Article

Unemployment and the informal economy in Uganda: An empirical investigation

Stephen Esaku[1,*], Salmon Mugoda[2]

[1] Kyambogo University Uganda, Kampala 256, Uganda

[2] Makerere University Uganda, Kampala 256, Uganda

* Corresponding author: Stephen Esaku, esaku_stephen@yahoo.com

Abstract: This paper investigates the relationship between unemployment and the informal economy in Uganda. Using annual time series data from Uganda, covering the period from 1991 to 2017, we apply the ARDL method to investigate this relationship. The results indicate a positive and statistically significant relationship between unemployment and the shadow economy in both the long- and short-run. This implies that an increase in unemployment increases the shadow economy in both the long- and short-run. These findings reveal that a high level of unemployment is detrimental to the formal economy since it spurs informal sector activities in both the short-and long-run. These results suggest that any attempt to regulate unemployment without tackling informal sector activities may not succeed unless they are addressed simultaneously. Furthermore, the results also imply that curbing informality requires implementing fiscal, economic and political reforms aimed at ensuring proper functioning of the business environment.

Keywords: informality; hidden economy; government spending; unemployment
JEL Classification: E26; E62; N17; O47; J64

1. Introduction

Using annual data from Uganda for the period 1991–2017, we investigate whether more unemployment is a spur to the shadow economy. (This paper uses the word shadow economy to also mean informality, unofficial/informal economy/sector, and hidden/underground economy). We use these terms interchangeably. To achieve the objective of this paper, we apply the recently introduced econometric method of autoregressive distributed lag (ARDL) bounds testing method to cointegration. There can be reason to believe that more unemployment spurs informality given that this variable has recently been cited as a key driver of the shadow economy [1]. For example, Alexandru and Dobre [2] use data from the USA to investigate the link between unemployment and informality and find a unidirectional causality running from unemployment to the shadow economy. Additionally, Alexandru and Dobre [3] using data from Romania examine cointegration and causality between the informality and unemployment rates and find a positive effect of unemployment on the informal economy. However, the association between the unemployment rate and the size of the shadow economy is vague and/or not straightforward [4]. This is due to the fact that the informal economy employs a diverse workforce, ranging from unemployed youth, retired people, minors, housewives, to illegal immigrants. Additionally, the sector also accommodates people who simultaneously have jobs in

the informal and formal economies. Given the above, the effect of unemployment rates on informality remains weak or ambiguous [4].

Relatedly, Giles and Tedds [5] give a possible explanation for the ambiguous link between the informal economy and unemployment rates. According to the above authors, two opposing forces influence the connection between the informal economy and the unemployment rate. First, a rise in the unemployment rate may entail a drop in informality because it is positively correlated with GDP growth and ultimately negatively related to the unemployment rate, as suggested by Okun's law. Second, a rise in the unemployment rate tends to increase the workforce in the informal economy as individuals have to look for a means of survival to support their families. In the same vein, Fields [6] introduces another mechanism that could drive informal sector employment, that is, voluntary informal employment—a phenomenon where workers who are employed in the formal sector voluntarily leave this employment and instead prefer to work informally. The central focus is that informal employment is varied, with features of "easy-entry" and "upper-tier" informal employment. This implies that informal sector workers employed in "upper-tier" jobs find themselves better off than those who are in formal sector employment [7]. This suggestion is very plausible considering that the quality of formal sector employment is a determinant of voluntary informal sector employment. If the quality of formal sector jobs is low (in terms of their remuneration), this makes "upper-tier" informal sector employment appear very attractive, hence driving the informality in the process [7].

Relatedly, Lemieux et al. [8] propose another powerful mechanism that could explain the rise in informal sector employment. The above authors argue that in the formal labor markets, the costs of hiring workers are seriously compounded by the burden of taxation and contributions to social security on wages, especially in highly regulated economies. Their findings seem to indicate that hours taken working informally are sensitive to variations in the net wage payments in the official sector, hence reallocating work from this sector to the informal economy where there is no burden of taxation and welfare scheme. In some developed countries, the above costs are larger than the wages paid to the workers, hence a strong incentive for entrepreneurs to go underground. Additionally, Loayza and Rigolini [9] explored the effect of strong labor regulation on self-employment (informal employment) and found evidence that stronger credit, labor and business regulations positively influence the size of informal employment. In support of the suggestion of Loayza and Rigolini [9], Kucera and Roncolato [7] also explore the concept of informal sector employment by highlighting two issues: Intensive labor market regulations and voluntary informal employment. The authors provide a theoretical overview of the two issues and find evidence of how these factors encourage businesses informally.

Taken together, the above-mentioned discourse provides strong evidence that more labor market regulations cause distortions in the labor market, resulting in job loss and thus accelerating unemployment. Given this, one would argue that more unemployment in the official economy results in more employment in the informal economy as entrepreneurs seek alternative sources of income to support their families. Consequently, Mugoda et al. [10] indicate that the underground economy is

viewed as a substantial sector that provides essential social services that support the livelihood of the citizens and has become an established source of employment for many people. For instance, it is estimated that nearly 20% of informal economy businesses in South Africa provide employment to about 850,000 people, a majority of whom could not be absorbed in the official economy [11]. One could suggest that informality might not be harmful to the official economy after all. Moreover, the shadow economy facilitates income-generating opportunities for the underprivileged, which income also ends up in the official sector hence stimulating the demand for products produced by the official economy, as indicated by Blanchflower and Oswald [12].

