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SHADOW ECONOMY AND ECONOMIC GROWTH IN EGYPT:DOES CORRUPTION MATTER?

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- **Abstract**

Tis study aims to analyze the impact of the shadow economy (SE) on economic growth (EG) in Egypt, and how corruption affects the nexus between the shadow economic and EG, using discrete threshold regression method over the period (1991-2023). The results show that the nexus between the SE and EG in Egypt is neither linear nor constant but is clearly shaped by the level of corruption prevailing in the economic environment. The threshold value of the Corruption Perceptions Index (CPI) is 32points and indicates the presence of two distinct regimes that reflect different realities of the Egyptian economy.When corruption is high (i.e., CPI below 32), the SE has a Sig. negative impact on EG.While when CPI equal to or greater than 32 points, the impact of the SE on EG becomes weak and statistically inSig..Reducing corruption and improving governance quality not only directly enhance growth prospects but also serve as a key factor in mitigating the adverse effects of the SE, thereby fostering a healthier and more orderly economic environment. Hence, policies aimed at combating corruption and increasing transparency could be foundational pillars for achieving sustainable and inclusive EG in Egypt.

Keywords: Shadow economy, Corruption, Economic growth, Threshold regression, Egypt.

1. Introduction

In recent years, the SE has attracted Sig. attention from both policymakers and scholars, due to its far-reaching impact on both economic and social development, especially in developing countries where it is widespread(Elbahnasawy,*et al*., 2016). All economies around the world suffer from this old phenomenon, regardless of their level of development or economic system. These nations may differ in the causes of the SE's emergence, its stages of development, or the tools used to combat it (Flayyih et al., 2019; Talab et al., 2019).The SE (also known as informal economy, underground economy, second economy, hidden economy, black economy, parallel economy, etc.) refers to the part of the economy that occurs beyond the purview of organized economic activities(Ihrig & Moe, 2004; Ajide,*et al*.,2022).Describes SE as all economic activities that generate value but cannot be assessed since there are no official statistics; and must be considered when calculating national income.

The recent SE estimates by Medina & Schneider (2019) for 157 countries over the period (1991-2017) show that the African region has one of the largest sizes of shadow economies accounts for 38 % of the official GDP, after Latin America with 39 percent of the official GDP. Meanwhile, the SE is below 20% of GDP in the Organization for (OECD) countries (Esaku, 2021;Thijeel et al., 2024).

The existence of SE can affect the reliability of official economic data, and consequently other socio-economic indicators that rely on such data (Schneider & Enste, 2000; Dell'Anno& Schneider, 2003; Thijeel et al., 2025). The SE has numerous economic, social, and political consequences. For example, the SE reduces tax revenues, which in turn limits public spending on key areas such as infrastructure, education, and healthcare. It also weakens market efficiency, creates unfair competition for legally

established firms, and undermines the effectiveness of institutions, thereby affecting the main goals of social and economic policymaking (Arby,*et al*., 2012; Flayyih et al., 2024; Hasan et al., 2023).

On the other hand, there are also positive effects associated with the SE, such as, enabling firms to operate at lower (labor) costs; providing cheaper goods and services; and creating additional value that can be spent in the formal economy (FE). In addition,the SE can act as a social buffer by providing employment opportunities for low-skilled workers, especially in less developed economies with high unemployment rates (Chen, 2012; Nastav&Bojnec, 2007; Hassan & Schneider, 2016). This role becomes evident during periods of economic recessions and crises, as workers who lose their jobs in the FEturn to the SE to earn their livelihood (Becker, 2004; Arias & Khamis, 2008). According to the International Labor Organization (ILO) (2020), approximately 2 billion workers, or about 62% of the world's working population aged 15 years and above work informally ordedicate at least part of their time to informal sector activities, especially in light of corona pandemic andmost of them in emerging and developing countries.

Regarding Egypt, the SE also cannot be neglected, as it has retained a highly persistent share of the total economy over time.It constitutes an obstacle affecting the growth of the FE in Egypt; however, its positive effects cannot be ignored. Over the past fifty years, the SE has boomed, providing low-income households with cheaper, more affordable goods and services and providing job opportunities for individuals displaced from the formal sector or from other countries experienced shocks and unrest (Soliman, 2020). According toUNDP (2011) report, more than 60% of the jobs available between 2006 and 2011 in Egypt were within SE activities. The informal sector in Egypt represents about 50 percent of all non-agricultural employment, or 63 percent of total employmentin all sectors, informal employment is prevalent among younger, less educated workers, and those in low-skill occupations.This percentage is Sig.ly higher than in neighboring and competing countries such as Tunisia, Jordan and Turkey, as well as developed countries such as Britain and Sweden, where informal employmentrepresents59%, 44%, 34%, 13.6% and 8.2% total employment respectively (ILO, 2018; 2025).

