

Article

The nexus between the shadow economy and financial development in Uganda

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Abstract: This paper examines the nexus between the shadow economy and financial development in Uganda, making use of yearly time series data over the period 1991 to 2017, and the autoregressive distributed lag (ARDL) method is applied. Findings are quite telling. We find that financial development reduces the shadow economy in a significant manner, in both the long- and short-run. This finding is robust to the use of alternative measures of financial development. Our results have far-reaching implications. Firstly, findings indicate that financial structure plays a key role in mitigating the increase of the shadow economy given that the financial sector can provide access to credit that eases financial constraints faced by entrepreneurs. Thus, a well-functioning financial sector could facilitate access to credit by entrepreneurs, which reduces their motivation to operate underground. These findings seem to suggest that reforming financial institutions to facilitate improved access to domestic credit could help tackle widespread informality in developing economies. Additionally, minimizing informality also requires reforming the political system, institutional framework, and macroeconomic environment to become responsive to the needs of businesses.

Keywords: financial development; informal sector; shadow economy; tax evasion; time series models

1. Introduction

Recently, the financial sector has been viewed as one important variable that could potentially influence the size of the shadow economy (also known as underground economy/sector, informal sector/economy, informality, hidden economy/sector) [1,2]. Consequently, the financial sector facilitates the performance of the overall economy through improved access to the much needed financing for businesses. Furthermore, it provides a means to monitor business transactions for the purpose of taxation [3]. Given its importance, the financial sector can slow down the expansion of shadow activities by raising the opportunity cost of engaging in underground economies [2]. Consequently, this could be a motivation for businesses to operate formally given that banks and/or other financial institutions require these businesses to be visible so as to access financing for their operations [1].

Indeed, the literature reveals that a well-functioning financial sector provides a mechanism through which governments can mitigate the expansion of informal sector activities. For example, Bittencourt et al. [4] advance a theoretical model indicating how poor financial structure increases informality. The above authors examine this theoretical model applying data from 150 economies from 1980 to 2009. They find empirical evidence supporting their theoretical model. Similarly, Berdiev and Saunoris [3] assess the dynamic association between informality and financial

structure in a sample of 161 economies across the world. Their findings show how a developed financial sector is vital in curtailing the expansion of informal sector activities. Additionally, Capasso and Jappelli [2] use a panel vector autoregression framework to study the association between underground economies and financial development, applying data from 161 economies from 1960 to 2009. Their findings reveal that a reduction in the cost of external financing not only reduces the expansion of underground activities but also addresses tax evasion. Additionally, their findings also confirm the conjecture that domestic financial development corresponds with a smaller size of the hidden sector, all else equal. Ridwan et al. [5] investigate the association between financial development and informality in 45 African countries and find no clear effect of financial development on the shadow economy. Their finding seems to contradict previous studies that have shown a negative impact of financial development on informality.

While the bulk of studies indicate a negative impact, some papers have unearthed no clear connection between the two variables. This suggests that the impact of financial development on informality remains a contested issue that is unsettled yet. This paper examines whether there is a relationship between the shadow economy and financial development in the short and long run in Uganda, applying the ARDL method to cointegration to investigate this relationship. The research question we ask is whether an improvement in financial development can reduce informality in Uganda. Uganda is chosen for various reasons. Firstly, this country is characterized as a less developed country that continues to grapple with poverty and inequality. Its financial sector is still evolving but plays a pivotal role in financial intermediation. Investigating whether the financial sector can reduce informal sector activities is meaningful given that informality is wide spread in this country [6,7]. Secondly, Uganda experienced a chaotic economic downturn in the 1970s when the military junta took over power from the elected government of Apollo Milton Obote [8]. The takeover created economic upheaval, which hindered growth of the financial sector, increasing informality in the process. The important question now is whether financial development can reduce wide-spread informality given that explosive shadow activities can be harmful to the official sector [9].

Thirdly, Uganda has undertaken key steps in improving the financial structure over the past 30 years following the introduction of reforms to open up the economy to trade. With these reforms in place, it's plausible to suggest that improvement in the financial sector should negatively affect the shadow economy as credit is expected to be readily available for businesses. Consequently, we investigate whether financial development can dampen citizens' motivation to work in the informal sector.

We make contributions to the literature as follows: Firstly, we investigate the association between the informal sector and financial development in a less studied country. Much of what is known about this relationship is drawn from studies from developed economies. Having another perspective on this relationship from a low-income country goes a long way toward enriching our understanding. Secondly, the findings from this study could help inform policy aimed at mitigating wide-spread informality. The results could also be generalizable to the African context, given that most countries in Africa share common socio-economic characteristics.

The remaining sections of this paper include a literature review, which is

presented in section two; data, which is reported in section three; the methodology presented in section four; the findings and discussion reported in section five; and finally, the conclusion of the study, which is reported in section six.

2. Literature review

The extant literature has indicated that much of the economic activities take place in two sectors: the informal and the formal sectors. Shadow activities show enduring trends over time. Specifically, individuals who survive in informal sector production and distribution activities in the current period were also involved in the same sector (informal) in the previous period [10]. In both the developed and the developing world, informal economy activities are relatively large and difficult to trace because of their hidden nature [7]. Recently, Medina and Schneider [11] show that informal economy activities are increasing in many countries across the world, and the sector's activities are still a substantial part of the production and distribution process in the global economy. The shadow economy continues to contribute to the creation of jobs and generating income for the most vulnerable and disadvantaged segments of the population [8].

