exchange for a bribe. The reduction in the entrepreneur's tax liability is a strong incentive for colluding entrepreneurs to continue operating in the informal economy. This might seem to be the case for Uganda.

Table 3. Results of the unit root test

Variable	Augmented-Dickey-Fuller (ADF)				Phillip-Perron (PP)				Structural breaks	
	In levels		In First Diff		In levels		In First Diff		In levels	First Dif
	T&C	Const	T&C	Const	T&C	Const	T&C	Const		
Shadow E	−2.305	−1.246	−3.547*	−3.187**	−2.949	2.105	−2.655	−2.641*	−0.973	−9.552
Corruption	−3.745**	−2.912*	-	-	−2.519	−2.243	−2.721**	−3.439**	−11.389**	−7.430**
Ins.quality	−3.031	−1.295	−4.003**	−3.752**	−1.573	−1.893	−3.197	−3.142**	−13.867**	−7.848**
Growth	−3.154	−2.749*	−6.671***	−6.584***	−3.046	−2.576	−7.377**	−6.865***	−4.549**	−7.460**
Gov/gdp	−1.792	−1.505	−3.583*	−5.444***	−1.792	−1.505	−5.253***	−5.350***	−3.880	−7.427**
Polity2	−4.975**	−2.996**	-	−3.678**	−5.809***	−3.053**	-	−3.636**	−4.629**	−6.430**
Corp	−2.412	−1.845	−4.175**	−3.827**	−1.780	−1.748	−4.150**	−3.787**	−3.572	−5.905**

Source: Author's calculations. *,**,***; denote significance at 10%, 5% and 1% levels. Break dates for Shadow E is 1994; corruption is 1995; inst.quality and polity2 is1992; growth and gov/gdp is 1988, and corruption perception (Corp) is 2003.

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Table 4. Results of the ARDL Bounds test

Model	ARDL	F-statistic	Diagnostics		
			X^2(normality)	X^2 (heteroscedasticity)	X^2 (correlation)
Eq. (1)	(1,2,2,0,0,2)	31.658	0.938	0.609	0.233
Eq. (2)	(1,0,0,0,0,0)	29.678	0.305	0.518	0.634
		Asymptotic Critical values (T = 25)			
	Lower Bound I(0)		Upper Bound I(1)		
10%	2.26		3.35		
5%	2.62		3.79		
2.5%	2.96		4.18		
1%	3.41		4.68		

Source: Author's calculation.

Moreover, these findings are in line with the results of Goel and Saunoris (2014) who show that corruption and the size of the shadow economy are positively correlated.

The implication of these findings is that corruption seems to be the main driver of informality in the long-run, in Uganda. As pointed out by Johnson et al. (1998), one can expect a rise in the level of corruption to increase informality in countries where the institutional framework is weak. This is because corruption could be viewed by the entrepreneurs, as an "additional cost" to be incurred so as to join the formal sector. This "additional cost" induces entrepreneurs to operate underground to avoid regulators, which leads to the increase in informality. Given that corruption significantly increases the size of the shadow economy, addressing it would require; first, reforming the political system to have the political will to tackle political corruption and go after politicians who use their influence and power to circumvent institutions. Second, institutional reforms to address political patronage and influence peddling would go a long way into addressing systemic corruption which in turn would help mitigate the spread of informal sector activities. Third, strengthening the enforcement of existing laws to identify and punish culpable public officials who use their offices for private gain would also address the level of informality in the country.

We further explain the remaining part of the results in Table 5. We can observe that improvement in institutional framework is important in mitigating the expansion of informal sector activities. This study finds that an improvement in institutional quality significantly reduces the size of the shadow economy in the long-run, all else equal. Specifically, an improvement in institutional quality reduces the size of the shadow economy by 0.733 units, statistically significant at 1% level. This finding indicates the importance of a strong institutional framework in mitigating wide spread informal sector activities. As shown in the literature, the quality of institutions in the country is important in enforcement of the tax laws and regulating business practices (see Elgin & Oztunali, 2014; Esaku, 2021a; Luong et al., 2020). Correspondingly, the empirical results also show the importance of the level of economic growth and development in mitigating increases in informal sector activities. We can observe that the coefficient on growth is negative and statistically significant at 1% level. Specifically, the results show that an increase in economic growth reduces the size of the shadow economy by 0.027 units, statistically significant at 1% level. This is consistent with the literature that shows the crucial role of economic growth in reducing the size of informal sector activities (see Esaku, 2021b; Luong et al., 2020). This implies that an increase in annual growth of GDP significantly mitigates increase in informal sector activities. If improvements in economic growth also translate into the betterment of the poor, then the formal sector can