Thus, we follow the literature that investigates the effect of unemployment on informality. Specifically, this paper examines whether there is a short- and long-run association between the informal economy and unemployment rates in Uganda. Examining this relationship is important given that the two variables (unemployment and shadow economy) undermine the government's ability to better livelihood opportunities of its citizens. These two societal challenges must be addressed to improve the livelihood of the marginalized groups like women and the youth. The link between the shadow economy and unemployment rates is not straightforward in many cases [4]. Using conventional wisdom, one would argue that this relationship is positive since a high unemployment rate that is sustained over a period of time would increase the incentive for individuals to seek employment in the hidden economy.

Given that there is a probable positive effect of unemployment rates on informality, this paper further explores this connection in the low-income country Uganda. We consider Uganda for the following motivations. First, recent investigations of the link between unemployment rates and informality have been carried out in developed economies with less attention given to the developing countries. This paper seeks to bridge this loophole by providing understanding on how unemployment rates shape informality in low-income countries like Uganda. Second, the bulk of papers that examine the relationship between unemployment and the shadow economy have largely used panel data and cross-sectional regression methods. One prime challenge of studies that focus on panel data and cross-sectional estimation methods is that they assume homogeneity of coefficients. These papers believe that countries are similar such that findings can be applied across these countries [13]. Conversely, the premise of homogeneity may sometimes be violated due to the fact that countries are heterogeneous in terms of level of development, business environment, and quality of institutions, among others. If this cross-sectional homogeneity assumption fails to hold, then results cannot be generalizable, which may lead to policy recommendations that do not reflect the local economic conditions of the countries involved. This paper narrows this void by conducting the examination of this relationship in a country-specific context.

This paper makes a contribution in three principal ways: Firstly, we extend the examination of the link between unemployment and the hidden economy to a less studied context, Uganda. Investigating this relationship in Uganda's context may help provide an understanding of how the unemployment rate influences the informal economy in a low-income country. The results could be generalized to

other low-income countries given that Uganda shares similar characteristics with the rest of the low-income countries. Second, previous papers investigated the diverse aspects of informality, notably the size [14] and the determinants [15]. Nevertheless, the mass of these papers mainly focuses on the institutional, financial and economic dimensions, but scant studies are done on important macroeconomic variable— unemployment. Thirdly, we investigate the main connection between unemployment rates and informality that has ramifications for policy. For example, if indeed more unemployment spurs informality, what policy framework should governments adopt to regulate informality? This is an important question given that unemployment rates tend to drive the shadow economy [16].

Apart from the preceding, section 2 reviews related literature, while section 3 presents the methodology, data, descriptive statistics and estimation strategy. Section 4 presents the results and discussions, while section 5 concludes this paper.

2. Literature review

2.1. Empirical evidence

In recent years, commodities are increasingly being produced in both the shadow and formal economies. The literature provides estimates of the shadow economy, which average about 31% of GDP and these estimates are pervasive in some regions of the world [17]. The extant literature estimates that nearly 17% of the global non-agricultural labor force derives their livelihood from the shadow economy [18]. Across global regions of the world, the share of the non-agricultural workforce ranges from 26% in Sub-Saharan Africa, 23% for Latin America, 19% for East Asia, to 8.5% for Europe. These estimates suggest that informality is not a trivial peripheral feature of the overall economic landscape in the world but rather a common feature that dogs the global economic landscape. Consequently, informality is viewed as a substantial sector that provides essential goods and services and has become an established source of employment for many people [10]. For instance, it is estimated that nearly 20% of informal sector businesses in South Africa provide employment to about 850,000 people, a majority of whom could not be absorbed in the formal sector [11]. Furthermore, the international Labor Organization of the United Nations (ILO) argues that at least 60% of the global workforce is employed in the underground economy [19]. Given the above, there is growing empirical evidence indicating that the informal sector is crucial in providing employment and income-generating avenues for those who cannot find employment in the official economy [20].

Nonetheless, the continued rise and expansion of informality have become an issue of grave concern due to negative economic implications [21]. More informality creates inefficient use of economic resources since the workforce in this sector is largely semi- or unskilled and less likely to adopt modern technology of production. In the same vein, Alm and Embaye [22] argue that the shadow economy distorts investment and aggravates misallocation of productive resources due to the hidden nature of operations in this sector. Accordingly, the shadow economy can introduce distortions into the official economy due to the inability of governments to regulate and account for its activities in the national accounts [23]. Distortions introduced by

the informal economy into the formal economy may hinder the correct estimation of the overall economy. Thus, relying on data from countries with large shadow economies for planning could lead to the formulation of policies that do not reflect the reality of the overall economy [24]. Moreover, the bulk of operations in the unofficial sector are done underground and are difficult to track or tax, which aggravates the chances of tax evasion. A rise in the probability of tax evasion undermines the ability of governments to attain their planned tax revenue targets, which worsens the provision of social services by the government.

