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*Corresponding author: Stephen Esaku, Department of Economics and Statistics, Kyambogo University, Kampala, Uganda
E-mail: esaku_stephen@yahoo.com

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Evan Lau, Department of Economics, Universiti Malaysia Sarawak, Kuching, MALAYSIA

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GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

The long- and short-run relationship between the shadow economy and trade openness in Uganda

Stephen Esaku^{1*}

Abstract: This paper examines the relationship between the shadow economy and trade openness in Uganda, using autoregressive distributed lag bounds testing approach. We find that the shadow economy and trade openness have a long- and short-run relationship. These results hold even when alternative econometric methods are used. The empirical evidence indicates that more exposure to foreign trade significantly reduces the size of the shadow economy. This could imply that as countries become more integrated into the world economy, firms and individual entrepreneurs are induced to engage in the formal sector so as to reap the benefits of international markets. This paper shows that trade openness is an important determinant of the shadow economy in both the short- and long-run. At the policy level, any policy framework that strengthens integration into the global economy will be an effective tool that can reduce shadow activities in both the short- and long-run. The practical implication of these results is that countries that have fully reformed their economies to allow for free trade and investment inflows experience a decline in shadow activities implying that, in more open economies, more trade reduces informality.

Subjects: Globalization; Politics of International Trade; International Finance; International Trade; incl; trade agreements & tariffs; Development Economics; Political Economy; PublicFinance; Public Management

Keywords: Globalization; informal sector; shadow economy; trade; trade openness

JEL Classifications: F10.F14.F61.O17.P10

ABOUT THE AUTHOR

Stephen Esaku is an adjunct faculty at 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

Businesses that operate outside the radar of public regulation have become an issue of concern today because of the problem associated with their operations. First, these businesses rarely meet their tax obligation because they have the habit of evading taxes. Second, some of them are involved in illegal activities like selling drugs, human trafficking among others. As a way of addressing informality, policy makers are crafting policies and testing their effects on informality. One such policy is liberalizing the economy so businesses can engage in international operations without hindrance. We test the effect of such policy on the size of the shadow economy. We find that more trade with the outside world significantly reduces the size of the shadow economy in both the long- and short-run.

1. Introduction

Recently, one common feature of most economies has been the increase and expansion of the shadow economy¹ across the world. Recent estimates by Medina and Schneider (2019), show that informality is high and expanding in both developing and developed economies. For instance, in a sample of 157 economies, the size of the shadow economy was estimated to average 31% of the gross domestic product (GDP) across the surveyed economies. From the economies surveyed, Latin America had the highest estimate, on average, with Bolivia having the largest, averaging of 62.9% of GDP, followed by Europe, where Georgia leads with about 62%. On the African region, there is evidence of the rising trend as well, with Nigeria having 56.8%, followed by Tanzania, with 56% of GDP, respectively (Medina & Schneider, 2019). This evidence shows that the shadow economy is becoming a permanent feature of most economies around the world.

In this paper, we examine the short- and long-run relationship between trade openness and the shadow economy. Our main objective is to analyze how trade openness affects the size of informal sector activities in Uganda and suggests policy recommendations to address informality in the country. Recently, the concept of informality has gained acceptance as a “new normal” in the production and distribution of goods and services, given that this sector plays a central role (Esaku, 2021; Jutting & Laiglesia, 2009). This contrasts with the earlier notion of the 1970s where the informal sector was considered stagnant, unproductive and a “refuge” sector for the urban unemployed who recently arrived from rural areas (Esaku, 2021b; Harris & Todaro, 1970).

Evidence of the rise and expansion of the shadow economy has become an issue of concern among policymakers because of the distortions it causes to the formal economy (Esaku, 2021c). First, most entrepreneurs who operate in the shadow economy are known to evade taxes which undermines governments’ ability to levy and collect taxes (Esaku, 2021b). Second, failure by governments to collect taxes implies that there will be a tax revenue shortfall, which in turn weakens the provision of essential public goods and services like security, health care infrastructure and education among others (Esaku, 2021). If entrepreneurs operate in the formal economy, governments can reliably assess their tax liability and hence a high likelihood that they may comply with the requirement to pay up which ensures fiscal health of the country. Earlier studies on the shadow economy viewed this sector as stagnant, with its entrepreneurs being considered the result of underdevelopment, which is a common indicator for most developing countries (Harris & Todaro, 1970) but would disappear once substantial economic development is realized. But in recent years, there is a general perception that informality is a phenomenon that is tending towards permanency (Esaku, 2021b; Jutting & Laiglesia, 2009). Moreover, informality is recognized as widespread, expanding and persistent in many parts of the world (Medina & Schneider, 2019). Across borders, informality is increasing and cannot be considered as minor mode of production and distribution of goods and services but should be taken as substantial and enduring.

Recently, there is a growing interest among research and policymakers to understand the main determinants of informality and the policy framework that can be used to tackle its expansion (see Mugoda et al., 2020). The literature has majorly focused on studying the fiscal determinants of the shadow economy. Specifically, the literature suggests that businesses voluntarily leave the formal sector to join the shadow economy to circumvent burdensome regulations, over taxation and public sector corruption (Loayza, 1996). If this is the case, then informality could be viewed as “popular resistance” to burdensome government policies which stifles the operations of these entrepreneurs (Maloney, 2004). However, some papers have examined the political aspects of the economy that could be drivers of informality in the both developing and developed economies. For instance, Buehn and Schneider (2012) using data from 51 economies from the period 2000 to 2005 find empirical evidence that corruption increases informality. Borlea et al. (2017) reach similar conclusions by emphasizing that high levels of corruption are strongly correlated with a large size

of the shadow economy. Correspondingly, Teobaldelli and Schneider (2013) investigate how direct democracy affects informality and find empirical evidence that democracy matters in addressing increase in shadow activities.

