Examining Corruption's Impact on Economic Growth in the MENA Region: A GMM Estimation Approach

Nour Mohamad Fayad*

PhD Candidate, Faculty of Business Administration Beirut Arab University, Lebanon.

Abstract: Numerous research studies have been conducted to investigate the relationship between corruption and economic growth, with conflicting findings regarding its negative or potentially positive effects on the economy. This particular study focuses on understanding the impact of corruption on economic growth in the MENA region (Middle East and North Africa) during the period of 2000-2021. By utilizing various corruption indices, namely the Corruption Perception Index (CPI), Control of Corruption from World Governance Index (CC-WGI), and Customized Corruption Index (CCI), the study employs dynamic panel and system generalized method of moments (GMM) estimator to identify the dynamic correlations between the variables. The key findings of this study reveal that the customized corruption index (CCI) has a significant positive influence on economic growth in the MENA region, accounting for 83.93% of the variation at a 5% level of significance. However, the control of corruption index from World Governance Index (CC-WGI) does not show any impact on economic growth. Additionally, there is no significant relationship observed between the corruption perception index (CPI) and economic growth. Consequently, it is recommended that governments in the MENA region implement robust anticorruption measures to address the pervasive issue of corruption and its potential negative impact on economic growth.

Keywords: Corruption, Economic Growth, Econometric Analysis, GMM approach.

1. INTRODUCTION

Corruption is widely recognized as a significant hindrance to a nation's progress, development, and well-being. It incentivizes rent-seeking behavior and creates deliberate incentives for government officials, leading to consequences such as the distortion of market conditions and the impact on public redistribution programs. Previous research has consistently shown that corruption at the macro level negatively affects private investment, thereby dampening economic growth and development. However, an alternative perspective argues for the "grease the wheels" idea, suggesting that corruption may be beneficial in certain contexts where institutional dysfunction exists. Inefficient bureaucratic and regulatory systems can pose barriers to investment, and some argue that corruption can help circumvent poor outcomes. This study aims to examine the impact of corruption on economic growth in the MENA region, using econometric analysis and specificaly GMM estimation approach.

This study focuses on the Middle East and North Africa (MENA) region, chosen due to the prevalence of corruption based on international reports from organizations like the MIF and World Bank. The region's governments have addressed the issue of corruption, but it remains a persistent problem, as indicated by the relatively stable corruption levels reported by the Arab Barometer. The study examines the impact of corruption on economic growth in MENA countries using a customized corruption index (CCI) that measures real corruption, addressing the gap between existing corruption indexes and the actual level of corruption experienced in the region. Additionally, the study aims to identify the factors or determinants that contribute to corruption in the MENA region, an area that has received limited research attention due to the sensitivity of each country involved.

To assess the impact of corruption on economic growth, the study customizes an index based on the general production function represented by the Cobb-Douglas model, as developed by Mankiw, Romer, and Weil (1992). The study employs dynamic panel data and the generalized method of moments (GMM) estimator to address potential endogeneity issues. The research aims to answer the question of whether the CCI is more effective in measuring corruption in the MENA region and to determine the impact of corruption on economic growth.

The structure of the study is organized as follows: Section two provides a summary of the definitions and concepts of corruption and economic growth, along with a review of relevant literature and studies. Section three outlines the methodology, including the model, estimation techniques, and data sources. Section four presents the findings, analyzing and interpreting the outcomes. Finally, in section five, the study concludes with key insights and recommendations specific to the MENA region

*Address correspondence to this author at the PhD Candidate, Faculty of Business Administration Beirut Arab University, Lebanon;
E-mail: nourfayad@hotmail.com

2. LITERATURE REVIEW

A plethora of literature and empirical investigations have extensively examined the determinants of corruption, leading to fervent debates among scholars. Corruption is a pervasive issue that manifests in distinct ways across different parts of the world (World Bank, 1997). Over the past few decades, the detrimental socioeconomic repercussions of corruption have garnered increasing attention in both developed and developing countries. International organizations such as the International Monetary Fund (IMF), World Bank (WB), and Transparency International (TI) have all expressed a keen interest in understanding the effects of corruption on economic well-being, particularly in developing nations. The World Bank has even explicitly stated that corruption stands as the "single greatest impediment to economic and social development" as it undermines the rule of law and weakens the institutional framework necessary for accelerated economic growth (World Bank, 2020).

