ERF Working Papers Series

Financial Development, Corruption and Shadow Economy: Evidence from MENA Countries

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ECONOMIC RESEARCH FORUM
منتدى البحوث الاقتصادية

Working Paper No. 1687
December 2023

FINANCIAL DEVELOPMENT, CORRUPTION AND SHADOW ECONOMY: EVIDENCE FROM MENA COUNTRIES[1]

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[1] This paper was originally presented during the ERF 29th Annual Conference on "The Future of MENA Development Path: Risks and Opportunities in an Emerging World Order," 4-6 May 2023.

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First published in 2023 by
The Economic Research Forum (ERF)
21 Al-Sad Al-Aaly Street
Dokki, Giza
Egypt
www.erf.org.eg

Abstract

This paper examines the relationship between financial development (FD), corruption, and the size of shadow economies in the MENA region from 1996 to 2018. An important contribution is the study of how FD and corruption can interplay to affect informality. Several pooled regressions are run on the entire sample and various subsamples in order to understand the heterogeneity that might exist among countries. Even after addressing the potential endogeneity problem of the variables, we find robust results showing that increases in corruption and FD reduce the size of the informal sector. Therefore, corruption plays the role of "greasing the wheels" in the Middle East and North Africa (MENA) region. Moreover, these two dimensions are substitutable in relation to the unofficial economy; the marginal impact of increasing along one dimension is higher when the other dimension is low. The subsample analysis reveals that the impacts of FD and corruption can be remarkably different between low-corruption and highly corrupt countries. Interestingly, the statistical significance of these two factors vanishes for the high-income countries. Obviously, the efforts against informality in the MENA region are multidimensional and dynamic. Further, at each stage of economic, financial, and institutional development, new factors may appear and gain importance.

Keywords: Financial development, Corruption, Shadow economy.
JEL Classifications: G20, O17.

ملخص

تبحث هذه الورقة في العلاقة بين التنمية المالية والفساد وحجم اقتصادات الظل في منطقة الشرق الأوسط وشمال إفريقيا من عام 1996 إلى عام 2018. وثمة مساهمة هامة تتمثل في دراسة الكيفية التي يمكن بها للتفاعل والفساد أن يؤثرا على الطابع غير الرسمي. يتم تشغيل العديد من الانحدارات المجمعة على العينة بأكملها وأجزاء فرعية مختلفة من أجل فهم عدم التجانس الذي قد يكون موجودًا بين البلدان. حتى بعد معالجة مشكلة التجانس المحتملة للمتغيرات، نجد نتائج قوية تظهر أن الزيادات في الفساد والتنمية المالية تقلل من حجم القطاع غير الرسمي. لذلك، يلعب الفساد دور «دهن العجلات» في منطقة الشرق الأوسط وشمال إفريقيا. وعلاوة على ذلك، يمكن الاستعاضة عن هذين البعدين بالاقتصاد غير الرسمي ؛ ويكون الأثر الهامشي المترتب على الزيادة في أحد الأبعاد أكبر عندما يكون البعد الآخر منخفضا. يكشف تحليل العينة الفرعية أن آثار التنمية المالية والفساد يمكن أن تكون مختلفة بشكل ملحوظ بين البلدان منخفضة الفساد والبلدان شديدة الفساد. ومن المثير للاهتمام أن الأهمية الإحصائية لهذين العاملين تتلاشى بالنسبة للبلدان ذات الدخل المرتفع. ومن الواضح أن الجهود المبذولة لمكافحة الطابع غير الرسمي في منطقة الشرق الأوسط وشمال أفريقيا هي جهود متعددة الأبعاد وديناميكية. وعلاوة على ذلك، قد تظهر عوامل جديدة وتكتسب أهمية في كل مرحلة من مراحل التنمية الاقتصادية والمالية والمؤسسية.

1. Introduction

Informality, i.e., the shadow economy,[4] is a common issue that countries face all over the world, particularly developing countries. In 2015, the International Labour Organization (ILO) Recommendation No. 204 concerning the transition from the informal to the formal economy referred to the "informal economy" as all economic activities by workers and economic units that are – in law or in practice – not covered or insufficiently covered by formal arrangements.[5]

The shadow economy presents a formidable policy challenge for policy setting, not only in emerging and developing economies but also in developed countries (Schneider and Enste, 2000; Torgler and Schneider, 2009). Previous research has generally concluded that informal activities can have a negative impact on an economy.[6]

In identifying the causes of informality, the literature has largely focused on the roles of taxes as well as social security complexity and fairness; the burdens of bureaucracy; regulations; and corruption (Schneider, 1994; Loayza et al., 2005; Johnson et al., 1998; Friedman et al., 2000; Schneider, 2007). The literature has also investigated how the level of financial development (FD) can affect the size of the shadow economy.

In the context of the Middle East and North Africa (MENA) region, the informal economy stands at the heart of the region's key political and economic challenges. It absorbs a large share of the region's youth unemployment, exemplifies the inability of the state to promote inclusive development, and puts marginalized individuals at the mercy of the police and security services. The informal economy directly connects to key themes of the 2011 uprisings: economic inequality, accountability, dignity, and social justice. However, very little has been written about the region's informal economy. Moreover, very little has changed for the over 50 million people making a living in the region's informal economy.

This paper aims to provide an initial analysis of the determinants of the informal economy in the MENA region. Principally, two factors motivate us to take MENA countries as a case study. In addition to the fact that the presence and prevalence of the informal economy in many countries in this region is a concerning issue for their economic development, we observe that while some MENA countries face difficulties in tackling unofficial activities (Tunisia, Egypt, and Morocco), others have succeeded in reaching shadow economy levels like those recorded in the developed economy (Bahrain, Iran, Qatar, and Jordan). Therefore, we focus principally on FD and corruption to explain the observed disparities.

Theoretically, it is expected that as a country becomes able to control corruption by improving the quality of its governance and institution, and as the access to loanable funds increases, the incentives for entrepreneurs to operate in the official economy increase. Nevertheless, several studies have shown that the relationship between FD, corruption, and informality is still ambiguous. In addition, while the impact of FD and corruption on the shadow economy have been studied extensively, the effect of their interaction has not. Accordingly, in addition to

[4] In this paper, the terms 'informality,' 'informal economy,' 'shadow economy,' 'underground economy,' and 'unofficial economy' will be used interchangeably.

[5] OECD/International Labour Organization (2019), "Definitions of informal economy, informal sector and informal employment," in Tackling Vulnerability in the Informal Economy, OECD Publishing, Paris.

