https://doi.org/10.1142/9781800614734_0014

Chapter 14

Exploring the Financial Development and Economic Complexity Nexus in MENA Countries: Does Corruption Matter?

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Abstract

This chapter aims to assess the effect of corruption on the relationship between financial development and economic complexity in MENA. To this end, we estimate a panel data model on 21 MENA countries between 1995 and 2020 using the double least squares method. Overall, the analysis shows significant heterogeneous results conditional on corruption. Specifically, corruption worsens the effect of financial access, and the depth and efficiency of economic complexity over the sample period. In contrast, it improves the effect of financial stability on economic complexity in the region. The results appear to be robust to an alternative estimation technique.

Keywords: Economic complexity, financial development, corruption

14.1. Introduction

The issue of economic complexity has been the focus of scientific and policy attention in recent decades because it provides an important model for understanding the key societal questions and challenges of our time (Balland *et al.*, 2022). This interest has led to a large body of literature on the levers that policymakers should use to

improve the level of knowledge and technological progress in the productive structure of an economy (Romero & Gramkow, 2021; Hidalgo & Hausmann, 2009).

One strand of this literature has focused on the role of financial development, leading to controversial results (Haraguchi *et al.*, 2019; Nguyen & Su, 2021). For example, the effects of financial development as a driver of economic complexity have been documented in several studies, including Haraguchi *et al.* (2019), Nguyen & Su (2021), and Rajan & Zingales (2001). Conversely, studies such as Ewetan & Ike (2014) and Larrain (2006) show that greater financial development leads to reduced economic complexity, consistent with the Woo (1986) hypothesis. Moreover, a nonlinear U-shaped relationship has also been found (Kothakapa *et al.*, 2021). While this work has highlighted the lack of consensus around the effect of financial development on economic complexity, the reasons for this controversy, through the mediating factors, remain underexplored.

Therefore, the objective of this study is to fill this gap by assessing how corruption can affect the relationship between financial development and economic complexity. Following the work of Aram & Beji (2016), we postulate that corruption in an economy can alter the beneficial effects of financial development on economic complexity. Such an assertion can be justified because an efficient financial sector promotes entrepreneurship and encourages new players in the sector (Sharma & Paramati, 2020). This increases competition in the market. It is known that corruption is lower in countries where firms face more competition (Sharma & Paramati, 2020). By reducing their level of corruption in this way, we note that these countries will be able to increase the complexity of their export baskets. This is because good institutions, which translate into secure competitive markets, affect the relative returns to different productive economic activities. Therefore, the quality of institutions, especially the control of corruption, fundamentally determines the investments and innovative activities (Vu, 2020).

Thus, this article contributes to the economics literature on two levels. First, it highlights the heterogeneous nature of the effects of financial development on economic complexity in the specific case of the MENA region, which can be explained by institutional quality, including corruption. Indeed, it has been shown that this variable is likely to affect economic development, of which economic complexity is a part (Chong & Calderon, 2000), and also influence financial

development (Pagano & Volpin, 2005; Wiliamson, 1975). The advantage is to see which variable is most relevant to the institutional environment of MENA economies and therefore to formulate appropriate economic policies.

Second, unlike previous work, this study emphasizes the importance of financial development as a lever of economic complexity by using a multidimensional approach to measure financial development in terms of depth, access, stability, and efficiency financial.[1] The advantage is to see which variable is most relevant in MENA and therefore to formulate the most appropriate economic policies. To the best of our knowledge, this is the first study that highlights the effect of corruption in the relationship between financial development and economic complexity using a dimensional analysis in the MENA region, where the situation is more problematic and the problem is more accentuated by corruption.

Indeed, the factual analysis[2] shows that the level of economic complexity in MENA is low. In fact, it was around −1.14 according to *Atlas of economic complexity* during the 1995–2020 period. Moreover, data show that with regard to corruption, financial development, and economic complexity in MENA, there can be three types of situations in general. We can have countries such as Libya with a low level of financial development (16.63) and a high level of corruption (−1.60) but a low level of economic complexity (−0.78). Next to this, we also have countries with a high level of financial development (96.27), a high level of corruption (−0.27), and still a low level of economic complexity (−0.33) such as Morocco. Finally, we have countries like Jordan that have a high level of financial development (83.14), with rather a low level of corruption and a high level of economic complexity.

The remainder of the article is organized as follows: Section 14.2 discusses the literature review, Section 14.3 describes the methodology,

[1]We distinguish between the dimensions of accessibility (which reflects the ability of individuals and firms to access financial services), efficiency (which captures the ability of institutions to provide good-quality, low-cost financial services), and depth (which represents the size and liquidity of financial markets), as distinguished by Svirydzenka (2016), and stability (which is the resilience of banks to economic shocks).

[2]Based on the Economic Complexity Atlas (2020) database for economic complexity, ICRG (2020) for corruption, and the Global Financial Development Index (2021) for financial development.

Section 14.4 discusses the results, Section 14.5 describes the effects of corruption, Section 14.6 takes account of a concurrent estimation technique, and Section 14.7 presents the conclusion.

14.2. Literature Review

14.2.1. *Theoretical anchoring*

The basic relationship between financial development and economic complexity has been the subject of theoretical controversy. Indeed, Mckinnon (1973) and Shaw (1973) have shown that finance through financial development has an effect on development in general. In fact, financial development makes more financing available to economic agents to engage in productive activities in order to increase the complexity of their economies. Bencivenga and Smith's (1991) study has highlighted how the creation and growth of financial institutions lead to a positive effect on growth. Indeed, financial intermediaries play a central role in allocating capital to its best possible use. The work of Guiso *et al.* (2004) supports this by finding that the level of financial development of a country impacts its ability to grow.