Despite attempts to study the main determinants of informality across the world economies, little is known about how trade openness shapes informality. There is a possibility that more openness may be correlated with the shadow economy, either positively, or negatively, and in some cases this relationship is inconclusive. From both the theoretical and empirical point, trade openness is expected to improve productivity and reallocation of resources leading to high aggregate productivity (see Melitz, 2003; Esaku & Krugell, 2020; Esaku & Nsiah, 2020a). In light of this, trade openness could reduce informality as a result of high productivity but also may cause shedding off of jobs (when resources are reallocated from low to high productivity firms) which then leads to unemployment (Esaku & Watson, 2020b). A rise in unemployment increases informality as those unable to find jobs in the formal sector end up operating in the shadow economy.

Clearly, the effect of trade openness on informality is not straightforward (Birinci, 2013). In a study of 12 advanced countries from the period 1964 to 2010, the above author finds that the relationship between the shadow economy and trade openness is at best, inconclusive. Similarly, Fiess and Fugazza (2012) investigate the relationship between the shadow economy and trade liberalization using various datasets and find mixed results. The above authors find evidence when macro data is used, that liberalizing the economy increases informality. However, when they use micro data they find no evidence of the conventional thinking that liberalization increases the size of the shadow economy. Furthermore, Goldberg and Pavcnik (2003) using data from Brazil and Colombia investigate the relationship between the shadow economy and trade liberalization. They find no evidence of a positive relationship between the shadow economy and trade liberalization. Blanton et al. (2018) study how economic openness affects the size of the shadow economy and find support for the negative relationship. Specifically, the above authors show that economic openness reduces the size of the shadow economy in a panel of 145 countries. Y Bayar and Öztürk (2019) find similar results for European Union transition economies when they analyzed data covering the period from 2000 to 2015. Similar conclusions were reached by Berdiev et al. (2018) for a panel of 100 countries covering the period from 2000 to 2015. Taken together, the above findings show conflicting results on the relationship between trade openness and informality.

Although some papers have examined the relationship between the shadow economy and trade openness, empirical evidence is contradictory and inconclusive. On account of inconclusive results from the extant literature, this paper investigates the short- and long-run relationship between the shadow economy and trade openness, using Uganda as a case. There is reason to believe that Uganda is suitable for examining the above relationship because of government's effort to reform the economy. Since the 1990s, Uganda has carried out a number of economic and financial reforms aimed at dismantling trade barriers (Obwona, 2001). Furthermore, examining the relationship between the size of the shadow economy and trade openness is important because trade is considered to be the main engine of economic growth in most economies especially those of South East Asia. If more trade indeed reduces (increases) informality, it is important to craft policies that promote (hinder) trade so as to address the persistence and expansion of the shadow economy. Conclusions reached in this paper may be applied to other developing economies in Africa and other regions, since Uganda has common characteristics with many low-income countries.

This paper makes two important contributions to the literature. Firstly, this study examines the relationship between the shadow economy and trade openness, which has many policy implications. For example, which policies are required to promote trade that may also have a negative effect on the informal economy? Certainly addressing the rise of shadow activities in a developing country like Uganda is important because a large size of the shadow economy could hinder government's fiscal goals and undermines its ability to provide essential services that are necessary for promoting the

welfare of the citizens. Secondly, this paper is the first (to the best of our knowledge) to examine the relationship between informal economy and trade openness in Sub-Saharan Africa. Specifically, does trade openness have a long-run relationship with informal economy in a context where trade is important? The findings from this paper will provide important understanding and policy direction that can guide policymakers in Uganda and Africa as a whole.

Apart from section 1, the rest of paper is arranged as follows. Section 2 reviews related literature, while section 3 reports data sources, summary statistics and correlation matrix. In section 4, we present the methodology while in section 5 the empirical results and discussion are presented. Section 6 reports the conclusion of this paper.

2. Review of related literature

The relationship between trade openness and the size of the shadow economy is important and yet it has received little attention, from both the theoretical and empirical viewpoints. The general view (unofficial) is that more trade with the rest of the world should bring in immense benefits to trading partners and reduce informality. There are theoretical arguments that support the view that opening up the economy for trade provides benefits to trading partners. For example, Melitz (2003) presents a tractable model that demonstrates the impact of trade liberalization on productivity growth of firms. In a dynamic industry model with heterogeneous firms, the above author studies intra-industry effects of foreign trade and establishes two stylized facts. First, more exposure to international trade induces only the large and more productive firms to engage in international trade while the less productive ones continue to serve the domestic markets. Second, foreign trade leads to aggregate industry productivity growth as a result of resource reallocation effects which then contributes to welfare gains. As demonstrated in Melitz (2003) model, more exposure to international trade should lead to welfare gains which should also mitigate the rise of informal economy activities (Esaku, 2019a). This is possible given the fact that freedom to trade internationally is highly correlated with reduced shadow activities (see Berdiev et al., 2018). Correspondingly, Goldberg and Pavcnik (2003) develop a dynamic efficiency model to study the relationship between informality and trade liberalization using data from two Latin American countries that experienced substantial reductions in trade barriers. The above authors establish that trade liberalization does reduce the size of the shadow economy in some cases but not always. Additionally, using a small open economy theoretical framework in the presence of heterogeneous firms, Paz (2014) investigates the likely changes in the informal and formal economy mix in the labor market as a result of trade liberalization. The above author shows that abolishing home trade tariffs has an ambiguous and inconclusive effect on informality while reducing import taxes has a substantial negative effect on the size of the shadow economy, through its effect on informal employment.

Conversely, Ghosh and Paul (2008) present a labor transition model with features of job creation and job loss in the formal sector of the economy, to study the effect of trade liberalization on job transitions. These authors show that an increase in trade liberalization increases the size of the shadow economy. Additionally, Kar and Marjit (2001) use a model with segmented labor markets to study the effect of trade openness on employment in the informal sector. The above authors find evidence of a positive relationship between trade openness and informal economy employment. Specifically, they find that as the economy becomes more integrated into world trade, informal sector employment expands significantly. Similarly, Marjit and Acharyya (Marjit & Acharyya, 2003) following closely the arguments advanced by Kar and Marjit (2001) investigate the effect of trade openness on wages in the informal sector and find evidence that more openness raises wages and employment in the informal sector.