Table 5. Long-run relationship between shadow economy and corruption

Explanatory variables	Outcome variable: shadow economy					
	ARDL		DOLS		FMOLS	
	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
Corruption	0.175***	3.416	0.175***	5.161	0.145***	4.905
Inst. Quality	−0.733***	−10.221	−0.733***	−13.335	−0.703***	−14.442
Growth	−0.027***	−3.306	−0.027***	−4.152	−0.029***	−5.087
GOV./GDP	0.063***	4.639	0.063***	7.443	0.067***	9.145
Polity2	0.026**	2.826	0.027***	3.417	0.023**	2.573
Constant	1.078**	2.368	1.078**	2.749	0.815**	2.437
R-Squared	0.998		0.998		0.997	
R-bar-Squared	0.997		0.997		0.996	
Durbin Watson	1.912					

Source: Author's calculation. **, ***, indicate statistical significance level at 5% and 1% respectively.

Table 6. Short-run relationship between shadow economy and corruption

Explanatory	Outcome variable: shadow economy		
	Coefficient	t-statistics	Prob.
ΔCorruption	0.257***	5.469	0.000
ΔInstitutional Quality	−0.799***	−10.397	0.000
ΔGrowth per capita	−0.018**	−2.941	0.011
ΔGov./GDP	0.060***	4.799	0.000
ΔPolity2	0.037***	4.394	0.000
ECM(-1)	−0.791***	−3.036	0.003
Constant	−0.015	−0.221	0.829
R-squared	0.834		
R-bar-squared	0.702		
Durbin-Watson	2.025		

Source: Author's calculation. **, ***, indicate statistical significance level at 5% and 1%, respectively.

support the provision of goods and services that improve the welfare of the poor. The impact of this is that the incentive for entrepreneurs to operate in the informal sector is dampened since the formal sector can address any gaps in the provision of public goods and services which are essential for improving the lives of the poor.

Additionally, we find that government spending (as % of GDP) is another key driver of informality in Uganda in the long-run. We can observe that the coefficient on Gov/Gdp is positive and statistically significant at 1% level. Specifically, an increase in government spending as a proportion of GDP significantly increases the size of the shadow economy by 0.063 units. This is consistent with Hibbs and Piculescu (2005) who emphasize that the "grabbing hands" of the corrupt official could also potentially become the "helping hands" for entrepreneurs who see the "grabbing hands" as an "extra burden" to their business hence inducing these entrepreneurs to conceal their operations from the regulators. Similarly, Buehn and Schneider (2012b) study the determinants of the shadow economy and find evidence that high taxes induce entrepreneurs to operate underground. Our results seem to mirror this conclusion. Furthermore, the results also

indicate that governance is important in influencing the size of the shadow economy in the long-run. Contrary to the literature showing that good governance reduces the size of the shadow economy (see Esaku, 2021c; Teobaldelli & Schneider, 2013), our results seem to suggest that it encourages informality especially where there is widespread corruption. Specifically, we find that an improvement in governance significantly increases the size of the informal sector by 0.026 units, statistically significant at 5% level.

As a robustness check, Menegaki (2019) advises to use DOLS (dynamic OLS) and FMOLS (fully modified OLS) to validate the robustness of the results. This is because the two econometric techniques generate asymptotically efficient coefficients and can address the issue of endogeneity and serial autocorrelation (Menegaki, 2019). Additionally, Ali et al. (2017) has shown that DOLS is important because it accommodates the mixed order of integration of variables in the cointegration framework. We report these results in Table 5 columns 4 and 6. These results are qualitatively and quantitatively similar to the ARDL results. We can observe that an increase in corruption positively and significantly increases the size of the shadow economy in the long-run. For Uganda's case, this paper finds that corruption and the size of the shadow economy are highly correlated in the long-run.