[6] Some literature has attempted to show some positive effects of informality in reducing unemployment and enhancing entrepreneurial activity (Blanchflower, 2000; Thurik et al., 2008; Bacchetta et al., 2009; Perry et al., 2007).

examining the direct effect of two major determinants of informality (i.e., corruption and FD on the shadow economy in the MENA region), this study tries to fill the gap in the literature by investigating how these two factors interact with each other in relation to the shadow economy. A priori, we expect that the development of the financial system in MENA countries can moderate the negative effect of corruption on the economy by motivating entrepreneurs to operate officially.

The rest of the paper is structured as follows. The next section exhibits a brief literature review on the relationships between corruption, FD, and the shadow economy. Section 3 details the methodological framework of our empirical work, while section 4 presents the empirical results. Sections 5 and 6 provide robustness checks of our baseline results and extend the empirical work to a subsample analysis, respectively. Section 6 concludes.

2. Literature review

This obscure and complex side of the economy, namely, the shadow economy, is a subject that has attracted the attention of many economists in an attempt to better understand its causes and consequences on growth and development. One of the main topics in this literature is the relationship between the corruption phenomenon and the shadow economy, despite the difficulties that researchers have found in collecting data.[7] For example, on the basis of a theoretical and empirical framework, Johnson et al. (1997) studies the unofficial economy in Eastern European countries and the former Soviet Union in transition from communism to capitalism and finds that during the transition, the consequence of the political control of the economy has been the growth of the unofficial economy, wherein entrepreneurs can avoid taxes, regulation and bribe payment. They show that a one-point decrease in corruption reduces the share of the unofficial economy by five to six percentage points. Working on the data of 69 countries, Friedman et al. (2000) confirm this finding and assert that corruption is associated with a more unofficial economy. They point out that entrepreneurs go underground not to avoid official taxes but to reduce the burden of bureaucracy and corruption. Conversely, Choi and Thum (2005) and Dreher et al. (2008) predict a negative (substitution) relation between corruption and the shadow economy. Dreher and Schneider (2010) study the data of a cross-section of 98 countries and argue that the relationship between corruption and the shadow economy is sensitive to the measure of corruption used in the regression; namely, perception- or structural model-based. When the latter is employed, corruption and the shadow economy both become complements in low-income income countries and not in high-income ones.

Another no less important theoretical determinant of an unofficial economy is the accessibility to loanable funds. Entrepreneurs and workers operating unofficially are often credit-constrained and unable to access credit markets. The literature on the nature of the relationship between FD and the size of the informal economy is complex and not clear-cut; in fact, the relationship can either be positive or negative. On the one hand, Blackburn et al. (2012) prove, theoretically, that the lack of FD expands the size of the informal sector. Capasso and Jappelli (2013) argue that a well-established and functioning financial system reduces the cost of credit and discourages economic agents from engaging in informal activities, hence impeding informality. Bittencourt et al. (2014) study panel data from 150 countries over the period 1980-2009 and find that higher levels of FD and lower inflation reduce the shadow economy. Berdiev and Saunoris (2016), using panel data from 161 countries during the period 1960-2009, find evidence of a negative association between FD and informality. Liu-Evans and Mitra (2019)

[7] Early studies have mostly worked on small samples.

further confirm the previous results.

Several theoretical studies develop the channels through which FD can influence firms' choices to operate informally, whether totally or partially. These modeling efforts rely on financial market imperfections, especially information asymmetries, and regulatory and tax compliance costs. The typical model setup assumes that firms weigh the access to finance, or the cost of funding, which is only available to formal activity with compliance cost. Greater FD reduces the cost of finance and/or expands access to finance, and therefore entices firms to operate formally.

On the other hand, Evans and Jovanovic (1989) develop a microeconomic model and prove that an individual unconstrained by liquidity is more likely to be informally employed (i.e., self-employed).[8] Using the economic growth-informality nexus and several empirical specifications, Sirisankanan (2017) argues that FD can ease the liquidity constraints of individuals who want to set up their enterprises, thereby encouraging informal employment/self-employment. Conversely, FD can also reduce informality by stimulating economic growth and therefore positively contributes to employment in the formal sector by reducing informal employment.

Akçay and Karabulutoğlu, (2021) employ a pool mean group (PMG)/panel ARDL approach and a panel dataset over the period 1980-2015 and find that the effects of FD on the informal economy in North African countries depend on the levels of remittances. They find that remittances can moderate the negative relationship between FD and the informal economy in the North African region. Finally, Njangang et al. (2020) study a sample of 41 sub-Saharan countries using panel data for the period 1991-2015; they find a nonlinear U-shaped relationship between FD and the informal economy. Accordingly, this suggests that in low-income countries, the development of the financial system decreases the informal economy in the first stage. Then, in the second stage and after a certain threshold, any development in finance would be associated with an increase in informality.

Some studies have also underscored the importance of the interaction between FD and corruption, showing that FD reduces corruption (Altunbas and Thornton, 2012; Jha, 2019). This suggests that looking at the relationship between FD and corruption may provide valuable insights into FD's global effect on the informal economy. Yet, there are no studies investigating the link between the three.

In addition to their relationship with the shadow economy, the literature has also examined the relationship between corruption and FD. Based on a cross-country analysis between 1960 and 2004, Ahlin and Pang (2008) study the effect of corruption and FD on growth, and, notably, their interactive effect. The empirical framework shows that the interaction term coefficient is negative and significant. This result points out that FD and corruption are substitutes in relation to growth. The marginal impact of improving is higher when the other dimension is less advanced.

Guiso et al. (2004) show that FD leads to an increase in market competition by promoting entrepreneurial activity. They find that FD is positively associated with the probability of an individual starting their own business and the entry of new firms. Since efficiency concerns become crucial with increases in both the number of firms and an increase in market

[8] According to the occupational choice theory advanced by Evans and Jovanovic (1989).

competition, FD is likely to reduce the scope of paying bribes for the latter, which translates into a higher cost of production. Indeed, it has been shown that corruption is lower in countries where firms operate in highly competitive markets (Ades and Di Tella, 1999).

By combining different strands of literature, the idea of this paper, which is – to a certain extent – inspired by Ahlin and Pang (2008), aims to investigate the effects of corruption and FD and their interaction on the MENA region's unofficial economies. This paper has two principal objectives. First, it contributes to enriching the literature on the shadow economy in the MENA region by uncovering its determinants; the literature is very meager when it comes to the impact of FD on the shadow economy in MENA countries. To do so, we start from the hypothesis that policies to tackle informality in some MENA countries could be impeded by the development delay of their financial sector. Second, since researchers have not yet examined the interactive effect of corruption and FD on informality, to the best of our knowledge, this paper aims to fill this gap in the literature. Our hypothesis is that FD can alleviate the theoretically positive role of corruption in feeding the unofficial economy.