Given the growing concerns over the proliferation of informality globally, policy-makers and scholars have sought to understand the factors that drive its expansion. Recently, four strands of literature have emerged. The first strand investigates the size, the causes and the impact of informality [14,15]. The second strand of literature examines the role of institutions in influencing informality [25], and the third strand focuses on the role of the financial sector [26,23]. The fourth strand focuses on the interrelationships between informality and other variables, such as institutionalized democracy [24], economic growth [27,28], and income inequality [29]. Recently, the fourth strand of literature has expanded to include the examination of the effect of unemployment on informality [30].

Although the connection between informality and unemployment is ambiguous, some papers find that unemployment is a significant driver of informality [1,31]. Dell'Anno and Solomon [32] estimate the informal economy in the US using the method of structural equation and find a significant positive relationship between unemployment and the shadow economy. Additionally, Alexandru and Dobre [2] use data from the USA to analyze the connection between unemployment rates and informality and find one-way causality running from unemployment to the shadow economy. As shown above, there is a positive relationship when data from developed economies is used to examine this relationship. However, little is known about the link between unemployment rates and informality.

Correspondingly, Bajada [33] examines the connection between unemployment and the underground economy in Australia and finds a positive link between the two variables. Additionally, Bajada and Schneider [34] use data from selected OECD countries to assess the link between unemployment rates and the hidden economy and find a significant positive relationship. Furthermore, Alexandru and Dobre [3] using data from Romania investigate cointegration and causality between informality and unemployment rates and find a positive relationship between the two variables. Mauleón and Sardà [30] find similar results for a panel of European countries. Taken together, there is empirical evidence indicating a significant positive link between the informal economy and unemployment rates, but this evidence is largely from developed economies.

2.2. Changes influencing the rise of the shadow economy

The theoretical developments on the informal sector emphasized that the shadow economy was a transient phenomenon accelerated by underdevelopment, traditionalism and backwardness but was expected to disappear once world economies attained sufficient economic growth [35]. The general view among policy

makers and economists in the 1950s through to the 1970s was that the official (formal) economy was expected to grow faster and provide an incentive for skilled workers to find employment in the formal economy while the unskilled remained trapped in the shadow economy [36]. Thus, the co-existence between the shadow economy and the formal economy was expected to continue but their co-existence was supposed to be transitory. Consequently, the size of the shadow economy would be more substantial in economies that are less developed and backward than those that are modern. Informality would disappear when economies record substantial growth rates.

Although the shadow economy was expected to wane down once the world economies gained sufficient levels of economic growth and development, it has still remained a factor that dogs the economic landscape of the global economy. In both the developed and developing economies, the shadow economy remains substantial in the production and distribution of goods and services [37]. Over the past 50 years, the number of workers employed in the shadow economy has risen dramatically in all regions of the world, with developing countries leading in informal employment. In developing economies, substantial economic growth and development were only recorded by countries of East and Southeast Asia, while the rest of the developing economies recorded slow and insignificant economic growth and development. This implies that informality remains pronounced in economies that have not recorded high rates of economic growth and development. Some of the changes that affected the global economy include the slow economic growth that affected most developing countries in the 1990s. In the wake of the financial crisis of 2007-2008, most developing economies had already experienced sizeable declines in wages offered by the formal economy, which also accelerated the rise in the size of the shadow economy [38]. Thus, estimates show that before the financial crisis, the share of the shadow economy in the nonagricultural employment rose to nearly 80% in Africa [39]. Some of the driving factors for the rise of informality are associated with challenges in economic growth. Over the past 50 years, most countries experienced slow or no economic growth, while others experienced growth but without related job creation, in what came to be known as jobless growth. In both aspects, the size of the shadow economy continues to rise given that the official economy cannot employ all those looking for employment.

Relatedly, the economic reforms imposed by the International Monetary Fund (IMF) and the World Bank that required governments to make structural adjustments in their economies meant that workers were retrenched thus aggravating the unemployment situation in the countries that adopted restructuring programs. Those retrenched workers ended up working informally to ensure that they continue to support their families. This was the case with Uganda in the 1990s, which compounded the unemployment situation in the country. This can be seen clearly in **Figure 1**. From **Figure 1**, we can see that the shadow economy was about 40% of GDP in 1991 while unemployment rates in the country averaged more than 3%. Another driving factor is associated with the globalization of the world economy, which created a restructuring of the production and distribution processes. Global trade and investment introduced modern ways of production that benefited highly skilled workers at the expense of low- or semi-skilled workers who have little