Notwithstanding the important contribution of this sector, some analysts argue against its rising pattern. Elbahnasawy et al. [12] reveal that expansion of informality lowers proper use of productive resources and distorts investments of the country since activities in this economy are done clandestinely. Moreover, some studies show that large informality substantially worsens income distribution and impedes economic growth, hence damaging livelihood opportunities for the poor [13]. Consequently, a bulging informal sector seems to be a worrying phenomenon that undermines the effort of governments around the world to improve the livelihoods of their citizens. High levels of informality also worsen efforts to tackle tax evasion and improve revenue collection, hence undermining the provision of social services by the government.

Given the above discourse, the shadow economy has generated concerns from researchers and policymakers over the recent years. This debate is concentrated around four dimensions. First, a number of studies focused their assessment on the size, trends, and causes of informality [11,14]. Second, some have investigated the association between informality and corruption [15]. The third dimension is the interplay between informality and other variables, such as income inequality [13], political stability [12], and democracy [16], among others. The fourth dimension focuses on the relationship between the informal sector and the financial structure of the economy [1,2]. We follow the fourth strand of extant literature that investigates the association between informality and financial development.

3. Data

3.1. Data and data sources

In this paper, we use Uganda's yearly data over the period 1991 to 2017 from a number of data sources. The shadow economy (se17) is from Medina and Schneider [11], financial development (dob), proxied by domestic credit to the private sector by

banks (% of GDP), is the main explanatory variable, while political fractionalization index (govfrac), democracy index (demo), government expenditure (gov/gdp), and GDP per capita growth, or simply growth (gw), are the main control variables to control for economic, fiscal, and institutional factors that influence informality. We also estimate a different equation (alternative specification) where we substitute (dob) for dcf (domestic credit provided by the financial sector) and dcp (domestic credit provided by the private sector), as indicated in the Appendix, **Table A1**.

3.2. Summary statistics

Table 1, panel (a), reports summary statistics, while in panel (b), the correlation matrix is also shown. Average values of the key variables are: shadow economy (Se17), 37.059; financial development (dob), 8.316; fractionalization (govfrac), 0.138; democracy (demo), 0.481; government expenditure (Gov/gdp), 11.473; growth (gw), 3.137; domestic credit provided by the financial sector (dcf) is 9.758; and domestic credit to the private sector (dcp), 9.559. In Panel (b), our main variables of interest (shadow economy and financial development) are negatively connected, indicating a possible relationship between these two variables, an indication that an improvement in financial development is vital in mitigating the spread of shadow activities in Uganda. To confirm this conjecture, we should conduct formal assessments of this association by evaluating how these variables are correlated.

Table 1. Summary statistics and correlation matrix.

	Se17	Dob	Govfrac	Demo	Gov/gdp	Gw	Def	Dcp
Panel (a): Summary statistics								
Mean	37.059	8.316	0.138	0.481	11.473	3.137	9.758	9.559
Median	40.300	8.269	0.000	0.000	11.745	3.020	8.861	8.400
Maximum	43.700	13.785	0.588	1.000	16.792	8.140	18.015	16.512
Minimum	28.000	3.528	0.000	0.000	6.636	0.030	2.584	4.001
Std. Dev.	5.778	3.290	0.243	0.509	3.086	2.286	4.783	4.511
Skewness	-0.471	0.121	1.197	0.074	-0.034	0.436	0.252	0.300
Kurtosis	1.518	1.602	2.543	1.005	1.730	2.271	1.933	1.574
#Obs.	27	27	27	27	27	27	27	27
Panel (b): Correlation matrix								
Se17	1.000							
Dob	-0.847	1.000						
Govfrac	-0.451	-0.494	1.000					
Demo	-0.868	0.878	-0.561	1.000				
Gov/gdp	0.719	-0.332	0.354	-0.471	1.000			
Gw	0.293	-0.142	0.025	-0.102	0.443	1.000		
Def	-0.731	0.761	-0.260	0.607	-0.308	-0.317	1.000	
Dcp	-0.915	0.968	-0.495	0.881	-0.433	-0.222	0.831	1.000

Source: Authors' calculations.

4. Methodology

4.1. Specification of model for testing the relationship

We predict that informality is a function of variables expressed as follows:

$$se17 = F(dob, govfrac, demo, Gov/gdp, gw) \quad (1)$$

where *se17* is a measure of informality, *F* represents the function, *dob* is a measure of domestic credit to the private sector by banks, *govfrac* denotes fractionalization, *demo* is a measure of democracy, *Gov/gdp* denotes government spending or expenditure, and *gw* denotes GDP per capita growth. As a robustness check, we also specify two alternative equations (Equations (2) and (3)), where we use other measures of financial development. In Equation (2), we use credit provided by the financial sector (% of GDP), which we denote as (*dcf*), while in Equation (3), we use credit provided by the private sector (% of GDP), which we denote as (*dcp*). We formally express the two equations as follows:

$$se17 = F(dcf, govfrac, demo, Gov/gdp, gw) \quad (2)$$

$$se17 = F(dcp, govfrac, demo, Gov/gdp, gw) \quad (3)$$

As indicated in the literature review, there is reason to believe that the informal economy and financial development are interlinked. As shown in the study of Berdiev and Saunoris [3], a well-functioning financial sector significantly reduces underground activities. In line with the literature, we include political fractionalization. Elbahnasawy et al. [12] and Esaku [8] emphasized that political processes do influence enacted policies, which in turn determine resource allocation. Given the above, resource allocations are usually influenced by the political system, which is crucial in determining the welfare system in place, hence affecting the spread of shadow activities. Furthermore, we also control the state of institutional quality, as this is crucial for the operation of the economy. We capture this by the index of democracy. Extant literature reveals the significance of democracy in influencing informal sector activities [16]. Correspondingly, development has also been indicated to be important in shaping informality [9]. Relatedly, extant literature reveals that government expenditure bears significant influence on informality.