Although the SE in Egypt absorbs a huge percentage of workers and can be considered a backdoor for Egyptian citizens to increase their income, particularly in times of economic crises, it also represents a Sig. loss of tax revenues for the state (Barbary, 2024).Statistics indicate that the state is losing approximately EGP 400 billion in tax annually due to the SE (Elfeki, 2021).

The rise of informal enterprises and workers in Egypt has happened through distinct wavesas response to economic challenges. The earliest wave began in the early 1990s during the country's initial economic reform, which focused on privatizing the public industrial sector. This led to a sharp decline in formal employment and a simultaneous growth of the informal sector due to the government's suspension of hiring new graduates (Krafft & Assaad, 2020). Subsequent waves of informal activity escalated duringthe second economic reform in 2005, the 2011 Egyptian revolution, the COVID-19 pandemic, and the global stagflation resulting from the Russia-Ukraine war. In 2013, the number of informal economic units was 1.3 million with 2.8 million informal workers: by 2018, these figures had risen to 2 million units and 4 million workers respectively (ILO, 2025).

Despite government efforts, the SE continues to persist due to reasons such as underdeveloped institutionsandcorruption. The most common and simplest definition of corruption is the misuse of public power for private gain (Nguyen & Duong, 2021). Corruption has become a major obstacle for Egyptian businesses, with entrepreneurs often forced to establish personal connections with officials or make informal paymentsto navigate the system. This corruption manifests in various forms including issues related to the ease of registration and doing business (Moses, 2019; ILO, 2025).

Larger firms and wealthier individuals can better bear these additional costs, whereas small firms are unable or unwilling to affordsuch burdens and find themselves at a disadvantage, affecting their trust in the government and their motivation to join or remain in the FE (World Bank, 2013).In addition to increasing

the operational costs associated with conducting business in the formal sector, corruption can also contribute to the expansion of the SE by creating market distortions, allowing officials to favor certain businesses in exchange for bribes, which leads to the persistence of informal activities and hinders fair competition.Furthermore, corruption causes inefficient use of resources by diverting them from efficient and productive uses to exploitative activities, as corruption plays a role in resource allocation, especially in developing countries where talent allocation is based on rent seeking activities. Through diverting resources and creating unequal opportunities, corruption not only fosters the SE but also impedes sustainable EG (Heckelman & Powell, 2010; Friedman,*et al*., 2000; Hakimi & Hamdi, 2017).

The estimates show that the overall costs of international corruption amount to $ 3.6 trillion (an amount equal to up to 4 percent of the global GDP or the entire GDP of France) (OECD, 2014b). In developing countries, the financial losses due to corruption are estimated to be ten times the amount of the total Official development Assistance. In Egypt, the cost of corruption is estimated at $37 billionannually .This figure is estimated based on the loss of job opportunities, reduced foreign investment, and embezzled and wasted public funds.[1]

Measuring thesize of the SE is difficult, due to its entities' tendency to operate beyond the oversight of official authorities, as well as the diversity and complexity of its activities. Several methods have been developed to estimate its size including direct methods (such as surveys and tax auditing), indirect methods (such asdiscrepancies in labor force statistics and the currency demand approach), and the model-based approach (MIMIC method) (Gauci & Rapa, 2020). Based on the foregoing, this study will investigate the impact of the SE on EG in Egypt in the presence of corruption. The study further estimates the size of the SE in Egypt using multiple causes and multiple indicators method (MIMIC) for the period (1991-2023) and includes three new variables as causes of the SE in Egypt (poverty, urbanization and financial development).

2. Literature Review and Hypothesis development

Thenexus between the SE and EG is still debatable in research circles; several theoretical arguments have developed over time regarding the SE's impact on EG. One stream of the literature associates higher SE with lower EG, as its expansion can lead to a reduction in the tax base and government revenues, which in turn limits investment in public infrastructure and undermines the quality and efficiency of public goods and services such as education and health. Moreover, the SE creates unfair competition for formal firms and influences the allocation of economic resources. SE activities are generally described as low productive activities, relying on outdated technology and most of these activities related to consumer service industries(Baklouti&Boujelbene, 2019; Loayza,*et al*., 2004; Nguyen & Duong, 2021; Johnson, *et al*., 1997; La Porta & Shleifer 2014; Ihrig & Moe 2004; and Broms, 2011).