Taken together, the above theoretical literature suggests that more trade openness leads to increased informality. However, Alema-Castilla (Aleman-Castilla, 2006) uses heterogeneous model to investigate the effect of trade liberalization (through reduced trade costs) on informality and finds evidence that the reduction of trade costs, as a result of trade liberalization, induces some firms to operate in the formal sector instead of the shadow economy. In this view, the lowering of

trade costs implies a reduction in marginal costs of production which has a positive effect on productivity and welfare of the citizens. Improved productivity as a result of lower marginal costs could lead to increased profitability and more odds of firm survival, which dampens the incentive of the firms to operate in the informal economy.

As the theoretical evidence above shows, theoretical prediction of the effect of trade openness on the size of the shadow economy is mixed and inconclusive. This effect varies between countries and variables used to measure informality. This provides the justification that the relationship between trade openness and the size of the shadow economy still requires more investigation. From the empirical point of view, some studies show that increasing freedom to trade internationally is potent in reducing the size of informal economy. For example, Berdiev et al. (2018) investigate the impact of economic freedom on the size of the informal economy in a panel of 100 economies covering the period from 2000 to 2015. These authors establish that economic freedom has a significant negative effect on the size of the informal economy. Disaggregating economic freedom into its main elements, the authors provide evidence indicating that opening up the country to trade internationally reduces the size of the shadow economy. Additionally, Bayar and Öztürk (Y Bayar & Öztürk, 2019) examine the effect of economic freedom on the informal economy in the European Union transition countries. These authors investigate this relationship using data that cover the period from 2000 to 2015, and find evidence of a negative effect of economic freedom on the size of the shadow economy.

One could also argue that more trade with the rest of the world is synonymous with globalization. In this is the case, the literature shows that globalization is important in curbing shadow activities. For instance, A.N. Berdiev and Saunoris (2018) investigate the effect of globalization on the size of the shadow economy in a panel of 119 economies. The above authors find evidence of a negative correlation between the shadow economy and globalization. Specifically, these authors show that the political component of globalization is significant in hindering the rise of informal sector activities. Given the above empirical evidence of a negative relationship between

Table 1. Data definition and sources

Variable	Definition	Source
Se15	The size of the shadow economy (an estimate of shadow economy as percent of GDP)	Medina and Schneider (2018)
Open	Trade openness measured using exports plus imports as a share of Gross domestic product (GDP) NE. TRD.GNFS.ZS	The World Bank World Development Indicators (World Bank, 2020)
Gw or simply growth	GDP per capita growth (annual %) NY. GDP.PCAP.KD.ZG	The World Bank World Development Indicators (World Bank, 2020)
Gov/gdp	General government final consumption expenditure (% of GDP) NE.CON.GOV.TS	The World Bank World Development Indicators (World Bank, 2020)
Law	Law and order which of measure of institutional quality.	International Country Risk Guide (International Country Risk Guide (ICRG) Researchers Dataset, 2017)
Inflation (inf)	Inflation, consumer prices (annual %) FP.CPI.TOTL.ZG	The World Bank World Development Indicators (World Bank, 2020)
Dc	Domestic credit to private sector by Banks (% of GDP) FD.AST.PRVT.GD. ZS, which is our preferred measure of financial development.	The World Bank World Development Indicators (World Bank, 2020)

Source: Author's elaboration.

the size of the shadow economy and trade openness, it is plausible to expect that more trade openness reduces the size of the shadow economy in Uganda.

3. Data

3.1. Data sources

In Table 1, we report the data sources and definition of the main variables. The data used in this paper are annual time series downloaded from various data sources. They cover the period from 1991 to 2015. The outcome variable, the size of the shadow economy is measured as a percent of the shadow economy and is from Medina and Schneider (2018). The above authors use a mixture of econometric methods, such as the new macro method, Currency Demand approach (CDA) and Multiple Indicators Multiple Causes (MIMIC) to estimate the average size of the shadow economy covering the period from 1991 to 2015, for 158 economies. The authors argue that these estimates are quite comparable to others estimated by statistical offices or surveys (see Medina & Schneider, 2018). Table 1 shows that the bulk of the data come from the World Bank (2020), with International Country Risk Guide (International Country Risk Guide (ICRG) Researchers Dataset, 2017) providing data on the quality of institutions (law and order).

3.2. Descriptive statistics and correlation matrix

Apart from data definitions and sources, we also present a graphical analysis of the main variables (Se15 and open) in Figure 1. In Figure 1, we can observe that during periods when trade openness is at its lowest (years 1992 and 1993) informal sector activities seem to be rising. However, as the country becomes more open to international trade, the size of the shadow economy begins to decline steadily. This can be seen by scanning through the two variables from years 2002 to 2015. A visual inspection of Figure 1 clearly indicates that as trade openness trends upwards, the size of the shadow economy trends downwards. This graphical illustration of the main variables mirrors the efforts of the government of Uganda's attempts to reform its economy to facilitate trade and investment inflows (see Obwona, 2001).

We also present descriptive statistics and correlation matrix in Table 2. Panel (a) reports the summary statistics while panel (b) presents the correlation matrix. In pane (a), we observe that this study covers 25 years, with our two main variables of interest, trade openness (open) and the size of the shadow economy (se15) having average values of 38.743 and 36.223, respectively, over the period 1991 to 2015. Similarly, growth (gw), government expenditure (gov/gdp), and institutional quality (law) have average values of 3.444, 11.775 and 3.574, respectively. Finally, inflation (inf) and domestic credit (dc) have average values of 8.254 and 9.037, respectively. In panel (b), we observe that the two variables of interest (se15 and open) have a negative correlation of 93.9% implies that an increase in one variable leads to a decrease in the other. However, this negative correlation may not infer that these variables have a negative relationship unless an empirical investigation is considered.