3. Data and model

We collected data on 20 MENA countries during the period 1996 to 2018.[9] As emphasized in the literature on informality, the shadow economy is very difficult to measure due to its nature. Besides being evaluated through surveys in the fields, some economists employ sophisticated methods to estimate the size of the shadow economy. Our first data on the size of the shadow economy as a percentage of the GDP are estimated based on a Multiple Indicators Multiple Causes (MIMIC) approach. According to this approach, the level of an unobservable, latent variable (such as a nation's shadow economy as a percentage of GDP) is estimated by using two sets of equations linking the size of the shadow economy to its "indicators" and "causes." The principal advantage of this approach is that the obtained estimates are based on several measures, consequently reducing the problem of measurement errors. The second set of data on the shadow economy is estimated using the Dynamic General Equilibrium (DGE) approach. Both data are obtained from the World Bank's Informal Economy Database as provided by Elgin et al. (2021).

To measure the level of corruption, three indicators are employed. The first measure is the Corruption Perception Index (CPI), as provided by Transparency International (TI). It is the most widely used global corruption ranking in the world, and it measures how corrupt each country's public sector is perceived to be, according to experts and businesspeople. The second measure is the index provided by the International Country Risk Guide (ICRG). This indicator is based on the analysis of a worldwide network of experts. The third measure of corruption is provided by the World Bank (Kaufmann et al., 2010) and is called the Control of Corruption Index (WB). It captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as the "capture" of the state by elites and private interests. All these three measures are rescaled so that 0 represents no corruption and 1 represents the highest corruption.

The macroeconomic and development data related to the FD are from the World Bank databases. The regulation index data is taken from the Economic Freedom of the World (Gwartney et al., 2021).

[9] Only Iraq is not included in the sample because of the lack of shadow economy data on this country.

Using the data detailed above, we use the following pooled model to estimate the effects of the FD, corruption, and their interplay on the share of the shadow economy (SE) in MENA countries:

$$SE_i = \beta_0 + \beta_1 FD_i + \beta_2 Corr_i + \beta_3 FD_i \times Corr_i + \sum_{j=1}^{m} \alpha_j X_{ji} + \varepsilon_i \quad (1)$$

Where:
SE is the share of the shadow economy as a percentage of the GDP.
FD is the level FD as represented by the percentage of private credits in the GDP.
$Corr$ the level of corruption in the economy.
X is the vector of control variables.
i and j are subscripts for the country i and the variable of control j, respectively.
ε is an error term.

We employ some control variables in accordance with the literature. Alm and Embaye (2013), Autio and Fu (2015), and Gërxhani (2004) argue that economic conditions and income might provide incentives to operate underground. For this reason, we employ the logarithm of the GDP per capita as a control variable, and we employ an indicator for a country's openness to international trade. This indicator is the sum of the exports and imports as a percentage of the GDP. Schneider and Enste (2000), Were (2015), and Cahn et al. (2020 argue that openness to international trade affects not only the official side of the economy but also its unofficial side. Also, a measure of the regulation burden is included in equation (1). Neck et al. (2012), Johnson et al., (1998), and Friedman et al. (2000) point out that excessive government and labor regulations and taxes are associated with a large shadow economy. To account for the labor market characteristics, we include the proportion of a country's population that is employed; the greater the unemployment rate, the greater the pressure on labor markets to absorb new entrants, and the greater the incentives to work in the informal economy. We also consider the proportion of the urban population to measure the pressure on the urban labor market. To control for education, we use the percentage of secondary education completion. The higher the education level of the population, the lower the informal economy. This data is provided by the World Development Indicators database of the World Bank.

Finally, since MENA countries are principally divided into two categories: oil exporters and oil importers, we add a dummy variable for oil-exporting countries to control for the effect of the level of economic diversification on the size of informality in the economy. Table 1 exhibits the summary statistics of the data described above.

Table 1. Summary statistics

	N	Mean	Median	Std. Dev.	Min	Max
SE (mimic)	435	26.306	26.698	7.366	16.694	39.009
SE (DGE)	437	24.141	22.127	7.06	14.536	40.742
Credits to GDP ratio (%)	446	68.506	59.402	44.078	8.579	260.618
Corruption (TI)	353	0.611	0.640	0.156	0.23	0.89
Corruption (ICRG)	380	0.627	0.667	0.133	0.167	0.917
Corruption (WB)	483	0.558	0.559	0.149	0.187	0.833
lngdp capita	476	8.851	8.509	1.162	6.859	11.084
Openness	464	79.395	77.359	33.714	0.027	191.873
Regulation	361	6.388	6.464	1.231	3.054	8.746
Urban pop. (%)	483	69.66	71.589	19.934	24.249	100
Unemp. Rate (%)	483	9.312	9.604	5.612	0.11	29.77
Second. Education Completion (%)	368	21.457	19.315	9.351	3.58	41.4

The ordinary least square method is employed to estimate the pooled model (1). Of particular interest for us is whether FD, in addition to its direct effect, acts as a potential *moderator* in the corruption-informal economy relationship. CK Jha (2019) argues that continuous financial liberalization can impact corruption in several ways. First, Beck et al. (2006) point out that by mandating banks to reveal precise information about their finance, the obstacle to credits that firms face in an environment of a corrupt banking sector can be extenuated. The entry of private and foreign banks into the market would stimulate competition in the banking sector, thereby pressuring them to be more efficient and offer better financial services, along with low-cost and corruption-free loans. Second, FD leads to an increase in market competition by promoting entrepreneurial activity. Guiso et al. (2004) show that the FD increases the probability of starting new businesses and new firms' entry into markets. The resulting stimulation of competition would reduce the scope of paying bribes demanded by officials because it translates into a higher cost of production. Hence, market competition lowers corruption. In light of this theoretical background stands the contribution of this paper and, accordingly, an interaction term between FD and corruption is added to model (1).

The marginal effects of FD and corruption can be measured simply by taking the partial derivative of Equation (1) with respect to corruption control as follows:

$$\frac{\partial SE_i}{\partial\, Corrup_{\,i}} = \delta + \gamma \times FD_i$$

If ψ is significant, then we can say that the impact of corruption on the informal economy depends on FD. From Equation (2) if $\delta, \gamma > 0$, then the higher the FD, the more corruption would spread in the informal economy. On the other hand, if δ, γ have different signs, it means that there is a threshold effect, suggesting that the effect of corruption on the informal economy differs with the levels of FD. For instance, if $\delta > 0$ and $\gamma < 0$, the marginal impact of corruption control would be positive for low values of FD, and negative for high values of FD. Hence, to verify this, it is essential to gauge the marginal effects within the sample.