4.2. Estimation strategy

This paper makes use of the ARDL approach proposed by Pesaran et al. [17], which is widely used for testing cointegration as opposed to traditional approaches to cointegration. This approach is acknowledged as a flexible and robust econometric method for investigating cointegration or relationships in time series data [17]. Furthermore, this approach is able to accommodate sufficient lags, allowing for the capture of the data-generating process as a result. Moreover, it can be used regardless of whether the time series are integrated of order zero, *I*(0s), or order one, *I*(1s), or even fractionally integrated, but not of order two, *I*(2s). Additionally, the ARDL approach can also accommodate any sample size, both small and large, and provides reliable estimates regardless of the problem of endogeneity among explanatory variables [18,19]. Moreover, ARDL is able to eliminate residual correlation [20] and has the ability to correct for outliers using impulse dummies [21].

Therefore, we formally express the ARDL model for the empirical estimation of

Equation (1) as follows:

$$\begin{aligned} \Delta se17 = & \beta_0 + \sum_{i=1}^n \beta_{1i} \Delta se17_{t-i} + \sum_{i=0}^n \beta_{2i} \Delta dob_{t-i} + \sum_{i=0}^n \beta_{3i} \Delta govfrac_{t-i} + \sum_{i=0}^n \beta_{4i} \Delta demo_{t-i} \\ & + \sum_{i=0}^n \beta_{5i} \Delta gov/gdp_{t-i} + \sum_{i=0}^n \beta_{6i} \Delta gw_{t-i} + \lambda_1 se17_{t-1} + \lambda_2 dob_{t-1} + \lambda_3 frac_{t-1} \\ & + \lambda_4 demo_{t-1} + \lambda_5 gov/gdp_{t-1} + \lambda_6 gw_{t-1} + \mu_t \end{aligned} \quad (4)$$

where, β_0 denotes the constant term while β_1, \dots, β_6 and $\lambda_1, \dots, \lambda_6$ are the short- and long-run coefficients, and μ_t denotes the error term. Note that Equations (2) and (3) can analogously be expressed as in Equation (4), but with dcf and dcp replacing dob.

Using the F -statistic, we first test for cointegration to determine the presence of a long-run relationship among the variables. We express the null hypothesis of no cointegration as $(H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0)$, as opposed to the alternative hypothesis of the presence of cointegration, which is expressed as $(H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0)$. The F -statistic is assessed against the critical values specified in the study of Pesaran et al. [17]. If the F -statistic values are higher than the upper critical bound values, the H_0 (the null hypothesis) is rejected; otherwise, the alternative is accepted. However, there are also cases where the calculated F -statistic values are within the bounds; if this is the case, then the test result can be considered undetermined.

We first determine the optimal lag length, ascertained based on the appropriate lag length selection criteria using the Schwartz-Bayesian criterion (SBC), for the ARDL model before conducting ARDL bounds testing procedure. The result of the ARDL testing is shown in the Appendix, **Table A2**.

The error correction model (ECM) for a long-run association is indicated as:

$$\begin{aligned} \Delta se17_t = & \beta_0 + \sum_{i=1}^n \beta_{1i} \Delta se17_{t-i} + \sum_{i=0}^n \beta_{2i} \Delta dob_{t-i} + \sum_{i=0}^n \beta_{3i} \Delta govfrac_{t-i} \\ & + \sum_{i=0}^n \beta_{4i} demo_{t-i} + \sum_{i=0}^n \beta_{5i} \Delta gov/gdp_{t-i} + \sum_{i=0}^n \beta_{6i} \Delta gw_{t-i} + \gamma ECT_{t-1} + \mu_t \end{aligned} \quad (5)$$

With γ representing the coefficient of the ECT (error correction term), capturing long-run adjustment to the equilibrium after disturbance. Correspondingly, μ_t represents residual error term. ECT coefficient validity is in its magnitude and sign. Enders [22] emphasized that the coefficient of the error correction term (γ) ought to be negative, equal to or below 1 and statistically significant. Similarly, if the results of the cointegration test indicate a long-run relationship, the alternative specifications can also be expressed as in Equation (5).

5. Findings and discussion

5.1. Stationarity tests

Before conducting ARDL tests, we first implemented unit root tests to determine the stationarity and order of integration using the Augmented-Dickey-Fuller test (ADF) and Phillip-Perron (PP), with intercept and with trend and intercept. Appendix, **Table A2**, indicates the outcome of these tests, which also shows that variables are

either stationary at levels or after first differencing.

From **Table 2**, we can note that calculated F -statistics are higher than the asymptotic critical value bounds shown in the study of Pesaran et al. [17]. With the outcome of the F -statistic indicating possibility of cointegration, we fail to accept the null hypothesis and conclude that variables are cointegrated. Furthermore, we conducted residual diagnostic tests to ensure the reliability of the bounds test results. Specifically, Breusch-Godfrey Serial Correlation LM, heteroskedasticity (Breusch-Pagan-Godfrey), and normality tests were employed, which indicated that the bounds test results are reliable, confirming the validity of calculated F -statistics. Following the above tests, the long- and short-run coefficients of the ARDL model were then estimated. According to the Schwartz information criterion (SIC), the optimal lag length selected is ARDL (1,0,0,0,0) for all three equations.

Table 2. ARDL Bounds test results.