Additionally, some studies reinforce this perspective throughSE's ability to enhance overall competitiveness, provideopportunities for entrepreneurs to evade strict government regulations in the informal sector, act as a buffer by employing unemployed workers, provide cheaper goods and services, alleviate povertyand reduce income inequality (Schneider, 2008; Williams,2006; Amaral & Quintin 2006; Levy 2008; Elgin & Uras 2013; D'Erasmo& Moscoso Boedo, 2011; David,*et al*.,2024; Sakanko,*et al*., 2024).

In 17 developing countries and 33 developed countries, Baklouti & Boujelbene (2020) analyzed this nexus and found that it is bidirectional in developed economies, while in developing economies; the nexus is unidirectional and negative. Waqar,*et al*. (2024) investigated the impact of the SE on EG (ECOG) and explored how this nexus is moderated by financial inclusion (FINI), using system GMM and difference

[1]Transparency International, Egypt 2014 National Integrity System Assessment.

GMM techniques on 120 developing economies, over the years from 2002 to 2020. The results revealed that a sizable SE hampers EG, while higher levels of financial inclusion improve it. Additionally, financial inclusion undermines the adverse effects of the SE on EG.

Bennihi&Bouriche (2019) examined the impact of SE on Algeria's non-oil GDP growth from 1991 to 2017, using the ARDL method.The results revealed that the SE and non-oil GDP growth are co-integrated. In the short run, the SE has a negative impact on non- oil EG, while in the long run, its impact ispositive, indicating a changing influence over time. A comparative study of Schneider (2005), covering 21 OECD and 89 developing and transition economies over 1999- 2000, found that the influence of SE on EG differs between developing and developed countries. In developing countries, the SE has a negative and Sig. effect on EG due to huge tax evasion, which limits the provision of essential public goods and services; contrary to in developed and transitioning countries, a positive effect is apparent as it generates income that boosts consumption within the FE.

Some studies have found that the impact of SE on EG is not always Sig.. For example, Sakanko & Ewugi (2017) examined this nexus in Nigeria from 1985 to 2014 and found an inSig. positive impact of the SE on growth in the long - run. Similarly, Hallunovi & Vangjel (2023) investigated the correlation between EG and the SE and their connection to government tax revenue in Albania between 1996 and 2019, using autoregressive distributed lag (ARDL) bound test. Their findings revealed no Sig.nexus between the SE and EG;however, Granger causality analysisindicated a unidirectionalcausal effect running from the SEtoEG.

In addition, some studies reveal there is a non- linear nexus between the SE and EG. For instance, Wu & Schneider (2019) studied the long- run nonlinear nexus between the SE and economic development,measured by GDP per capita across 158 countries from 1996 to 2015, using panel regression strategy, the results revealed a robust U-shaped nexus between the SE size and GDP per capita. Additionally, the study of Elgin & Birinci (2016) identified an inverted- U nexus between the SE's size and growth of GDP per capita, using classical growth model for 161 countries from 1950 to 2010; both small and large sizes of the SE are linked to lowerEG while medium sizes are associated with higher levels of growth.

Similarly, Saafi,*et al*. (2022) examined the nonlinear threshold effect of the SE on sustainable developmentacross 83 developed and developing countries over the period 1996-2017, using both dynamic and static panel threshold models. The results revealed an inverted U-shapednexus;the size of the SE has a positive impact on sustainable development; however, once the SE exceeds a certain threshold, SE size dampens sustainable development, and these results are consistent across both developed and developing economies. Likewise, Linh,*et al*. (2023) investigated the nonlinear impact of SE on EG in 8 ASEAN countries during the period (2002-2019), using the method of threshold effects and the System - GMM approach. They found that the size of SE has negative impact on EG; moreover, they found a threshold point in the impact of SE on EG, after which the impact remains negative, but becomes lower than that in the pre threshold region.

In terms of studies analyzing the combined effects of SE and corruption on EG,Baklouti&Boujlbene (2019) studied how corruption level affectsEG and how this affect depended on the SE, for 34 OECD countries from 1995 to 2014, using OLS, fixed effects, and system GMM. The results revealed that both corruption and SE lead to decrease in EG. The SE magnifies the effect of corruption on EG, and addressing either corruption or SE through policy measures could mitigate the adverse effects of both. Nguyen & Luong (2020) investigated the interactions of corruption and the SE with EG in 17 Asian countries from 2000 to 2015, using GMM method. The results showed that corruption has a statistically Sig. positive impact on EG, while the SE has a Sig. negative impact.

Ngouhouo,*et al*. (2022) analyze the impact of EG on the SE in the context of corruption, using FE, system GMM, MG, AMG, and IV-2SLS methods, for 112 countries over the period 1991 to 2015. The results showed that EG reduces the size of the SE in the direct effect regression. Moreover,its interaction with corruption leads to negative net effects up to a corruption threshold of 4.79745, after which this effect is nullified. This negative net effect is robust across various regional groupings and income groups,except in the Middle East and North Africa (positive net effect), and in high income and upper-middle-income countries (direct effects only),resulting in different thresholds per sample.