However, the work of Woo (1986) challenges the opinion of Mckinnon (1973) and Shaw (1973) by demonstrating that two patterns are possible in this relationship through the notions of financial development and economic growth in particular. On the one hand, they find that economic growth induces the expansion of the financial system. This is called "demand leading". The absence of financial growth is a manifestation of the absence of demand for financial services. On the other hand, the expansion of the financial system precedes the demand for services. By channeling scarce income sources from savers to investments at relative rates of return, the financial sector precedes and induces real growth. This pattern is called "supply leading".

14.2.2. *Financial development and economic complexity: A review of the literature*

Empirical analysis of the effect of corruption on the relationship between financial development and economic complexity is done in

this study in a sequential manner, that is, first, to show the relationship between financial development and economic complexity and, second, to show the limits of this relationship and the interaction with corruption.

The relationship between financial development and economic complexity yielded several results depending on the region studied, the estimation technique, and the variables used. First, we observe a positive link. In particular, we start from work by Nguyen & Su (2021) who find a positive link between financial development and economic complexity, using a panel of institutional indicators (financial institutions and financial markets). They add that financial institutions have a stronger effect than financial markets. Next, Nguyen *et al.* (2020) conduct an analysis of 52 economies, 32 high income and 20 middle income. The authors find that the effect of development on economic complexity is positive in the short run for financing reasons. However, in the long run, it has a negative effect due to an overly large financial sector that does not necessarily promote sophistication of operations and business production. Also, Nieminen (2020) shows in his work that financial development influences export performance because exporters need external financing and face credit constraints. He conducts a firm-level analysis of over 60 countries and confirms that access to domestic financial services contributes positively to export diversification.

Chu's (2019) study examines the effect of financial development on economic sophistication using a panel of 94 high- and middle-income countries between 1968 and 2015 with the GMM method, and finds that financial development through banking sector and stock market development has a positive effect on economic sophistication. Also, the effect of financial development through domestic credit on export diversification was studied by Fosu & Abass (2019). The authors work over the period 1962–2010 with 80 countries, 62 of which are developing countries and 29 African countries. Using GMMs, they show the importance of domestic credit for African countries while its role is marginal in developing countries. Other authors have focused on this relationship, but specifically in Nigeria (Adeola & Evans, 2017). Indeed, they conduct an analysis between 1981 and 2014 with the fully modified least squares (FMOLS) method and conclude that financial development has a positive effect on economic diversification. However, this effect is not significant.

Second, the negative effect of financial development on economic sophistication has also been raised by work such as Moore & Mirzaei (2016), with UNIDO industry-level data for a panel of 82 countries finding that the crisis has led to a decline in the production of sophisticated products. However, the effect is more pronounced for industries that are traditionally dependent on external financing services. Also, Ewetan & Ike (2014) show that financial development through the ratio of money supply to GDP has a negative effect on sophisticated products. They conduct an analysis from 1981 to 2011 with time series data with a multivariate VAR model and a vector error correction model.

Finally, we also note an "inverted U" relationship with the work of Kathakapa *et al.* (2021). They use the system-based GMM estimation method for the period 1970–2014 with a dynamic panel model to analyze the relationship between financial development and industrialization (which is the lower stage to economic complexity) in the context of low- and high-income countries. The authors show that financial development has a negative effect on industrialization up to a certain point.

Looking for the causes of such contradictions and in the light of past empirical work, the divergence of results can be explained by the measure of financial development used. Indeed, we note that some authors used domestic credit (Nieminen, 2020) and others even the money supply ratio (Ewetan & Ike, 2014). Moreover, this controversy can also be explained by the consideration of the institutional aspect, especially corruption. Indeed, corruption through the fact that it can facilitate the obtaining of credit by individuals will encourage private sector agents to benefit from credits and the latter will use these credits to improve their complex activities, which are very profitable (Altunbaş & Thornton, 2012; Vu, 2022).

14.3. Methodology

This section identifies the model used, the different variables chosen, and the estimation technique used in this study.

14.3.1. *Model specification*

In order to examine the effect of corruption on the relationship between financial development and economic complexity, our model is specified as follows:

$$\begin{aligned}\mathrm{ECI}_{it} = {} & \beta_0 + \beta_1 \mathrm{FD}_{it} + \beta_2 \mathrm{Corrupt}_{it} \\ & + \beta_3 \mathrm{DF}_{it} \# \mathrm{Corrupt}_{it} + Z_{it} + \mu_i + \delta_t + \varepsilon_{it}, \end{aligned} \quad (14.1)$$

with i and t being the country and the year, respectively; μ and δ are the country fixed effects and the year fixed effects, respectively; β is the coefficient; ε is the error term; ECI is the economic complexity; Z is the vector of control variables; FD is the financial development; *Corrupt* is the level of corruption; and $\mathrm{FD}_{it}\#\mathrm{Corrupt}_{it}$ represents the combined effect of financial development and corruption.

This study is conducted for the period 1995–2020 for 21 MENA countries. The different data for this work are taken from WDI (2020), ICRG (2020), Altas of economic complexity (2020), and Global financial development index (2020).

14.3.2. *Variables*

14.3.2.1. *Measuring economic complexity*

We measure economic complexity using Hidalgo & Hausmann's (2009) Economic Complexity Index (ECI). The idea is that an economy that is complex in terms of the products it produces and exports is an economy that has a developed secondary sector (Gala *et al.*, 2018; Pugliese *et al.*, 2014). Also, the economic complexity atlas notes that manufactured goods are clearly characterized as more complex goods (Gala *et al.*, 2018). Economic complexity is an indicator that measures both the sophistication of an economy and its productive structure. According to the authors (Hidalgo *et al.*, 2007), economies grow by improving the products they produce and export. Growth is measured by economic diversity and ubiquity.

Economic diversity refers to the number of products produced by a country. Note that the productivity of a country lies in the

diversity of its available non-tradable "capabilities" (Hidalgo & Hausmann, 2009). The ubiquity of a product here represents the number of countries that export that product (Hidalgo & Hausmann, 2009). Products that are exported by few economies (i.e., products with low ubiquity) seem to have more difficulties in gathering the necessary capacities.