	ARDL model	F -stat.	Residual diagnostics		
			X^2 (Heterosce.)	X^2 (Corr.)	X^2 (Normality)
Equation (1)	(1,0,0,0,0)	8.071	0.899	0.684	0.339
Equation (2)	(1,0,0,0,0)	6.336	0.468	0.565	0.503
Equation (3)	(1,0,0,0,0)	8.586	0.589	0.228	0.476
Actual sample size ($T = 26$)					
Critical values					
	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: Authors' estimation.

5.2. Informality and financial development in the long-run

We carried out the empirical analysis using the ARDL approach, but also to ensure the robustness of our findings, the fully modified ordinary least squares (FMOLS) and dynamic least squares (DOLS) methods were used. The results are reported in **Table 3**. Column 2 reports ARDL values, while FMOLS and DOLS values are reported in columns 5 and 8, respectively. We first present and discuss the results of the ARDL model, which are reported in column 2. From column 2, we observe a connection between two variables of our interest, informality and financial development. Specifically, findings provide proof of cointegration in the long run. The coefficient on financial development (dob) is negative and highly significant, implying that an improvement in the availability of domestic credit mitigates informality by 0.446 units. This finding bodes well with previous studies indicating the effect of financial development on shadow production of goods and services [1]. As rightly emphasized by Berdiev and Saunoris [3] in their investigation of the dynamic link between shadow activities and financial development across 161 economies, improvement in financial development significantly mitigates informality. Similarly, Bayar and Ozturk [23] find a negative correlation between informality and financial

development in the long run. On the same note, Capasso and Japelli [2] provide another empirical suggestion of a negative association between financial development and informality. Their finding suggests that access to domestic credit that leads to a decrease in costs of borrowing could be significant in reducing the shadow economy. Correspondingly, when firms choose to invest with internal financing with lower interest rates compared to external financing charging higher interest rates, improvement in financial development lowers tax evasion, which has a negative effect on informality by reducing the informal economy.

Table 3. Shadow economy and financial development in the long-run.

Explanatory	Dependent variable: Shadow economy								
	ARDL model			Fully-Modified OLS			Dynamic OLS		
	Coeff.	t-stat.	Prob.	Coeff.	t-stat.	Prob.	Coeff.	t-stat.	Prob.
Dob	-0.446***	-3.650	0.002	-0.446***	-8.653	0.000	-0.446***	-3.434	0.003
Frac	-1.125*	-1.906	0.072	-1.255***	-3.590	0.002	-1.125	-1.316	0.204
Demo	-1.435**	-2.215	0.039	-1.460***	-5.064	0.000	-1.435*	-1.887	0.075
Gov/GDP	0.459***	6.968	0.000	0.457***	12.939	0.000	0.459***	4.935	0.000
Gw	-0.178***	-3.502	0.002	-0.185***	-5.565	0.000	-0.178**	-2.166	0.043
Constant	16.131***	6.497	0.000	16.282***	13.794	0.000	16.131***	5.255	0.000

Source: Authors' estimation.

Note: *, statistical significance at 10% level.

**, statistical significance at 5% level.

***, statistical significance at 1% level.

The above results have major implications. Firstly, the results indicate that when access to credit is eased, a substantial number of businesses are able to access the much-needed financing, which improves the production processes of the said businesses. Relaxing credit constraints implies that entrepreneurs facing hurdles in accessing finance can now borrow to expand their production or to acquire the much-needed technology. Improving production technology lowers the per-unit cost of production, which improves the firm's productivity and profitability [24]. This is crucial for smaller and or start-up firms which face challenges in upgrading of their production technology. Secondly, tackling widespread informality in the long run requires improving access to financing for entrepreneurs who face financing constraints. These findings confirm our postulation that any improvement in the availability of domestic credit is effective in reducing informality in the economy. Additionally, column 2 also shows fractionalization hinders the increase of shadow activities since the coefficient on (govfrac) is negative and highly significant, meaning that an increase in fractionalization reduces informality by 1.125 units, which seems to support the view that the political system is crucial in shaping the business platform [8]. Democracy significantly reduces the shadow economy, as can be observed from the coefficient on (demo), which is negative and statistically significant at 5% level. This seems to agree with Teobaldelli and Schneider [16], who find a negative association between informality and the financial sector. Accordingly, our empirical results indicate good democracy reduces the shadow economy by 1.435 units.

We also find evidence of the positive effect of government spending or

expenditure on informality, which is statistically significant at the 1% level. This implies that an increase in government expenditure seems to be a main driver of the shadow activities, especially in Africa [25]. This suggests that more public spending requires that the government levies taxes and collects revenue to finance the provision of public services. If this is the case, then more revenue collection requires tighter regulation and closing up any available loopholes in the tax system. Tighter regulation has a positive impact on revenue collection but a negative one on the formalization of businesses, hence driving entrepreneurs to operate underground to evade tax or reduce tax liability. Additionally, a country's development is critical in influencing informality since the coefficient on (gw) is negative and statistically significant at the 1% level. Following the suggestion of Menegaki [26], we use FMOLS and DOLS to validate the ADRL model results shown in **Table 3** columns 5 and 8. Accordingly, FMOLS and DOLS results seem to provide a similar picture to the ARDL model results, suggesting that improving financial development significantly reduces informality in the long run for the case of Uganda.

In summary, this paper provides further evidence that better financial development substantially reduces the shadow economy in Uganda. Additionally, fractionalization, democracy, and growth significantly reduce the expansion of informality in the country.

5.3. Shadow economy and financial development in short-run

From **Table 4**, the coefficient on financial development (dob) is negative and highly significant, meaning that informality and financial development are negatively correlated in the short run, all else equal. We note that an improvement in access to domestic credit reduces shadow economy activities by 0.365 units, confirming a long- and short-run relationship between financial development and the shadow economy in Uganda. This relationship largely agrees with the literature, which has demonstrated that an improvement in financial development reduces the informal economy [3]. This is because more access to credit provides an opportunity for financially constrained businesses to borrow so as to improve and/or expand their operations [1].