mobility across jobs [40]. The restructuring process across industries and sectors is characterized by outsourcing and subcontracting, which results in the laying off of workers who were engaged in those activities that have been outsourced or subcontracted. This means that workers who have been laid off have to look for ways of survival by looking for alternative means of employment where they end up in the shadow economy [38]. Moreover, globalization tends to favor large firms that are able to expand production and acquire a large share of the market quickly hence affecting the survival rates of small firms. Small firms that cannot survive in the market close their operations hence aggravating the already bad unemployment situation in economies that are struggling with high unemployment rates.
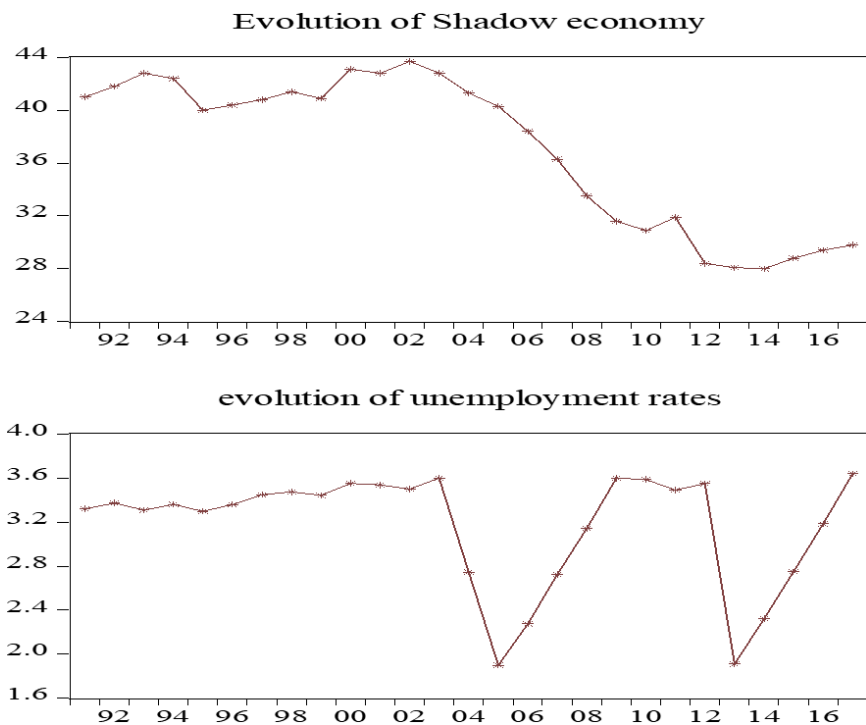

Figure 1. Evolution of shadow economy and unemployment rates in Uganda (1991–2017).

3. Methodology

In this section, we present the data, data sources descriptive statistics, model specification and estimation method used to test the empirical relationship. The details are reported in the next sections.

3.1. Data, data sources and descriptive statistics

This paper uses annual time series data drawn from various internationally recognized sources for the period from 1991 to 2017. We present the details in the Appendix (**Table A1**). As shown in **Table A1**, the response variable, the shadow economy (se17) is from Medina and Schneider [17], while our main independent variable, unemployment (uemp) is the total of unemployment rate as a percent of the total labor force as modeled by the International Labor Organization (ILO) and comes from the World Bank. We include the following control variables: Gross domestic product growth (annual %), government final consumption expenditure (%

GDP), trade openness—measured as the sum of total exports and imports (% GDP), regime durability and inflation. The summary of the data and sources is reported in **Table A1**.

Correspondingly, we also report the summary statistics (panel a) and correlation matrix (panel b) in **Table 1**. The average values are shadow economy (se17), 37.059; unemployment (uemp), 3.163; growth (gw), 6.459; government expenditure (gce), 11.454; openness (open), 37.122; regime durability (dur), 5.741; and inflation (inf), 11.539. Furthermore, we also present the correlation matrix in panel (b), which indicates that shadow economy and unemployment rates are positively correlated. This could mean that more unemployment rates lead to more shadow activities. To confirm this possibility, a formal examination of this relationship is needed.

Table 1. Summary statistics and correlation matrix.

Variable	Se17	uemp	gw	Gce	Open	dur	Inf
Panel (a): Summary statistics							
Mean	37.059	3.163	6.459	11.454	37.122	5.741	11.539
Median	40.300	3.361	6.333	11.745	36.025	6.000	5.638
Maximum	43.700	3.640	11.523	16.793	56.258	12.000	85.353
Minimum	28.000	1.900	3.131	6.585	27.839	0.000	−3.170
Std. Dev.	5.778	0.522	2.322	3.099	6.434	3.547	17.926
Skewness	−0.471	−1.319	0.416	−0.046	1.001	0.033	2.977
Kurtosis	1.518	3.488	2.315	1.729	4.183	1.945	12.085
# Obs.	27	27	27	27	27	27	27
Panel (b): Correlation matrix							
se17	1.000						
Uemp	0.246	1.000					
Gw	0.263	−0.066	1.000				
Gce	0.724	0.087	0.413	1.000			
open	−0.475	−0.267	0.209	−0.101	1.000		
Dur	−0.340	0.145	−0.524	−0.156	−0.087	1.000	
Inf	−0.001	0.244	−0.068	−0.359	0.059	−0.142	1.000

Source: Author's calculations.

3.2. Model specification

We posit that informality is influenced by formally shown as:

$$se17 = F(uemp, gw, gce, open, dur, inf) \tag{1}$$

where *se*17 is the shadow economy (% GDP), gw is GDP growth (annual %), gce is government expenditure (% GDP), open is trade openness, dur is regime durability index and inf is inflation, GDP deflator (annual %).