Figure 1. Evolution of the shadow economy and trade openness in Uganda, 1991–2015.

Source: Author's elaboration

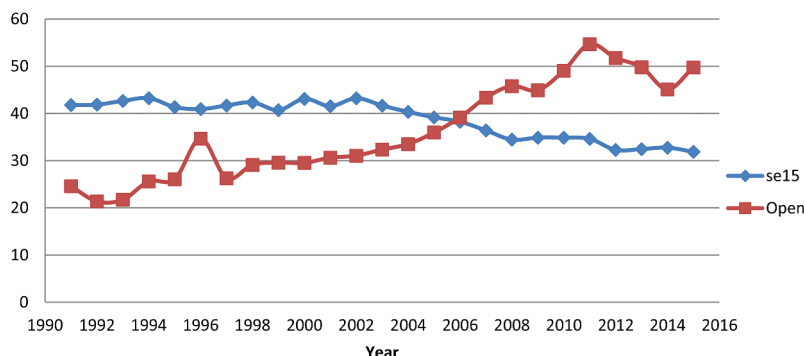


Table 2. Descriptive statistics and correlation matrix of main variables

	Se15	open	Gw	Gov/gdp	Law	Inf	Dc
Panel (a): Summary statistics							
Mean	38.743	36.223	3.344	11.775	3.576	8.254	9.037
Median	40.720	33.514	3.080	11.757	4.000	6.550	8.058
Maximum	43.250	54.689	8.140	16.792	4.000	30.820	16.512
Minimum	31.880	21.368	0.030	6.636	1.000	-0.290	4.001
Std. Dev.	4.008	10.255	2.245	3.005	0.759	7.581	4.232
Skewness	-0.521	0.289	0.360	-0.178	-2.553	1.695	0.454
Kurtosis	1.679	1.747	2.280	1.878	8.677	5.713	1.774
# Obs.	25	25	25	25	25	25	25
Panel (b): Correlation matrix							
Se15	1.000						
Open	-0.939	1.000					
Gw	0.143	-0.0365	1.000				
Gov/gdp	0.584	-0.336	0.374	1.000			
Law	0.017	0.170	0.336	0.458	1.000		
Inf	-0.021	-0.096	-0.184	-0.298	-0.820	1.000	
Dc	-0.939	0.959	-0.106	-0.337	0.113	-0.105	1.000

Source: Author's calculations

4. Methodology

4.1. Model specification

This paper proposes that the shadow economy is a function of determinants that can be specified as:

$$se15 = F(open, gw, gov/gdp, law, inf, dc) \quad (1)$$

Where se15 is the size of the shadow economy, open is the index of trade openness, gw is GDP per capita growth, gov/gdp is government expenditure as a share of GDP, law is law and order which is our measure of the quality of institutions, inf is annual inflation rate, and dc is domestic credit which is our measure of financial development.

From the theoretical view point, there is reason to believe that trade openness and informality are correlated. Theory suggests that trade generates productivity improvements and resource reallocation (Melitz, 2003). More openness implies that domestic firms have to compete for customers with international firms, requiring that only the productive and large firms may circumvent the intense competition (Esaku, 2020d). The less efficient firms will be forced to either cease operations or only serve the domestic market (Esaku, 2020c). Consequently, informality is expected to increase because local firms will have to downsize their operations hence triggering unemployment in the process. Indeed, empirical evidence shows that trade openness induces productivity improvements and resource reallocation, as labor force moves from low productivity firms to high productivity firms (see Esaku, 2019a; Esaku & Krugell, 2020).

Turning to the control variables, empirical evidence indicates that the included variables are some of the main determinants of the size of the shadow economy. For instance, Schneider (2005) shows that the country's development influences the size of the shadow economy. This view is supported by a number of other empirical papers (see Alm & Embaye, 2013; La Porta & Schleifer, 2008). Additionally, taxation burden is also shown to be another main driver of the

shadow economy (see Buehn & Schneider, 2012). When entrepreneurs view taxation system as unnecessarily burdensome, they will be motivated to operate underground hence the increase in informal sector activities (Loayza, 1996). Since tax burden is measured by the tax rate, data on tax rate is not available and in some cases, it is incomplete hence we follow the standard practice in the literature and proxy it using government expenditure as a share of GDP (see Goel & Nelson, 2016; Schneider, 2005). Similarly, the literature shows that the quality of institutions is important since it reflects the level of government efficiency. If this is the case, then any improvement in the efficiency level of government ensures the proper functioning of the economy as institutions regulate its operations (see Esaku, 2021cc). As shown by Alm and Embaye (2013), entrepreneurs who are inclined to underreport their earnings will first evaluate the efficiency of the enforcement to detect and punish offenders before they engage in tax evasion. If their evaluation of the enforcement shows the possibility of being discovered, then these entrepreneurs will be dissuaded to evade tax. So we include the quality of institutions, measured by law and order, in the main estimation equation.

Additionally, recent studies have also observed the importance of inflation and financial development as determinants of the shadow economy. For example, Alm and Embaye (2013) show that high inflation rates increases the demand for currency implying that the higher the inflation rate, the higher the size of the shadow economy. We include inflation in the main estimation equation. Finally, financial development is shown in the literature as a main indicator of shadow economy. Financial development significantly reduces informal sector activities as credit becomes readily available to entrepreneurs (see A. N Berdiev & Saunoris, 2016). We also include domestic credit, as a measure of financial development, in the main estimation equation.

