In the Dark or Out of the Shadows? Trade Liberalization and Underground Economies in Sub-Saharan Africa

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Abstract This article contributes to the understanding of other understudied effects of international trade by analyzing its impact on the informal economy in 24 countries in Sub-Saharan Africa (SSA) over the period 2000-2020. This article employs various estimation methods, including ordinary least squares, fixed effects, instrumental variables, and the system generalized method of moments. The results indicate that international trade significantly reduces the size of the SSA's informal economy across various parameters. In addition, the results demonstrate that governance is a mechanism by which international trade reduces the size of the informal economy. Therefore, SSA countries undertake more economic reforms in favor of free trade so that they can not only reap the benefits of globalization but also alleviate their thorny problem of informality.

Keywords: international trade, informal economy, governance, SSA

JEL Classifications: F14, O17, O55

I. Introduction

International trade allows for economies of scale, resulting in lower production costs. From this perspective, international trade increases factor productivity, particularly capital factor productivity, not through the specialization of economies, but through industrial concentration. Free trade allows companies to sell more, produce more, and benefit from economies of scale. The opening of borders to international trade allows companies to find new customers in foreign markets. If this is the case, companies will have to produce more to sell more. This increase in production leads to economies of scale and, as a result, a reduction in production costs in many sectors, particularly industrial sectors. Lower prices due to economies of scale increase consumers' purchasing power, thereby increasing market size. The reduction of production costs in companies through economies of scale allows for lower selling prices of goods and services. Consumers' purchasing power rises, allowing them to purchase more goods and services (either the same or new products) (Nkemgha et al., 2021).

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According to UNCTAD (2015), global trade in goods and services has increased dramatically, rising from US$5 trillion in 1994 to nearly US$24 billion in 2014. Thus, the increased global trade has benefited all countries and created extraordinary opportunities for many of them. Furthermore, World Bank statistics show that the openness rate of the Sub-Saharan African (SSA) region, for example, increased by 14.2% from 1990 to 2015. The reduction of tariff and non-tariff barriers to international trade, the reduction of barriers to direct investment, and the progress in the information and communication technology sector have all contributed to this growth.

In the 1980s and early 1990s, many developing countries drastically reduced tariffs and non-tariff barriers, exposing their economies to external competition. Although proponents of the classical school have lauded trade openness as a factor of growth and economic efficiency, most countries have expressed concern that trade openness may contribute to increasing the gap between low and high income groups, and thus income inequality. Moreover, one of the concerns about trade liberalization is how informality will react to trade opening (Stallings and Peres, 2010).

Informality refers to the proportion of a country's goods and services production that does not adhere to government regulations. It is prevalent in most countries but is greater and more widespread in developing countries (Schneider and Enste, 2000; Tokman, 2007).

According to Medina and Schneider (2019), informality is high and growing in both developing and developed economies. For example, in a sample of 157 economies studied, the underground economy was estimated to be worth an average of 31% of gross domestic product (GDP). Among the economies surveyed, Latin America has the highest estimate, with Bolivia having the highest average of 62.9% of GDP, followed by Europe, where Georgia tops the list with around 62% of GDP. The trend is also upward in the African region, with Nigeria accounting for 56.8% of GDP and Tanzania accounting for 56% (Medina and Schneider, 2019). This evidence indicates that the underground economy is becoming a permanent feature of most economies worldwide, and it merits the attention of researchers and policymakers around the world.

Underground economies have been linked to crime (Schneider, 2004), drug trafficking (Ardizzi et al., 2014), budget deficits (Dabla-Norris and Feltenstein, 2003), and human rights violations (Donna, 2000) in developing countries. Naturally, high levels of the underground economy have negative consequences for society because they result in inefficient resource allocation. This is why understanding the antecedents and effects of underground economies has been a major focus of social science research, especially in the last decade (Schneider and Enste, 2000). Although critics frequently dismiss the utility of data on the underground economy due to the complex and multidimensional concept they imply, substantial empirical evidence posits that fiscal pressure, economic structure, political system, and institutions are powerful predictors of underground activities at the national level (Schneider, 2004).

Recently, researchers and policymakers have become increasingly interested in understanding the main drivers of informality and the policy framework that can be used to combat its expansion

(Mugoda et al., 2020).

The literature has primarily focused on the study of the tax determinants of the underground economy. More specifically, the literature suggests that firms leave the formal sector voluntarily to join the underground economy and thus circumvent binding regulations, overtaxation, and public sector corruption (Loayza, 1996). If this is the case, informality could be interpreted as "popular resistance" to government policies that stifle the activities of these entrepreneurs (Maloney, 2004). However, some articles have examined the political aspects of the economy that may be driving informality in both developed and developing economies. For example, Buehn and Schneider (2012) found empirical evidence that corruption increases informality using data from 51 economies between 2000 and 2005. Borlea et al. (2017) reached similar conclusions by demonstrating that high levels of corruption are strongly associated with a large underground economy. Accordingly, Teobaldelli and Schneider (2013) studied how direct democracy affects informality and found empirical evidence that democracy is important in combating the rise of parallel activities.

Aside from these determinants, the size of the informal economy is frequently linked to trade liberalization. In this context, trade liberalization, if perceived as a more competitive force for domestic producers, should increase informality as firms shed formal (input) workers to reduce costs (Kar and Marjit, 2001). Schneider and Enste (2000) therefore argued that policies aimed at promoting greater economic integration, such as eliminating trade barriers, can induce participants to migrate from the informal to the formal sector.