This study will examine the impact of the SE on EG in Egypt in the context of corruption, based on two hypotheses:

Hypothesis 1: The SE has a negative impact on EG in Egypt.

Hypothesis 2: Corruption magnifies the negative effects of the SE on EG.

3. Model Specification

Based on the study hypotheses and previous literature such as Boitano & Abanto (2019), Etim & Daramola (2020), Khuong, *et al*. (2021), and Sultana, *et al*. (2022), the following general linear model will be adopted to illustrate the nexus between the size of the SE and EG, as shown in the following equation (1):

$$Growth_t = C + \gamma_1 Shadow_t + \sum_{k=1}^{K} \beta_k X_t^k + \epsilon_t \quad \textbf{(1)}$$

Where ($Growth_t$) represents the level of EG in Egypt at time$t$, (where $t = 1, 2, \dots, n$). C denotes the constant term of the function. ($Shadow_t$) represents the independent target variable, which is the size of the SE in Egypt at time$t$. Meanwhile, (X_t^k)denotes a vector of control variables, representing potential determinants of EG other than the SE. These variables were selected in accordance with previous studies, which suggest that EG depends on domestic and foreign investment, trade openness, government expenditure, and the level of financial development. Finally, (ϵ_t)represents the error term with its usual properties. Therefore, the study model in function (1) can be considered as representing the determinants of EG in Egypt.

In order to test the general role of corruption in the nexus between SE and EG and achieve the research objective, the study will use the threshold regression method proposed by Hansen (2000) to allow for contradictory or varying effects of the SE on EG based on the prevailing level of corruption in Egypt (i.e., discovering the nonlinear behavior of the SE). Consequently, function (1) can be developed into the following form:

$$Growth_t = C + \begin{cases} \beta_1 Shadow_t \ \ if\ Corr < \lambda \\ \beta_2 Shadow_t \ \ if\ Corr \geq \lambda \end{cases} + \gamma X_t + \epsilon_t \quad \textbf{(2)}$$

Where ($Corr$) (i.e., the level of corruption) represents the threshold variable used to divide the sample into regimes or groups. It is an exogenous variable not included in the list of explanatory variables. λ is the unknown threshold parameter value (which is estimated using the least squares method). Consequently, the coefficient β_1 reflects the effect of the SE on EG in Egypt during periods of high corruption (low transparency), while the coefficient β_2 reflects the same effect during periods of low corruption (high transparency). It is evident that under the null hypothesis $H_0; \beta_1 = \beta_2$, the model becomes linear and reduces to the functional form of equation (1). Therefore, the final form of the study model in a semi-logarithmic specification is as follows:

$$lnGrowth_t = \beta_0 + \beta_1 Shadow_t I(Corr_t < \lambda) + \beta_2 Shadow_t I(Corr_t \geq \lambda) + \beta_3 FDI_t + \beta_4 GFCF_t + \beta_5 Open_t + \beta_6 Gov.Exp._t + \beta_7 FD_t + \epsilon_t \quad \textbf{(3)}$$

Thus, function (3) indicates that EG in Egypt ($Growth_t$) is a function of the SE ($Shadow_t$), and the control variables represented by foreign direct investment (FDI_t), domestic investment ($GFCF_t$), trade

openness ($Open_t$), government expenditure ($Gov.Exp._t$), and financial development (FD_t), in addition to the function constant (β_0). Here, $I(.)$ is an indicator function that takes the value 1 if the condition within the indicator function holds, and 0 otherwise. This modeling strategy allows for the differing role of financing depending on whether the level of corruption is below or above an unknown thresholdλ.

Theoretically, the effect of the SE on EG varies according to the level of corruption in the country. During periods of high corruption, regulatory institutions weaken, and the effectiveness of public policies declines, allowing the SE to expand unchecked without compliance with taxes or laws. Conversely, during periods of low corruption, the business environment improves and institutional effectiveness increases, gradually enabling the integration of informal activities into the FE. In such a context, the SE can transform into a source of economic activity and employment opportunities, especially in marginalized or underserved areas, positively contributing to EG, provided that supportive policies and sustainable institutional reforms are in place. Consequently, the coefficient (β_1)is expected to be negative, whereas (β_2)may be positive or statistically inSig..