4.2. Econometric methodology

This paper uses the autoregressive distributed lag (ARDL) modeling approach or bounds testing method to cointegration to test the short- and long-run relationship between the shadow economy and trade openness. Compared to other traditional methods like Johansen and Engle-Granger methods, the ARDL method is widely accepted as the most flexible approach in modeling time-series data especially in cases where the sample size is small (Haug, 2002). Moreover, the ARDL method is capable of testing hypotheses for short- and long-run relationship (Halicioglu, 2007) and can be used irrespective of whether the variables are integrated of order zero $I(0)$ or order one $I(1)$ as shown by Pesaran et al. (2001). Additionally, since the ARDL approach accommodates lag differences in a number of variables, this method is regarded as flexible, attractive and versatile in time-series data (Menegaki, 2019). Additionally, this method provides reliable estimates regardless of possible endogeneity issues among some explanatory variables (Jalil & Ma, 2008). Correspondingly, using appropriate lag selection eliminates residual correlation thereby reducing the problem of endogeneity (Ali et al., 2016). Finally, the implementation of the ARDL method and interpretation of its output or results is direct and straightforward because this approach applies a single form equation rather than a system of equations (C Bayar & Hanck, 2013; Rehman & Kashem, 2017).

We specify the ARDL model for the empirical estimation of equation (1) as follows:

$$\begin{aligned} \Delta se15 = & \beta_0 + \sum_{i=1}^p \beta_{1i} \Delta se15_{t-i} + \sum_{i=0}^q \beta_{2i} open_{t-i} + \sum_{i=0}^q \beta_{3i} \Delta gwt_{t-i} + \sum_{i=0}^q \beta_{4i} \Delta gov/gdp_{t-i} \\ & + \sum_{i=0}^q \beta_{5i} \Delta law_{t-i} + \sum_{i=0}^q \beta_{6i} \Delta inf_{t-i} + \sum_{i=0}^q \beta_{7i} \Delta dc_{t-i} + \pi_1 se15_{t-1} + \pi_2 open_{t-1} + \pi_3 gwt_{t-1} \\ & + \pi_4 gov/gdp_{t-1} + \pi_5 law_{t-1} + \pi_6 inf_{t-1} + \pi_7 dc_{t-1} + \mu_t \end{aligned} \quad (2)$$

where β_0 denotes the constant term while $\beta_1, \dots, \beta_7$ and $\pi_1, \dots, \pi_7$ denote the short- and long-run coefficients, respectively, and μ_t denotes the error term.

Running ARDL bounds testing procedure requires that we first test for the existence of a long-run relationship among the variables using the F-statistic or t-statistic. In this case, we can specify 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 we compare against the alternative hypothesis that there is cointegration among variables, ($H_a : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq 0$). The outcome of the F-statistic test is then analyzed and compared to the critical values specified in Pesaran et al. (2001). This calls for the decision rule which can be specified as follows: in a situation where the values of the F-statistic are higher than the upper critical bound values specified in Pesaran et al. (2001), the H_0 (the null hypothesis) should be rejected and vice versa. However, if the values of the F-statistic fall within the bounds, this shows that there is no definitive conclusion that can be made out of that test. Initial steps require that the optimal lag length for the ARDL model is first ascertained before applying ARDL bounds testing approach. We used Schwartz-Bayesian criterion (SBC) selection criteria to determine the appropriate lag length.

Given that results of the cointegration test on equation (2) show long-run relationship, we can proceed to express the error correction model (ECM), as follows:

$$\Delta se15_t = \beta_0 + \sum_{i=1}^p \beta_{1i} \Delta se15_{t-i} + \sum_{i=0}^q \beta_{2i} \Delta open_{t-i} + \sum_{i=0}^q \beta_{3i} \Delta gw_{t-i} + \sum_{i=0}^q \beta_{4i} \Delta gov/gdp_{t-i} + \sum_{i=0}^q \beta_{5i} \Delta law_{t-i} + \sum_{i=0}^q \beta_{6i} \Delta inf_{t-i} + \sum_{i=0}^q \beta_{7i} \Delta dc_{t-i} + \theta ECT_{t-1} + \mu_t \quad (3)$$

With θ denoting the coefficient of the ECT (error correction term) which reflects the long-run adjustment of shadow economy to any disequilibrium, while μ_t denotes the residual error term. The ECT coefficient denotes the speed of adjustment after deviations from equilibrium. Its coefficient (θ) should be negative, statistically significant and between 0 and 1 for results to be considered valid (Pesaran et al., 2001).

5. Results and discussion

5.1. Stationarity tests

To facilitate empirical analysis of the variables of interest, we first carried out stationary test using Augmented-Dickey-Fuller test (ADF) and Phillip-Perron (PP) tests, with intercept and with trend and intercept. The test results are presented in Table (A.1) in the appendix. The test results indicate that

Table 3. Results of the ARDL bounds test

Panel (a): The equation to be tested

Equation	Dependent variable	Function
Eq. (1)	Se15	F(se15 open, gw, gov/gdp, law, inf, dcp)

Panel (b): Results of ARDL bounds test

	ARDL Model	F-Stat.	Diagnostics		
			χ^2 (Normality)	χ^2 (Heteroscedasticity)	χ^2 (Correlation)
Eq.(1)	(1,1,0,0,0,0)	6.060	0.955	0.737	0.496
Actual sample size (T = 24)					
Critical values					
	Lower Bound I(0)			Upper Bound 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

Table 4. Long-run relationship between trade openness and shadow economy											
Explanatory	Dependent variable: Shadow economy										
	ARDL model			Fully-Modified OLS			Dynamic OLS				
	Coeff.	t-stat.	Prob.	Coeff.	t-stat.	Prob.	Coeff.	t-stat.	Prob.	t-stat.	Prob.
Open	-0.100**	-2.135	0.049	-0.097***	-7.323	0.000	-0.098**	-2.135	0.049	-2.135	0.049
Gw	-0.136**	-2.651	0.017	-0.135***	-7.002	0.000	-0.136**	-2.651	0.017	-2.651	0.017
Gov/gdp	0.418***	4.719	0.000	0.418***	8.555	0.000	0.418***	4.718	0.000	4.718	0.000
Law	-0.328	-0.725	0.479	-0.312	-1.366	0.192	-0.328	-0.725	0.479	-0.725	0.479
inf	-0.004	-1.144	0.270	-0.027***	-3.549	0.003	-0.036	-1.144	0.270	-1.144	0.270
Dc	-0.596***	-5.586	0.000	-0.597***	-8.197	0.000	-0.560***	-5.586	0.000	-5.586	0.000
Constant	45.406***	5.281	0.000	45.334***	4.954	0.000	45.406***	8.600	0.000	8.600	0.000
R-sq.	0.975			0.974			0.975				
R-bar-sq.	0.963			0.962			0.963				
Durb. W.	1.898										
Residual diagnostics											
X ² (Correlation- BGS LM Test)			0.921								
X ² (Heteroskedasticity-BPG)			0.754								
X ² (Normality)			0.944								

Source: Author's calculation.