The efficiency wage model established the theoretical relationship between trade liberalization and the informal economy. This model shows that domestic firms are exposed to foreign competition following trade liberalization. Firms in the formal sector respond to increased foreign competition by replacing permanent workers with part-time workers or contracting out to informal sector establishments, who then seek employment in the informal sector. However, Aleman-Castilla's (2006) heterogeneous business model demonstrated that trade liberalization reduces the incidence of informality. According to this author, the exit of the least productive companies from the market due to competition, combined with the increase in production of the most productive (formal) companies, results in an overall increase in productivity.

Several empirical studies have analyzed the relationship between international trade and the informal economy. Some authors maintain a positive relationship between the two variables (Kar and Marjit, 2001; Goldberg and Pavcnik, 2007; Dix-Carneiro and Kovak, 2019), whereas others find a negative relationship between the two variables (Berdiev et al., 2018; Blanton et al., 2018 and Bayar and Öztürk, 2019).

The theoretical underpinnings and empirical evidence on the relationship between international trade and the informal economy appear ambiguous and inconclusive.

The absence of agreement on the subject demonstrates that additional contributions are welcome because they will enrich the debate. Furthermore, no study has focused on the case of African

countries among the authors who have analyzed the impact of international trade on the informal economy. However, after Latin America, Africa is ranked second in the world for the highest informality rate. It is critical to fight against the rise of parallel activities in developing countries such as those in SSA, as a large underground economy could jeopardize the government's budgetary objectives and negatively impact its ability to provide the necessary services to promote citizens' well-being.

This article thus makes three contributions: first, it is one of the few attempts to investigate the effect of international trade on informality in SSA countries. Previous studies have focused on developed or developing countries, but they have not specifically addressed the case of SSA countries. To the best of our knowledge, this is the first article to empirically analyze the effect of international trade on informality in SSA countries. Second, this is the first article to analyze the effect of international trade on informality using the instrumental variables method. Finally, in several studies on this relationship, informal employment has been used as an indicator of the informal sector. This indicator, however, is far from representative of the sector. The use of the size of the underground economy as a percentage of GDP as an indicator of informality is another contribution of this work.

The rest of this article is structured as follows. Section 2 presents the theoretical framework and empirical work in the literature. Section 3 describes the data and methodology. Section 4 summarizes and analyzes the results. Section 5 concludes the paper with policy recommendations.

II. Literature Review

This section is organized into two subsections: the theoretical foundations (Section 2.1) and the empirical evidence of the relationship between international trade and the informal economy (Section 2.2).

A. Theoretical foundations of the relationship between international trade and informal economy

According to the efficiency wage model theory, trade reforms expose formal establishments to increased foreign competition. In response, these businesses try to cut labor costs by replacing full-time employees with part-time workers or contracting out to informal sector businesses such as micro-businesses and independent contractors. Meanwhile, firms in the formal sector can respond to increased foreign competition by laying off workers who do not belong to them and will seek employment in the informal sector.

Hence, Goldberg and Pavcnik (2003) adopted a model that unambiguously generates such

a positive relationship. Their model is based on a wage model with dynamic efficiency and three key assumptions. First, the representative firm faces demand uncertainty. Second, the representative firm can hire workers from either a formal or informal labor pool. Third, formal employment is governed by labor market legislation, and formal employees are entitled to benefits and severance pay. A shift in the probability function governing price shocks represents trade liberalization. Goldberg and Pavcnik's (2003) model suggested that the impact of trade liberalization on informality depends on the degree of labor market liberalization: the less flexible labor markets, the greater the importance of reallocation from the formal to the informal sector. However, not all theoretical models make such clear predictions about the relationship between trade liberalization and informality.

Furthermore, our analysis must answer the question of why companies concerned with maximizing profits did not make greater use of informal workers prior to the reforms, if these workers were indeed associated with lower labor costs. Saint-Paul's (1996) model provided an answer to this question.

Saint-Paul's (1996) dynamic efficiency wage model provided a possible justification for the concurrent use of formal and informal workers. It best describes and formalizes the reasoning behind the claim that trade liberalization will increase informality. The following fundamental assumptions underpin the Saint-Paul model (1996): (i) the business faces demand uncertainty; (ii) the company can hire workers from two poles: a pole of formal workers and a pole of informal workers; (iii) The two poles differ on two important aspects. First, the employment of formal workers is governed by labor market legislation; these workers are entitled to benefits, cannot be fired unless the company has gathered sufficient evidence, and should receive severance pay when fired. This implies that the adjustment cost associated with the employment of these workers is higher than that of the employment of unregulated workers. One approach would be to model trade liberalization as a negative price shock. As previously stated, a direct implication of the dynamic efficiency wage model is that the firm would respond by first laying off its informal workers while keeping its entire formal workforce. After all, this flexibility to fire informal workers in times of tough competition (as a result of liberalization) is critical to explaining the existence of the informal sector. Formal workers will be affected only if the shock is severe enough.

Note that the preceding analysis concentrated on effects within firms representing specific industries, thus ignoring general equilibrium effects. In the general equilibrium, the effects of trade liberalization on informality may differ as workers shift from industries with large reductions in trade barriers to industries less affected by trade liberalization. However, if workers moved to industries that employ more informal workers (e.g., the service sector), we would see an increase in informality, but this would be due to labor reallocation between industries rather than the described mechanism.

What does the heterogeneous business model of Aleman-Castilla (2006) reveal about the

relationship between international trade and informality?

According to Aleman-Castilla's (2006) heterogeneous business model, trade liberalization (i.e., lower trade costs) implies that some firms will find it more profitable to enter the formal sector rather than remain in the informal sector. Only the most productive (formal) firms will export to international markets, whereas the least productive (informal) firms will be forced out. In this case, trade liberalization reduces the prevalence of informality.

