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The nexus between the shadow economy and the unemployment rate in Libya: FMOLS method

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Abstract

The current study investigates the influence of unemployment rate on the shadow economy in Libya using data that covers the period from 1995 to 2020. Using a time series estimation, namely the fully modified ordinary least squares (FMOLS), this study confirmed the positive association between the unemployment rate and the shadow economy in Libya. The findings indicate that the unemployment rate is associated with an increase in the shadow economy during the time period under study. Meanwhile, we show that more trade openness reduced the size of the shadow economy relative to GDP. Finally, this study suggests some policy implications. The government should pay more attention to the private sector to enhance job creation in the formal economy and overcome the inverse effects of the shadow economy in Libya. In addition, trade openness will contribute to non-oil exports and increase GDP growth, which in turn decreases the size of the informal economy.

Keywords: Shadow economy, Unemployment, FMOLS, Libya.

العلاقة بين الاقتصاد الخفي والبطالة في ليبيا: طريقة FMOLS

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الملخص:

بحثت الدراسة الحالية في تأثير معدل البطالة على الاقتصاد الخفي في ليبيا باستخدام بيانات تغطي الفترة من 1995 إلى 2020. وباستخدام تقدير السلاسل الزمنية، أي المربعات الصغرى العادية المعدلة بالكامل (FMOLS)، أكدت هذه الدراسة العلاقة الايجابية بين معدل البطالة والاقتصاد الخفي في ليبيا. تشير النتائج إلى أن معدل البطالة يرتبط بزيادة في الاقتصاد الخفي خلال الفترة الزمنية قيد الدراسة. وفي الوقت نفسه، تظهر النتائج أن المزيد من الانفتاح التجاري قد قلل من نسبة حجم الاقتصاد الخفي إلى الناتج المحلي الإجمالي. وأخيراً، تقترح هذه الدراسة بعض التوصيات السياسية. يجب على الحكومة ان تبدي المزيد من الاهتمام للقطاع الخاص لتعزيز خلق فرص العمل في الاقتصاد الرسمي والتغلب على الآثار العكسية للاقتصاد الخفي في ليبيا. بالإضافة إلى ذلك، سيساهم الانفتاح التجاري في زيادة الصادرات غير النفطية وزيادة نمو الناتج المحلي الإجمالي، مما يقلل بدوره من حجم الاقتصاد غير الرسمي.

الكلمات المفتاحية: الاقتصاد الخفي، البطالة، FMOLS، ليبيا.

1. Introduction

The nexus between the shadow economy and unemployment have been the reason of many debates in both academic circles and policy. The definition and the size of the shadow economy remain a matter of continuous debate in the economic literature. In both developed and developing countries, the unemployment rate and the shadow economy represent important elements of the nation's economy. In the context of the Libyan economy, people generally engage within the shadow economy because of increased government failure, unemployment rates, increased rates of inflation, and low GDP per capita. For instance, Sahnoun &

Abdennadher, (2019) suggests that the increase in the unemployment rate multiplies the possible hours spent in the shadow economy.

Oil countries have distinct characteristics with regard to economic performance. Oil revenues mostly generate significant government gains, which provide a considerable portion of the total GDP (Kraim et al., 2023b). Consequently, oil dependency influences GDP growth as well as the unemployment rate and the informal sector. In this respect, oil rents might drive economic growth, while the output share of the other economic sectors, such as “agriculture, industry, and services”, contributes less to GDP growth (Kraim et al., 2023a; Matallah, 2020). Thus, the oil sector limits the development of other non-oil sectors within these economies; hence, it encourages participation in the informal economy (shadow economy).

Within the same vein, the shadow economy plays a critical role in the Libyan economy in terms of job creation, performance, the utilization of local skills, self-reliance, and expanded sectoral connections. The shadow economy produces inaccurate indicators for official statistics used in macroeconomic policy decisions, limiting tax collection, exchange rate volatility, and lower GDP growth (Ahmad Wan Omar et al., 2020; Kraim, 2024). However, the Central Bank of Libya's goals are to regulate the expatriate labor market and eliminate the shadow economy in Libya, as well as to realize the vision of digital transformation. As seen in Figure 1, the share of the shadow economy was about 35% of total GDP on average from 1995 to 2020, representing the essential issue of the informal sector in the Libyan economy.