In sum, these findings confirm the expectation of this study by showing a positive relationship between corruption and the shadow economy. Subsequently, it can be concluded that an increase in corruption, government spending and polity2 do increase the size of the shadow economy in Uganda. However, economic growth and institutional quality could be viewed as effective remedies against the expansion of the shadow economy since an increase in the level of these variables lead to a decrease in the size of the shadow economy.

5.3. The short-run relationship between the shadow economy and corruption

In this section, we report the results of short-run relationship between the shadow economy and corruption. The findings are shown in Table 6, column 2. We can note that, in the short-run, there is a statistically significant relationship between the shadow economy and corruption. The above results show that corruption has a statistically significant effect on the size of the shadow economy, significant at 1% level. Specifically, the short-run results indicate that an increase in corruption significantly increases the size of the shadow economy by 0.257 units, statistically significant at 1% level, all else equal. This might indicate that a country that fails to control corruption, could actually be encouraging shadow activities in the economy. The implication of this result is that corruption significantly induces entrepreneurs to go underground in the short-run as well as the long-run. As entrepreneurs initiate operations, the business and regulatory environment is important in their consideration to either operate in the formal economy or join the informal economy. If there is any possibility for the corrupt tax official to ask for bribes in the initial stages of business registration or operations, this could be an incentive for entrepreneurs to collude with the tax official and continue operating underground as shown by Hindricks et al. (1999) and Johnson et al. (1998).

Correspondingly, this paper also finds evidence confirming the importance of institutional quality in shaping the size of the shadow economy. Specifically, we establish that an improvement in the quality of institutions significantly reduces the size of shadow economy by 0.799 units, statistically significant at 1% level, all else equal. This is consistent with the literature showing the importance of institutional quality in reducing the size of the shadow economy (see Elgin & Oztunali, 2014). Additionally, Dreher et al. (2009) present a model that captures how the interrelationship between the shadow economy, corruption and institutional quality unfold and find evidence of a negative effect of institutional quality on corruption. Their paper shows that an improvement in institutional quality negatively affects the shadow economy and reduces corruption. This implies that improvement in institutional quality undermines the

ability of corrupt officials to ask for bribes from entrepreneurs, which in turn encourages these businesses to operate in the formal economy rather than operate in the underground economy.

Additionally, the short-run results indicate that economic growth is important in mitigating the size of the shadow economy. We observe that the coefficient on growth is negative and statistically significant at 5% level. This implies that an increase in the level of economic growth significantly reduces the size of the shadow economy by 0.018 units. This is consistent with the finding in Buehn and Schneider (2012b) which shows that the level of economic development is another main determinant of informality. Furthermore, we find evidence of a short-run positive and statistically significant relationship between the size of the shadow economy and government spending. The short-run results indicate that a rise in government spending increases the size of the shadow economy by 0.060 units, statistically significant at 1% level. This indicates that high taxes do drive entrepreneurs and individual households to conceal their business operations from tax bodies hence an increase in informal sector activities, consistent with the suggestions in Buehn and Schneider (2012b). Correspondingly, the results also show evidence of a positive relationship between governance and the size of the shadow economy. Contrary to the literature, we find that an improvement in governance promotes informal sector activities. Specifically, we find that an improvement in governance significantly increases the size of shadow activities by 0.037 units, statistically significant at 1% level. Although this seems to contradict the literature, one possible explanation could be that democracy may not temper informality in the presence of widespread corruption.

Finally, we analyze how the shadow economy adjusts to any deviations from the equilibrium. This is done by examining the size and significance of the coefficient on the lagged error correction term (ECT). We can observe that the lagged coefficient of ECT is negative, between zero and one, and statistically significant at 1% level. Specifically, the ECM results indicate that the shadow economy adjusts to any deviations from long-run equilibrium at a speed of adjustment that is, 79.1%, statistically significant at 1% level.