Note: ***, **, * indicate statistical significance at 10%, 5% and 1% levels respectively. HAC (Newey-West) standard errors and covariance used.

the variables are either stationary in levels or stationary after first differencing. Furthermore, the results of the tests vary depending on the type of stationarity test used. Implementation of stationarity tests facilitated ARDL bounds testing to determine the presence of the long-run relationship between the main variables. Table (3) panel (a), formally expresses the equation to be tested, while panel (b) presents the results of the ARDL bounds test for cointegration. The results of the ARDL bounds test indicate that the calculated F-statistic is 6.060, higher than the upper critical bound values specified in Pesaran et al. (2001), implying that the variables have a long-run relationship. Accordingly, we reject the null hypothesis of no cointegration in favor of the alternative hypothesis.

Further, we conduct residual diagnostics to ensure that the results are not driven by serial autocorrelation. We carried out, Breusch-Godfrey Serial Correlation LM Test, Heteroskedasticity Test: Breusch-Pagan-Godfrey, and Normality Test. The test results are reported in panel (b) columns 4 to 6, and show no evidence of serial correlation. After ascertaining the reliability of the ARDL bounds testing procedure, we then estimated the long-run and short-run estimates for the model by first establishing the optimal lag length using the Schwartz information criterion (SIC). This model selected is ARDL (1,1,0,0,0,0) model.

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

Table 4 reports the results of the long-run relationship between trade openness and the shadow economy. We first present results of the ARDL model in column 2, and then the results for Fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares are presented in columns 5 and 8. The FMOLS and DOLS results are used as a robustness check on the validity of the ARDL model results since these two techniques are shown to generate asymptotically efficient coefficients and can correct for endogeneity and serial autocorrelation at the same time (Menegaki, 2019).

In Table 4, column 2, the results indicate that the shadow economy and trade openness have a long-run relationship. The coefficient on trade openness (open) is negative and statistically significant at 5% level and implies that more openness significantly reduces the size of the shadow economy, all else equal. We can observe that an increase in trade openness significantly decreases the size of the shadow economy by 0.100 units, all else equal. This finding bodes well with the conclusions in Y Bayar and Öztürk (2019), Blanton et al. (2018), and Berdiev et al. (2018) where these authors showed that more freedom to trade significantly reduces informal sector activity. Our results seem to suggest that reforming the economy to increase its openness improves the ability of entrepreneurs to trade internationally providing an incentive for these entrepreneurs to formalize their operations. As previous studies have indicated, a more restrictive trade regime provides the incentive for entrepreneurs to operate underground, causing a proliferation of illegal activities such as smuggling, black market and underground activities. The choice to operate in the informal sector mirrors dissatisfaction with the regulatory framework in the country, as entrepreneurs decide to forfeit the advantages of operating in the formal sector and prefer operating informally.

Our results show that global integration into the world economy provides an incentive for entrepreneurs to take advantage of increased globalization hence causing the informal sector to contract as businesses start the process of formalization to benefit from international trade. More exposure to international trade is beneficial to domestic businesses since participation in foreign markets helps them to learn, through learning-by-exporting mechanism (Esaku, 2019a, 2021d; Esaku & Nsiah, 2020a) which in turn improves their productivity thereby reducing their incentive to operate informally. Moreover, participation in foreign markets may also create pressure for a country to improve production and labor standards which forces firms to formalize their operations. The practical implication of the long-run results is that countries that have fully reformed their economies to allow for free trade and investment inflows should experience a decline in the size of shadow activities. Although the coexistence of two sectors, formal and informal, is expected to continue, more trade openness may encourage businesses to formalize to take advantage of international trade which reduces the incentive of domestic entrepreneurs to operate in the informal sector. Moreover, in more open economies, informality rises but at a decreasing pace, while the growth of

the formal sector offsets any increase in the informal sector. Dismantling trade barriers could promote trade, improve productivity and welfare gains.

In other results in Table 4, we can observe that the level of development is important in curbing the growth of informality. The coefficient on growth (gw) is negative and statistically significant at 5% level. This indicates that an increase in per capita growth significantly reduces the size of the shadow economy by 0.136 units. This is consistent with the findings in Elgin and Erturk (Elgin & Erturk, 2016) and La Porta and Shleifer (La Porta & Schleifer, 2008), who show that an increase in a country's development significantly reduces the size of the shadow economy. These results also indicate that government expenditure is a significant determinant of the shadow economy. The coefficient on government expenditure is positive and statistically significant at 1%, implying that an increase in government expenditure significantly increases shadow economy by 0.418 units. This agrees with previous studies that emphasize that more government expenditure leads to the expansion of the shadow economy (see Alm & Embaye, 2013; Goel & Nelson, 2016). We also find evidence of long-run relationship between the shadow economy and financial development. The coefficient on domestic credit (dc) is negative and statistically significant at 1% level, implying that an improvement in financial development reduces shadow economy by 0.596 units. These results line up with previous studies that indicate that a well-developed financial sector reduces the incentive to operate in the informal sector (see A. N Berdiev & Saunoris, 2016). We also find that institutional quality is important in reducing the size of the shadow economy, but the coefficient on law is statistically insignificant.