As presented in the earlier sections, there is a probability that the informal economy and unemployment rates are correlated. The extant literature shows that more unemployment leads to more informality [16]. Besides, we also control for economic, political, institutional, and fiscal status of the overall economy [14]. Finally, we include two important variables (regime durability and inflation) to

control for political and economic environment of the country. Next, we proceed to present econometric methodology. The justification for the inclusion of control variables lies in the extant literature. As previous literature shows, economic growth (gw) is one of the factors that influences the size of the shadow economy. For example, Esaku [41] shows that low levels of economic growth do increase the size of the shadow economy since low levels of economic growth affects the general welfare of the citizens hence provides them with incentives to find means of survival in the shadow economy. Similarly, Dell'Anno et al. [1] study the drivers of the shadow economy in Tanzania and find evidence indicating that government expenditure (gce) is one of the robust determinants of the shadow economy. Correspondingly, Esaku [42] studies the relationship between the shadow economy and trade openness in Uganda. The author finds evidence of the short- and long-run relationship between the two variables indicating that trade openness influences the size of the shadow economy. Furthermore, Elbahnasawy et al. [43] investigate the relationship between political instability (proxied by regime durability) and the shadow economy and find evidence of a negative relationship. The authors emphasized the importance of regime durability in mitigating the size of the shadow economy. Esaku [44] finds similar results. Finally, Buehn and Schneider [45] study shadow economies around the world and find evidence that inflation is one of the indicators of the shadow economy. Therefore, our inclusion of the control variables is based on the discussions above.

3.3. Econometric methodology

In this section, we present econometric methodology for estimating the relationship among variables. We make use of the ARDL method of Pesaran et al. [46] to explore the connection between these variables. Before applying the ARDL bounds technique, we first conducted stationarity tests for the long-run link between the variables. Then we carried out the ARDL bounds testing method for cointegration. This method has merits relative to other cointegration techniques. First, this method can be used regardless of the nature and order of integration, such as I(0s) and/or I(1s) or even fractionally integrated, but not I(2s) since this could invalidate the F-statistic and all critical values [46]. Second, the ARDL performs well and can provide super estimates and valid t-statistics regardless of the problem of endogeneity among explanatory variables [47]. Third, this method can correct for possible endogeneity among explanatory variables, hence eliminating residual correlation in the process [48,49]. Fourth, the method can be expressed in a single-form equation [50].

Accordingly, Equation (1) can be expressed in estimable form in the ARDL model as:

$$\Delta se17 = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta se17_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta uemp_{t-i} + \sum_{i=0}^{n} \beta_{3i} \Delta gw_{t-i} + \sum_{i=0}^{n} \beta_{4i} \Delta gce_{t-i} + \sum_{i=0}^{n} \beta_{5i} \Delta open_{t-i}$$

$$+ \sum_{i=0}^{n} \beta_{6i} \Delta dur_{t-i} + \sum_{i=0}^{n} \beta_{7i} \Delta inf_{t-i} + \lambda_1 se17_{t-1} + \lambda_2 uemp_{t-1} + \lambda_3 gw_{t-1} + \lambda_4 gce_{t-1} \quad (2)$$

$$+ \lambda_5 open_{t-1} + \lambda_6 dur_{t-1} + \lambda_7 inf_{t-1} + \mu_t$$

where β_0 is the constant term, $\beta_1, \ldots, \beta_7$ and $\lambda_1, \ldots, \lambda_7$ denote the coefficients for the short- and long-run, respectively, and μ_t represents the error term.

Therefore, we express the null hypothesis of no cointegration as ($H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$), which is compared with the alternative hypothesis of cointegration, expressed as ($H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq 0$). The outcome of the calculated F-statistic is then compared with critical values specified in Pesaran et al. [46]. The criterion for rejection of H_0 (null hypothesis) is when the calculated values of the F-statistic exceed the upper critical bound values and vice versa. Conversely, if the F-statistic values are inside or within the bounds, we conclude that the outcome of the bounds test is inconclusive.

Furthermore, this paper first determined the optimal lag length, which was ascertained based on Schwartz-Bayesian criterion (SBC) appropriate lag selection criteria. After the cointegration test on Equation (1), the error correction model (ECM) is formally expressed as:

$$\Delta se17_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta se17_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta uemp_{t-i} + \sum_{i=0}^{n} \beta_{3i} \Delta gw_{t-i} + \sum_{i=0}^{n} \beta_{4i} \Delta gce_{t-i} + \sum_{i=0}^{n} \beta_{5i} \Delta open_{t-i}$$

$$+ \sum_{i=0}^{n} \beta_{6i} \Delta dur_{t-i} + \sum_{i=0}^{n} \beta_{7i} \Delta inf_{t-i} + \delta ECT_{t-1} + \mu_t \quad (3)$$

where δ represents the coefficient of error correction term (ECT) indicating the long-run correction to the equilibrium after divergence from equilibrium. The ECT represents the momentum of correction and its validity is in the sign and size of the coefficient. Enders [51] suggests that (δ) should be negative, equal to or less than 1 and significant.

4. Results and discussion

4.1. Stationarity tests

Before conducting the empirical exercises, we first carried out unit root tests by applying Augmented-Dickey-Fuller test (ADF) and Phillip-Perron (PP) test. The outcome of the test is presented in **Table A2**. Furthermore, after carrying out unit root tests, we applied ARDL bounds testing for cointegration to determine the existence of the long-run association between the main variables. The estimates are presented in **Table 2**. Panel (a), expresses the function to be tested and panel (b) indicates the outcome of the ARDL bounds test for cointegration. The estimates show that the calculated *F*-statistic is 7.436, higher than the upper critical bound

values hence the variables have a long-run relationship. We do not accept the null hypothesis of no cointegration but instead accept the alternative hypothesis. Additionally, we carried out residual diagnostics to ensure reliability of the test outcome. Specifically, Heteroskedasticity Test: Breusch-Pagan-Godfrey, Normality and Serial Correlation LM Tests were implemented. The outcome of these tests is reported in panel (b) columns 4 to 6, and the ARDL model is free from serial correlation. After reliability of the ARDL model was determined, we carried out the estimation of long-run and short-run relationships. This was done after first establishing the optimal lag length using the Schwartz information criterion (SIC). The models selected are; ARDL (2,0,0,0,0,0,0).