Let's define a matrix called M_{ab} and postulate that an element of this matrix equals 1 if country a exports product b with a revealed comparative advantage (RCA > 1) and 0 otherwise. Then, diversity and ubiquity can be computed by adding the rows and columns of the matrix together:

$$\text{Diversity} = k_{a,o} = \sum_{b} M_{ab}. \tag{14.2}$$

$$\text{Ubiquity} = k_{b,o} = \sum_{a} M_{ab}. \tag{14.3}$$

By generalizing, this allows us to measure economic complexity as follows:

$$\text{ECI} = \frac{k^{-} - avg(k^{-})}{\sigma(k^{-})}. \tag{14.4}$$

14.3.2.2. *Measuring financial development*

We want to use a good indicator of financial development to capture its effect on economic complexity. However, this is a difficult task as the literature raises a number of indicators that capture the level of financial development.[3] It should be noted here that financial development is a multidimensional concept (Svirydzenka, 2016; De Haan & Sturm, 2017). To this end, and according to the International Monetary Fund database, we distinguish the dimension of financial accessibility (FAI) which reflects the ability of individuals and firms to access financial services. We also use financial efficiency (FEI) which captures the ability of institutions to provide good-quality and low-cost financial services and financial depth (FDI)

[3]Bittencourt *et al.* (2019) use the ratio of nominal stock market wealth per capita to nominal personal income per capita as a variable. Also, other studies, including those by which Jauch and Watzka (2016), De Haan and Sturm (2017), have used variables such as M2/GDP, liquid liabilities, and credits among others.

(which represents the size and liquidity of financial markets) as distinguished by Svirydzenka (2016). To this, we add the stability dimension (which is the resilience of banks to economic shocks), which is not taken into account by this author.[4]

Also, our work relies on only banking or institutional sector data. This choice is justified by the argument that, for authors such as Zhang & Naceur (2019), the development of the banking system is more important for developing countries than the stock market system. Also, the International Monetary Fund (2019) finds that the banking system provides better risk sharing than the stock markets.

14.3.2.3. *Measuring corruption*

The consideration of corruption in the relationship between financial development and economic complexity is important because the institutional environment is fundamental to achieving a given level of economic complexity. Indeed, according to the work of Aram & Beji (2016), the effect of financial development on economic complexity could be influenced by the institutional environment. In line with the work of Mijiyawa (2017), the inclusion of institutional variables in the model is therefore crucial, especially with regard to corruption. To this end, the authors show that institutions with corruption at a high level in a country are likely to encourage several market failures (Kocenda & Poghosyan, 2018; Pellegrini, 2011), and government actions in order to resolve them will be less successful. This study uses political corruption as a variable of corruption.

14.3.2.4. *Control variables*

This model takes into account several control variables including natural resources, economic growth, trade openness, and population. Natural resources are measured by the benefits derived from natural resources relative to GDP (Camargo & Gala, 2017). Note that an economy that specializes in the primary sector is more volatile and

[4]Note that in the paper, the different dimensions of financial development refer to FAI, FDI, FEI, and BankZscore.

vulnerable to shocks. According to the literature, natural resources have an inverse relationship with economic complexity.

Another control variable used in our model is economic growth measured by the growth rate of GDP per capita (Albeaik *et al.*, 2017). It is often used to assess development levels across countries (Rodrik, 2013). The expected effect according to the literature is the positive sign. The literature also identifies trade openness as an important variable (Baltagi *et al.*, 2009). It is measured by the sum of exports and imports of goods and services relative to GDP. The more an economy trades with the outside world, the more complex it becomes. The expected sign here is positive according to the literature.

Population is also an important variable in that it captures the size of the domestic market. It is measured by the growth rate of the total population (Hidalgo & Hausmann, 2009). The expected sign here is positive. FDI also seems relevant as an explanatory factor for structural transformation. Indeed, FDI can affect structural transformation in the sense that it allows the creation of new productive capacities that contribute to a large diversification (Hausmann & Rodrik, 2003). The expected sign is positive.

14.3.3. *Estimation technique*

In order to achieve the abovementioned objective, this chapter uses the double least squares (IV-2SLS) method of Basmann (1957) and Theil & Nagar (1961). This choice is justified because it allows us to correct the endogenous bias inherent in panel data. Indeed, although the study focuses upstream on the effect of financial development on economic complexity, reverse causality is possible (Khan *et al.*, 2020). In addition, some control variables clearly identify financial development and economic complexity. For example, there is a relationship between financial development and growth on the one hand (Ibrahim & Alagidede, 2018) and between growth and the complexity index on the other hand (Ahmed *et al.*, 2022; Zhu *et al.*, 2017). It is then necessary to use instrumental variable techniques to correct for this bias.

This method consists in assigning at least one instrumental variable to each variable suspected of suffering from endogeneity bias. The instrumental variable is a variable that is correlated with the source variable of endogeneity, but which is not correlated with the

error term or the dependent variable. In the case of double least squares, in addition to the instrumental variables that are exogenous to the model, it is also possible to use the lagged variables of the endogenous variables as instruments, since these are assumed to be endogenous reference variables as instruments, since they are assumed to be uncorrelated with the residuals.

14.4. Results

This section presents first the descriptive statistics, second the scatterplot analysis, and third the results of the effect of financial development on economic complexity and those of the interaction with corruption in this relationship.

14.4.1. *Descriptive statistics*

According to the descriptive statistics, we note that the economic complexity variable varies from −2.77 to 0.69 for an average of 0.49 in the MENA countries. As for the financial development variables, the table of descriptive statistics shows that these variables generally vary around 0 and 0.88, for a maximum average of 23.03. For the different control variables, population is the variable with the highest number of observations with a maximum level of 17.7 and a minimum of −4.53. As for education, it varies between 23.36 and 128.46. Corruption varies very little (−1.86 and 1.56) with an average of −0.41. Economic growth is a variable that varies quite widely (from −62.07 to 123.13) with a mean of 3.36 and a standard deviation of 8.45. Trade openness and natural resources have respective averages of 83.62 and 16.61. They vary between 0.78 and 347.99 for trade openness and between 0.001 and 67.91 for natural resources (see Table 14A).