Table 4. Shadow economy and financial development in short-run.

Explanatory variable	Outcome variable: ΔShadow economy		
	Equation (1)		
	Coefficient	t-statistic	Probability
ΔDob	-0.365***	-7.231	0.000
ΔGovfrac	-2.453***	-5.857	0.000
ΔDemo	-0.878***	-3.381	0.004
ΔGov/gdp	0.502***	8.439	0.000
ΔGwc	-0.136**	-2.719	0.015
ECT (-1)	-0.590***	-3.163	0.006
Constant	-0.118	-0.631	0.537

Source: Authors' estimation.

Note: *, statistical significance at 10% level.

** , statistical significance at 5% level.

***, statistical significance at 1% level.

In other results, column 2 indicates that the political environment is a crucial determinant of informality in the short run, suggesting that in the short run, any improvement in fractionalization reduces informality by 2.453 units, statistically significant at the 1% level. These findings are in line with the notion that the political environment determines the government's incentives to invest in enforcement of revenue collection, which influences the government's capability to enact measures and policies that curb informality in the economy [12]. Correspondingly, the 'politics of the day' also influence the democracy in the country [8]. Correspondingly, this paper finds evidence of the importance of the country's growth in curbing the spread of shadow activities. The findings indicate that improvement in the country's development reduces informality by 0.136 units, statistically significant at the 1% level, agreeing with other studies that have shown how the country's development curbs wide-spread informality [9]. Furthermore, these findings also indicate that public spending requires that tax enforcement measures be strengthened, which action will further drive businesses underground. From the findings, we can note that the coefficient on government expenditure is highly significant, implying that a rise in government expenditure also raises informality by 0.502 units, statistically significant at the 1% level consistent with previous studies [25].

Finally, we evaluated the speed of adjustment of the informal economy to departure from long-run equilibrium, which is assessed by examining the sign, magnitude, and significance level of the error correction term (ECT). Accordingly, the coefficient on ECM is negative and statistically significant at 1% level, indicating that the shadow economy adjusts to any departures from long-run equilibrium at a speed of adjustment of 59%, statistically significant at 1% level, as shown in the study of Enders [22].

Taken together, this paper establishes a negative long- and short-run relationship between the shadow economy and financial development, all else equal, suggesting that financial development is an important component of the policy framework that could be used to address informality in Uganda. This postulation is acceptable given the fact that more access to domestic credit relaxes financial constraints faced by businesses, especially small and start-ups, since they can now borrow to finance available business opportunities. Furthermore, improved access to domestic credit allows borrowers to procure the much-needed production equipment, which, if deployed, might improve efficiency by cutting down the marginal costs of production, as shown by Esaku [8]. Consequently, the above findings emphasize that reforming financial institutions to facilitate improved access to domestic credit could help tackle widespread informality in developing economies. Additionally, the findings also reveal that minimizing the informal sector also requires reforming not only the financial sector but also the institutional, macroeconomic, and political environment so that these become responsive to the needs of businesses.

5.4. Stability tests

To ascertain the stability of the ARDL model, diagnostic tests were implemented by evaluating recursive estimates, especially cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMQ) plots.

The CUSUM and CUSUMQ plots are reported in **Figures 1** and **2**. As the figures report, we can observe that the plots lie within the boundaries at the 5% level of significance and give further proof indicating that the ARDL models are stable. Conclusively, these findings suggest and confirm a statistically significant negative connection between the shadow economy and financial development in both horizons.

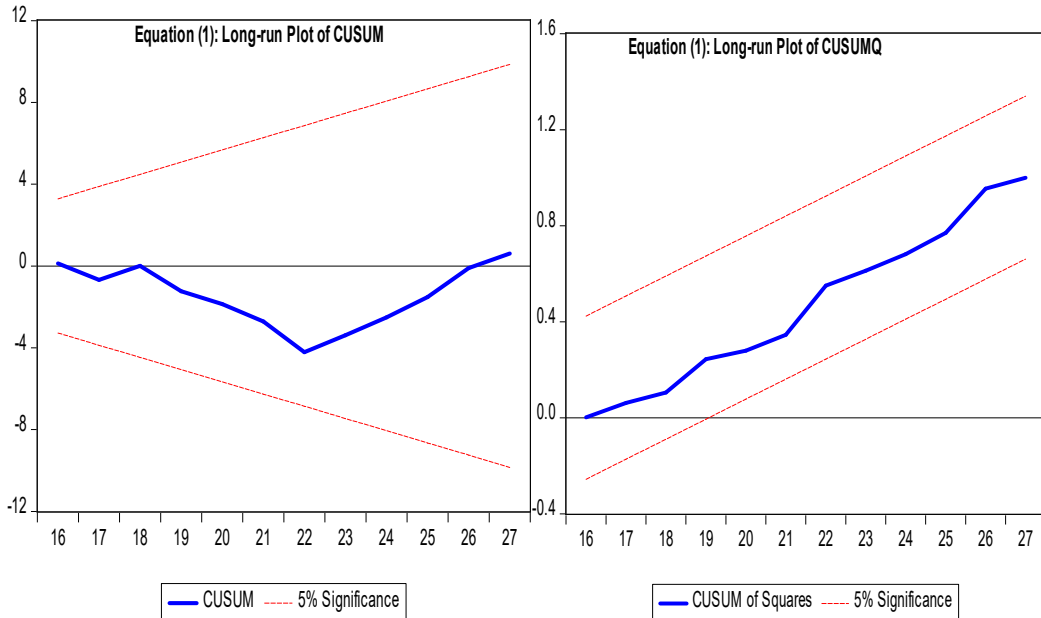


Figure 1. CUSUM and CUSUMQ plots for ARDL model in the long-run.