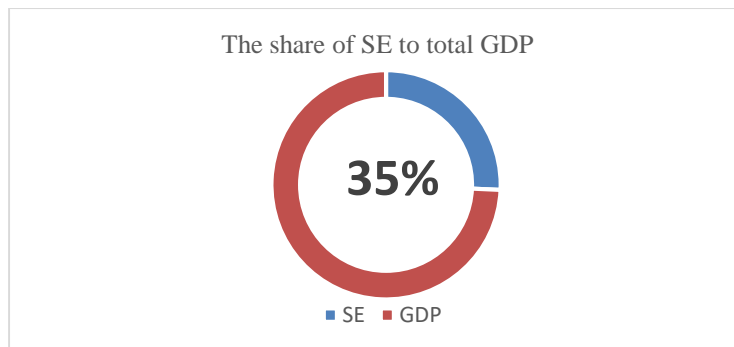


Fig 1. The share of the shadow economy to total GDP in Libya (1995-2020).

Relatedly, the economic reforms in Libya require structural adjustments to its economy, which means that workers who ended up in the informal sector to ensure they continue having a job can be motivated to reintegrate into the formal sector. Hence, it may lead to overcoming the labour market issues in the case of the Libyan economy, which is suffering from an unemployment situation. Figure 2 shows the evolution of the shadow economy to total GDP. As seen, the shadow economy remained relatively stable with an adequate upward trend, rising from around 32% to roughly 33% from 1995 to 1999. A sharp increase in the shadow economy occurred from 1999 to 2001, which registered between 35 to 35.5%. This may reflect some structural or policy changes that led to the rise in informal activities.

A gradual decrease appears, with the shadow economy declining from about 35% to 33.5% during the time 2001 to 2008. Aligns with Libya's political instability and conflict following 2011, which likely expanded "informal economic activities" due to weak state institutions, a significant rise in the informal economy occurred in 2014, registered at 36.8%. Lastly, the shadow economy remains high but shows some fluctuation from 2015 to 2020. Thus, this persistence reflects outstanding economic uncertainty and limited formal job creation.

In addition, Figure 3 highlights the evolution of the unemployment rates in Libya. The unemployment rate in Libya remained relatively high from 1995 to 2003 at 19 to 19.5% and shows mild fluctuations. A slight decline appears between (2003–2005), which registered about 18.6–18.7% reflecting the lowest point in the data series. An improvement in "labor market conditions" may have led to this.

An upward trend starts in 2006 to 2014, with unemployment rising and peaking at nearly 19.6% in 2014. This corresponds with major political and security shocks post-2011. After a temporary decline in 2017, the unemployment rate in Libya increased again to around 19.5% in 2020.

The two graphs below indicate that weak institutional quality, political instability; with economic disruptions have a strong association with the informal economy in the Libyan economy. This can be seen clearly, since the conflict years show clear spikes, whereas periods of stability coincide with a significant decrease. Thus, structural issues in "Libya's labor markets and regulatory

framework" are due to the consistently high level of the informal economy.

In all, the times of high levels of unemployment are often correlated with an increase in the shadow economy, especially post-2011. The data indicated a complementary association between both the shadow economy and the unemployment rate in the Libyan economy. High unemployment may push workers into the informal sector.

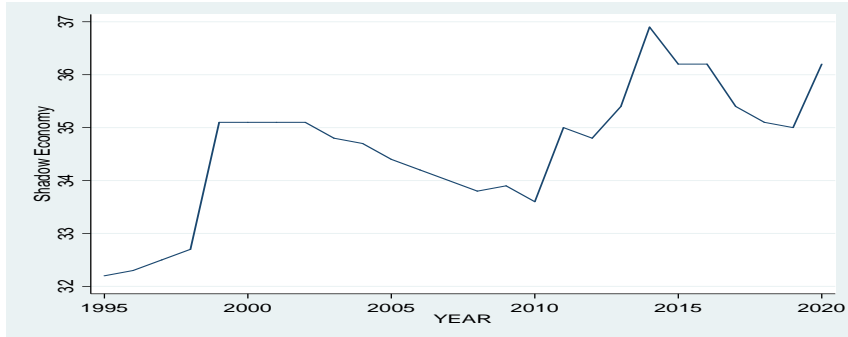


Fig 2. The evolution of the shadow economy to total GDP in Libya.



Fig 3. The evolution of the unemployment rate in Libya.

In this short paper, we re-examine this issue by investigating the relationship between the shadow economy and unemployment rates in Libya. We study whether the Libyan economy has made a significant contribution in terms of employment creation, overcoming the informal sector. The present work employs a time series analysis for Libyan economic data over the period 1995 to

2020. To achieve our purpose, we employed the fully modified ordinary least squares (FMOLS) method for the model estimation. Our study contributes to the economic literature that has studied the relationship between the shadow economy and the unemployment rate by highlighting whether the shadow economy leads to job creation in the context of the government's failure to achieve this goal.