Table 2. Outcome of the ARDL bounds test.

Panel (a): The equation to be tested

Equation	Dependent variable	Function
Eq. (1)	Se17	F (se17 | uemp, gw, gce, open, dur, inf)

Panel (b): Results of ARDL bounds test

	ARDL Model	F-Stat.	Diagnostics X^2 (Normality)	X^2 (Heteroscedasticity)	X^2 (Corr.)
ARDL	(2,0,0,0,0,0,0)	7.436	0.641	0.816	0.340
	Actual sample size ($T = 25$)				
	Critical values				
	Lower Bound ARDL I(0)		Upper Bound ARDL I(1)		
10%	2.12		3.23		
5%	2.45		3.61		
2.5	2.75		3.99		
1%	3.15		4.43		

Source: Author's calculation.

4.2. Results of long-run relationship

In this section we report the ARDL estimation results for the long-run relationship between unemployment and the informal economy in Uganda, in **Table 3**. Firstly, we present estimates of the ARDL model in column 2 while columns 4 and 6 report the estimates of the Dynamic Ordinary Least Squares (DOLS) and Fully-Modified Ordinary Least Squares (FMOLS). The DOLS and FMOLS estimates are used to validate the results of the ARDL since these two approaches are considered to correct for serial correlations as well as any possible endogeneity [52]. We focus our discussion on the ARDL results in column 2. The coefficient on unemployment rate is significant at 5% level and positive as well. These results confirm a long-run positive and significant relationship between unemployment and shadow economy implying that more unemployment rate significantly leads to more informality in the long-run. Specifically, a unit increase in unemployment rate positively increases informality by 0.782 units. This finding lines up with the extant literature [2,30]. We argue that the findings of the long-run relationship between the above variables broadly reflect the findings in the extant literature, which also confirms the expectation of this paper.

The findings of this relationship are quite important. The key question one would ask is what possible mechanism explains the above positive relationship between unemployment and the informal economy? One channel that could explain the above relationship is that the informal economy provides complementary income to entrepreneurs. As proposed by Fields [6], informal employment is heterogeneous, with features of "easy-entry" and "upper-tier" informal employment which implies that as the quality of employment in the formal economy drops this is followed by low remuneration paid to the workers which worsens the quality of life for workers in the formal sector. Consequently, such workers might voluntarily leave their formal employment in favor of the informal employment hence increasing the workforce in this sector. The second possible explanation is that the costs of hiring workers in the formal labor markets are high due to the burden of taxation and contributions to social security which are mandatory for firms that are licensed and operating under the radar of government regulators [8]. This burden can be seen by risk averse entrepreneurs as distortionary to the labor market outcomes hence this provides incentive for them to hide in the shadows from the scrutiny of government regulators increasing the size of the shadow economy in the process. Additionally, the tax and social security burden lower the profitability of the businesses which also reduces employment prospects by these businesses, occasioning job losses in the process. Therefore, a rise in unemployment rate tends to increase the workforce working informally since individuals have to look for a means of survival to support their families. Indeed, Loayza and Rigolini [9] find evidence that stronger credit, labor and business regulations positively influence the size of informal employment, hence a rise in informality. Additionally, Kucera and Roncolato [7] provide theoretical overview indicating that intensive labor market regulations and voluntary informal employment provide incentive for entrepreneurs to operate underground.

In other long-run results, there is positive effect of government expenditure on the informal economy. The coefficient on (gce) is significant at 1% level implying that government expenditure is a key factor in informal sector [1]. Furthermore, there is evidence indicating that growth and development is very important factor that should be considered in curbing the shadow economy. As the empirical results show, growth (gw), is significant at 5% level, meaning that a unit increase in growth decreases the shadow economy by 0.192 units, agreeing with the extant literature [28]. Additionally, we find that a country's economic stance is important in curbing the informal economy. Thus, a unit increase in trade openness decreases the shadow economy by 0.226 units, significant at 1% level, which lines up well with extant literature.

To evaluate whether our estimates can hold even when alternative econometric estimation methods are used, we follow the advice of Menegaki [52] that the use of DOLS and FMOLS to validate the robustness of the ARDL model could provide a better alternative. The estimates are indicated in **Table 3**, columns 4 and 6, which provide evidence that the results of the ARDL estimation estimates largely mirror the same evidence of a positive and statistically significant relationship between the two variables in the long run. We conclude that the ARDL model results are robust to alternative estimation methods.