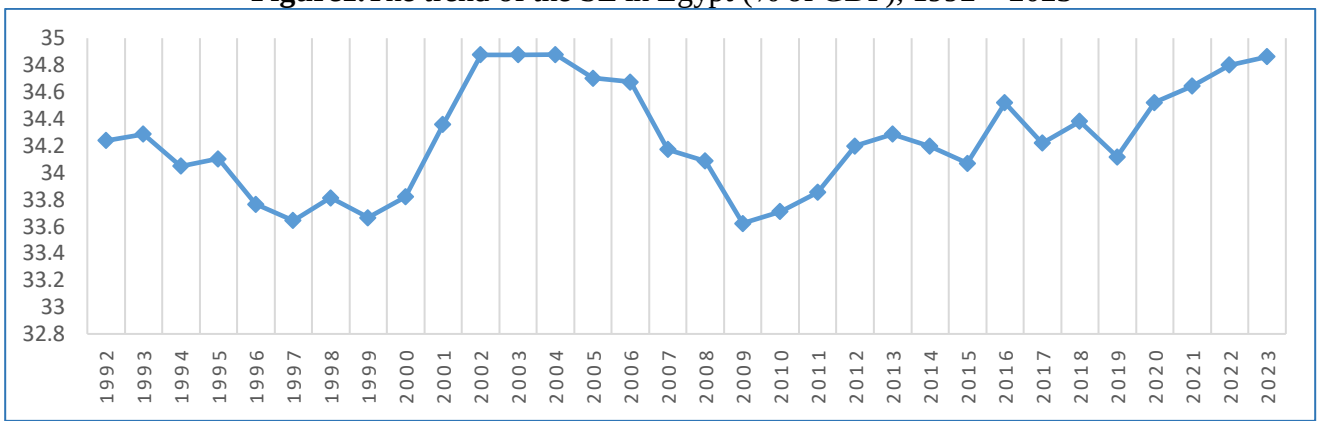
4. Data Specification

To estimate the study model, annual time series data for Egypt over the period from 1991 to 2023, totaling 33 annual observations, will be used. These data were obtained from the World Development Indicators of the World Bank, the International Monetary Fund, and Transparency International.

Regarding the dependent variable (EG), it is measured by the annual growth rate of real Gross Domestic Product (GDP). For the moderating variable (corruption) is measured using the widely recognized CPI issued by Transparency International.For the control variables, the study relies on net inflows of Foreign Direct Investment (FDI) as a percentage of GDP, and Gross Fixed Capital Formation as a percentage of GDP to represent foreign and domestic investment respectively. The trade openness level is proxied by the trade index as a percentage of GDP. The annual growth rate of government final consumption expenditure is included, as well as the overall financial development index published by the IMF. Finally, Table (A) in the appendix presents a brief description of the variables used in the empirical analysis along with their symbols and data sources.

Regarding the independent variable (SE), the study uses the index of the SE size as a percentage of GDP, which was calculated by the researcher using the multiple indicators and multiple causes model (MIMIC method) with an 8-1-3 specification. This means using eight indexes representing potential causes of the SE in Egypt, one latent variable reflecting the SE, and three indicators representing the effects resulting from the SE. the potential causes of the SE in Egypt, selected in line with previous literature: Self-employment, Unemployment, Inflation, Regulatory restrictions, Tax burden, Financial development, Urbanization, Poverty. While the SE explains the vector of indicators affected by the SE, which includes EG rate, Labor force participation rate, Broad money supply. Figure (A) and Table (B)in the appendix show the results of estimating the MIMIC (8-1-3) model.While figure (1) shows the size of the SE as a percentage of GDP during the period calculated using a MIMIC model by the researcher.

Figure1. The trend of the SE in Egypt (% of GDP), 1992 – 2023



Source: researcher's calculations using MIMIC method.

From Figure (1), it is evident that the SE in Egypt constitutes between 33.6% and 34.9% of the GDP, reflecting a structural stability in its size over more than three decades. The data show no sharp declines or sudden spikes; rather, the indicator hovers around an average of approximately 34.3%. This stability indicates that the SE is not merely a temporary response to crises or policies but rather an inherent part of Egypt's economic and social fabric.

During the period from 1992 to 2023, the SE in Egypt experienced relative fluctuations, beginning at a relatively stable level around 34% of GDP in the1990s, unaffected Sig.ly by early economic reforms. In the early 2000s, the size of the SE increased due to the complexity of governmental procedures and the limited absorption capacity of the formal labor market, reaching its peak in the mid-2000s. Throughout the global financial crisis and the 2011 revolution, the informal sector acted as a safety net, with some relative fluctuations in its size. Following the 2016 currency float and rising inflation, reliance on this sector increased as a coping mechanism, causing its share to rise again. Finally, during the COVID-19 pandemic, the informal economy expanded further as it absorbed the impact of the crisis on employment and income. This confirms that the informal sector reflects deep structural challenges within the Egyptian market, necessitating comprehensive reforms to improve governance and support the formal sector. Finally, Tables 1 and 2 show the statistical description of the study variables and the correlation matrix between them, respectively.