In sum, this paper provides evidence of a positive relationship between corruption and the shadow economy in Uganda. These results seem to suggest that corruption could be partly responsible for the rise of informal sector activities in low-income countries like Uganda given that these countries have weak institutions that cannot effectively fight corruption. The practical

Table 7. Long run estimates

Explanatory variables	Outcome variable: shadow economy					
	ARDL		DOLS		FMOLS	
	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
Corruption	−0.015*	−2.129	−0.015**	−3.050	−0.017**	−3.526
Inst. Quality	−0.100	−0.527	−0.100	−0.755	−0.040	−0.082
Growth	−0.015*	−2.355	−0.015**	−3.374	−0.013**	−2.839
GOV./GDP	0.057***	5.627	0.057***	8.061	0.053***	7.433
Polity2	−0.056*	−3.514	−0.056***	−5.035	−0.056***	−5.381
Constant	0.870	1.519	0.870*	2.176	0.379	0.703
R-Squared	0.899		0.824		0.798	
R-bar-Squared	0.733		0.701		0.671	
Durbin Watson	2.208					

Source: Author's calculation. *,**,and ***, indicate statistical significance level at 10%, 5% and 1%, respectively.

Table 8. Short run estimates

Explanatory	Outcome variable: shadow economy		
	Coefficient	t-statistics	Prob.
ΔCorruption	−0.020*	−2.395	0.075
ΔInstitutional Quality	−0.682*	−1.807	0.083
ΔGrowth per capita	−0.022**	−4.057	0.015
ΔGov./GDP	0.047**	3.871	0.018
ΔPolity2	−0.056**	−3.114	0.017
ECM(-1)	−0.673***	−4.321	0.000
Constant	−0.273*	2.114	0.062
R-squared	0.893		
R-bar-squared	0.705		
Durbin-Watson	1.852		

Source: Author's calculation. *,**,and ***, indicate statistical significance level at 10%, 5% and 1%, respectively.

Table 9. Model diagnostics

Equation (1)				
Normality test			Jarque-Bera	0.428
			Probability	0.807
Breusch-Godfrey serial correlation LM Test	F-statistic	0.681	Prob.F(2,14)	0.522
	Obs*R-sq.	2.039	Prob. Chi-Squared(2)	0.361
Heteroskedasticity Test Breausch-Pagan-Godfrey	F-statistic	1.785	Prob.F(6,6)	0.166
	Obs*R-sq.	9.223	Prob. Chi-Squared(6)	0.161
Equation (2): Alternative specification				
Normality test			Jarque-Bera	1.204
			Probability	0.548
Breusch-Godfrey serial correlation LM Test	F-statistic	0.222	Prob.F(2,2)	0.818
	Obs*R-sq.	2.182	Prob. Chi-Squared(2)	0.336
Heteroskedasticity Test Breausch-Pagan-Godfrey	F-statistic	1.044	Prob.F(7,4)	0.514
	Obs*R-sq.	7.756	Prob. Chi-Squared(7)	0.355

Source: Author's calculations.

implication of the findings in this paper is that tackling informality requires carrying political and institutional reforms to empower institutions to tackle corruption. Secondly, policy effort be directed at strengthening enforce of existing laws to be able to detect, investigate and prosecute corrupt officials and individual who promote corrupt practices. This policy framework should include a policy package that makes it harder or nearly impossible for the corrupt tax official to ask for bribes from entrepreneurs.

5.4. Alternative specification

To test the sensitivity of our results, this paper uses an alternative specification of eq. (1), where corruption-based indices are used instead of index of corruption. We report the results of the empirical analysis for the long-run relationship in Table 7 and short-run in Table 8. In both of these tables, we can observe that corruption seems to reduce the size of the shadow economy activities instead of increasing them. This finding seems to agree with Dreher and Schneider (2010) study

Table 10. Long-run granger causality results (Wald F-statistics)

	shadow E	Corruption	Ins.qualty	Growth	Gov/GDP	Pol2
Shadow E	-	9.689(0.005)***	7.779(0.004)***	6.453(0.008)***	4.341(0.015)**	1.306(0.298)
Corruption	3.347(0.061)*	-	4.511(0.028)	1.008(0.387)	3.500(0.055)*	9.905(0.002)***
Ins.qualty	1.793(0.198)	5.740(0.012)**	-	1.423(0.269)	3.351(0.061)*	0.424(0.661)
Growth	2.559(0.107)	0.020(0.980)	0.474(0.631)	-	0.335(0.720)	0.603(0.559)
Gov/GDP	0.989(0.392)	0.791(0.470)	0.845(0.447)	2.796(0.088)*	-	0.881(0.433)
Pol2	11.597(0.001)***	1.558(0.241)	6.709(0.007)***	5.071(0.019)*	6.794(0.007)***	-