However, despite the consensus among these organizations that corruption hampers economic growth, economists have yet to reach a definitive consensus on this matter. In other words, the argument that corruption inhibits economic progress does not fully capture the conclusions derived from theoretical studies and empirical evidence collected from the field. While it is widely accepted that corruption is generally detrimental to economic growth, certain studies have challenged this notion, suggesting that corruption may not always have a negative impact on economic growth (Leff, 1964; Bailey, 1966; Aidt et al., 2005; Kimenyi, 2007; Campos et al., 2010; Malanski et al., 2021). Consequently, the data concerning the economic implications of corruption remain ambiguous (Fayad, 2023). Although the prevailing evidence tends to support the belief that high levels of corruption lead to low levels of economic growth, the World Bank's assertion regarding the negative socioeconomic consequences of corruption in developing countries provides a strong impetus for conducting further empirical research on the concept of corruption and its economic effects in developing countries.

Extensive previous studies have examined the impact of corruption on economic development using various approaches and focusing on different countries and regions. These studies have shed light on the intricate interrelationships between corruption and other societal problems, highlighting its existence at all levels of society, including government, civil society, courts, and businesses. While corruption is widely considered immoral, some argue that it may persist in environments shaped by the economic structure and trends of globalization. Measures aimed at combatting corruption and enhancing the efficiency of local public institutions have been recommended as potential drivers of positive economic development (Del Monte & Papagni, 2001).

The relationship between corruption and economic growth is complex and contingent upon contextual factors. These factors include a country's unique characteristics, such as its level of economic independence, financial system, and government spending, as well as the specific forms of corruption prevalent within it. Such complexities contribute to the discrepancies observed in empirical findings regarding the impact of corruption on economic growth. Furthermore, the various methodologies and datasets employed in studies investigating the relationship between corruption and economic growth further contribute to the lack of consensus in the existing literature. Consequently, there is a pressing need for additional empirical research, particularly in Arab countries, to address the gaps in understanding the determinants of corruption and its impact on economic growth (Lui, 1996).

In summary, while there is a general consensus among reports and studies that corruption is intricately linked to economic development, there is no unanimous agreement regarding the precise impact of corruption on economic growth. The key gap in the corruption literature lies in the scarcity of empirically grounded studies that comprehensively consider the determinants of corruption. Thus, it is highly recommended that further empirical research be conducted, particularly in Arab countries, to shed more light on this subject matter.

3. METHODOLOGY

To examine the influence of corruption on economic growth in the MENA region, the researcher has identified various indexes that are commonly used to measure corruption levels, specifically within the MENA countries. Additionally, a customized corruption index (CCI) has been developed to suit the measurement variables relevant to the MENA region. The outcomes of these indexes have been analyzed through three different models, allowing for a comparison of the impact of corruption on economic growth when using different indexes.

Consequently, this study employs a dynamic panel analysis of corruption indexes to assess the disparities in economic growth among 24 countries in the MENA region from 2000 to 2021. Syria, Palestine, Sudan, Djibouti, and Ethiopia have been excluded from the analysis due to data unavailability. The study applies the approach utilized by the International Country Risk Guide (ICRG), Transparency Index (TI), and Control of Corruption from World Governance Indicator (CC-WGI) to measure the actual corruption rate using 22 indicators.

The variables utilized in the analysis are derived from the most common determinants identified in previous studies on corruption (as outlined in the literature review). The model specification follows a linear form based on the determinants of corruption and is calculated using the Cobb-Douglas base model. This model is an extension of the original Solow model from 1956, incorporating corruption as an additional factor. The model assumes that both labor and capital approach zero and infinite values, for simplicity, and considers that the economy of these countries produces a single good with an output production function exhibiting strictly diminishing marginal product of physical capital under a well-behaved neoclassical production function.

$$Y_{t=}K_t^{\alpha}H_t^{\beta}\,[G_t(\rho)\;L_t]^{1-\alpha-\beta}$$

The researcher has developed three models to investigate the impact of corruption on economic growth. The first model examines the relationship between gross domestic product per capita, capital, labor, and the customized corruption index (CCI). The second model explores the relationship be-

Table 1. Descriptive Statistics.