However, the models presented above assume that all goods can be exchanged in principle. However, in reality, there are also non-tradable goods (i.e., those intended for local consumption and not for export).

Non-tradability is established endogenously and is determined solely by firm characteristics rather than product characteristics. If some goods are allowed to be non-tradable, the impact of trade liberalization on informality will be further influenced by the real exchange rate's reaction and/or relative sectoral productivities. If the informal sector is equated with the non-tradable sector, and non-tradable goods are only for consumption, the relationship between trade openness and informality may become negative. In this context, trade liberalization would reduce the price of non-tradable goods relative to tradable goods (i.e., the price of the non-tradable good would be lower than the price of the tradable good), reducing the size of the informal[1] market sector. Under certain conditions, trade liberalization may result in real appreciation,[2] thus increasing the size of the informal sector.

What is the tax environment's role in the relationship between trade liberalization and informality?

The tax environment can also influence the relationship between trade liberalization and informality. Existing models generally assume that government spending fully adjusts to tax revenue, without specifying how this is accomplished. Higher taxes or new tax instruments may be required for tax consolidation, and both are likely to affect firms' incentives to expand informal inputs and workers' decisions to become informal.

Finally, Ulyssea (2014) proposed two mechanisms by which international trade contributes to the spread of informality. According to the author, if trade openness causes a negative price shock for domestic firms, the environment would predict an increase in labor informality via two channels. For starters, more firms would decide to enter the informal sector, and informal firms can only hire informal workers. This is the wide range of informality. Second, formal firms would face increased competition (lower prices), encouraging them to hire more informal workers. It is the intensive margin of informality. As Ulyssea (2014) explained, the government can target either margin separately.

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1) See, for example, Li (2004), for theoretical treatment and empirical evidence.
2) For example, Calvo and Drazen (1998) showed that trade liberalization of uncertain duration could lead to real appreciation, due to an upward jump in the consumption of tradable and non-tradable goods.

In summary, the theoretical basis for the relationship between international trade and the size of the underground economy is ambiguous and inconclusive. What about empirical data?

B. Empirical evidence of the relationship between international trade and the informal economy

This subsection is enriched by two antagonistic visions: the pessimistic vision, which maintains that international trade leads to the proliferation of the informal sector, and the optimistic vision, which believes that international trade is a factor in the contraction of the informal sector.

1. The pessimistic vision

Kar and Marjit (2001) used a model with segmented labor markets to analyze the effect of trade openness on employment in the informal sector. The aforementioned authors found evidence of a positive relationship between trade openness and informal economy employment. Specifically, they find that as the economy integrates with global trade, employment in the informal sector grows significantly. Similarly, Goldberg and Pavcnik (2007) have argued that trade liberalization can lead to firms disregarding labor regulations and increasing informality. Birinci (2013) found evidence that economic liberalization increases informality in a study of 12 advanced countries between 1964 and 2010. Moreover, Acosta and Montes-Rojas (2014) found that trade liberalization in Argentina promotes labor informality. According to Dix-Carneiro and Kovak (2019), after the trade liberalization episode of the 1990s, Brazilian regions more exposed to foreign competition experienced increased unemployment in the medium run. In the long term, the effect on unemployment has faded, but the informal sector has grown in these regions relative to the national average. Based on these results, they hypothesized that the informal sector serves as an important shock absorber, and that without it, the effect of import competition on unemployment would have persisted in the long run.

In contrast to this pessimistic vision, other authors' analyses showed a negative relationship between international trade and the size of informality (optimistic vision).

2. The optimistic vision

Berdiev et al. (2018) studied the impact of economic freedom on the size of the informal economy in a panel of 100 economies from 2000 to 2015. These authors established that economic freedom significantly negatively affects the size of the informal economy. By disaggregating economic freedom into its main components, the authors provide evidence that opening a country to international trade reduces the size of the underground economy. Blaton et al. (2018) analyzed how economic openness affects the size of the underground economy and found evidence for a negative relationship. In particular, the authors demonstrate that economic openness reduces

the size of the underground economy in a sample of 145 countries. When Bayar and Öztürk (2019) analyzed data from 2000 to 2015, they found similar results for the European Union's transition economies.

III. Data and Methodology

A. Data

The data used are derived from secondary sources. The work considers data from each variable of the study for the period 2000-2020 on 24 countries. These data are extracted from the World Bank database (WDI 2020), Medina and Schneider's (2019) database, and the Governance Indicators database (WGI, 2020). The study period and number of countries are determined by the availability of data. Given that the goal is to establish a link between international trade and the informal economy in SSA, it is prudent to define and indicate the method of calculation for the various economic aggregates that must be used in this modeling work.

Informality is our dependent variable. Medina and Schneider (2019) provided the informal sector data used in the baseline analysis. The size of the underground economy as a percentage of GDP captures informality. This variable is becoming more popular in the literature (Ngouhouo and Njoya, 2020; Njangang et al., 2020). In terms of the dependent variable, international trade has been measured in a variety of ways throughout the literature. Among these measures, the degree of openness is the most commonly used classic indicator. It calculates the level of external constraint by dividing the value of foreign trade by the gross domestic product. The calculation of the degree of openness (also known as the openness rate) is equal to the sum of imports and exports divided by the GDP. This variable is becoming more popular in the literature (Jouini, 2015; Keho, 2017; Nkemgha et al., 2021).