4. Results

These measures are the ICRG corruption indicator[10] and the World Bank's Control of Corruption Index.[11]

4.1 Baseline model results

The baseline model in equation (1) is estimated and the results are given in Table 2. At this stage of the empirical work, we do not control for a potential endogeneity problem and estimate the model using the ordinary least square. Two sets of shadow economy data, the dependent variable, are employed; the first is the MIMIC-based data as estimated in Schneider (2005),[11,12] and the second set is the data as estimated in Elgin and Oztunali (2012). The results of the MIMIC-based shadow economy measure are given in columns (1), (2), and (3). Columns (4),

[10] Measures corruption in the political system as a threat to foreign investment based on the analysis of a worldwide network of experts. Rescaled so that the greater this indicator, the greater the level of corruption in a country.

[11] Kaufmann et al. (2003). This index is also rescaled so the greater it becomes, the greater the level of corruption in a country.

[12] We are very grateful to Professor Schneider for providing us with the recent data on MIMIC-based shadow economy data.

(5), and (6) show the results based on the second set of SE data.

The estimation results in all shadow economy regressions and for all three measures of corruption show that the FD coefficients are negative and highly statistically significant. It appears then that in the MENA region, and in accordance with the theory, as the financial system develops, its efficiency further eases the accessibility of entrepreneurs to loanable funds as more firms get incentives to transit from the unofficial economy to the official one.

All direct corruption coefficients in the three MIMIC-based shadow economy regressions are also negative and highly statistically significant, revealing that as the level of corruption in a country increases, the share of informality in the economy shrinks. The negative sign of this coefficient supports the substitutability view between corruption and the shadow economy, as opposed to the complementarity view.

Seemingly, and unlike many low-income countries, corruption in the MENA region provides incentives for entrepreneurs to operate and stay in the formal sector instead of the informal one. Two possible reasons can explain the substitutability view in MENA region. The first is that in order to stay in the formal sector and escape from paying the due amounts of taxes, entrepreneurs pay bribes to public officials to get their protection from regulatory and judiciary punishment. The second is based on the "greasing of the wheels" effect; in fact, as argued by Kaufmann and Wei (1999) and Méon and Sekkat (2005), corruption can compensate for the poor quality of public services and speed up inefficient and lengthy bureaucratic processes that face daily entrepreneurs. By playing this role, corruption can, inadvertently, attract more informal entrepreneurs to the official economy. In other words, paying bribes becomes a means for firms and self-employed individuals to smooth the burden of complex regulation and inefficient public services to accelerate the red tape underlying stressful and lengthy processes and plays, hence, the role of greasing the wheels for formal operations. The operative ease that corruption is able to provide firms in the MENA region is significant to the level that makes the opportunity cost of the formal economy very low producing and, consequently, an incentive to seek and stay in the formal economy. Formality is contingent on corruption in the MENA region.

On the other hand, the coefficients of the interaction terms in all regressions are positive and statistically significant. This evidence demonstrates that the corruption effect (the FD) effect on the shadow economy depends on the level of FD (the level of corruption) in MENA countries. FD and corruption appear to be substitutes in reducing informal economic activities; that is, the marginal impact of increasing along one dimension is higher when the other dimension is low. The efficiency of the financial sector in MENA economies reduces the corruption-induced advantages that encourage firms to seek and stay in the formal sector.

The effect of FD, i.e., the marginal impact of corruption on the shadow economy, can happen in various ways. The first way is, as asserted by Beck et al. (2006), through the reforms-induced banking transparency. The promotion of financial reforms and banking supervision and the stimulation of banking competition by allowing new private and foreign banks entry into the market, would compel banks (notably public financial institutions) to eliminate any source of inefficiencies, such as their own corruption. The second way is through the stimulation of competition in markets. Guiso et al. (2004) assert that further liberalization of financial systems enhances competition, and as markets become competitive, bribery becomes a cost burden to firms facing harsh market conditions. The third way is through the FD effect on

corporate governance; since creditors in a developed financial sector have the task of regularly monitoring debtors, borrowers become mandated to disclose their financial information and submit to transparency. Consequently, the reduction in bankers' corruption, notably in the public sector, the stimulation of entrepreneurs' competition, and the obligation of firms to meet transparency requirements are likely to increase the opportunity cost of seeking and staying in the formal sector for some firms. Evidently, and despite the corruption-induced advantages (such as tax evasion) detailed earlier, financial reforms in the MENA region can wipe them out for some firms, thereby incentivizing them to choose to leave the official economy, partially or entirely, and go underground.

Table 2. Baseline model

	MIM IC-based SE data			DGE-based SE data		
	(1)	(2)	(3)	(4)	(5)	(6)
	SE	SE	SE	SE	SE	SE
Private credits ratio (GDP %)	-7.938***	-0.311***	-0.375***	-9.094***	-0.308**	-0.432***
	(1.204)	(0.0887)	(0.0675)	(1.180)	(0.101)	(0.0680)
Corruption_TI	-76.46***			-85.70***		
	(10.88)			(10.20)		
Corruption_ICRG		-43.05***			-41.35***	
		(10.63)			(12.31)	
Corruption_WB			-74.68***			-83.97***
			(10.63)			(10.49)
Private credits ratio x Corruption_TI	8.316***			9.508***		
	(1.259)			(1.235)		
Private credits ratio x Corruption_ICRG		0.654***			0.632***	
		(0.149)			(0.177)	
Private credits ratio x Corruption_WB			0.787***			0.858***
			(0.124)			(0.128)
ln (gdp per capita)	4.118***	7.107***	4.544***	3.059**	5.808***	2.770***
	(0.894)	(0.707)	(0.660)	(0.944)	(0.697)	(0.573)
Openness	0.0348**	0.0319***	0.0312***	0.00155	0.00103	-0.00351
	(0.0108)	(0.00953)	(0.00798)	(0.0120)	(0.00996)	(0.00755)
Regulation	0.161	1.282**	0.486	0.341	1.343***	0.499
	(0.532)	(0.415)	(0.341)	(0.501)	(0.385)	(0.311)
Urban pop. (%)	-0.472***	-0.517***	-0.488***	-0.399***	-0.441***	-0.408***
	(0.0385)	(0.0490)	(0.0295)	(0.0361)	(0.0506)	(0.0287)
Unemp. rate (%)	0.781***	0.846***	0.767***	0.762***	0.738***	0.631***
	(0.111)	(0.0789)	(0.0661)	(0.131)	(0.0823)	(0.0591)
Secondary education completion	-0.265***	-0.311***	-0.287***	-0.225***	-0.295***	-0.255***
	(0.0327)	(0.0388)	(0.0293)	(0.0294)	(0.0379)	(0.0267)
Dummy oil	0.923	-0.372	0.177	0.266	-1.373	-0.852
	(0.844)	(0.833)	(0.697)	(0.739)	(0.815)	(0.641)
Constant	60.82***	8.858	50.99***	70.50***	16.22	69.14***
	(12.10)	(7.947)	(9.259)	(12.17)	(8.268)	(8.303)
Observations	213	217	261	209	215	257
R^2	0.739	0.643	0.704	0.756	0.638	0.727
F	106.0	71.41	110.7	125.6	59.48	143.8

Notes: Standard errors in parentheses* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As for the control variables, most coefficients' signs in all regressions are consistent with the theoretical predictions. The positive and statistically significant coefficients of the GDP per capita in all regressions reveal that in the MENA region, any upward shift of the aggregate demand, following an improvement of the income per capita, nurtures the shadow economy as the aggregate demand shifts upward.[13] Also, the positive and significant openness coefficients in the MIMIC-based shadow economy regressions show that international trade is another reinforcing factor of informality. Carr and Chen (2002) and Goldberg and Pavcnik (2003) argue that after facing harsher competition from foreign firms, less efficient and less productive local formal firms escape to the unofficial economy to boost their survival probability.