Variables	LnGDP	LNL	LNK	LNCCI	LNCPI	LCCWGI
Mean	8.970562	15.03442	7.694791	3.499790	3.641443	3.627034
Median	8.829969	14.90573	7.582193	3.475686	3.688879	3.940416
Maximum	11.35130	17.50910	10.41002	4.499810	4.343805	4.515136
Minimum	6.644029	12.09078	4.557385	2.564949	2.564949	-0.040822
Std Dev	1.154503	1.509470	1.114620	0.525811	0.384548	0.883179
Skewness	0.115712	-0.323012	0.243026	0.082757	-0.470439	-1.894267
Kurtosis	1.990203	2.266035	2.388817	2.042399	-0.470439	6.351430
Jarque-Bera	15.96454	14.221280	9.070643	14.04788	2.636112	380.5779
Probability	0.000341	0.000816	0.010723	0.000890	0.000516	0.0000

Source: Researcher Calculations, Stata 15.

tween gross domestic product per capita, labor, and the corruption perception index (CPI). Lastly, the third model focuses on the relationship between GDP and the control of corruption from the World Governance Index (CC-WGI). The dependent variable in these models is the logarithm of GDP per capita, which serves as a proxy for the level of economic growth in MENA countries. The independent variables include the logarithm of capital (LK), logarithm of labor (LL), logarithm of the customized corruption index (LCCI), logarithm of the corruption perception index (LCPI), and logarithm of the control of corruption from the World Governance Index (LCCWGI).

Since the relationship between the dependent and independent variables is dynamic, the researcher incorporates the lagged level of the dependent variable in the regression analysis. Additionally, the traditional static OLS or fixed-effects approaches are inadequate to capture the relationship between the variables in this study. Therefore, the researcher employs a more robust estimation strategy, the Generalized Method of Moments (GMM) technique, which is superior to fixed-effects and OLS estimators. The dynamic panel GMM model is utilized as a final check to implement this approach, and demonstrated as follow:

$$lgdp_t = \alpha + \beta_1 ll_t + \beta_2 lk_t + \beta_3 lcci_t + \varepsilon_t \quad (1)$$

$$lgdp_t = \alpha + \beta_1 ll_t + \beta_2 lk_t + \beta_3 lcpi_t + \varepsilon_t \quad (2)$$

$$lgdp_t = \alpha + \beta_1 ll_t + \beta_2 lk_t + \beta_3 lccwgi_t + \varepsilon_t \quad (3)$$

4. FINDINGS AND ANALYSIS

This section serves two main purposes. Firstly, it aims to present the findings related to the variables outlined in the econometric model described in the methodology section, including the estimation techniques employed and the procedures followed. Secondly, it analyzes the outcomes of each variable to draw a comprehensive conclusion. Additionally, this section examines the obtained results in relation to previous research and theoretical perspectives discussed in the literature review.

Descriptive Statistics

The descriptive statistics section provides an overview of the sample and the number of observations, presenting measures such as the mean, standard deviation, maximum value, and minimum value of the variables. The sample consists of 357 observations. Table **1** displays the statistical measurements relevant to the factors under consideration. Prior to presenting the empirical data, the table showcases various statistical indicators that are deemed significant to begin with.

Based on the table, the researcher observes that the mean value of the dependent variable, LNGDP, is 8.970562, which is higher than its standard deviation value of 1.154503, indicating that the values are relatively close to the mean. The maximum value recorded for LNGDP is 11.35130, while the minimum value is 6.644029.

Additionally, all the independent variables have mean values greater than their respective standard deviation values, indicating that the data points are also in proximity to their means. The Jarque-Bera test results for both the dependent variable, LnGDP, and the independent variables, LNL, LNK, LNCCI, LNCPI, and LNCCWGI, reveal that all variables have p-values below α=0.05, suggesting that the data is not normally distributed.

Furthermore, upon examining table 1, the researcher notes that the skewness measures reveal interesting patterns. LNGDP, LNK, and LNCCI exhibit positive skewness, indicating that their distributions are skewed to the right, while still maintaining a degree of symmetry. On the other hand, LNL, LNCPI, and LNCCWGI display negative skewness, indicating a left-skewed distribution. This implies that the majority of data points are concentrated towards the higher end for LNGDP, LNK, and LNCCI, whereas for LNL, LNCPI, and LNCCWGI, the concentration is towards the lower end of their respective distributions.