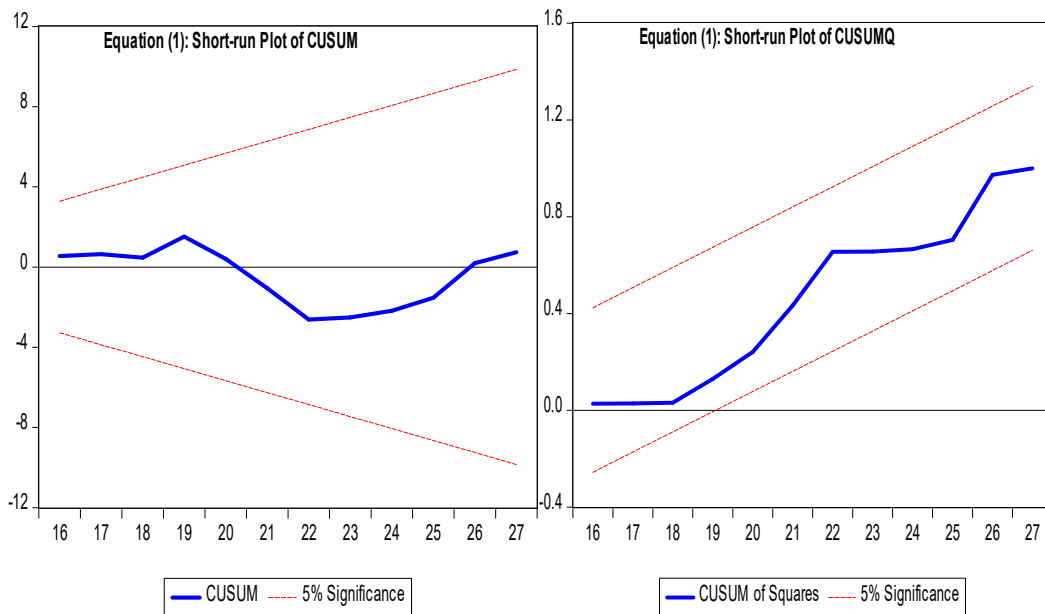


Figure 2. CUSUM and CUSUMQ plots for ARDL model in the short-run.

5.5. Additional robustness checks

As an additional robustness check, we estimate Equations (2) and (3), where we use an alternative index of financial development. In other words, we use domestic credit provided by the financial sector (dcf) and domestic credit to the private sector (dcp) as our measure of financial development to give credence to the ARDL model

results. We present the results of these estimations in **Tables 5** and **6**. In **Table 5**, we present the long-run results, which show a negative and statistically significant relationship between the shadow economy and financial development (regardless of the measure of financial development used). Next, the short-run results of this relationship are in **Table 6**. As **Table 6** shows, informality and financial development are highly correlated in the short run as well. Correspondingly, this paper also conducted stability tests by examining recursive estimates, especially CUSUM and CUSUMQ plots, which are reported in **Figures 3–6**. We still find that the results of the alternative specification are robust. Overall, this paper shows a negative and robust association between the variables of interest and the inclusion of alternative estimation methods and indices of financial development.

Table 5. Shadow economy and financial development in long-run.

Explanatory variables	Dependent variable: Shadow economy					
	Model (1)			Model (2)		
	Coefficient	t-statistics	Probability	Coefficient	t-statistics	Probability
DCF	-0.156**	-2.270	0.035	-	-	-
DCP	-	-	-	-0.502***	-3.963	0.000
Frac	-0.577	-0.910	0.374	-1.572**	-2.825	0.011
Demo	-2.891***	-3.648	0.002	-1.650***	-2.979	0.008
Gfce	0.391***	5.755	0.000	0.543***	6.699	0.000
Gw	-0.209***	-4.286	0.000	-0.178***	-3.443	0.003
Constant	14.438***	5.549	0.000	23.691***	7.744	0.000

Source: Authors' estimation.

Note: Model (1) uses dcf as measure of financial development, while Model (2) uses dcp as the measure of financial development.

Note: *, statistical significance at 10% level.

**, statistical significance at 5% level.

***, statistical significance at 1% level.

Table 6. Shadow economy and financial development in short-run (alternative specification).

Explanatory variables	Dependent variable: Shadow economy					
	Model (1)			Model (2)		
	Coefficient	t-statistics	Probability	Coefficient	t-statistics	Probability
ΔDCF	-0.081	-1.219	0.240	-	-	-
ΔDCP	-	-	-	-0.482***	-7.977	0.000
ΔGovfrac	-1.674**	-2.853	0.011	-2.633***	-4.389	0.000
ΔDemo	-1.479***	-6.019	0.000	-1.054***	-6.071	0.000
ΔGfce	0.468***	7.639	0.000	0.571***	10.481	0.000
ΔGw	-0.160***	-2.944	0.009	-0.115**	-2.354	0.031
ECT (-1)	0.731***	-5.409	0.000	-0.585***	-3.530	0.003
Constant	-0.144	-0.797	0.437	-0.059	1.0349	0.732

Source: Authors' estimation.

Note: *, statistical significance at 10% level.