The control variables in our econometric model are all drawn from the literature. Terrorism, for example, has been shown by UNDP (2019) to promote the proliferation of informality. Foreign direct investment has a beneficial impact on the size of the informal economy (Harish et al 2020). Remeikien et al. (2021) demonstrated that information and communication technologies significantly reduce informality. Similarly, Njangang et al. (2020) demonstrated that domestic credit reduces informality significantly. Furthermore, Anthelme (2021) showed that inflation prevents informality from growing. According to Elgin and Oyvat (2013), urbanization is a driving force behind the growth of the informal economy. In terms of international trade, Wu et al. (2019) found that it is positively associated with informality, whereas Esaku (2021) discovered a negative relationship between the two variables.

The appendix summarizes the sources, definitions, and list of panel countries (Tables A1

and A2). Tables 1 and 2 show the descriptive statistics and the correlation matrix, respectively. Furthermore, Pesaran's (2004) cross-sectional dependence test demonstrated that all variables in the econometric model admit cross-sectional dependence. Table 3 presents the result of this test. This result allows us to apply the Driscool and Kraay (1998) estimation method.

Table 1. *Descriptive Statistics*

	Shadow	Totter	Mobileph	Inflation	FDI	Urbanp	Domesticcr	Trade
Mean	36.8591	0.6339	117755	7.8835	4.5450	34.4806	17.0602	71.7460
Median	36.6400	0.0000	36.7581	5.0336	2.6188	35.9935	13.5144	64.3000
Maximum	59.9300	6.3007	6200000.	513.9070	69.0896	70.1720	108.0690	209.8900
Minimum	16.56	0.0000	0.0180	-9.6161	-4.8522	8.2460	0.1982	20.7200
SD	8.4377	1.0605	734927.2	28.2154	7.6303	14.1067	16.6142	33.7006
Obs	504	504	504	504	504	504	504	504

(Source) Authors' own work.

Table 2. *Correlation Matrix*

	1	2	3	4	5	6	7	8
Shadoweco (1)	1.000							
Trade (2)	-0.3705	1.000						
Mobilephone (3)	-0.0854	0.1764	1.000					
Domesticcred (4)	-0.5438	0.3626	0.1605	1.000				
Urbanpop (5)	-0.0017	0.3626	0.0634	0.2015	1.000			
FDI (6)	0.0646	0.3178	-0.0417	-0.0404	0.1781	1.000		
Totter (7)	0.3597	-0.1874	-0.0928	-0.0649	0.1207	0.0558	1.000	
Inflation (8)	0.1002	-0.1088	-0.0359	-0.0987	-0.0299	-0.0273	-0.0203	1.000

(Source) Authors' own work.

Table 3. *Cross-sectional Dependence Test*

Variables	CD-test	P-value	Corr	Abs (corr)
Shadow	2.21	0.027	0.099	0.639
Trade	9.24	0.000	0.316	0.613
Inflation	5.26	0.000	0.181	0.300
Domesticcred	17.09	0.000	0.582	0.627
Monilephone	73.59	0.000	0.967	0.967
Urbanpop	58.95	0.000	0.774	0.933
FDI	4.29	0.000	0.056	0.267
Totter	5.01	0.000	0.066	0.240

(Source) Authors' own work.

B. Methodology

We develop the following econometric model based on recent literature on the informal economy (Ngouhouo and Njoya 2020):

$$Shadoweco_{it} = \beta_0 + \beta_1 Trade_{it} + \beta_2 Mobilephone_{it} + \beta_3 Domesticcred_{it} + \beta_4 Urbanpop_{it}$$
$$+ \beta_5 FDI_{it} + \beta_6 Totter_{it} + \beta_7 Inflation_{it} + u_i + v_t + e_{it} \tag{1}$$

where Shadoweco, trade, Mobilephone, Domesticcred, Urbanpop, FDI, Totter, and Inflation represent the informal economy variables, international trade, mobile phones, domestic credit to the private sector, urbanization, foreign direct investment, total terrorism, and inflation, respectively. The β_n are the model's theoretical regression coefficients. u_i, v_t, and e_{it} represent respectively country-specific effects, time effects and random errors that capture all unexplained shocks including measurement errors.

Based on previous research, some authors contend that endogeneity is a significant issue in econometric studies (Fisman and Svensson, 2007; Dollar et al., 2005; Aterido and Hallward-Driemeier, 2010; Hallward-Driemeier and Aterido, 2007). The direction of causality is frequently unclear, in that the causal link may sometimes originate from the informality variable (dependent variable) and lead to the explanatory variable (Batra and Stone, 2004). The equations (first and second stages) used to instrument the endogenous variables are as follows:

$$Shadoweco_{it} = \beta_0 + \beta_1 Trade_{it}(endog) + \beta_2 Mobilephone_{it} + \beta_3 Domesticcred_{it}$$
$$+ \beta_4 Urbanpop_{it} + \beta_5 FDI_{it} + \beta_6 Totter_{it} + \beta_7 Inflation_{it}$$
$$+ u_i + v_t + e_{it} \tag{2}$$

$$Trade_{it}(endog) = \beta_0 + \beta_1 Instruments_{it} + \beta_2 Mobilephone_{it} + \beta_3 Domesticcred_{it}$$
$$+ \beta_4 Urbanpop_{it} + \beta_5 FDI_{it} + \beta_6 Totter_{it} + \beta_7 Inflation_{it}$$
$$+ u_i + v_t + e_{it} \tag{3}$$

where $Trade_{it}(endog)$ is the assumed endogenous variable, and the instruments include the assumed exogenous variables of the model.