Table 3. Results of Long-run relationship.

| Explanation variables | Outcome: The size of the shadow economy | | | | | |
| | ARDL | | DOLS | | FMOLS | |
	Coeff.	*t*-stat	Coeff.	t-stat	Coeff.	*t*-stat
Uemp	0.782**	2.521	0.782**	2.389	0.850***	5.130
Gw	−0.192**	−2.253	−0.192***	−2.946	−0.194***	−4.272
Gce	0.474***	5.465	0.474***	5.567	0.470***	10.174
Open	−0.236***	−9.063	−0.236***	−7.471	−0.226***	−14.701
Dur	−0.033	−0.582	−0.033	−0.519	−0.010	−0.313
Inf	0.004	0.361	0.004	0.431	0.001	0.229
Constant	10.574***	4.775	10.575***	4.187	9.900***	7.900
R-sq.	0.984					
R-bar-sq	0.977					
D. Watson	1.271					

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

4.3. Short-run estimates of the link between unemployment and informal economy

This section reports estimates of the ARDL estimation indicated in **Table 4**. In **Table 4**, it shows a positive and significant association between unemployment and the informal economy suggesting that in the short run, more unemployment rates significantly lead to more shadow economy. This lines up with Dell'Anno et al. [1], who find evidence indicating that unemployment drives informality. The positive results of the long- and short-run relationship between the shadow economy and unemployment are expected in a low-income country like Uganda that has been struggling to provide employment to its citizens. As shown by Fourie [11], informal businesses have become centers of 'refuge' for the unemployed, especially the youth and the women. In cases where unemployment rates are high, it is natural to expect the informal economy to expand as people try to find a means of survival and sustenance for their families, further driving informality.

Turning to more estimates of the short-run estimation, (gce) is positive and significant at 1% level implying that a unit increase in government expenditure increases informality by 0.470 units. This lines up well with the extant literature [1]. Additionally, this paper finds evidence that inflation is another indicator of informality. We can note that (inf) is 0.007 units, positive and significant at 1% level which lines up well with the extant literature that shows the positive relationship between inflation and informality [53]. Conversely, we also find that (gw) is 0.160 units, negative significant at 5% level indicating that growth is an important determinant of the informal economy [27].

Finally, we also examined the adjustment of the informal economy to any divergence from long-run equilibrium as measured by the size and sign of the coefficient on the error correction term (ECT). We can see that the lagged coefficient of the ECT is negative, less than 1 and significant at the 5% level indicating that the informal economy corrects for any divergences from long-run equilibrium at a

momentum of adjustment, which is 52.8%, statistically significant at the 5% level, in agreement with [51].

Table 4. Results of short-run relationship.

Explanatory variable	Outcome: The size of the shadow economy		
	ARDL Model		
	Coefficient	t-statistics	Probability
Δuemp	0.974***	3.379	0.004
Δgw	−0.160***	−3.519	0.003
Δgce	0.470***	11.670	0.000
Δopen	−0.154***	−5.885	0.000
Δdur	−0.027	−1.592	0.132
Δinf	0.007***	3.193	0.006
ECT	−0.528**	−2.570	0.021
Const	−0.136	−0.982	0.342
R-squared	0.859		
R-bar-squared	0.784		
Durbin Watson stat.	1.229		

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

4.4. Diagnostic tests

We carried out stability tests for the ARDL results. Specifically, we assessed the plots of the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMQ). The plots of CUSUM and CUSUMQ are reported in **Figures 2** and **3**. As can be noted from **Figures 2** and **3**, the plots of both CUSUM and CUSUMQ show that the above relationship is stable since these plots lie inside the borders at a 5% significance level. We sum by arguing that the estimates of ARDL bounds tests hold even when alternative estimation methods.
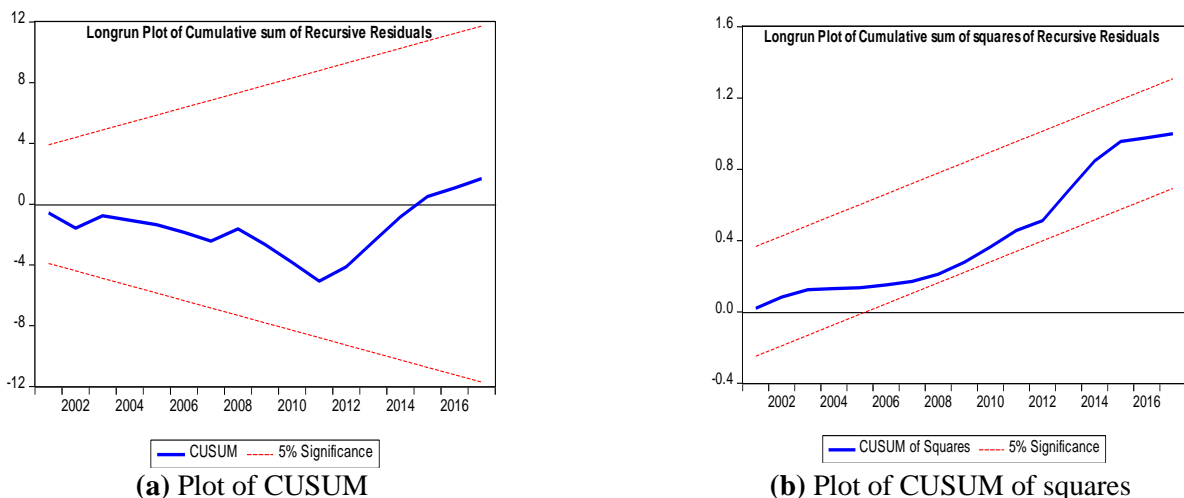

(a) Plot of CUSUM

(b) Plot of CUSUM of squares

Figure 2. Long-run plot of CUSUM and CUSUMQ for ARDL model. **(a)** Plot of CUSUM; **(b)** Plot of CUSUM of squares.