**, statistical significance at 5% level.

***, statistical significance at 1% level.

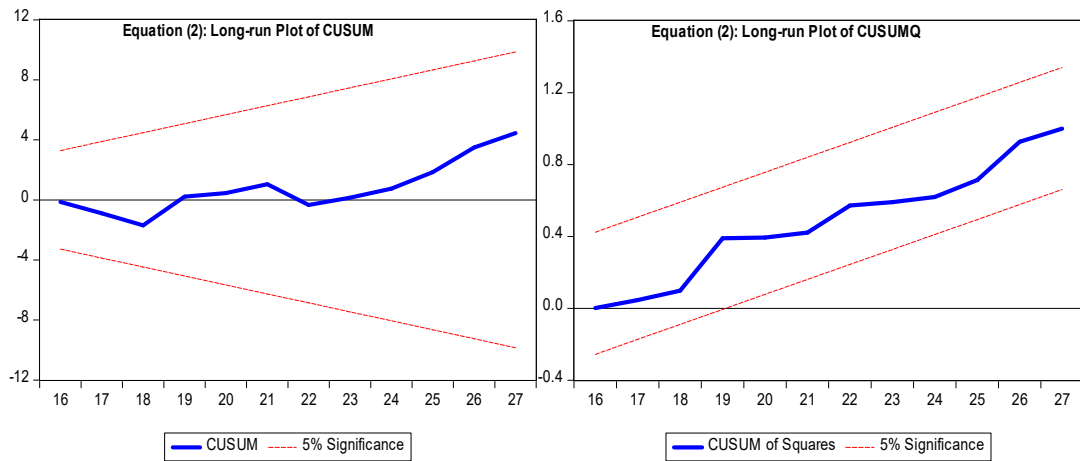


Figure 3. CUSUM and CUSUMQ plots for ARDL model in the long-run for Equation (2).

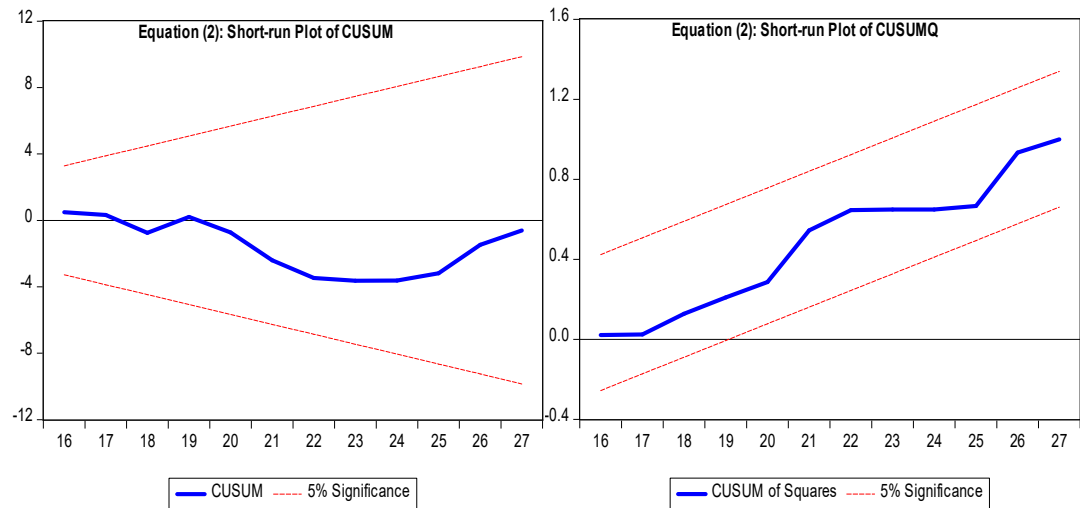


Figure 4. CUSUM and CUSUMQ plots for ARDL model in the short-run for Equation (2).

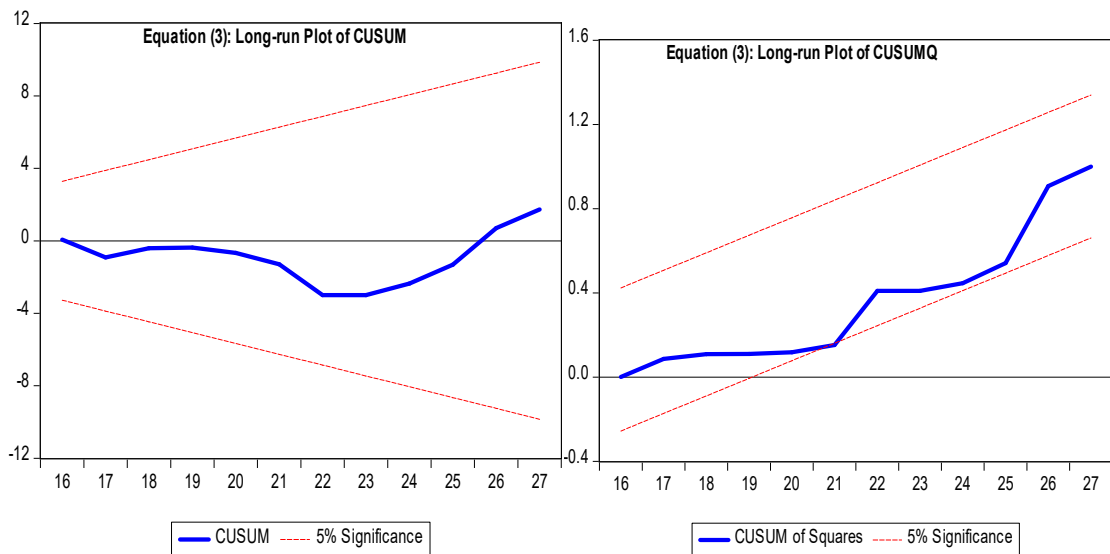


Figure 5. CUSUM and CUSUMQ plots for ARDL model in the long-run for Equation (3).