Two basic assumptions must be verified for the instruments to be valid. (i) The instrumental variables must be correlated with the ostensibly endogenous constraint variables. We used Cragg and Donald's (1993) statistics for the first condition to perform the instrument relevance test. Here we use the criterion of Stock and Yogo (2005): for a single endogenous variable, the F statistic of the instrumentation equation must be at least equal to 10 for the instruments to be relevant. (ii) The instruments must meet the orthogonality requirement: they must not

be correlated with the error. To test this hypothesis, we employ the over-identification test, based on Hansen's (1982) J statistic and governed by the Chi-square (Chi^2) law. For probabilities greater than 5% or 10%, the Hansen statistic confirms that the estimated system of equations is over-identified and thus the instruments are valid.

The variable assumed to be endogenous in this study is international trade. The transport index and non-life insurance are used to instrument this variable. These two international trade instruments have not yet been documented in the literature, but they are correlated with the international trade variable, as demonstrated by the theoretical and empirical explanations below.

Above all, insurance is a commercial activity, and its growth contributes to the growth of international trade by improving the structure of the trade balance. Non-life insurance is well-known for its contribution to domestic and international trade and entrepreneurial activity. Non-life insurance used in international trade is divided into goods insurance (cargo insurance), transport insurance (CASCO insurance), and liability insurance. The international nature of insurance services relating to goods traded internationally is not a new phenomenon (Outreville, 2013). Indeed, transit-transport insurance and export credit insurance have long been linked to the structure of international trade (Outreville 2013). Whether one is an importer or exporter of insurance services, the evolution of insurance has a direct effect on the structure of the invisible trade balance. Furthermore, many goods and services are only manufactured and sold because adequate non-life insurance is available to cover the risks involved (Skipper and Kwon 2007).Therefore, insurance is a crucial factor in promoting cross-border trade and investment (Brainard 2008). Insurance can thus be viewed as a potential source of comparative advantage following the Hecksher-Ohlin-Vanek model. The main prediction of theoretical works suggests that financial development should promote production and trade. Sawadogo (2019) recently demonstrated that financial development through insurance development impacts the development of international trade in 52 developing countries.

In terms of the transport index, the cost of moving goods, which includes transportation, insurance, and storage, is one of the trade barriers or obstacles that reduces the profitability of the exchange, and thus that of international trade.

The other main trade barriers are tariff and non-tariff regulatory barriers and information transmission costs. Ceteris paribus, changes in transportation costs will shift the boundary between tradable and non-tradable goods, affecting trade volume.

The costs vary depending on the mode of transport (air, sea, rail, road), the type of vessel, and the distance, but also on the characteristics of the goods (weight, fragility, value, durability, etc.), the quantity transported, the route (quality of infrastructure, frequency of passage, transport opportunities on the way back), the situation (heavy or light congestion), and the carrier's market power. Transport costs are fixed per unit of weight or volume transported, as opposed to customs duties, which are fixed ad valorem. As a result, the higher the cost of transportation, whether

due to distance or mode of transportation, the more advantageous it is to exchange more expensive products or varieties of the same product: this is the hypothesis of Alchian and Allen (1964), which has been quantitatively confirmed by Hummels and Skiba (2004) on detailed bilateral trade data.

IV. Results

The results are displayed in the following tables. Table 4 presents the result of the Driscool and Kraay method for calculating the impact of international trade on the informal economy (grouped OLS). Table 5 also shows the basic regression with fixed effects. Meanwhile, Table 6 presents the results of estimating the effect of international trade on informality using the instrumental variables technique. Table 7 examines the robustness of the results obtained in Table 6 by increasing other explanatory variables. Table 8 uses the generalized method of moments (GMM) to replicate the results shown in Table 6. Finally, Table 9 reproduces the results from Table 6, while accounting for the role of governance in the relationship between international trade and the informal economy.

A. Baseline results

Tables 4 and 5 present the preliminary estimation results using the Driscool and Kraay method and fixed effects, respectively. The results clearly suggest that international trade significantly reduces the informal economy, implying that the growth of international trade is an impediment to the expansion of the underground economy. For example, the results of column (5) in Tables 4 and 5 suggest that an increase in international trade of one unit leads to a 5% and 9.5% reduction in informality, respectively.

Table 4. *Effect of Trade Liberalization on Informality using the Driscool and Kraay Method*

Variables	1	2	3	4	5
Trade	-0.0508***	-0.0669***	-0.0772***	-0.0573***	-0.0563***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mobilephone	3.05 E-09*	3.24 E-09*	4.32 E-09**	5.92E-09***	5.99 E-09***
	(0.08)	(0.07)	(0.01)	(0.00)	(0.00)
Domesticcred	-0.2409***	-0.2488***	-0.2387***	-0.2404***	-0.2389***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Urbanpop		0.1149***	0.1091***	0.0754***	0.0747***
		(0.00)	(0.00)	(0.00)	(0.00)
FDI			0.1247**	0.0916***	0.0917***
			(0.01)	(0.00)	(0.00)

Table 4. *Continued*

Variables	1	2	3	4	5
Totter				2.1555***	2.1717***
				(0.00)	(0.00)
Inflation					0.0127
					(0.2)
Cons	44.5845***	41.9086***	42.0979***	40.6281***	40.4377***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Prob(F-stat)	0.00	0.00	0.00	0.00	0.00
R^2	0.33	0.36	0.37	0.44	0.44
Nb. countries	24	24	24	24	24
Nb.Obs	504	504	504	504	504

Note. ***, **, and * represent the significance thresholds at 1%, 5%, and, 10% respectively. Values in parentheses represent probabilities.
(Source) Authors' own work based on Stata12 software.