Table (1) shows that the average real EG rate in Egypt was 4.37% annually, reflecting a moderate economic performance. However, the variability of this rate (standard deviation = 1.57) indicates Sig. fluctuations in growth across the years, which may be attributed to economic cycles, external crises, and internal political events. It is noted that the normal distribution of this variable supports its use in econometric models without the need for transformations.

Table 1. Descriptive summary statistics, 1991 – 2023

	Unit	Obs.	Mean	Median	Std. Dev.	Min	Max	Normality test
Dependent variable:								
GDP growth	(Annual %)	33	4.371	4.372	1.57	1.125	7.156	[0.6200]
Independent variable:								
SE	(% of GDP)	33	34.25	34.22	0.39	33.62	34.88	[1.4382]
Moderator variable:								
CPI	(scale 0 - 100)	33	30.94	32.00	4.30	18.00	37.00	[21.724]***
Control variables:								
FDI, net inflows	(% of GDP)	33	2.319	1.509	2.22	-0.205	9.349	[35.491]***
Gross fixed capital formation	(% of GDP)	33	18.25	17.92	4.00	11.52	27.07	[1.2226]
Trade Openness	(% of GDP)	33	46.58	43.74	10.8	29.86	71.68	[2.1140]
Gov. Exp.	(annual % growth)	33	3.915	4.023	2.16	-2.783	8.416	[5.3053]*
Financial Development Index	(scale 0 - 1)	33	0.294	0.299	0.06	0.185	0.434	[0.4258]

Note:***, **, * indicate significance at 1%, 5% and 10% respectively.

Table 2. Correlation matrix between study variables, 1991 – 2023

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln GDP growth	**(1)**	1							
SE	**(2)**	-0.189	1						
Corruption (CPI)	**(3)**	0.176	0.298*	1					
FDI, net inflows	**(4)**	0.541***	0.120	0.098	1				
GFCF	**(5)**	0.139	-0.493**	-0.735**	0.037	1			
Trade Openness	**(6)**	0.119	-0.043	-0.549**	0.544**	0.588***	1		
Gov. Exp.	**(7)**	-0.126	-0.377**	-0.203	-0.365**	0.207	-0.213	1	
Financial Development	**(8)**	0.383**	0.279	0.445***	0.629***	-0.328*	0.240	-0.380**	1

Note:***, **, * indicate significance at 1%, 5% and 10% respectively.

For the SE, its average during the period was 34.25%, with slight variability (standard deviation = 0.39), ranging between 33.62% and 34.88%, reflecting relative stability in the size of this sector over the past three decades. Regarding the corruption variable, represented by (CPI), the average score during the

study period was 30.94 points, indicating relatively high levels of administrative and financial corruption. This variable exhibits considerable variability (standard deviation = 4.30) and a highly non-normal distribution, with a normality test value of 21.724, statistically Sig. at the 1% level.

Table (2) indicates a weak and statistically inSig. negative correlation (-18.9%) between the SE and EG, according toGoller, *et al*. (2020). This suggests that an increase in the size of the informal sector may be associated with a decline in growth rates. This indicates an indirect effect of the SE on growth, occurring through other channels such as reduced public revenues, weak tax collection, or reluctance of formal investors. It may also suggest that the SE acts as a "shock absorber" during crises, thereby reducing its direct negative impact on growth. Similarly, there is a weak and statistically inSig. positive correlation between transparency (the inverse of corruption) and EG, at (17.6%). This reflects that improvements in governance may not show a direct impact on growth except through broader interactions with other variables.

Regarding the key nexus between the SE and corruption, the results reveal a positive correlation of (29.8%), which is statistically Sig. at the 10% level. This supports the theoretical proposition that a corrupt environment contributes to the expansion of the SE, either through regulatory evasion or through facilitation of illegal activities.Concerning the correlations among independent variables themselves, all correlation coefficients range from weak to moderate strength.According to Bartelt & Evans (1996), no evidence of multicollinearity was found among the study variables.

5. Econometric Analysis and Results

After verifying the stability of the variables, the quality of the model, and its freedom from various measurement problems, the threshold test using the Bai-Perron method was estimated in Table (3).