Also, for the following scatter plots analysis on economic complexity, financial development, and corruption (see Figure 14.1), the graphs show us that the different dimensions of financial development affect the economic complexity index differently according to the different levels of corruption in MENA region. The analysis of dispersions does not allow us to conclude a priori how corruption may affects the effect of financial development on the economic

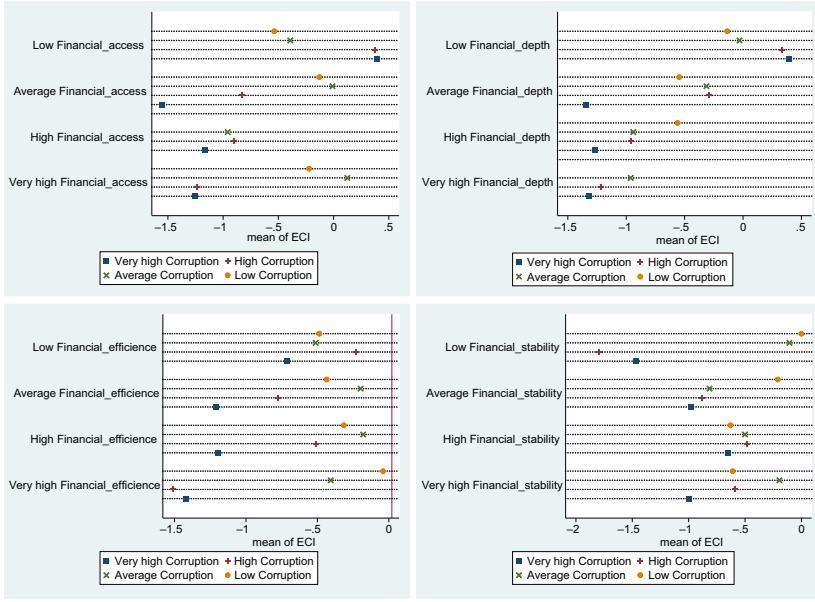

Figure 14.1. Financial development and complexity economic in MENA by level of corruption.

complexity index. The mixed analysis of these scatters then legitimizes the econometric analysis.

14.4.2. *Effect of financial development on economic complexity in MENA*

Table 14.1 highlights the relationship between the dimensions of financial development and economic complexity in MENA countries using the double least squares method. We present the results on the effect of financial development on the one hand and the effect of control variables on the other. The columns from 1 to 4 represent the effect of depth, efficiency, stability, and financial access on economic complexity, respectively.

14.4.3. *Effect of financial development*

The analysis in Table 14.1 generally leads to two effects. First, we observe that access and financial depth improve the level of economic

Table 14.1. Effect of financial development on the economic complexity index in MENA.

	(1)	(2)	(3)	(4)
	ECI	ECI	ECI	ECI
Population	0.020**	0.025***	0.012	0.010
	(0.010)	(0.009)	(0.009)	(0.009)
Economic growth	−0.006	−0.005	0.004	−0.006
	(0.005)	(0.005)	(0.006)	(0.005)
Trade openness	−0.000	0.006***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Natural resources	−0.011***	−0.022***	−0.019***	−0.023***
	(0.003)	(0.002)	(0.003)	(0.003)
Foreign direct investments	−0.001	−0.006	−0.008	−0.004
	(0.009)	(0.012)	(0.012)	(0.009)
Financial depth index	3.194***			
	(0.528)			
Financial efficiency index		−0.783**		
		(0.307)		
BankZscore			0.000	
			(0.002)	
Financial access index				1.454***
				(0.232)
Constant	−0.776***	−0.095	−0.518***	−0.840***
	(0.090)	(0.252)	(0.112)	(0.097)
Obs.	**225**	**225**	**263**	**225**
R-squared	**0.470**	**0.388**	**0.263**	**0.461**
Hansen	**0.549**	**0.761**	**0.619**	**0.282**

Notes: Values in parentheses are standard deviations corrected for heteroskedasticity. $^{**}p < 0.05$ and $^{***}p < 0.01$ represent the significance levels of the different coefficients at 5% and 1%, respectively.

complexity in MENA countries. Specifically, when access to financial services and financial depth increase by 1%, economic complexity increases by 1.454% and 3.194%, respectively. These results are significant at the 1% level and can lead to two conclusions.

One, the coefficient on financial access implies that financial inclusion significantly boosts economic complexity in the region. This result can be explained by the fact that when agents have access to financial services, it allows them to have the financing to acquire

equipment to produce products that other countries do not have. Two, the coefficient on financial depth also tells us that financial depth increases economic complexity. The fact that the banking system in MENA countries has a high level of development provides agents with several tools to facilitate credit.

Second, the regressions show that financial efficiency rather has a negative effect on economic complexity in MENA countries. Indeed, when financial efficiency increases by 1%, economic complexity decreases by 0.783%. This result may reflect the fact that banks are less efficient in this region, which discourages economic complexity. This can be explained by the fact that banks cannot grant the minimum amount of credit to their clients and, therefore, they cannot obtain the technologies to make their products more complex.

14.4.4. *Effect of control variables*

Consistent with the effect of the control variables, the analyses show that population and trade openness have a positive effect on economic complexity and natural resources have a negative effect.

With respect to population and trade openness, Table 14.1 shows that they increase economic complexity by 0.020% and 0.025% in models (1) and (2), respectively, and by 0.006, 0.005, and 0.005% in models (2), (3), and (4), respectively. As for the population, this result can be explained in the sense that in MENA economies, the increase in population allows one to really educate this population. Thus, it will direct people's knowledge to the sectors that allow them to make their economies more complex. Being educated enough for these sectors, the population will turn to knowledge-intensive activities such as industry and innovation, activities that lead to economic complexity.