Table 5. *Effect of Trade Liberalization on Informality using the Fixed Effects Method*

Variables	1	2	3	4	5
Trade	-0.0830***	-0.0796***	-0.0924***	-0.0901***	-0.0954***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mobilephone	2.78 E-09	3.81 E-09	5.25 E-09	5.32E-09	5.64 E-09
	(0.4)	(0.2)	(0.1)	(0.1)	(0.1)
Domesticcred	-0.2838***	-0.0966***	-0.1056***	-0.1052***	-0.1033***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Urbanpop		-0.7300***	-0.7428***	-0.7588***	-0.7772***
		(0.00)	(0.00)	(0.00)	(0.00)
FDI			0.0930**	0.0907**	0.0930**
			(0.02)	(0.03)	(0.03)
Totter				0.2252	0.2340
				(0.4)	(0.4)
Inflation					-0.0140***
					(0.00)
Cons	47.6251***	69.3515***	70.4264***	70.6719***	71.7429***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Prob(F-stat)	0.00	0.00	0.00	0.00	0.00
R^2	0.24	0.41	0.42	0.42	0.43
Nb. countries	24	24	24	24	24
Nb. Obs	504	504	504	504	504

Note. ***, **, and * represent the significance thresholds at 1%, 5%, and 10%, respectively. Values in parentheses represent probabilities.
(Source) Authors' own work based on Stata12 software.

Although the Driscool and Kraay estimation technique is robust to error autocorrelation and heteroscedasticity, it does not account for fixed effects. Even if Table 5 accounts for fixed effects, it is still limited by its inability to account for the possibility of endogeneity issues.

The work of the instrumental variable method considers the possibility of endogeneity.

B. Results through the instrumental variables method

When the Hausman test is applied to the international trade variable (trade), the results show that this explanatory variable of interest is endogenous because the p-value in the fifteenth row of Table 6 is equal to zero. As a result of this finding, we can rule out the null hypothesis that the international trade variable is exogenous. This result nullifies the previous fundamental results. To solve this problem, we used the instrumental variables method, the results of which are shown in Table 6.

The use of the instrumental variable technique for analyzing the relationship between international trade and informality is only valid if three conditions are met: there is no under-identification of instruments, the instruments are relevant, and there is no over-identification of instruments. The results in Table 6 show that the instruments are not under-identified in terms of the p-value ($p = 0$) of the KPLM (Kleibergen-Paap) test, allowing us to reject the null hypothesis of instrument under-identification. Similarly, the Cragg-Donal Statistics for each column is greater than 10, indicating that the instruments used are good or relevant and can replace the endogenous explanatory variable. Furthermore, the instrument over-identification test demonstrates that the instruments are valid for each column. This means that the instruments are not correlated with the error term (the orthogonality condition is met) in terms of the Sargan test p-value, which is greater than 5% for all columns.

The results in Table 6 show that international trade has a negative and significant effect on the underground economy. Thus, a 1% increase in openness leads to a 0.11% decrease in informality (column 5). This means that greater trade openness reduces the size of an economy's informal sector. This result can be explained by the fact that a trade policy reform in favor of free trade will allow entrepreneurs to structure and formalize their operations in order to reap the benefits of this reform. As a result, some entrepreneurs will transition from the informal to the formal sectors. This result is consistent with Bayar and Öztürk's (2019) findings and Berdiev et al. (2018), who found that greater trade freedom significantly reduces informal sector activity. However, this result contradicts the findings of Birinci (2013), who found evidence that economic liberalization increases informality.

In contrast, a more restrictive trade regime encourages entrepreneurs to operate underground, resulting in an increase in illegal activities such as smuggling, black market, and underground activities. The decision to operate in the informal sector reflects entrepreneurs' dissatisfaction with the country's regulatory framework, as they choose to forego the benefits of operating informally in the formal sector.

Our results show that integration into the global economy encourages entrepreneurs to capitalize

on increased globalization, causing the informal sector to contract as firms begin the formalization process in order to benefit from international trade. Greater exposure to international trade benefits domestic firms because participation in foreign markets facilitates learning via a learning-by-exporting mechanism (Esaku, 2019, 2021; Esaku and Nsiah, 2020), which improves productivity and reduces the incentive to operate informally. Furthermore, participation in foreign markets can pressure a country to improve its manufacturing and labor standards, forcing companies to formalize their operations. The long-run results imply that countries that have completely reformed their economies to allow free trade and investment flows should see a decrease in the size of parallel activities. Although the coexistence of formal and informal sectors is expected to continue, greater trade openness may encourage firms to formalize to benefit from international trade, reducing the incentive for domestic entrepreneurs to operate in the informal sector.

Table 6. *Effect of Trade Liberalization on Informality using the Instrumental Variables Method*

Variables	1	2	3	4	5
Trade	-0.1138***	-0.1127***	-0.1307***	-0.1126***	-0.1119***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mobilephone	6.55 E-09	5.59 E-09	7.27 E-09*	8.61 E-09**	8.65 E-09**
	(0.1)	(0.1)	(0.09)	(0.03)	(0.03)
Domesticcred	-0.1971***	-0.2224***	-0.2055***	-0.2079***	-0.2069***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Urbanpop		0.1476***	0.1399***	0.1109***	0.1105***
		(0.00)	(0.00)	(0.00)	(0.00)
FDI			0.1938***	0.1642***	0.1642***
			(0.00)	(0.00)	(0.00)
Totter				1.7908***	1.8013***
				(0.00)	(0.00)
Inflation					0.0084
					(0.8)
Cons	48.3131***	43.5922***	43.9592***	42.6800***	42.5555***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Prob(F-stat)	0.00	0.00	0.00	0.00	0.00
R^2 centered	0.27	0.33	0.34	0.40	0.41
KPLM	0.00	0.00	0.00	0.00	0.00
Cragg-Donald	116	138	119	110.51	109.68
Sargan	0.79	0.73	0.57	0.35	0.35
DWH (trade)	0.00	0.00	0.00	0.00	0.00
Nb. Obs	504	504	504	504	504
Nb. countries	24	24	24	24	24

Note. ***, **, and * represent the significance thresholds at 1%, 5%, and 10%, respectively. Values in parentheses represent probabilities.
(Source) Authors' own work based on Stata12 software.