The rest of this paper is organized as follows. Section 2 discusses the literature review, while the empirical methodology and data used are presented in Section 3. Section 4 displays the empirical results of this paper, containing the baseline model and the econometrics analysis. Finally, Section 5 concludes.

2. Literature review

The shadow economy has persistently attracted scholars due to its importance for economic policy. In this regard, researchers have studied the shadow economy for developed as well as developing nations. For instance, Sahnoun & Abdennadher, (2019), have studied the links between the shadow economy and the unemployment rate for developed and developing countries. Using a dynamic simultaneous-equation model over the period 2000 to 2015, this paper confirmed the presence of unidirectional and inverse causality from the unemployment rate to the so called "shadow economy" in developing countries. On the other hand, bidirectional and inverse causal links between the underground economy and the unemployment rate have been assured in the developed countries. Also, Goel & Saunoris, (2017) used the GMM estimation method to study the effect of unemployment on the shadow economy. The results reported a positive and significant effect of unemployment on the informal economy. Precisely, male unemployment has a positive influence on the informal economy, while female unemployment shows relatively less effect. In the same vein, Saafi et al., (2015) applied parametric and non-parametric techniques to examine the dynamic linkages between unemployment and the shadow economy for a sample of developed and developing countries. As a result, this paper concludes that the relationship between unemployment and the shadow economy is not neutral. Another study by Davidescu Alexandru, (2014), scrutinizes the potential effect of unemployment rates on the shadow economy

in the case of the Romanian economy. By using both the ARDL and the structural VAR (SVAR) methods, the findings indicated that there is no long-run relation between the two variables in the Romanian economy. The relationship between unemployment rates and the shadow economy is confirmed only in the short run. Moreover, Davidescu Alexandru, (2014) studies the relationship between the shadow economy and the unemployment rates for the Romanian economy. In this sense, the Toda-Yamamoto method for quarterly data covering the period 2000 to 2010 is used. Because of this study, the existence of unidirectional causality between the unemployment rate and the shadow economy is established.

Recently, a study by Khan, (2025) has examined the relationship between the shadow economy and informal employment for time series analysis from 1991 to 2016. As a result, this paper indicated a significant correlation between the shadow economy and the informal employment in the Indian economy. Abada et al., (2021), used the Tado-Yamamoto approach over the period 1980Q1 to 2018Q4 to investigate the association between the shadow economy and unemployment rate at the national level. They found a strong positive relationship between the shadow economy and the unemployment rate. Using panel data from 2000 to 2017, Tran Pham Khanh, (2021) investigates the relationship between the shadow economy and unemployment for 7 selected ASEAN countries. The results of the DOLS and FMOLS methods showed that unemployment is a significant factor contributing to the growth of the shadow economy for 7 selected ASEAN countries. Furthermore, Esaku & Mugoda, (2025) used annual time series data to study the association between the unemployment rate and the shadow economy in the case of Uganda. This paper employed the ARDL method to examine this relationship and found evidence of a positive and statistically significant relationship between unemployment and the informal economy in both the long and short run.

On the other hand, scholars have investigated the links between the shadow economy and economic growth. For example, Lukman & Kartiasih, (2025) applied the Multiple Indicators and Multiple Causes (MIMIC) method and investigated the size of the shadow economy across 34 Indonesian provinces from 2015 to 2021. This study confirmed that the significant factors influencing the shadow

economy were "tax burden, government regulations, regional autonomy, self-employed labor, and economic openness." In all, the above-mentioned empirical studies have concluded that this topic is controversial and has aroused the interest of specialists since the 60's, when the phenomenon took great hold. Thus, the present paper contributes to the empirical work by examining whether the informal sector has contributed to job creation in the case of the government's failure. Our analysis applies a dynamic model that controls for the long run and short run to examine whether our variables have moved together in the end. In addition, we take into account the importance of the other control factors, such as trade openness and government effectiveness, in affecting the share of the informal sector in the Libyan economy. This objective can provide better insight into the policy impact of the relationship between the shadow economy and the unemployment rate.