This result is contrary to the work of Lapatinas (2019). With respect to trade openness, we note that the more commercially open a MENA economy is, the more sophisticated its products are. This result can be explained in that trade openness allows economies to import foreign products that are more sophisticated than local products. Economies can then model the composition and manufacture of these products, which they will then reproduce themselves, making their production more complex. This result is consistent with the work of Nguyen *et al.* (2020).

However, natural resources are significantly (at 1%) and negatively related in each model to economic complexity in MENA countries (−0.011%; −0.022%; −0.019%; and −0.023%). Indeed, this result can be explained in the sense that products from natural resources cannot be complexified. They come from the primary sector, which is known to be the least complex sector. Thus, as the natural resources of an economy increase, the products of that economy become less complex. This result is consistent with the work of Camargo *et al.* (2017).

14.5. Effect of Corruption on the Relationship Between Financial Development and Economic Complexity in MENA

Table 14.2 shows the effect of corruption on the relationship between financial development and economic complexity in MENA countries. Columns 1 to 4 represent the interaction between corruption and financial development, taking into account each of its dimensions (financial depth, efficiency, stability, and access, respectively) on economic complexity. The variables Financial depth index#Corruption, Financial access index #Corruption, Financial efficiency index #Corruption, and BankZscore#Corruption represent the interaction between corruption and financial depth, access, efficiency, and stability, respectively.

Table 14.2 shows the effect of corruption on the relationship between financial development and economic complexity in MENA countries. Three effects can be noted in general. First, corruption reduces the effect of financial access and depth on economic complexity. The coefficients associated with these dimensions are positive while those associated with their interactions are negative. These results lead to the conclusion that corruption in MENA reduces the effect of financial accessibility and financial depth on ECI by 2.273% and 3.802%, respectively. The rationale for this result is that low levels of corruption control reduce the magnitude of financial access and financial depth in terms of economic complexity. Our results are consistent with the predictions of Chong & Calderon (2000) that in countries with low institutional quality, policies to boost economic performance fail. Indeed, they put forward the prediction that poor

Table 14.2. Effect of corruption on the relationship between financial development and economic complexity in MENA.

	(1)	(2)	(3)	(4)
	ECI	ECI	ECI	ECI
Corruption	0.657***	0.831***	1.567***	−0.182
	(0.072)	(0.097)	(0.474)	(0.182)
Population	−0.004	0.006	−0.001	−0.011
	(0.009)	(0.008)	(0.011)	(0.010)
Economic growth	−0.006***	−0.006**	−0.006	−0.001
	(0.002)	(0.002)	(0.003)	(0.003)
Trade openness	0.002	0.002	0.002	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)
Natural resources	−0.014***	−0.020***	−0.022***	−0.021***
	(0.003)	(0.002)	(0.002)	(0.003)
Foreign direct investment	−0.001	−0.007	0.012	0.009
	(0.007)	(0.008)	(0.011)	(0.012)
Financial depth index	2.000***			
	(0.416)			
Financial depth index × Corruption	−3.802***			
	(0.383)			
Financial access index		0.682***		
		(0.213)		
Financial access index × Corruption		−2.273***		
		(0.287)		
Financial efficiency index			−0.645**	
			(0.307)	
Financial efficiency index × Corruption			−1.795***	
			(0.633)	
BankZscore				−0.003
				(0.002)
BankZscore × Corruption				0.022***
				(0.006)
Constant	−0.499***	−0.200	0.271	−0.184
	(0.117)	(0.136)	(0.236)	(0.144)
Obs.	**219**	**219**	**219**	**229**
R-squared	**0.586**	**0.564**	**0.473**	**0.417**
Hansen	**0.387**	**0.246**	**0.847**	**0.807**

Notes: Values in parentheses are standard deviations corrected for heteroskedasticity. $^{**}p < 0.05$ and $^{***}p < 0.01$ represent the significance levels of the different coefficients at 5% and 1%.

countries with low levels of development will remain trapped in the primary sector unless a sound and credible institutional climate is established.

Second, we find that corruption positively affects the relationship between financial efficiency and economic complexity. This is justified by the fact that the coefficient of the direct effect is negative, and thus the coefficient of the interaction is also negative (−1.795%). Thus, corruption reduces the negative effect of financial efficiency on economic complexity. Indeed, this result can be analyzed in the sense that since banks do not facilitate the mechanisms for granting credit, individuals are sometimes obliged to *bribe* the competent authorities in order to simplify the mechanisms for granting credit. Thus, the effect of financial efficiency on economic complexity will be reduced in MENA countries through corruption.

Third, this table also shows that financial stability only has an effect on economic complexity when the effect is through corruption. We note that while the direct effect of financial stability is not significant, the coefficient associated with the "BankZscore#corruption" interaction was significant and positive at 0.022%.

14.6. Taking into Account a Concurrent Estimation Technique

To test the robustness of our results, this study performs a quantile regression analysis. The double least squares approach focuses on the average effect of economic complexity, but the relevance of our results may be questioned because the effect of different dimensions of financial development may vary across different intervals of economic complexity.