C. Robustness tests

We tested the sensitivity of our results in two ways. The first was to repeat the analyses in Table 6 with more explanatory variables. Table 7 presents these results. As an alternative estimation method, the second method employs the GMM technique. Table 8 shows the results of the GMM method's estimation of the effect of international trade on the informal economy.

Table 7. *Analysis Results with more Control Variables using the Instrumental Variable Method*

Variables	1	2	3	4
Trade	-0.1102***	-0.1621***	-0.1629***	-0.1839***
	(0.00)	(0.00)	(0.00)	(0.00)
Mobilephone	8.91 E-09**	1.45 E-08**	1.44 E-08**	1.59 E-08***
	(0.02)	(0.01)	(0.01)	(0.00)
Domesticcred	-0.1774***	-0.1611***	-0.1582***	-0.1225***
	(0.00)	(0.00)	(0.00)	(0.00)
Urbanpop	0.0581**	0.0300	0.0295	0.0265
	(0.01)	(0.2)	(0.2)	(0.3)
FDI	0.1329***	0.2000***	0.2010***	0.2310***
	(0.00)	(0.00)	(0.00)	(0.00)
Totter	1.2958***	1.0548***	1.0413**	0.9627**
	(0.00)	(0.00)	(0.01)	(0.02)
Inflation	0.0119	0.009	0.0087	0.0044
	(0.2)	(0.3)	(0.4)	(0.6)
Oil rent	0.2461***	0.2869***	0.2842***	0.2753***
	(0.00)	(0.00)	(0.00)	(0.00)
Unemployment		0.1458	0.1513	0.2147*
		(0.1)	(0.1)	(0.05)
Voice account			-0.1597	0.1494
			(0.8)	(0.8)
FIT				-1.3251***
				(0.00)
Cons	43.4191***	45.8824***	45.7894***	54.3270***
	(0.00)	(0.00)	(0.00)	(0.00)
Prob(F-stat)	0.00	0.00	0.00	0.00
R^2 centered	0.4637	0.4397	0.4392	0.4430
KPLM	0.00	0.00	0.00	0.00
Cragg-Donald	153.27	37.24	35.42	33.03
Sargan	0.28	0.50	0.49	0.30
DWH (trade)	0.00	0.00	0.00	0.00
Nb. Obs	504	504	504	504
Nb. Countries	24	24	24	24

Note. ***, **, and * represent the significance thresholds at 1%, 5%, and 10%, respectively. Values in parentheses represent probabilities.
(Source) Authors' own work based on Stata12 software.

Table 7 demonstrates that even after controlling for four variables (oil rent, unemployment, voice and accountability, and freedom to international trade (FIT)), the previous results remain valid: an inverse and significant relationship exists between international trade and the informal economy in each of the four columns of Table 7. Similarly, for the five columns of Table 8, the same results were found using another instrumental variable method, namely, the GMM.

Table 8. *Effect of International Trade on Informality using the GMM Method*

Variables	1	2	3	4	5
Trade	-0.0130***	-0.0150***	-0.0261***	-0.0438***	-0.0452***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mobilephone	1.46 E-08	1.42 E-09	3.11 E-09	2.15 E-09	-1.27 E-08
	(0.1)	(0.6)	(0.4)	(0.6)	(0.4)
Domesticcred	0.0120	0.0166**	0.0310***	0.0210	0.0066
	(0.1)	(0.04)	(0.00)	(0.1)	(0.5)
Urbanpop		0.0119**	0.0169**	0.0346***	0.0610***
		(0.04)	(0.04)	(0.00)	(0.00)
FDI			0.0531***	0.0637***	0.0405**
			(0.00)	(0.00)	(0.02)
Totter				-1.1685**	0.0363
				(0.01)	(0.8)
Inflation					0.1288***
					(0.00)
Lag Dependent	0.9628***	0.9799***	1.0062***	0.9591***	0.8765***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Cons	1.4198	0.6235	-0.3504	3.0508	4.0646**
	(0.1)	(0.3)	(0.6)	(0.1)	(0.01)
Prob(Chi2)	0.00	0.00	0.00	0.00	0.00
AR(1)	0.00	0.00	0.00	0.00	0.00
AR(2)	0.76	0.73	0.63	0.37	0.45
Sargan	0.21	0.33	0.67	0.75	0.1
Hansen	0.39	0.22	0.07	0.57	0.06
Instruments	11	17	17	17	18
Nb. Obs	480	480	480	480	480
Nb. Pays	24	24	24	24	24

Note. ***, **, and * represent the significance thresholds at 1%, 5%, and 10%, respectively. Values in parentheses represent probabilities.
(Source) Authors' own work based on Stata12 software.

Given that international trade reduces the size of the informal sector, we attempted to conduct additional analyzes to look for a possible indirect link between international trade and the underground economy.