3. Methodology and Data

3.1 Methods

This section explains the approach as well as the method used to study the influences of unemployment rates on the shadow economy over the period from 1995 to 2020. The estimated equation for the shadow economy (informal economy) in the i th country is taken to be a function of "labour market outcomes" and economic growth (GDP), and other control variables (Goel & Saunoris, 2017; Porta, 2008). Following the empirical model by Goel & Saunoris, (2017), this paper will estimate the following model:

$$SE_t = \beta_0 + \beta_1 UN_t + \beta_2 INF_t + \beta_3 TR_t + \beta_4 LF_t + \beta_5 GOV_t + \varepsilon_t$$

Where SE_t is the shadow economy, UN_t represents the unemployment rate, INF_t is the inflation rate, TR_t is terms of trade, LF_t represents the labour force rate (% of total population) and GOV_t is the government effectiveness, ε_t is the error term. For the estimation analysis, this study applies DOLS, FMOLS method. The FMOLS approach has several advantages compared to OLS method. This estimator is robust to the endogeneity bias and produces consistent estimation. Besides, using OLS method to estimate the relationship between macroeconomic variables that

may display non-stationary could lead to second-order bias (Kurozumi and Hayakawa, 2009). Therefore, we used the FMOLS methods that are capable of handling or addressing all the issues mentioned above.

Pre-estimation analyses will be performed to test the properties of the variables prior to presenting the primary estimate. First, we will use the unit root test to determine whether all of the variables are stationary. This study used the Augmented Dickey-Fuller (ADF) unit root test to achieve its purpose. Second, the cointegration test is used to confirm the existence of cointegration between the variables being studied. We use the well-known Johansen's cointegration technique to achieve this purpose.

3.2 Data

To achieve the research objective, we use a time series of Libyan economy data covering the period from 1995 to 2020. The macroeconomic data are obtained from the World Bank's World Development Indicators (WDI) and the International Monetary Fund (IMF). The definition of the main variables is shown in Table 1 as follows:

TABLE 1. Data and sources of the variables.

Variable	Definitions	Source
Shadow economy (SE)	The size of the shadow economy % (GDP)	World Bank
Unemployment (UN)	The percentage of the labour force that is without work but seeking employment.	WDI
Inflation rate (INF)	Inflation as measured by the CPI "reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly".	WDI
Terms of trade (TR)	The sum of exports and imports of goods and services as % GDP.	WDI
Labour force rate (LF)	LFR represents the "participation rate of the labour force" for individuals aged (15- 24) as a proportion of the population	WDI

Government effectiveness (GOV)	of the same age who are active. Represent the “quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government’s commitment to such policies”.	WGI
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Source: Author’s elaboration, WDI is “World Development Indicators”; WGI is Worldwide Governance Indicators.

4. Empirical Results

4.1 Summary statistics

In this section, we show the results of the current estimation using the FMOLS method. Before presenting our main results, it is important to conduct some of the pre-estimation analyses to test the characteristics of our variables. Table 2 presents the summary statistics of the estimated variables.

TABLE 2. Descriptive Statistics

Variable	Mean	Std. Dev	Min	Max
<i>UN</i>	19.16538	.2714842	18.613	19.649
<i>SE</i>	34.60385	1.227512	32.2	36.9
<i>LF</i>	50.27273	.5840093	49.121	50.954
<i>INF</i>	4.707186	8.48531	-9.797647	25.85387
<i>GOV</i>	-1.212762	25.47952	34.80163	107.6209
<i>TR</i>	71.06395	25.47952	34.80163	107.6209

Source: Authors’ calculations using STATA 17.

As seen in Table 2, the average rate of unemployment in our sample study is 0.19, which is considered high compared with other oil countries. In addition, our interest variable, the shadow economy, is shown to be high in the mean value registered at about 34.6.

4.2 Unit root test

Table 3 shows the results of the time series unit root test. It is clearly presented that not all the variables are stationary at the level but become stationary at the first difference. The null hypothesis of the ADF unit root tests is that the variables contain a unit root is rejected

at the first difference, and the variables are integrated in the order of $I(1)$.

TABLE 3. Unit root test results.

Variable	Level	Augmented Dickey-Fuller		
		First Deference		
	Stat	p- value	Stat	p- value
<i>SE</i>	-1.985	0.2930	-4.710	0.0001
<i>UN</i>	-2.288	0.1759	-4.317	0.0004
<i>INF</i>	-2.181	0.2131	-4.007	0.0014
<i>TR</i>	-1.647	0.4587	-4.124	0.0009
<i>LF</i>	-1.648	0.4580	-4.532	0.0002
<i>GOV</i>	-0.011	0.9576	-5.732	0.0000

Source: Authors' calculations using STATA 17

4.3 Cointegration Test

The Johansen cointegration test is applied to test the existence of cointegration among the variables. The null hypothesis of this test is that there is no cointegration among variables. We reject the null hypothesis if the "Trace and Max-Eigen statistics" are greater than the critical values. As seen in Table 4, the values of Trace and Max-Eigen statistics are greater than the critical values in most cases; hence, the null hypothesis is rejected, which indicates the presence of cointegration among variables. Thus, the presence of a long-run cointegrating relationship among variables is confirmed.