[13] According to an ILO report (2019), it is not growth itself; rather, the type of growth that shapes the trajectory of informality. The same report documents that "in countries where the growth performance is largely driven by manufacturing and agriculture, informality may persist or even increase" (pp. 50).

The oil-dummy coefficients are not statistically significant in all regressions. Overall, the level of economic diversification does not have a significant effect on the informal activities in the MENA region.

5. Robustness checks

5.1 Addressing endogeneity

Endogeneity may be a concern in our data, as FD and the shadow economy can determine each other. In many countries, the public sector plays a dominant role in the financial system. To make up for the lost revenue arising from the hidden activities, the public sector often chooses to foster inefficiency in the banking sector by imposing additional taxes, fees, and other costs (Giovannini and De Melo, 1993; Gupta and Ziramba, 2009). In addition, by lowering agents' ability to put up collateral, informality could adversely affect the depth of the banking sector (De Soto, 2000; Dabla-Norris and Feltenstein, 2005; Dabla-Norris and Koeda, 2008; Gatti and Honorati, 2008).

It is important to note that finding instruments is a challenging task, especially when it comes to macroeconomic settings. Bose et al. (2012) point out that the literature on the informal economy has ignored the endogeneity issue (Loayza, 1996; La Porta and Shleifer, 2008).

In order to solve the endogeneity problem and further check the robustness of our results, we estimate the following specification (2) where the FD variable is replaced by its lagged one. We can assert that a one-year time difference is not long enough to change the effect of FD on the informal sector. Moreover, using a lagged FD variable is a typical and safe way to cope with the problem of endogeneity without facing the challenging and tedious task of finding suitable instruments.[14]

$$SE_i = \beta_0 + \beta_1 lagFD_i + \beta_2 lagCorr_i + \beta_3 lag(FD_i \times Corr_i) + \sum_{j=1}^{m} \alpha_j X_{ji} + \theta_i \quad (2)$$

Where $lagFD$ and $lagCorr$ are the lagged percentage of private credits to GDP and the lagged indicator of corruption, respectively. θ is an error term.

The OLS estimations are given in Table 3. Qualitatively, the results do not change with respect to our benchmark results in Table 1 for both shadow economy measures. By solving the potential problem of endogeneity of the FD variable, the results given by model (2) confirm the robustness of our benchmark model findings.

[14] We tried to use several instrument variables for FD that were given by the literature, particularly Bose et al. (2012), such as British and French legal origins and the average value of the banking sector indicator in the previous period, but the quality of these instruments as given by several tests were not satisfactory.

Table 3. Model with lagged FD and corruption variables

	MIMIC-based SE data			DGE-based SE data		
	(1) SE	(1) SE	(1) SE	(1) SE	(1) ELGIN	(1) ELGIN
Lag. Private credits ratio (GDP %)	-9.069***	-0.309***	-0.419***	-9.572***	-0.310**	-0.447***
	(1.124)	(0.0862)	(0.0675)	(1.125)	(0.0951)	(0.0662)
Lag. Corruption_TI	-80.81***			-87.82***		
	(9.972)			(9.475)		
Lag. Corruption_ICRG		-41.16***			-40.55***	
		(10.16)			(11.51)	
Lag. Corruption_WB			-76.61***			-85.46***
			(10.41)			(9.988)
Lag.(Private credits ratio x Corruption_TI)	9.501***			10.01***		
	(1.174)			(1.177)		
Lag.(Private credits ratio x Corruption_ICRG)		0.654***			0.643***	
		(0.142)			(0.164)	
Lag.(Private credits ratio x Corruption_WB)			0.880***			0.894***
			(0.123)			(0.124)
ln (gdp per capita)	4.785***	6.898***	5.031***	3.263**	5.700***	2.829***
	(0.870)	(0.690)	(0.668)	(0.977)	(0.671)	(0.598)
Openness	0.0454***	0.0369***	0.0382***	0.00930	0.00682	0.000715
	(0.0112)	(0.00957)	(0.00896)	(0.0118)	(0.0102)	(0.00815)
Regulation	-0.114	1.191**	0.362	0.0573	1.225**	.389
	(0.555)	(0.441)	(0.358)	(0.509)	(0.411)	(0.326)
Urban pop. (%)	-0.462***	-0.501***	-0.477***	-0.385***	-0.426***	-0.400***
	(0.0385)	(0.0478)	(0.0315)	(0.0356)	(0.0492)	(0.0299)
Unemp. rate (%)	0.912***	0.861***	0.840***	0.830***	0.765***	0.668***
	(0.110)	(0.0793)	(0.0708)	(0.140)	(0.0810)	(0.0638)
Secondary education completion	-0.272***	-0.303***	-0.290***	-0.224***	-0.285***	-0.249***
	(0.0322)	(0.0384)	(0.0299)	(0.0294)	(0.0372)	(0.0271)
Dummy oil	0.733	-0.278	-0.0418	0.205	-1.172	-0.828
	(0.868)	(0.830)	(0.722)	(0.761)	(0.809)	(0.671)
Constant	56.29***	8.109	46.29***	69.11***	14.80	68.27***
	(11.79)	(7.799)	(9.354)	(12.51)	(7.964)	(8.371)
Observations	207	222	256	203	219	252
R^2	0.738	0.635	0.691	0.747	0.623	0.714
F	112.1	67.10	104.6	127.8	63.15	133.7

Notes: Standard errors in parentheses* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5.2 Nonlinearity of FD

$$SE_i = \beta_0 + \beta_1 FD_i + \beta_2 Corr_i + \beta_3 FD_i \times Corr_i + \beta_4 FD_i^2 + \sum_{j=1}^{m} \alpha_j X_{ji} + \vartheta_i \quad (3)$$

Where ϑ is an error term.