Thus, quantile regressions derived from the work of Koenker & Bassett (1978) provide an answer to this shortcoming. Indeed, it is an estimation technique that allows us to take into account the effect of one variable on another at different points of its distribution. So, this study analyzes the effect of the dimensions of financial development at different intervals of the distribution of the economic complexity index (10th, 25th, 50th, 75th, and 95th quantile). This method may be better than the double least squares method in that the estimate of the mean may sometimes be biased in the case where censored data

exist. QR regression studies the effect of a covariance on the entire distribution of the dependent variable, instead of focusing on its conditional average. Thus, by considering the effect of one variable on all points in the distribution of another variable, this method analyzes dimensional effects according to the magnitude of the relationship (Mignamissi & Mouhamed, 2022; Xu 2019; Dufrenot *et al.*, 2010). Low (high) quantiles thus reflect low (high) strength. The quantile estimator is obtained by minimizing the following equation for any the θth quantile $(0 < \theta < 1)$:

$$\min_{\beta \in R^K} \left[\sum_{i \in \{i: y_i \geq x'\beta\}} \theta |y_i - x_i'\beta| + \sum_{i \in \{i: y_i \prec x'\beta\}} (1-\theta)|y_i - x_i'\beta| \right], \tag{14.5}$$

where y_i is the education inequality index of country i, β is the vector of parameters to be estimated, and x_i is a $K-1$ vector of explanatory variables.

Tables 14.3 and 14.4 present the effect of financial development on different intervals of economic complexity and the effect of corruption in the relationship.

In the following tables, column 1 represents the baseline analysis, and columns 2–5 represent the regressions for the 10th, 25th, 50th, 75th, and 95th quantile, respectively. We note that the quantile regression analysis shows us that the positive and significant effect of access and depth is stable throughout the distribution of economic complexity. For financial efficiency, we find that its effect is positive and significant between the 10th and 25th quantile. Its effect is consistent with the baseline result from the 75th to the 95th quantile because at the 50th, the effect is negative and not significant.

Table 14.4 presents the effect of corruption in the financial development on different intervals of economic complexity nexus. Column 1 reports the baseline analysis, and columns 2–5 report the regressions for the 10th, 25th, 50th, 75th, and 95th quantile, respectively. We note that the quantile regression analysis does not change our basic results. Indeed, analysis shows that the effect of corruption on the relationship between financial development and economic complexity does not vary along the distribution of economic

Table 14.3. Financial development and economic complexity in MENA by quantiles.

	(1)	(2)	(3)	(4)	(5)	(6)
	2SLS	Q10	Q25	Q50	Q75	Q95
Financial depth index	3.194***	4.193***	4.362***	2.300***	2.342***	2.793***
	(0.528)	(0.785)	(0.654)	(0.669)	(0.552)	(0.527)
Control variables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Obs.	**225**	**327**	**327**	**327**	**327**	**327**
R-squared/Pseudo *R*-squared	**0.470**	**0.309**	**0.290**	**0.223**	**0.199**	**0.150**
Financial access index	1.454***	2.046***	2.239***	1.904***	1.334***	1.622***
	(0.232)	(0.467)	(0.302)	(0.257)	(0.206)	(0.242)
Control variables	Yes	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Obs.	**225**	**327**	**327**	**327**	**327**	**327**
R-squared/Pseudo *R*-squared	**0.461**	**0.276**	**0.310**	**0.277**	**0.266**	**0.202**
Financial efficiency index	−0.783**	1.800***	1.658***	−0.269	−0.742***	−0.887***
	(0.783)	(0.418)	(0.403)	(0.324)	(0.269)	(0.273)
Control variables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Obs.	**225**	**327**	**327**	**327**	**327**	**327**
R-squared/Pseudo *R*-squared	**0.388**	**0.254**	**0.215**	**0.185**	**0.196**	**0.146**
BankZscore	0.000	0.005	0.006	−0.001	−0.001	−0.001
	(0.002)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)
Control variables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Obs.	**263**	**293**	**293**	**293**	**293**	**293**
R-squared/Pseudo *R*-squared	**0.263**	**0.219**	**0.214**	**0.217**	**0.190**	**0.086**

Notes: Values in parentheses are standard deviations corrected for heteroskedasticity. $^{**}p < 0.05$; and $^{***}p < 0.01$ represent the significance levels of the different coefficients at 10%, 5%, and 1%.

Table 14.4. Corruption, financial development, and economic complexity in MENA by quantiles.

	(1)	(2)	(3)	(4)	(5)	(6)
	2SLS	ECI	ECI	ECI	ECI	ECI
Financial depth index × Corruption	−3.802***	−5.642***	−4.116***	−3.600***	−3.790***	−3.690***
	(0.383)	(1.176)	(0.867)	(0.734)	(0.701)	(0.610)
Control variables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Obs.	**219**	**281**	**281**	**281**	**281**	**281**
R-squared/Pseudo R-squared	**0.586**	**0.382**	**0.369**	**0.342**	**0.318**	**0.271**
Financial access index × Corruption	−2.273***	−2.047***	−1.951***	−1.677***	−1.717***	−2.596***
	(0.287)	(0.736)	(0.525)	(0.461)	(0.415)	(0.515)
Control variables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Obs.	**219**	**281**	**281**	**281**	**281**	**281**
R-squared/Pseudo R-squared	**0.564**	**0.356**	**0.377**	**0.338**	**0.308**	**0.242**
Financial efficiency index × Corruption	−0.645**	−1.838**	−1.268*	−2.415***	−3.098***	−1.814***
	(0.307)	(0.727)	(0.646)	(0.682)	(0.414)	(0.656)
Control variables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Obs.	**219**	**281**	**281**	**281**	**281**	**281**
R-squared/Pseudo R-squared	**0.473**	**0.355**	**0.312**	**0.248**	**0.260**	**0.188**
BankZscore × Corruption	−0.003	0.027***	0.019**	0.019***	0.019***	0.027***
	(0.002)	(0.010)	(0.009)	(0.007)	(0.007)	(0.007)
Control variables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Obs.	**229**	**270**	**270**	**270**	**270**	**270**
R-squared/Pseudo R-squared	**0.417**	0.311	**0.304**	**0.260**	**0.216**	**0.133**

Notes: Values in parentheses are standard deviations corrected for heteroskedasticity. $^{*}p < 0.10$; $^{**}p < 0.05$; and $^{***}p < 0.01$ represent the significance levels of the different coefficients at 10%, 5%, and 1%.

complexity in MENA. Consequently, whatever the level of economic complexity retained, the effect of corruption on the relationship between the three dimensions of financial development-access, efficiency, and financial depth-on economic complexity remains the same. Corruption mitigates the positive effect of financial development on economic complexity in MENA.