Source: Author's calculation. *,**,***, indicate statistical significance at 10%, 5% and 1% respectively.

which reveals that using perception-based indices of corruption is controversial and sometimes results into no robust relationship. In line with the above, one can argue that perception-based indices of corruption may indeed result into some debatable results. In what follows, we argue that the relationship between the size of the shadow economy and corruption is sensitive to the corruption indices used. The use of perception-based indices of corruption may, in some cases lead to either negative relationship or no significant relationship between the size of the shadow economy and corruption in both the long-run and short-run (see Dreher & Schneider, 2010).

5.5. Diagnostic tests

To confirm the reliability of these results we perform a number of diagnostic tests, such as residual and stability diagnostics. We test whether these results are driven by biases that could affect their reliability. We carry out Normality, Breusch-Godfrey serial correlation LM and Heteroskedasticity; Breusch-Pagan-Godfrey (BPG) tests and report the results of these tests in Table 9. The results of these tests show no evidence of any biases in the empirical estimation. This paper also reports the plots of cumulative sum of recursive residuals (CUSUM) and the plots of cumulative sum of squares of recursive residuals (CUSUMQ). We present these plots in Figures 1–4. As shown in these figures, the residual plots are tightly bound within the boundaries at a significance level of 5%. These plots provide additional evidence on the stability of the estimated model. As shown in these figures, the residual plots confirm the reliability of these findings since they show evidence of stability in the coefficients of the estimated ARDL models. In what follows, we summarize by arguing that these results show evidence of a positive and statistically significant relationship between the size of the shadow economy and corruption.

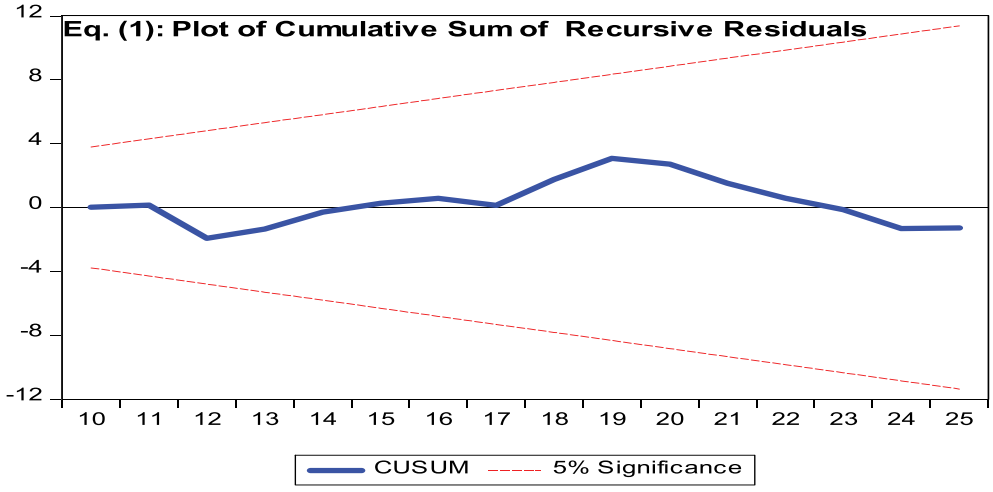

Figure 1. Plot of cumulative sum of recursive residuals for ARDL model (1).