On the basis of some studies showing that there is a non-linear effect of FD on the official economy given by an inverted U-shape, Njangang et al. (2020) estimate that the shadow economy may have a non-linear relationship with the FD, in reverse order (U-shape) compared with the official economy. We test this possibility for the MENA region and the results are given in Table 4.[15] Overall, the results do not change significantly with respect to the linear relationship in Tables 2 and 3. On the other hand, as revealed by the coefficients of determination, adding the square of the FD to the baseline model only improves the goodness-of-fit of the model very slightly. Moreover, the magnitudes of the new coefficients are very small compared to the FD coefficients, indicating the dominance of the linear component of the FD over the non-linear one. We can assert then that the hypothesis of non-linearity (U-shape) between the shadow economy and FD does not stand on strong evidence in the MENA region.

[15] In Table 3, we show only the main results of the estimation.

Table 4. Nonlinearity of FD

	MIMIC-based SE data			DGE-based SE data		
	(1) SE	(2) SE	(3) SE	(1) SE	(1) SE	(1) SE
Private credits ratio (GDP %)	-6.164***	0.229*	0.0577	-7.367***	0.193	-0.0455
	(0.785)	(0.101)	(0.0839)	(1.043)	(0.100)	(0.0917)
Squared Private credits ratio (GDP %)	-0.00288***	-0.00290***	-0.00237***	-0.00204***	-0.00274***	-0.00193***
	(0.000433)	(0.000461)	(0.000392)	(0.000458)	(0.000491)	(0.000380)
Corruption_TI	-65.18***			-74.36***		
	(7.830)			(8.691)		
Corruption_ICRG		-37.56***			-37.07***	
		(8.135)			(9.149)	
Corruption_WB			-67.29***			-73.58***
			(7.088)			(8.079)
Private credits ratio x Corruption_TI	6.962***			8.055***		
	(0.788)			(1.066)		
Private credits ratio x Corruption_ICRG		0.507***			0.511***	
		(0.112)			(0.128)	
Private credits ratio x Corruption_WB			0.688***			0.706***
			(0.0718)			(0.0978)
Observations	213	217	261	209	215	257
R^2	0.779	0.691	0.737	0.776	0.683	0.749
F	161.9	85.97	133.7	116.8	66.92	139.4

Notes: Standard errors in parentheses* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

6. Heterogeneity analysis

6.1. High-income countries versus middle- and low-income countries

In this section, we analyze the effect of FD and corruption on the shadow economy based on the heterogeneity of the sample. First, we study how these factors affect the informal economies among low/middle- and high-income countries. The categorization between middle/low- and high-income countries is done according to the World Bank country classification. Table 5 presents the estimation results of the baseline model and shows that for both subsamples, the coefficients' signs do not change substantially with regard to the entire sample's results, as shown in Table 2. Interestingly, the coefficients of the variables of interest – the coefficients of FD, corruption indicators, and the interaction terms – are statistically significant only in the regressions of the low/middle-income countries. For the high-income countries' regressions, these coefficients are mostly non-significant. Obviously, informal activities in the high-income countries of the MENA region are derived from other factors rather than corruption and FD. In the MENA region, there is a level of development (i.e., GDP per capita) beyond which these factors' effects on informality vanish. Therefore, we can assert that FD and the level of briberies in MENA countries affect only the informality in the low/middle-income. Moreover, the substitutability between FD and corruption exists only in this group of countries. Obviously, as these countries succeed in controlling the level of corruption of their public officials, their official economies benefit from the financial reforms.

The coefficients of the GDP per capita are positive and statistically significant for both subsamples, showing that economic development drives up informality in MENA countries. This income effect is more important in low/middle-income countries since its magnitude is at least as twice as in high-income countries. This result points out the correlation between the official and unofficial activities in the MENA region.

Moreover, there is strong evidence that openness to international trade seems to play an important role in intensifying informal activities in high-income countries rather than low/middle-income countries. In fact, the openness coefficients are positive and significant only in the regressions of the group of high-income countries. This result confirms our previous

finding that for the high-income countries in the MENA region, the determinants of the shadow economy are no longer FD and corruption; rather, they extend to other factors. Clearly, the struggle against the unofficial economy in the MENA region is multidimensional and these dimensions change from one development level to another.

The secondary education coefficients are negative and significant only in the regressions of the low/middle-income countries. These results point out that the theoretically positive effect of education on the informal economy is strong only in the less developed countries of the MENA region.

Another no less important result is given by the subsample analysis based on the level of development that is the effect of the oil dummy variable on the shadow economy. The coefficients of this variable are negative and non-significant in the low/middle-income countries but are positive and significant in the high-income countries. As for the shadow economy in the low-diversification economies of the MENA region, fossil energy-based development nurtures the shadow economy. We can assume from these results that the increased diversification of the economy in the MENA region can be beneficial to the official economy.

Table 5: Estimation results of the baseline model

	Middle-Income			**High-Income**		
	MIMIC-based SE data			**MIMIC-based SE data**		
	SE	**SE**	**SE**	**SE**	**SE**	**SE**
Private credits ratio (GDP %)	-10.94***	-0.235*	-0.584***	-2.225	0.0254	-0.0933
	(1.712)	(0.104)	(0.111)	(1.206)	(0.128)	(0.0651)
Corruption_TI	-133.2***			-14.47		
	(12.76)			(11.46)		
Corruption_ICRG		-41.72***			-8.613	
		(12.22)			(17.07)	
Corruption_WB			-129.0***			-34.02*
			(14.24)			(14.98)
Private credits ratio x Corruption_TI	11.41***			2.412		
	(1.779)			(1.269)		
Private credits ratio x Corruption_ICRG		0.574**			0.142	
		(0.188)			(0.226)	
Private credits ratio x Corruption_WB			1.105***			0.345*
			(0.191)			(0.153)
ln (gdp per capita)	13.81***	24.67***	16.58***	5.206***	5.896***	2.608
	(3.239)	(2.762)	(2.639)	(1.190)	(1.384)	(1.679)
Openness	0.0137	-0.151***	0.0219	0.0827***	0.0486***	0.0590***
	(0.0355)	(0.0381)	(0.0304)	(0.0128)	(0.0131)	(0.0113)
Regulation	0.506	0.630	-0.375	-0.0792	-0.370	-0.152
	(0.871)	(0.768)	(0.533)	(0.461)	(0.221)	(0.226)
Urban pop. (%)	-0.645***	-0.385***	-0.638***	-0.119	-0.288**	-0.154
	(0.0528)	(0.112)	(0.0517)	(0.0734)	(0.0945)	(0.0839)
Unemp. rate (%)	0.383**	0.865***	0.623***	0.755***	0.378**	0.509***
	(0.141)	(0.0968)	(0.0783)	(0.120)	(0.118)	(0.0951)
Secondary education completion	-0.392***	-0.716***	-0.504***	0.111	0.0486	0.0437
	(0.0913)	(0.0644)	(0.0717)	(0.0576)	(0.0702)	(0.0512)
Dummy oil	2.952	-10.71***	-2.154	2.664**	2.644**	2.652**
	(2.095)	(2.236)	(1.886)	(0.930)	(0.993)	(0.842)
Constant	37.78	-114.8***	9.975	-35.31*	-22.90	8.454
	(26.51)	(20.13)	(23.26)	(14.54)	(18.52)	(19.29)
Observations	130	136	160	83	81	101
R^2	0.839	0.703	0.804	0.768	0.726	0.730
F	131.5	44.23	116.9	39.86	34.15	54.97