(a) Plot of CUSUM

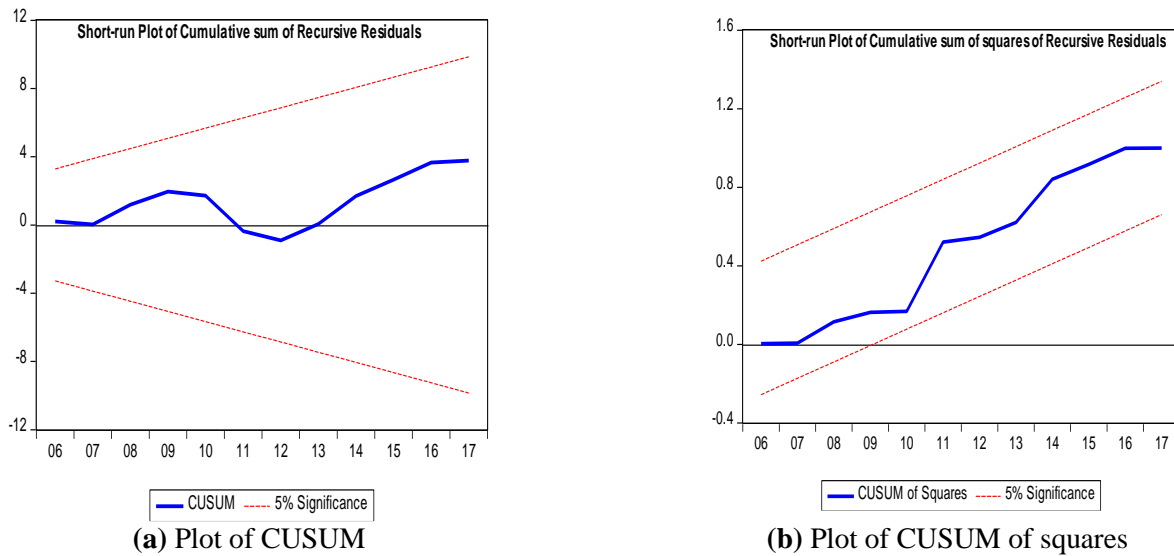(b) Plot of CUSUM of squares

Figure 3. Short-run plot of CUSUM and CUSUMQ for ARDL model. **(a)** Plot of CUSUM; **(b)** Plot of CUSUM of squares.

5. Conclusion

This paper examines the relationship between unemployment and informality using data from Uganda from 1991 to 2017. Findings indicate that more unemployment rates significantly lead to more informal economy in both the short- and long-run. This can be expected given the high level of unemployment in the country. In cases where unemployment is high, one can expect the shadow economy to expand as people try to find a means of survival for their families.

These findings have implications for policy. First, findings provide evidence that suggests that an attempt to regulate unemployment rates without tackling the shadow economy may not succeed unless the two variables are simultaneously addressed. Second, the results also imply curbing informality requires fiscal, economic and political reforms in the country. These seem to be viable policy options that can mitigate widespread informality in Uganda and Africa as a whole. One limitation with our study is the data coverage, which is limited to only 27 years. Future studies could provide more insights into this relationship by expanding data coverage. Furthermore, papers that advance theoretical models to explain this relationship could be fruitful areas for further research.

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Appendix

Table A1. Data and sources of main variables.

Variable	Variable description	Data source
Se17	Size of the shadow economy as a percent of gross domestic product (GDP) from 1991-2017	[17]
Uemp	Unemployment, total (% of total labor force) (modeled ILO estimate)	[54]
Gce	General government final consumption expenditure (% of GDP)	[54]
Gw	Gross domestic product growth (annual %)	[54]
Open	Domestic credit to private sector by banks (% of GDP)	[54]
Inf Dur	Inflation, GDP deflator (annual %) Regime durability index, reports a measure of authority patterns over a period of time. It is the duration since the last regime change that alters authority characteristics of a given nation.	[54] [55]

Source: Author's elaboration.

Table A2. Stationarity test results.

Variable	Levels				First difference			
	Intercept		Trend and intercept		Intercept		Trend and intercept	
	ADF	PP	ADF	PP	ADF	PP	ADF	PP
se17	−0.116	−1.862	−0.325	−1.715	−3.830***	3.841***	−3.731***	−3.754**
Uemp	−3.096**	−2.385	−3.158	−2.331	−4.195***	−4.201***	−4.138**	−4.143**
Gw	−3.847***	−3.847***	−4.039**	−4.039**	−5.480***	−11.230***	−5.473***	−18.673***
Gce	−2.142	−2.034	−2.727	−2.640	−5.578***	−7.788***	−3.618*	−11.382***
Open	−2.174	−2.145	−2.184	−2.249	−5.346***	−5.611***	−5.242***	−5.605***
Dur	−1.579	−1.637	−2.209	−2.255	−5.201***	−5.199***	−5.252***	−5.246***
Inf	−4.441***	−4.425***	−4.416***	−4.416***	−8.293***	−11.387***	−8.168***	−11.833***

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