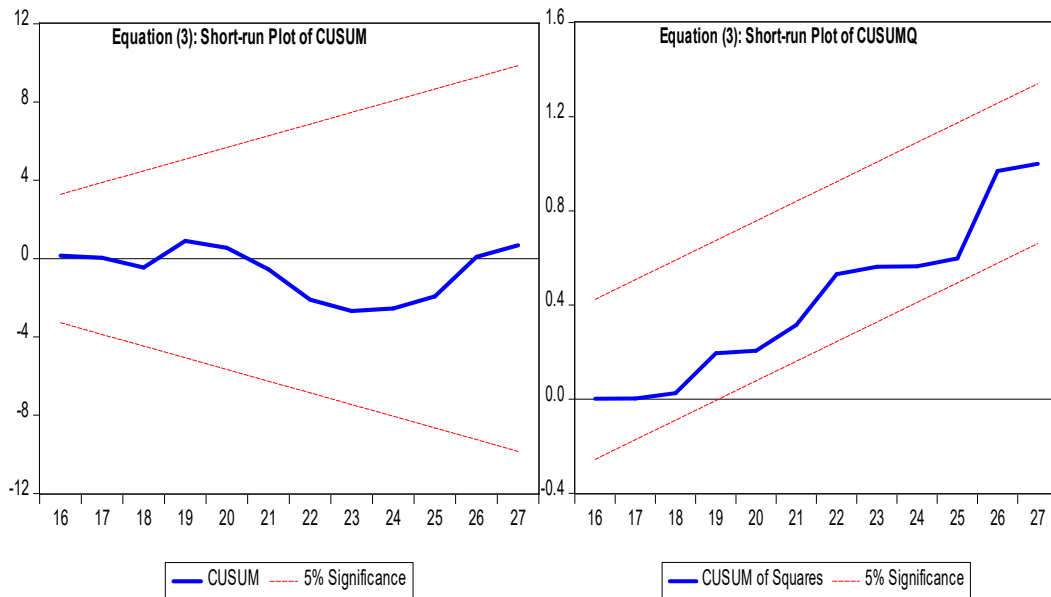


Figure 6. CUSUM and CUSUMQ plots for ARDL model in the short-run for Equation (3).

6. Conclusion

We investigate the short- and long-run relationship between the size of the shadow economy and financial development in Uganda, making use of the available time series data from 1991 to 2017. Employing the ARDL approach, a negative long- and short-run relationship between the above variables is unearthed. Our findings show that financial development mitigates the expansion of the underground economy in both the short- and long-run. The above results have important implications. First, these findings seem to reveal that improving access to credit helps a number of businesses access the much-needed business financing. Improving access to credit means that businesses can now borrow to revamp their activities in order to survive in a turbulent business environment. This helps credit-constrained businesses secure loans to expand their businesses as a result. Secondly, these findings reveal that financial development does matter and is a crucial component of the policy framework that can be used to hinder informality. This is because improving access to domestic credit relaxes financial constraints faced by businesses, which can now borrow to finance available business opportunities.

Taking policy into account, these results reveal that reforming financial institutions to facilitate improved access to domestic credit could help tackle hidden economic activities in low-income economies. Additionally, minimizing informality requires reforming the macroeconomic, political, financial, and institutional framework to be able to respond to the needs of businesses. Moving forward, developing a tractable theoretical model to provide the channels through which financial development could potentially impact the underground economy are possible areas for future research.

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Appendix

Table A1. Data and sources.

Variable	Definition	Source
Se17	The size of the shadow economy	[11]
Financial development (dob)	Domestic credit to private sector by Banks (% of GDP).	[27]
Govfrac	Fractionalization index	[28]
Demo	Institutionalized democracy, measures the existence of political institutions and processes which provide citizens avenues to express views about the type of leadership they prefer.	[29]
Gov/gdp	General government final consumption expenditure (% of GDP)	[27]
Growth	GDP per capita growth (annual %)	[27]
Financial development (dcf)	Domestic credit to private sector by financial sector (% of GDP)	[27]
Financial development (dcp)	Domestic credit to private sector by financial sector (% of GDP)	[27]

Source: Author's elaboration.

Table A2. Results of stationarity tests for all the variables.

	In levels				First difference				
	ADF		PP		ADF		PP		
	Intercept	Trend	& Intercept	Trend	& Intercept	Trend	& Intercept	Trend	& Intercept
Se17	-0.116	-1.715	-0.327	-1.862	-3.830***	-3.731**	-3.841***	-3.754**	
Dob	-0.957	-4.734***	-1.040	-4.733***	-8.972***	-8.824***	-21.383***	-23.228***	
Govfrac	-1.598	-2.144	-1.752	-2.176	-5.099***	-5.072***	-5.099***	-5.072***	
Demo	-1.036	-1.919	-1.034	-1.986	-5.292***	-5.194***	-5.292***	-5.193***	
Gov/gdp	-2.275	-2.983	-2.129	-2.983	-5.932***	-5.954***	-7.004***	-10.036***	
Gw	-3.894***	-4.363***	-3.953***	-4.363***	-5.982***	-5.934***	-9.107***	-9.241***	
Dcf	0.764	-2.217	-0.506	-2.286	-7.820***	-3.215	-7.884***	-8.209***	
DCP	-1.063	-2.187	-0.984	-2.245	-7.030***	-7.001***	-7.250***	-7.085***	

Source: Authors' estimation.

Note: *, statistical significance at 10% level.

**, statistical significance at 5% level.

***, statistical significance at 1% level.