Notes: Standard errors in parentheses* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

6.2 Highly corrupt countries versus low-corruption countries

Table 6 presents the regression results for two groups of countries in the MENA region; namely, the highly corrupt and low-corruption countries.[16, 17] It appears from the table that the coefficients of the variables of interest, i.e., FD and corruption, are mostly statistically significant but with opposite signs – negative in the regressions of the highly corrupt subsample and positive in the regressions of the lowly corrupt subsample. Moreover, the coefficients of the interaction terms are statistically significant in both groups' regressions but also with opposite signs; positive in the former group – like the entire sample's results, and negative in the latter group. The results of the low-corruption countries are the opposite of those given by the entire sample's regressions, revealing that FD and corruption have different effects on the shadow economy in the countries with better control of corruption mechanisms than the highly corrupt countries.

Noticeably, the sign of FD coefficients in the regressions of the low-corruption countries is in contradiction with the theory. In these countries, further financial reforms are, unexpectedly, associated with wider sizes of the shadow economy. This result confirms the theoretical analysis emphasizing the ambiguity and complexity of the relationship between the FD and the informal sector. In light of the literature background, it is very likely that the development of the financial system in the low-corruption countries of the MENA region has eased the liquidity constraints of self-employed individuals who want to set up their enterprises, accordingly encouraging informal employment (Sirisankanan, 2017). It is very likely that the low unemployment rate in this group of countries, which is 4.8 percent compared to the 10.2 percent in the group of highly corrupt countries, is largely attributed to these self-employed individuals working informally and not covering their employment status by formal arrangements.

On the other hand, the estimation results also reveal that when a MENA country succeeds in significantly controlling the corruption of its public officials by bringing it to a level below 0.5, the greasing-of-the-wheels effect of bribery loses its role as an incentive for entrepreneurs to stay in the formal sector. This improvement in the transparency and accountability of public officials is, evidently, the main reason behind the positive sign, in accordance with the theory, of the corruption coefficients.

However, since the coefficient of the interaction term is negative and significant in the regressions of the lowly corrupt sample of countries, we can claim that, despite the change in the signs of their direct impacts on the shadow economy with respect to the entire sample's results, the substitutability between FD and corruption persists in this group of countries.

The estimation results also show that economic development, openness to international trade, and unemployment rate boost the level of the shadow economy in the highly corrupt countries since the coefficients of these variables are positive and, unlike the group of low-corruption countries, statistically significant. Also, the level of secondary education has a negative and significant coefficient only in the highly corrupt countries' regressions.

[16] We assume that highly-corrupt countries are those having a corruption level greater than or equal to 0.5.

[17] We do not mention the results of the ICRG-based corruption measure regression for the low-corruption sample because the number of observations is very low and does not satisfy the statistical criteria needed for a regression.

Table 6. Regression results for highly corrupt and low-corruption MENA countries

	Highly corrupt (index >= 0.5) MIMIC-based SE data			Lowly corrupt (index < 0.5) MIMIC-based SE data	
	SE	**SE**	**SE**	**SE**	**SE**
Private credits ratio (GDP %)	-9.598***	-0.604***	-0.496***	11.82***	0.179**
	(1.810)	(0.118)	(0.132)	(2.571)	(0.0652)
Corruption_TI	-109.0***			75.96**	
	(13.76)			(22.40)	
Corruption_ICRG		-85.49***			
		(16.63)			
Corruption_WB			-124.0***		12.97
			(17.70)		(15.54)
Private credits ratio x Corruption_TI	10.05***			-12.62***	
	(1.880)			(2.743)	
Private credits ratio x Corruption_ICRG		1.119***			
		(0.196)			-0.570**
Private credits ratio x Corruption_WB			1.008***		(0.174)
			(0.207)		
ln (gdp per capita)	5.065***	5.717***	7.014***	1.100	-0.601
	(1.259)	(0.761)	(1.312)	(1.235)	(0.693)
Openness	0.0540*	0.0380***	0.0791*	0.00281	0.0154*
	(0.0219)	(0.0109)	(0.0356)	(0.00868)	(0.00720)
Regulation	-0.506	0.563	0.113	1.730*	0.413
	(0.803)	(0.427)	(0.441)	(0.738)	(0.319)
Urban pop. (%)	-0.563***	-0.481***	-0.624***	-0.516***	-0.379***
	(0.0691)	(0.0503)	(0.0826)	(0.0877)	(0.0342)
Unemp. rate (%)	0.884***	0.738***	0.875***	0.333*	0.0891
	(0.143)	(0.0875)	(0.0872)	(0.129)	(0.0815)
Secondary education completion	-0.294***	-0.286***	-0.276***	-0.0513	-0.164**
	(0.0434)	(0.0513)	(0.0596)	(0.0620)	(0.0540)
Dummy oil	3.322	0.408	1.567	1.157	0.554
	(2.085)	(1.078)	(2.064)	(1.579)	(0.975)
Constant	80.51***	49.67***	65.54***	15.91	58.50***
	(15.02)	(11.59)	(13.81)	(15.29)	(8.988)
Observations	149	193	145	64	116
R^2	0.763	0.684	0.719	0.879	0.821
F	107.2	67.54	81.10	46.28	61.21

Notes: Standard errors in parentheses* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

6.3 High FD countries versus low FD countries

Based on the median of the FD data, we divide our sample into two subsamples: the first, is composed of countries with high FD levels, and the second is composed of countries with low FD levels.[18] Table 7 shows that estimation results in both sub-samples are qualitatively similar to the results of the entire sample; in fact, the signs of the coefficients of interests in both subsamples do not change with respect the regression results of the entire sample. The only difference we can observe is that the magnitudes of these coefficients; namely the coefficients of FD, corruption, and interaction terms. Variables are higher in absolute terms in the regressions related to the MENA countries with relatively low FD. The reducing effects of FD and corruption on the shadow economy are more remarkable in this group of countries compared to the countries with high FD levels. As a MENA country develops its financial services, their separate reducing effects on the shadow economy decrease. Therefore, there are other more important factors that appear to gain importance in controlling the shadow economy over the FD. This finding confirms again that the struggle against informality in the MENA region is multidimensional and is not limited to the development of the financial sector.

Other equally important results are given by the regressions over the two subsamples; the coefficients of the GDP per capita are positive and statistically significant in the high FD sample regressions only. This finding shows that the official activities in the economies with better financial services in the MENA region contribute to boosting unofficial activities.