In this regard, in countries where corruption is systemic and the government budget lacks transparency and accountability, the obligation to pay taxes cannot be considered an accepted

social norm. Thus, the lack of transparency and the rule of law undermines citizens' willingness to participate in the formal economy. Citizens will feel cheated if they believe corruption is widespread, their tax burden is not being spent wisely, their government is not accountable, and the rule of law does not protect them. This increases the motivation to work in the informal sector. Thus, an increase in corruption expands the size of the underground economy (Borlea et al. 2017 and Bayar et al. 2018). Given the foregoing, can an improvement in corruption control be a channel through which international trade reduces the size of the informal sector?

D. What can governance do?

Given that corruption expands the informal sector, could reducing corruption be a channel through which international trade can reduce the size of an economy's informal sector? To answer this question, we used the instrumental variable method to analyze the relationship between international trade, corruption control, and the size of the informal economy. Table 9 shows the results of these estimates. This table yields three major results. First, the results reveal that international trade helps reduce the informal sector's size in African economies (Columns 1-2). The second result indicates that reducing corruption contracts informal sector activity (column 1). Finally, corruption control is an institutional channel through which international trade helps to reduce the informal sector.

Table 9. *Trade Liberalization, Corruption Control, and Informality*

Variables	1	2
Trade	-0.0547***	-0.0853**
	(0.00)	(0.01)
Mobilephone	3.15 E-09	8.16 E-10
	(0.4)	(0.8)
Domesticcred	-0.1790***	-0.1536***
	(0.00)	(0.00)
Urbanpop	0.0816***	0.0797***
	(0.00)	(0.00)
FDI	0.0588	-0.0046
	(0.1)	(0.9)
Totter	1.7535***	1.6645***
	(0.00)	(0.00)
Inflation	0.0088	0.0167*
	(0.3)	(0.08)
Controlecorr	-3.5939***	1.4974
	(0.00)	(0.4)
Trade*controlecorr		-0.0677***
		(0.00)
Cons	37.3084***	39.9749***
	(0.00)	(0.00)

Table 9. *Continued*

Variables	1	2
Prob(F-stat)	0.00	0.00
R^2 centered	0.48	0.50
KPLM	0.00	0.00
Cragg-Donald	109.42	70.82
Sargan	0.07	0.055
DWH (trade)	0.00	0.00
Nb. Obs	504	504
Nb. countries	24	24

Note. ***, **, and * represent the significance thresholds at 1%, 5%, and 10%, respectively. Values in parentheses represent probabilities.
(Source) Authors' own work based on Stata12 software.

V. Conclusion and Policy Implications

Despite a large body of literature on the determinants of the informal economy in SSA, no study has been conducted on the effect of international trade on the informal economy. The goal of our study was to fill a gap in the literature by examining the effect of international trade on the informal economy. To accomplish this, we mobilized the method of instrumental variables robust to autocorrelation, heteroskedasticity of errors, and the possibility of endogeneity on a panel of 24 SSA countries over the period 2000-2020. Two main results emerge from our estimates. First, international trade and the informal economy have a negative relationship, which is confirmed by the GMM method. Second, the results indicate that governance (corruption control) is a potential channel for international trade to transit to contract informal sector activities. Consequently, the SSA countries must accelerate their industrialization process, while also undertaking more economic reforms in favor of free trade, not only to benefit from the advantages of globalization but also to alleviate their vexing informality problem. African countries must also make greater efforts to combat corruption for international trade to reduce the size of the informal sector.

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Appendix

Table A1. *List of Panel Countries*

Burundi	Cote d'Ivoire	Malawi	Togo
Botswana	DRC	Central African Republic	Mali
Burkina Faso	Mauritius	Chad	Mozambique
Congo	Rwanda	Uganda	Lesotho
Cameroon	Madagascar	Senegal	Niger
Sierra Leone	Nigeria	Zambia	Tanzania

(Source) Authors' own work.

Table A2. *Summary of the Different Variables in This Study*

Variables	Signs	Variables definition (measurement)	Sources
Freedom to international trade	FIT	This indicator summarizes several factors: 1) tariffs; 2) the height of trade barriers; and 3) state restrictions on foreign transactions. The closer the indicator is to zero, the higher the tariffs, barriers, or limitations. In contrast, the closer the indicator is to 10, the lower the tariffs or restrictions.	World Perspective
Mobile phones	Mobilephone	Number of Mobile cellular subscriptions (per 100 people)	World Bank
Inflation	Inf	Consumer price index (%)	World Bank
Unemployment	Unemployment	Unemployment, total (% of total labor force)	World Bank
Shadow economy	Shadow	The size of the underground economy as a percentage of GDP	Medina and Schneider
Foreign direct investment	FDI	Foreign Direct Investment, net inflow (% of GDP)	World Bank
Urbanization	Urbanpop	Population in urban agglomerations of more than 1 million (% of total population)	World Bank
International trade	Trade	Total imports and exports over GDP.	World Bank
Insurance	Insurance	Volume of non-life insurance premiums on GDP (%)	FANAF
Voice and accountability	Voice and accountability	Voice and Accountability measures citizens' perceptions of their ability to participate in choosing their government, as well as freedom of expression, freedom of association, and a free media. Estimate provides the country's aggregate indicator score in standard normal distribution units, ranging from approximately -2.5 to 2.5.	World Bank
Domestic Credit	Domesticcred	Credit granted to the economy by banks (% of GDP)	World Bank
Oilrent	Oilrent	Oilrent (% of GDP)	World Bank
Control corruption	controcorr	Control of Corruption measures public perceptions of the extent to which public power is used for private gain, including petty and grand corruption, and the "capture" of the state by elites and private interests. Estimate provides the country's aggregate indicator score in standard normal distribution units, ranging from approximately 2.5 to 2.5.	World Bank
Total terrorism	Totter	The sum of domestic, transnational and dark terrorism	

(Source) Authors' own work.