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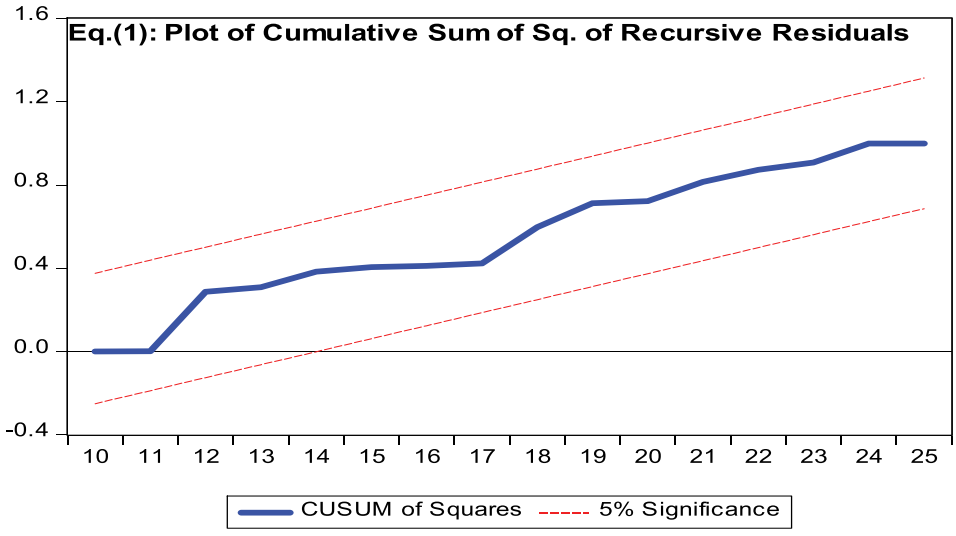

Figure 2. Plot of cumulative sum of squares of recursive residuals for ARDL model (1).

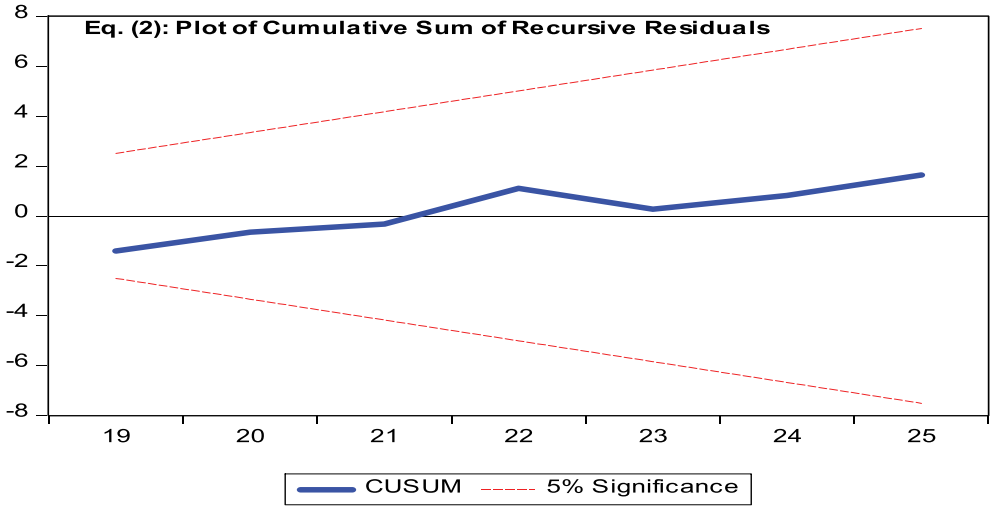

Figure 3. Plot of cumulative sum of recursive residuals for ARDL model (2).

5.6. Granger causality test

5.6.1. Long-run granger causality results

In this section, we conduct the pairwise granger causality test to ascertain whether there is a causal relationship among the variables. Our main interest is to determine whether the relationship between corruption and the size of the shadow economy is bidirectional in both the long-run and short-run. Table 10 reports the long-run results for the granger causality test. We can observe that, in the long-run, there is a causal relationship between the size of the shadow economy and corruption, where causality runs from the shadow economy to corruption and from corruption to the shadow economy. Thus this study establishes a long-run bidirectional relationship between corruption and the size of the shadow economy. This is consistent with the suggestion of Buehn and Schneider (2012a) which emphasizes a bidirectional relationship between the size of the shadow economy and corruption. Additionally, we also note a causal relationship between institutional quality and the size of the shadow economy, where causality runs from institutional quality to the size of the shadow economy.