[18] The median of the FD data is around 59.4 percent.

Moreover, if these economies are based on the oil-exporting sector, the reinforcement of the shadow economy by the official economy intensifies, since the oil-dummy coefficients are positive and statistically significant in this sub-sample. These two results confirm our claim that the struggle against the shadow economy in the MENA region is multidimensional and dynamic. Focusing on one or two dimensions, such as FD and/or the control of the corruption of public officials, all the time is not sufficient. Other factors start to gain importance and should then be taken into consideration in order to restrain the capacity of the official economy to strengthen the unofficial economy.

Table 7. Estimation results

	High FD (% >= median)			Low FD (% < median)		
	MIMIC-based SE data			MIMIC-based SE data		
	SE	SE	SE	SE	SE	SE
Private credits ratio (GDP %)	-0.321***	-0.395***	-0.389***	-0.761**	-1.198***	-0.704**
	(0.0868)	(0.102)	(0.0875)	(0.231)	(0.260)	(0.245)
Corruption_TI	-49.07***			-77.05***		
	(14.29)			(15.89)		
Corruption_ICRG		-69.05***			-86.19***	
		(14.81)			(15.47)	
Corruption_WB			-73.39***			-93.62***
			(15.77)			(16.21)
Private credits ratio x Corruption_TI	0.549***			1.158***		
	(0.154)			(0.323)		
Private credits ratio x Corruption_ICRG		0.772***			1.836***	
		(0.172)			(0.364)	
Private credits ratio x Corruption_WB			0.766***			1.195**
			(0.174)			(0.379)
ln (gdp per capita)	6.243***	7.030***	5.050***	0.659	1.849	-0.100
	(0.921)	(0.896)	(0.776)	(1.501)	(1.786)	(1.617)
Openness	.00761	0.0154	0.0183*	0.161***	0.104*	0.0732*
	(0.0109)	(0.00876)	(0.00816)	(0.0219)	(0.0417)	(0.0314)
Regulation	2.287***	1.123**	1.041**	0.653	1.626**	1.569***
	(0.599)	(0.390)	(0.390)	(0.543)	(0.541)	(0.416)
Urban pop. (%)	-0.623***	-0.626***	-0.560***	-0.138**	-0.0799	0.177**
	(0.0414)	(0.0438)	(0.0292)	(0.0429)	(0.0948)	(0.0584)
Unemp. rate (%)	0.903***	0.725***	0.718***	1.382***	0.986***	1.089***
	(0.107)	(0.0892)	(0.0881)	(0.189)	(0.161)	(0.108)
Secondary education completion	-0.269***	-0.229***	-0.230***	-0.340***	-0.361***	-0.212***
	(0.0355)	(0.0486)	(0.0387)	(0.0470)	(0.0784)	(0.0516)
Dummy oil	2.404*	4.262***	2.682**	1.536	-3.384	-3.214
	(1.098)	(1.020)	(0.940)	(1.704)	(2.512)	(2.314)
Constant	27.03*	34.51**	49.49***	55.71**	52.97**	72.91***
	(13.61)	(12.03)	(11.64)	(17.77)	(15.63)	(14.12)
Observations	163	145	189	50	72	72
R^2	0.768	0.764	0.747	0.958	0.840	0.896
F	180.9	150.4	177.8	166.8	41.39	82.29

Notes: Standard errors in parentheses* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

7. Conclusion

Utilizing recent panel data on the informality of 21 MENA countries during the period 1996 to 2018, and on the basis of several pooled regressions, we find that FD and corruption have overall negative direct impacts on the size of the shadow economy in this region. An important contribution of this paper is that it demonstrates the substitutability between these two factors; that is, the marginal impact of increasing along one of these two dimensions is higher when the other dimension is low. These results are robust even after addressing the potential endogeneity that can exist between the shadow economy variable, on the one hand, and FD and corruption variables, on the other hand.

The heterogeneity analysis shows that the impacts of both FD and corruption play significant roles only in the low/middle-income countries of the MENA region. Informal activities in the high-income countries of the MENA region are derived from factors other than the level of

development of the financial market and corruption. The empirical evidence shows that in this category of countries, openness to international trade and the low level of diversification of their economies play more significant roles.

When the sample is divided into low-corruption countries and highly corrupt countries, the results show that signs of FD and corruption coefficients change to positive in the former group. Interestingly, these findings show that in low-corruption countries of the MENA region, FD, as suggested by the literature, probably nurtures informality by encouraging informal employment. The low unemployment rate in these countries can be proof of this conjecture. Nevertheless, the substitutability between FD and corruption found in the entire sample does not disappear when we work on the low-corruption sample of countries.

When we compare the countries with high FD to the countries with low FD, the empirical results show that the reducing effects of FD and corruption on the shadow economy are more remarkable in the latter group of MENA countries.

In conclusion, we can assert that the struggle against the shadow economy in the MENA region is multidimensional, dynamic, and not limited to the dimensions of FD and corruption. Nevertheless, these two dimensions seem to play significant roles in low/middle-income and financially low-developed, countries. As a MENA country realizes more economic development and FD and further succeeds in restraining the corruption incentives of its administrative apparatus, other dimensions seem to gain importance in the fight against informality. These dimensions include the openness to international trade, the level of diversification of the economy, and the mechanisms through which developed financial systems promote informality, such as informal employment.

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Appendix

Table A. Data definition and sources

Variable	Definition	Data Source
GDP-capita	Official GDP per capita, PPP (constant 2005 international $).	WDI – World Bank
Urb Pop	Percentage of urban population in the total population.	WDI – World Bank
Unem. ratio	Unemployment to population ratio, 15+, total (%). It is the proportion of a country's population that is unemployed.	WDI – World Bank
Taxes	Taxes on income, profits, and capital gains are levied on the actual or presumptive net income of individuals, on the profits of corporations and enterprises, and on capital gains, whether realized or not, on land, securities, and other assets. (Current LCU) divided to GDP (current LCU).	WDI – World Bank
Regulation	Index on the basis of an unweighted average of the sub-indices on "Hiring regulations and minimum wage, Hiring and firing regulations, Centralized collective bargaining, Hour regulations, Mandated cost of worker dismissal, Conscription."	Fraser Institute, Economic Freedom of the World (2008)
Openness	Sum of exports and imports as a share of GDP.	International Monetary Fund,
lsc	Measure of education level: Percentage of secondary.	Barro and Lee Database
Corrupt.control	Control of corruption.	WGI Database
CPI	Corruption Perception Index.	Transparency International Database
M2	The ratio of M2 to GDP.	WB database
credit	The ratio of private domestic credit to GDP.	WB database
DGE	Informal economy size.	Elgin et al. (2019).
MIMIC	Informal economy size.	Schneider (2018