As a robustness check, we follow the suggestions of Menegaki (2019) to use either Dynamic ordinary least squares (DOLS) and or Fully modified ordinary least squares (FMOLS) to verify the robustness of the findings. According to the above author, using either of the methods is beneficial because they generate asymptotically efficient coefficients. Furthermore, they also account for any

Table 5. Short-run relationship between trade openness and the shadow economy

Explanatory variable	Outcome variable: Shadow economy		
	Equation (1)		
	Coefficient	t-statistic	Probability
$\Delta open$	-0.104***	-3.801	0.002
ΔGw	-0.116**	-2.562	0.022
$\Delta Gov/gdp$	0.416***	11.104	0.000
ΔLaw	0.042	0.176	0.863
Δinf	-0.016	-0.846	0.412
Δdcp	-0.627***	-6.732	0.000
ECM(-1)	-0.942***	-5.339	0.000
Constant	-0.011	-0.076	0.940
R-sq.	0.740		
R-bar-sq.	0.592		
Durbin W.	1.943		
Residual diagnostics			
X^2 (Correlation- BGS LM Test)			0.697
X^2 (Heteroskedasticity-BPG)			0.956
X^2 (Normality)			0.996

Source: Author's calculation.

Note: *,**,***, indicate statistical significance at 10%, 5% and 1% levels respectively. HAC (Newey-West) standard errors and covariance used.

possible serial autocorrelation and endogeneity. We report FMOLS and DOLS results in Table (4) columns 5 and 8. These results are qualitatively and quantitatively similar to the ARDL model results leading to the conclusion that an increase in trade openness significantly decreases the size of the shadow economy, all else equal. Additionally, we carry out residual diagnostics to rule out any serial autocorrelation. Specifically, we carried out Breusch-Godfrey serial correlation LM, Heteroskedasticity-Breusch-Pagan-Godfrey (BPG), and normality tests. The results of these tests show no evidence of any bias in the empirical estimation of the ARDL model results. In sum, it can be concluded that more trade with other nations decreases the size of the shadow economy, all else equal.

5.3. The short-run relationship between trade openness and shadow economy

This section presents the short-run results, which we report in Table 5 column 2. We can observe that there is a short-run relationship between the shadow economy and trade openness. The coefficient on trade openness (open) is negative and statistically significant at 1% level, implying that more exposure to foreign trade significantly reduces the size of the shadow economy. This finding agrees with previous studies that show that more exposure to international trade significantly reduces the size of the shadow economy (see Berdiev et al., 2018). The implication of this is that countries that reform their economies will experience increased international engagement which dampens the incentives for businesses to operate in the informal sector. We argue that trade openness is an important determinant of the size of the shadow economy in both the short- and long-run. Any policy framework that strengthens integration in the global economy will be an effective tool that can reduce the size of the shadow economy.

In other results, we find evidence that growth per capita is a significant determinant of the shadow economy in the short-run as well as in the long-run. We can observe that the coefficient on growth (gw) is negative and statistically significant at 5% level, implying that an increase in per capita growth significantly reduces the size of the shadow economy by 0.116 units. This is consistent with the findings in Elgin and Erturk (Elgin & Erturk, 2016) which show that economic development is a significant determinant of the shadow economy. Additionally, we find that government expenditure is a key driver of the shadow economy in Uganda. The coefficient on government expenditure is positive and statistically significant at 1%, implying that an increase in government expenditure increases the shadow economy by 0.416 units. This bodes well with the findings in Goel and Nelson (2016) which emphasize the role played by government expenditure in driving shadow activities. Additionally, the coefficient on financial development is negative and statistically significant at 1% level. This indicates that an improvement in financial development reduces the size of the shadow economy by 0.627 units,

Figure 2. Long-run plot of CUSUM and CUSUMQ of recursive residuals.

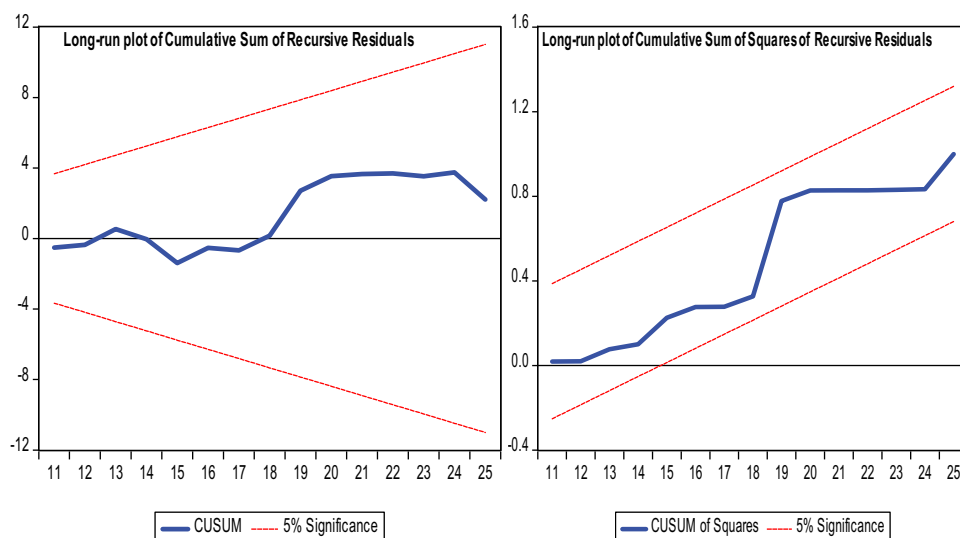
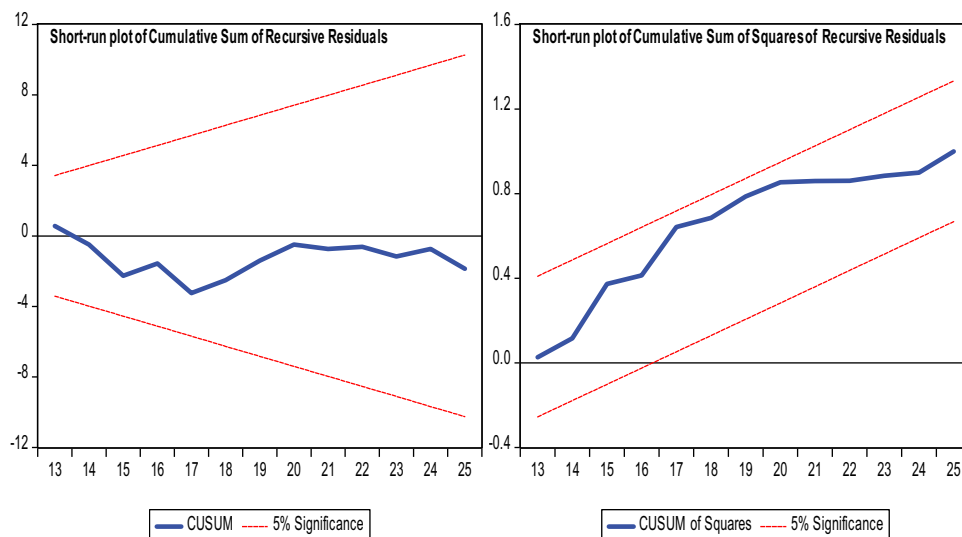