Table 3. Multiple threshold tests

Threshold variable: *CPI*(-2)
Estimated number of thresholds: 1
Method: Bai-Perron tests of L+1 vs. L sequentially determined thresholds

Threshold test	F-stats.	Scaled$F$-stats.	Critical value	Thresholdvalue
0 vs. 1	6.03901	12.0780	11.47	32
1 vs. 2	2.31534	4.63069	12.95	

The results of the threshold test using the Bai-Perron method revealed the existence of a single Sig. threshold in the nexus between the informal economy and EG in Egypt during the period 1991–2023, at a level of 32 points in the CPI. This indicates that the impact of the SE on EG is not a constant linear effect but varies according to the prevailing level of corruption in the economy. The results showed that the computed F-statistics for comparing the no-threshold model against the one-threshold model was 12.078, which exceeds the critical value of 11.47, indicating the presence of one statistically Sig. threshold at a high confidence level. Conversely, the comparison between the one-threshold and two-threshold models did not show statistical significance ($F = 4.63$), which is below the critical value, indicating no evidence for more than one structural break in the studied nexus.

Based on these findings, the nexus between the SE and EG can be divided into two distinct regimes: the first regime prevails when the corruption index is below 32, reflecting an environment with a high level of corruption, while the second regime applies when the index is 32 or higher, indicating a relative improvement in governance quality and anti-corruption efforts. This suggests that corruption acts as an institutional threshold that reshapes the effect of the SE on economic performance, highlighting the importance of the institutional context in understanding the dynamics of the SE. It also justifies the use of the threshold model to estimate this nexus in a nonlinear manner.

Table 4. SE, EG and Corruption: Empirical results
Dependent variable: ln GDP growth (annual %)
Method: Discrete Threshold Regression.

	Unstandardized Coefficient	Standardized Coefficient	Std. Err.	*t*- stat.	Prob.
Threshold Variables:					
***SE (when CPI < 32)* (14 Obs.)**	**-0.44968**	**-20.9865**	**0.1842**	**-2.4415**	**0.023****
constant	15.5988	21.4235	6.3909	2.4408	0.023**
***SE (when CPI ≥ 32)* (17 Obs.)**	**0.04638**	**2.19614**	**0.1943**	**0.2387**	**0.814**
constant	-1.04468	-1.43477	6.7297	-0.1552	0.878
Non-Threshold Variables:					
FDI, net inflows	0.08984	0.55115	0.0286	3.1435	0.005***
Gross fixed capital formation	0.08069	0.80312	0.0177	4.5689	0.000***
Trade Openness	-0.01927	-0.54421	0.0068	-2.8385	0.010**
Gov. Exp.	-0.01389	-0.08161	0.0211	-0.6585	0.517
Financial Development	0.88765	0.13874	1.0092	0.8796	0.389
Key regression statistics					
R-squared	0.7657	Adjusted R-squared		0.6805	
Fisher test (F-stats.)	8.9866 (0.000)***	DW stats.		2.3489	
Practical significance for SE: Effect Size					
SE (when CPI < 32)	$(r = -0.4617)$	$(d = -1.0410)$	Large Effect		
SE (when CPI ≥32)	$(r = 0.0508)$	$(d = 0.1018)$	No Effect		

Note*:**, **, * indicate significance at 1%, 5% and 10% respectively.

The results of the threshold regression presented in Table (4) confirm that the nexus between the SE and EG in Egypt is neither linear nor constant but is clearly shaped by the level of corruption prevailing in the economic environment. The threshold value of the CPI at 32 points indicates the presence of two distinct regimes that reflect different realities of the Egyptian economy.In the first regime, where corruption is high (i.e., CPI below 32), the SE has a Sig. negative impact on EG at the 5% significance level. The estimated regression coefficient was -0.4497, implying that a 1% increase in the size of the SE in a high-corruption environment leads to an average decrease of approximately 0.45% in EG.

This result highlights the SE as a tangible obstacle to EG. This can be explained by the fact that corruption at this stage undermines governance and regulatory mechanisms, allowing the SE to proliferate in an unorganized and unproductive manner.In a high-corruption environment, tax policies become less effective, and regulations are less enforceable, enabling informal activities to evade taxes and legal obligations. Consequently, the government loses critical funding sources, and the quality of public services

and infrastructure deteriorates, severely harming EG. Moreover, corruption exacerbates institutional weaknesses, reducing the official economy's ability to positively interact with the informal sector, which leads to the simultaneous intensification of corruption and the SE.

In the second regime, with improved corruption levels (CPI equal to or greater than 32), the picture changes dramatically. The impact of the SE on EG becomes weak and statistically inSig.. This indicates that improving governance indicators and anti-corruption efforts mitigate or even eliminate the negative effects of the SE. This does not necessarily mean the SE turns positive but suggests that a better institutional business environment makes the SE less distortive and more adaptable to the FE, possibly reducing its drain on resources or tax evasion. In other words, strong and transparent institutions create an environment where the SE is less harmful to growth or facilitates transforming part of it into economically valuable activities.