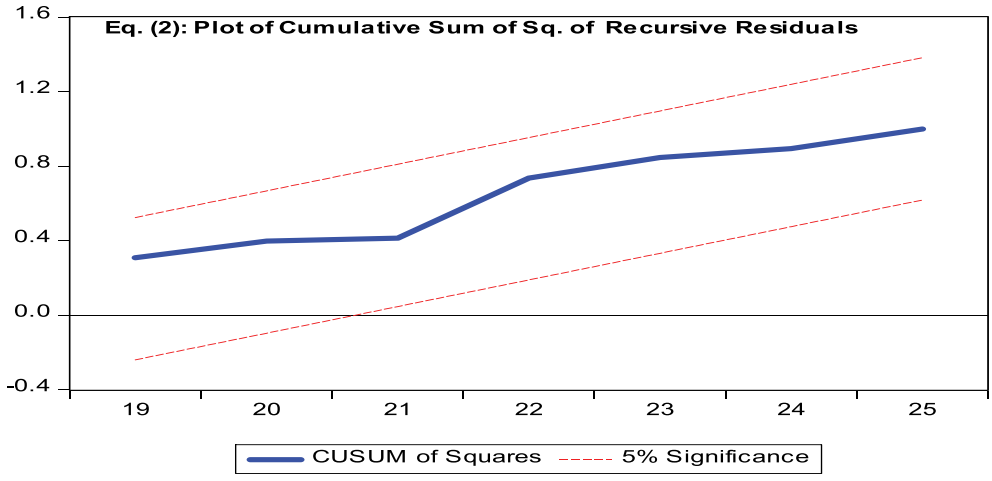

Figure 4. Plot of cumulative sum of squares of recursive residuals for ARDL model (2).

This could suggest that an improvement in the quality of institutions influences the size of the shadow economy (see Elgin & Oztunali, 2014). Similarly, we also observe a causal relationship between growth and the size of the shadow economy; where causality runs from growth to the shadow economy. This would agree with the literature that emphasizes the importance of the level of development in influencing the size of the shadow economy (see Esaku, 2021b). Similarly, this paper finds evidence of a causal relationship between government spending and the size of the shadow economy, running from government spending to shadow economy. The evidence shows that an increase in government spending increases the size of the shadow economy, consistent with the literature (see Buehn & Schneider, 2012b; Esaku, 2021e). From row 2, columns 6 and 7, there is evidence of a causal relationship between government spending and corruption, and between governance and corruption in the long-run. The causal results show that an increase in government spending significantly causes corruption, with causality running from government spending to corruption. Additionally, these results also indicate that more democracy (governance) causes corruption. This result seems to agree with the study in Jetter et al. (2015) which established that democracy worsens corruption especially in countries where the income level is low.

Turning to row 3, columns 3 and 6; we find a causal relationship running from corruption to institutional quality. Additionally, there is also causality running from government spending to institutional quality. This appears to suggest that a rise in corruption leads to the creation of institutions aimed at combating it. Furthermore, we also observe a causal relationship between growth and government spending. The results suggest that more growth significantly increases government spending due to the possible rise in revenue. Finally, we turn to row 7, columns 2, 4, 5 and 6. We observe that an increase in shadow activities influences the governance system, with causality running from shadow economy to governance. Additionally, improvement in institutional quality significantly causes good governance. Furthermore, there is evidence that improvement in economic growth and increase in government spending causes good governance.

Taken together, the pairwise causality results of the long-run relationship between corruption and the size of the shadow economy indicate a causal long-run relationship between corruption and the size of the shadow economy which is bidirectional.

5.6.2. Short-run granger causality results

In this section, we report the pair wise granger causality results for the short-run. The results are reported in Table 11. In column 2, and 3; rows, 2, and 3, there is evidence of a causal relationship

Table 11. Short-run granger causality results (Wald F-statistics)

	Δshadow E	ΔCorruption	ΔIns.qualty	ΔGrowth	ΔGov/GDP	ΔPol2
ΔShadow E	-	4.233(0.024)**	2.233(0.142)	1.614(0.230)	1.034(0.378)	0.515(0.607)
ΔCorruption	6.123(0.011)**	-	0.154(0.859)	5.042(0.021)**	1.246(0.316)	12.357(0.000)***
ΔIns.qualty	4.096(0.038)**	0.498(0.618)	-	2.085(0.159)	0.106(0.900)	4.893(0.023)**
ΔGrowth	5.624(0.014)**	0.083(0.921)	2.693(0.100)	-	0.713(0.505)	0.295(0.749)
ΔGov/GDP	0.166(0.848)	0.060(0.921)	0.252(0.781)	1.689(0.214)	-	0.461(0.639)
ΔPol2	0.333(0.722)	0.023(0.977)	0.820(0.459)	0.755(0.487)	0.461(0.639)	-