14.7. Conclusion and Policy Implications

The objective of this study is to assess the role of corruption in the relationship between financial development and economic complexity in 21 MENA countries over the period 1995–2020. To do so, our empirical strategy is based on the double least squares method. The results show that in MENA countries, there is a conditional relationship between financial development and economic complexity driven by the level of corruption. In general, corruption worsens the effect of financial development on economic complexity over the study period. Specifically, it decreases the effect of financial access, depth, and efficiency; in contrast, it improves the effect of financial stability on economic complexity in the region.

In light of these findings, the financial system, in the quest to promote economic complexity, needs to be embedded in a sound institutional framework combined with a drive to improve its performance in terms of financial service delivery. Specifically, the first recommendation calls on MENA authorities to improve the rule of law to better regulate contracts and enable effective implementation of redistributive policies. The second recommendation suggests that governments improve their capacity to formulate and implement policies and regulations, on one hand, and their capacity to effectively implement their stated programs, on the other hand. Increased stability will tend to improve the business climate and make investment attractive. While these results underscore the crucial role of institutional quality, it must be recognized that in MENA countries there is significant cultural dominance and transmission of circumstances. In contrast to this study, future studies could explore the relationship between financial development and economic complexity by taking cultural aspects into account.

Appendix

Table 14A. Descriptive statistics.

Variable	Obs.	Mean	Std. dev.	Minimum	Maximum
Economic complexity	390	−0.498265	0.6545088	−2.778437	0.696947
Financial depth index	456	0.1268772	0.1001172	0.0129599	0.4717021
Financial access index	456	0.1898268	0.154804	0	0.5201409
Financial efficiency index	456	0.6398093	0.1620707	0.1189775	0.8805239
Z-score	351	23.03758	12.38903	0.0244457	66.63377
Education	367	96.34998	17.69257	23.36354	128.4603
Corruption	420	−0.4104822	0.7475259	−1.868714	1.567186
Population	519	2.782549	2.387465	−4.533415	17.51221
Economic growth	468	3.36321	8.456321	−62.07592	123.1396
Trade	455	83.62317	44.19826	0.7846308	347.9965
Natural resources	499	16.61987	16.5784	0.0010569	67.91786

Table 14B. Table of correlation.

	ECI	FDI	FAI	FEI	BankZscore	Education	Corruption	Population	Growth	Trade openness	Natural resources
ECI	1.0000										
FDI	0.6203	1.0000									
FAI	0.3454	0.3068	1.0000								
FEI	0.0205	0.3604	0.1680	1.0000							
BankZscore	0.1265	0.2724	0.2807	−0.0548	1.0000						
Education	0.1042	0.0510	0.2808	0.0945	−0.0913	1.0000					
Corruption	0.3274	0.4763	0.5896	0.1311	0.1564	0.2689	1.0000				
Population	0.0288	0.1486	0.2647	0.0597	0.0318	0.0493	0.4412	1.0000			
Growth	−0.0693	0.0120	0.0535	0.0299	0.0407	0.0241	0.1206	0.2177	1.0000		
Trade openness	0.1786	0.5055	0.2598	0.2813	0.0423	−0.0838	0.4199	0.1817	0.1213	1.0000	
Natural resources	−0.4759	−0.2699	0.3170	0.1186	−0.1050	0.2244	0.2097	0.2198	0.1094	0.1169	1.000

Looking at the correlation between the variables of interest, Table 14B in the appendices highlights a positive correlation between economic complexity and the dimensions of financial development on one hand, and between economic complexity and corruption on the other hand.

References

Adeola, O. & Evans, O. (2017). Financial inclusion, financial development, and economic diversification in Nigeria. *Journal of Developing Areas*, *51*(3), 1–15.

Ahmed, Z., Adebayo, T. S., Udemba, E. N., Murshed, M., & Kirikkaleli, D. (2022). Effects of economic complexity, economic growth, and renewable energy technology budgets on ecological footprint: The role of democratic accountability. *Environmental Science and Pollution Research*, *29*(4), 24925–24940.

Albeaik, S., Kaltenberg, M., Alsaleh, M., & Hidalgo, C. A. (2017). Measuring the knowledge intensity of economies with an improved measure of economic complexity. arXiv preprint arXiv:1707.05826.

Altunbaş, Y. & Thornton, J. (2012). Does financial development reduce corruption? *Economics Letters*, *114*(1), 221–223.

Aram, B. & Beji, S. (2016). The determinants of industrialization: Empirical evidence for Africa. *European Scientific Journal*, *12*(10), 220–240.

Baltagi, B. H., Demetriades, P. O., & Law, S. H. (2009). Financial development and openness: Evidence from panel data. *Journal of Development Economics*, *89*(2), 285–296.

Basmann, R. L. (1957). A generalized classical method of linear estimation of coefficients in a structural equation. *Econometrica: Journal of the Econometric Society*, *25*(1), 77–83.

Bencivenga, V. & Smith, B. D. (1991). Financial intermediation and endogenous growth. *Review of Economic Studies*, *58*(2), 195–209.

Bittencourt, M., Chang S., Gupta, R., & Miller, S. M. (2019). Does financial development affect income inequality in the US States? *Journal of Policy Modeling*, *41*(6), 1043–1056.

Camargo, J. S. M. D. & Gala, P. (2017). The resource curse reloaded: Revisiting the Dutch disease with economic complexity analysis, *Real-World Economics Review*, *81*(1), 118–134.

Chu, L. K. (2019). The effects of financial development on economic sophistication: Evidence from panel data. *Applied Economics Letters*, *27*(4), 1–5.