Regarding control variables, the results showed that both foreign direct investment and domestic investment (gross fixed capital formation) have a strong positive effect on EG at the 1% significance level. This confirms the essential role of these variables as growth drivers. It underscores the importance of capital inflows, both internal and external, in boosting economic output through increased productive capacity and technology transfer. Conversely, trade openness showed a negative impact on growth at the 5% significance level, which may reflect challenges in the Egyptian economy's competitiveness in global markets or suggest that openness exposes the economy to external shocks negatively affecting stability and growth. Government expenditure and financial development, however, had no Sig. effect on EG, which may indicate weak public spending efficiency and difficulties in translating financial sector development into sustainable EG under the current institutional conditions.

Regarding the key regression statistics, it is evident that the adjusted R-squared ($\overline{R}^2$) value is relatively high, with the model explaining 68.1% of the variations in Egypt's EG. The remaining 31.9% is attributed to other random factors and determinants that were not controlled for within the model. The Durbin-Watson statistic (DW) for the model was calculated as 2.349, which is greater than the critical DW value, indicating no first-order autocorrelation in the residuals. Furthermore, the Fisher test (F-Statistic) rejects the null hypothesis and accepts the alternative, confirming the overall statistical significance of the model at the 1% significance level.

Finally, The Effect size offers an evaluation of the practical significance of the nexus, which statistical significance alone does not convey. In other words, it clarifies the real-world impact of the nexus. Here, effect size was calculated through partial correlations between the SE in the two regimes (high corruption and low corruption) and EG, controlling for other variables in the model (assuming they also affect the dependent variable). From the correlation statistic (r) and Cohen's d statistic (d) shown below Table (4), a large negative effect size of the SE on EG is evident during high corruption periods (CPI less than 32 points). Conversely, there was no practical effect (no meaningful impact) during low corruption periods (CPI greater than or equal to 32 points).

6. Conclusion and Recommendations

This study analyzes the impact of the SE on the EG in Egypt and how corruption affects thenexus between SE and EG, over the period 1991-2023, using discrete threshold regression method. The estimation will be conducted using the statistical software package E-Views 13.The results of the threshold regression confirm that the nexus between the SE and EG in Egypt is neither linear nor constant but is clearly shaped by the level of corruption prevailing in the economic environment. The threshold value of the CPI at 32 points indicates the presence of two distinct regimes that reflect different realities of the Egyptian economy. In the first regime, where corruption is high (i.e., CPI below 32), the SE has a Sig. negative impact on EG at the 5% significance level.

This result highlights the SE as a tangible obstacle to EG. In the second regime, with improved corruption levels (CPI equal to or greater than 32), the picture changes dramatically. The impact of the SE on EG becomes weak and statistically inSig.. This indicates that improving governance indicators and anti-corruption efforts mitigate or even eliminate the negative effects of the SE. This does not necessarily mean the SE turns positive but suggests that a better institutional business environment makes the SE less distortive and more adaptable to the FE, possibly reducing its drain on resources or tax evasion.This study also used size effect that offers an evaluation of the practical Sig. of the nexus. The results showed that during high corruption periods (CPI less than 32 points), a large negative effect size of the SE on EG is evident. Conversely, there was no practical effect (no meaningful impact) during low corruption periods (CPI greater than or equal to 32 points).

This provides strong support for theory development and the formulation of effective economic policies to support growth. The results indicate that the effect of the SE on EG is not absolute but depends on the institutional context. Its negative effect intensifies in high corruption environments, while it weakens or disappears in better governance settings. The findings also highlight the importance of distinguishing between statistical and practical significance, necessitating reliance on effect size measures to estimate the actual strength of nexuss. Consequently,the results recommend adopting dual policies targeting both the reduction of the SE and the improvement of institutional quality simultaneously, with an emphasis on tailoring policies to local contexts rather than applying ready-made models universally.

Another contribution of this study is estimating the size of the SE in Egypt during the period (1991–2023), using Multiple Indicators Multiple Causes method (MIMIC), and including three new variables as causes of the SE in Egypt such as poverty, urbanization and financial development.The results indicate that Egypt's SE during the study period was not a temporary phenomenon, but rather the product of structural conditions, most notably poverty, taxation, and bureaucracy. Therefore, any serious strategy aimed at integrating the informal sector into the FE must involve genuine efforts to alleviate poverty, simplify the regulatory framework, and expand financial inclusion, in addition to improving the business environment and creating decent formal employment opportunities.

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