Source: Author's calculation. **,***, indicate statistical significance at 5% and 1% respectively.

between the shadow economy and corruption. We can observe that shadow activities cause corruption, but also corruption causes shadow activities. Consequently, this paper establishes a short-run bidirectional causal relationship between shadow economy and corruption, consistent with the study of Buehn and Schneider (2012b). The results also indicate a causal relationship between shadow economy and institutional quality, with causality running from shadow economy to institutional quality. Similar results can be observed between shadow economy and growth, with causality running from shadow economy to growth. This could be suggesting that a large shadow economy undermines economic growth (see Esaku, 2021b). Correspondingly, the short-run results also indicate a causal relationship between the level of economic growth and corruption, with causality running from growth to corruption. This would imply that more growth creates corruption in the short-run (see Brown & Shackman, 2007). Similarly, there is also evidence of a short-run causal relationship between governance and corruption, with causality running from governance to corruption. This could suggest that bad governance promotes corruption as has been shown by Quah (2009). Additionally, we find evidence of a causal relationship between governance and institutional quality, with causality running from governance to institutional quality.

In sum, this paper establishes a short-run as well as long-run causal relationship between corruption and the size of the shadow economy in Uganda. This is a significant finding given that these factors (corruption and shadow activities) have been in the rise in the country. At the policy level, addressing the rise in informality requires reforming the political and institutional system to detect, investigate and prosecute cases of corruption in the corruption.

6. Conclusion

In this paper, we examine the relationship between the size of the shadow economy and corruption in a country-level analysis using ARDL modeling approach. We use annual time series data covering the period from 1984 to 2008, drawn from several data sources. The results of the empirical analysis on the relationship between the size of the shadow economy and corruption reveal a positive and statistically significant relationship, in both the long-run and short-run. Furthermore, the ARDL results that establish a long-run and short-run relationship between corruption and the size of the shadow economy are also backed by the granger causality results. These findings suggest that, a bidirectional causal relationship between corruption and the size of the shadow economy. Thus, an increase in corruption leads to an increase in the size of the shadow economy. Similarly, increase in informality also leads to corruption. These results line up well with the view that corruption and informality are complements, and are detrimental to the growth of economies. This implies that corruption and shadow activities distort the proper functioning of the market mechanism and undermine effort to improve the welfare of the poor. One can argue that the positive relationship between corruption and the size of the

shadow economy is expected, especially in low-income countries such as Uganda where the two variables are on the rise.

Overall, this paper provides evidence that seems to suggest that corruption could be responsible for the rise of informal sector activities in low-income countries like Uganda given the weak institutional framework that is ineffective in fighting corruption. Additionally, a large size of the shadow economy in Uganda could also be the result of corruption.

Given the complementary relationship between corruption and the size of the shadow economy, addressing widespread informality in the country would require; first, reforming the political system to have the political will to tackle political corruption and go after politicians who use their influence and power to circumvent institutions. Second, carrying out institutional reforms to address political patronage and influence peddling would go a long way into addressing systemic corruption which in turn could help mitigate the spread of informal sector activities. Third, strengthening the enforcement of existing laws to identify and punish culpable public officials who use their offices for private gain would also address the level of informality in the country.

We acknowledge that this study faces two main limitations. First this study uses data on the size of the shadow economy that cover 25 years. We suggest future studies may benefit from using historical data on size of shadow economy that cover more years. Second, data on the size of the shadow economy is aggregated at the national economy level making it difficult to explore how corruption affects the informal activities in various sector of the economy. Disaggregating the data on the size of the shadow economy would facilitate this analysis in future. Finally, future research could focus on developing a theoretical framework that explains the various channels through which corruption influences the size of the shadow economy

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Notes

1. We follow Dreher and Schneider (2010), and define corruption as "the abuse of pubic power for private gain."
2. In this paper, we follow Schneider (2005) and define the shadow economy as "all market-based legal production of goods and services that are intentionally hidden from regulators." The use of the word shadow economy also means the informal economy (sector) and underground economy. We use these words interchangeably.

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