Figure 3. Short-run plot of CUSUM and CUSUMQ of recursive residuals.



consistent with previous findings that emphasize the importance of financial development (see A. N Berdiev & Saunoris, 2016).

Next, we evaluate the validity of the ECT to ensure system convergence from short- to long-run equilibrium. We can note that the coefficient on ECT is negative and statistically significant at 1% level. This implies that the size of the shadow economy is corrected by deviations in the short-run toward long-run equilibrium path at a speed of 94.2%, statistically significant at 1% level. In sum, these findings suggest that addressing the shadow economy in Uganda requires reforming the economy to move towards more integration into the world economy. This seems to be a viable policy option since more exposure to the world economy reduces the incentive to operate in the informal sector. The practical implication of these results is that policies aimed at tackling the shadow economy should also incorporate trade reforms that increase the countries' exposure to international trade. Finally, we also conduct residual diagnostics to ascertain whether these findings are reliable. Both the results of Breusch-Godfrey serial correlation LM, Heteroskedasticity; Breusch-Pagan-Godfrey (BPG) and normality tests are within the accepted range and show no evidence of any biases in the empirical estimation of the ARDL model.

(1) Diagnostic tests

Following the estimation of the long-run and short-run coefficient of the relationship between the size of the shadow economy and trade openness, we carried out stability diagnostics by analyzing recursive residuals. We report the plots of cumulative sum of recursive residuals (CUSUM) and the plots of cumulative sum of squared residuals (CUSUMQ) for both long-run and short-run coefficients. Figures (2) and (3), report both the CUSUM and CUSUMQ plots and provide further evidence on the validity of the estimated ARDL model. All these plots present evidence showing that the ARDL model estimated is stable. As shown in these two figures, the results of the residual plots do not cross the boundaries at 5% level of significance, which confirms that there is stability in the parameters of the ARDL models.

6. Conclusion

In this paper, we analyzed the relationship between the shadow economy and trade openness using data from Uganda covering the period from 1991 to 2015. We used autoregressive distributed lag method because of the advantages associated with its use. We recognize that the expansion of informality is an indication of the dysfunctional connection between the business

regulatory framework and the markets which has far-reaching ramifications on the welfare of nations. We find that more exposure to international trade reduces the incentive to operate in the informal sector in both the short- and long-run. As countries become more integrated into the world economy, firms and individual entrepreneurs are stimulated to engage in international markets because of the advantages it offers. For example, participation in world markets also enhances firm-learning processes which lead to productivity improvements. Thus, this paper provides empirical evidence that supports the view that trade openness significantly reduces the expansion of the shadow economy in Uganda.

The practical implication of the long-run results is that countries that have fully reformed their economies to allow for free trade and investment inflows should experience a decline in the size of shadow activities. Although the coexistence of two sectors, formal and informal, is expected to continue, more trade openness may encourage businesses to formalize to take advantage of international trade, which in turn reduces the incentive of domestic entrepreneurs to operate in the informal sector. In more open economies, informality increases but at a decreasing rate, while the growth of the formal sector offsets any increase in the informal sector.

To sum, we acknowledge that this study has some limitations. Estimating shadow activities is quite challenging given that most of the activities in this sector are hidden and cannot be estimated with accuracy. While these data allow us to estimate the short- and long-run relationship between these variables, our estimation cannot allow us to exploit all the various channels through which trade openness affects the size of the shadow economy. Moreover, the data on the size of the shadow economy are aggregated at the national level, providing these data at the sectoral or industry-level would facilitate further analyses on the various aspects of informality. Furthermore, future research could be devoted to providing more measures of trade openness and analyzing how these new measures affect the size of the shadow economy.

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Author details

Stephen Esaku¹
 E-mail: esaku_stephen@yahoo.com
 ORCID ID: <http://orcid.org/0000-0002-2587-4092>
¹ Department of Economics and Statistics, Kyambogo University, Kampala, Uganda.

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Note

1. We use the word shadow economy to also refer to informal economy, informal sector, underground economy, unofficial economy and informality. We use these words interchangeably in this paper.

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Appendix A

Table 1. Results of stationarity tests for all the variables

Variables	In Levels			First difference:		
	ADF		PP	ADF		PP
	Intercept	Trend & Inter.	Intercept	Intercept	Trend & Inter.	Intercept
Se15	0.087	-2.128	0.087	-5.818***	-6.082***	-5.818***
Open	-1.228	-2.018	-1.141	-6.725***	-6.838***	-6.725***
Gw	-3.734***	-3.995**	-3.734***	-5.494***	-5.512***	-10.463***
Gov/gdp	-2.165	-2.739	-2.058	-5.588***	-3.651*	-7.822***
Law	-9.321***	-17.948***	-5.242***	-17.508***	-14.720***	-
Inf	-4.472***	-4.264**	-4.793***	-7.543***	-7.118***	-7.924***
Dc	0.496	-3.612**	0.125	-6.186***	-6.195***	-12.431***
						-14.348***

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



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