Chong, A. & Calderón, C. (2000). Causality and feedback between institutional measures and economic growth. *Economics and Politics*, *1*(1), 69–81.

De Haan, J. & Sturm, J. E. (2017). Finance and income inequality: A review and new evidence. *European Journal of Political Economy*, *50*, 171–195.

Dufrenot, G., Mignon, V., & Tsangarides, C. (2010). The trade-growth nexus in the developing countries: A quantile regression approach. *Review of World Economics*, *146*(4), 731–761.

Ewetan, O. O. & Ike, D. N. (2014). Does financial sector development promote industrialization in Nigeria? *International Journal of Research in Social Sciences*, *4*(1), 17–25.

Fosu, A. K. & Abass, A. F. (2019). Domestic credit and export diversification: Africa from a global perspective. *Journal of African Business*, *20*(1), 160–179.

Gala, P., Camargo, G., Rocha, I., & Magacho, G. (2018). Sophisticated jobs matter for economic complexity: An empirical analysis based on input-output matrices and employment data. *Structural Change and Economic Dynamics*, *45*(2), 1–8.

Guiso, L., Sapienza, P., & Zingales, L. (2004). Does local financial development matter? *Quarterly Journal of Economics*, *119*(3), 929–969.

Haraguchi, N., Martorano, B., & Sanfilippo, M. (2019). What factors drive successful industrialization? Evidence and implications for developing countries. *Structural Change and Economic Dynamics*, *49*(2), 266–276.

Hausmann, R. & Rodrik, D. (2003). Economic development as self-discovery. *Journal of Development Economics*, *72*(4), 603–633.

Hidalgo, C. A. & Hausmann, R. (2009). The building blocks of economic complexity. *Proceedings of the National Academy of Sciences*, *106*(26), 10570–10575.

Hidalgo, C. A., Klinger, B., Barabási, A.-L., & Hausmann, R. (2007). The product space conditions the development of nations. *Science*, *317*(5837), 482–487.

Ibrahim, M. & Alagidede, P. (2018). Effect of financial development on economic growth in sub-Saharan Africa. *Journal of Policy Modelling*, *40*(4), 1104–1125.

Jauch, S. & Watzka, S. (2016). Financial development and income inequality: A panel data approach. *Empirical Economics*, *51*(1), 291–314.

Kathakapa, G., Bhupartirajuset, S., & Siroki, R. A. (2021). Revisiting the link between financial development and industrialization: Evidence from low- and middle-income countries. *Annals of Finance*, *17*(4), 215–230.

Khan, H., Khan, U., & Khan, M. A. (2020). Causal nexus between economic complexity and FDI: Empirical evidence from time series analysis. *The Chinese Economy*, *53*(1), 374–394.

Kocenda, E. & Poghosyan, K. (2018). Export sophistication, a dynamic panel data approach. *Emerging Markets Finance and Trade*, *54*(2), 2799–2814.

Koenker, R. & Bassett, G. (1978). Regression quantiles. *Journal of the Econometric Society*, *46*(1), 33–50.

Larrain, B. (2006). Do banks affect the level and composition of industrial volatility? *Journal of Finance*, *61*(4), 1897–1925.

Lapatinas, A. (2019). The effect of the internet on economic sophistication: An empirical analysis. *Economics Letters*, *174*(1), 35–38.

McKinnon, R. (1973). *Financial Deepening in Economic Development*. Washington: Brookings Institution.

Mignamissi, D. & Mouhamed, M. N. (2022). Dimensional and dynamic effects of common currency on trade: The case of the African franc zone. *The Journal of International Trade and Economic Development*, *31*(2), 1243–1280.

Mijiyawa, A. (2017). Drivers of structural transformation: The case of the manufacturing sector in Africa. *World Development*, *99*, 141–159.

Moore, T. & Mirzaei, A. (2016). The impact of global financial crisis on industrygrowth. *Manchester School*, *84*(2), 159–180.

Nguyen, C. P. & Su, T. D. (2021). Financing the economy: The multidimensional influences of financial development on economic complexity. *Journal of International Development*, *33*(2), 644–684.

Nguyen, C. P., Schinckus, C., & Su, T. D. (2020). The drivers of economic complexity. *International Economics*, *164*(4), 140–150.

Nieminen, M. (2020). Multidimensional financial development, exporter behavior and export diversification. *Economic Modelling*, *93*(4), 1–12.

Rajan, R. G. & Zingales, L. (2001). Financial systems industrial structure and growth. *Oxford Review of Economic Policy*, *17*(4), 467–482.

Rodrik, D. (2013). Unconditional convergence in manufacturing. *Quarterly Journal of Economics*, *128*(1), 165–204.

Romero, J. P. & Gramkow, C. (2021). Economic complexity and greenhouse gas emissions. *World Development*, *139*(1), 1–18.

Pagano, M. & Volpin, P. F. (2005). The political economy of corporate governance. *American Economic Review*, *95*(4), 1005–1030.

Pugliese, E., Chiarotti, G. L., Zaccaria, A., & Pietronero, L. (2014). The discernment of heterogeneous country industrialization patterns through economic complexity. *Universita Politecnica Della Marche, Dipartimento di Economia Quaderno di Ricerca*, *327*(1), 1–8.

Shaw, E. (1973). *Financial Deepening in Economic Development*. London: Oxford University Press.

Svirydzenka, K. (2016). *Introducing a new broad-based index of financial development*. International Monetary Fund, Washington DC.

Woo, S. J. (1986). Financial development and economic growth: International evidence. *Economic Development and Cultural Change*, *34*(2), 333–346.

Zhang, R. & Naceur, S. B. (2019). Financial development, inequality, and poverty: Some international evidence. *International Review of Economics and Finance*, *61*(2), 1–6.

Zhu, S. & Li, R. (2017). Economic complexity, human capital and economic growth: Empirical research based on cross-country panel data. *Applied Economics*, *49*(38), 3815–3828.