TABLE 4. Johansen cointegration test

Hypothesized No. of CE(s)	<i>Eigenvalue</i>	<i>Trace Statistic</i>	<i>Critical Value 0.05</i>
None *	0.91798	62.5193	39.37
At most 1	0.69782	29.9179	33.46

Hypothesized No. of CE(s)	<i>Eigenvalue</i>	<i>Max Statistic</i>	<i>Critical Value 0.05</i>
None *	0.91786	62.4833	36.36
At most 1	0.46100	15.4509	30.04

Source: Authors' calculations

4.4 Estimation results and discussion

In this section, we report the main findings of the FMOLS estimation for the long-run relationship between the shadow economy and the unemployment rate in the Libyan economy. We begin by focusing on the effect of the unemployment rate on the shadow economy. The results of the FMOLS method are presented in Table 5. Based on the result, the coefficient of the unemployment rate is positive and statistically significant at the 5% significance level, which indicates the positive long-run relationship between the shadow economy and the unemployment rate. Specifically, a 1% increase in the unemployment rate positively increases the shadow economy by 0.9%. This implies that the higher rates of unemployment force individuals to participate in the shadow economy to obtain jobs. The number of individuals who work in the black economy increases as unemployed people rises. These findings are consistent with the results of the study by (Sahnoun & Abdennadher, 2019). As a result, informal sector employment seems very attractive, which drives the growth of informality. Thus, regulating unemployment rates without tackling the shadow economy may not succeed unless the two variables are simultaneously addressed.

TABLE 5. FMOLS Estimation Results.

DEPENDENT VARIABLE: SE					
Fully Modified Least Squares (FMOLS)					
Variable	Coefficient		Std. Error	t-Statistic	Prob.
<i>UN</i>	0.930**		0.315	2.949	0.012
<i>INF</i>	-0.059***		0.014	-4.024	0.001
<i>TR</i>	-0.042***		0.007	-5.726	0.000
<i>LF</i>	0.899***		0.240	3.749	0.002
<i>GOV</i>	0.304		0.403	0.754	0.465
Constant	-24.08*		12.41	-1.940	0.076
R-squared		0.71			
Adjusted R-squared		0.60			
Observations	26				

Source: Authors' calculations using STATA 17

***p < 0.01, **p < 0.05, *p < 0.1.

Additionally, there exists a statistically significant adverse effect of inflation and trade openness on the magnitude of the shadow economy in Libya. This implies that more open trade policies modernize the entire economy by improving other related sectors such as roads and transport systems, which in turn improve economic growth and decrease the size of the informal economy. In addition, the results of FMOLS estimation also indicate that the labor force rate is positively related to the shadow economy, while the government effectiveness has an insignificant impact on the size of the shadow economy. This indicates that a weaker labour market policy motivates people to participate in the shadow economy.

Concluding Remarks and Policy Implications

The main objective of this study has been to empirically establish a direct link between the shadow economy (informal economy) and the unemployment rate in Libya. The current paper utilized time series data to re-examine the effect of unemployment rate on the size of the shadow economy over the period 1995 to 2020. To achieve this goal, this research applies unit-root test, co-integration, and the FMOLS estimation method. The empirical findings confirmed that the size of the shadow economy is boosted by the unemployment rate in the Libyan economy. In other words, an increase in the unemployment rate enhances the increase in the shadow economy to GDP in Libya. In addition, our results found evidence that trade openness may reduce the size of the shadow economy in total GDP. Considering our empirical findings, we suggest significant implications enabling Libya's policymakers to combat the shadow economy and unemployment. First, we suggest that the importance of the private sector to be considered in the government's policy agenda in Libya. The shadow economy is boosted by the high rates of unemployment in this country. Therefore, governments should boost efficiency in the private sector to create more job opportunities to fight against the informal economy and combat unemployment.

Furthermore, trade openness can decrease the magnitude of the shadow economy. Hence, the substantial implications for Libya's policymakers are to gain more benefits from increasing non-oil exports, support and strengthen the agriculture sectors and the blue economy. Also, reconsider active labor market programs that are

designed to enhance labor force (re)integration into the formal economy, since our results confirmed evidence of the significant effect of the labor force on the shadow economy.

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