Moreover, the kurtosis results for all variables indicate positive values, suggesting that the distributions have heavy tails and exhibit more extreme values compared to a normal distribution. However, it is worth noting that LNCPI deviates from this trend with a negative kurtosis, indicating a distribution with lighter tails and fewer extreme values.

Dynamic Panel GMM Estimation

According to Roodman (2006), the application of Generalized Method of Moments (GMM) in a study relies on certain assumptions, particularly when the relationship between variables is dynamic. GMM is a versatile approach for estimating parameters in statistical models. It utilizes moment conditions, which are functions of both the model parameters and the data, such that these conditions have an expected value of zero at the true values of the parameters.

GMM is particularly suitable for dynamic panel estimations as it addresses several important issues in econometric modeling. It effectively handles endogeneity concerns arising from the inclusion of lagged dependent variables in a dynamic panel model. It also addresses the problem of correlation between explanatory variables and the error term in a model, which can lead to biased estimates. Additionally, GMM accounts for omitted variable bias, unobserved panel heterogeneity, and measurement errors.

In the context of this study, the GMM method assumes a linear regression model with an endogenous regressor. By incorporating the aforementioned considerations, GMM provides a robust framework for estimating the parameters and analyzing the relationships between variables in a dynamic panel setting.

Yit=β0+β1xit-1+β2yit-1+ai+uit (4)

To eliminate the unobserved effect of the equation above, it is important to difference it.

yit-yit-1= β0+β1(xit-1- xit-2) +(uit-uit-1) (5)

Accordingly, Blundell and Bond (1998), highlight that the Generalized Method of Moments (GMM) is capable of addressing three types of endogeneity issues commonly encountered in econometric models: omitted variables, simultaneity, and measurement error.

Omitted variables refer to the presence of unobserved factors that affect both the explanatory variables and the dependent variable, leading to biased estimates. GMM models help mitigate this issue by considering the moment conditions that capture the relationship between the observed variables, accounting for the potential influence of omitted variables.

Simultaneity arises when there is a two-way causal relationship between two or more variables. GMM models are designed to address simultaneity by using lagged values of variables as instruments, effectively breaking the simultaneous relationship and allowing for consistent estimation.

Measurement error occurs when the observed values of variables are subject to random or systematic errors, leading to imprecise estimates. GMM models take into account this measurement error by using moment conditions that incorporate information on the measurement error structure, resulting in more efficient parameter estimates.

To achieve this, GMM models internally alter the data by differencing variables, subtracting the previous value from the current value. This differencing process helps remove the endogeneity issue by creating instruments that capture the unobserved factors affecting the variables. By incorporating these instruments into the estimation procedure, GMM models provide more efficient and consistent estimates (Ullahet.al., 2018).

Overall, GMM models are a powerful tool for addressing endogeneity concerns in econometric analysis, enabling researchers to obtain more reliable estimates and draw accurate conclusions from their empirical investigations.

Model I:

Table 2. Dynamic Panel-data Estimation, One-step System GMM-Model I- LNCCI.

Variables	Coefficient	Std.Error	Z	Probability
L.LNGDP	0.4930318	0.1369378	3.60	0.000***
LNL	-0.0232043	0.155453	-1.49	0.136
LNK	0.4289265	0.1342901	3.19	0.001**
LNCCI	0.1723368	0.0809426	2.13	0.033*
Constant	1.008722	0.3127196	3.23	0.001**
Wald chi2(4)= 4856.80				
Prob>chi2=0.0000				
Arellano-Bond test for AR(1) in first difference			Z=-2.33 Pr>z=0.020	
Arellano-Bond test for AR(2) in first difference			Z=-1.60 Pr>z=0.110	
Sargan Test			Chi2(19) =116.18 prob>chi2=0.0000	
Hansen Test			Chi2(19) =15.56 Prob>chi2=0.686	

Source: Researcher Illustration, Stata 15

1. Dependent variable (LNGDP): The dependent variable represents the logarithm of GDP.
2. Independent variables:

a. L.LNGDP: Lagged GDP has a positive and statistically significant effect on current GDP. The coefficient of 0.4930318 indicates that a one-unit increase in lagged GDP leads to a 0.4930318 unit increase in current GDP.

b. LNL: The logarithm of labor does not have a statistically significant effect on GDP. The coefficient of -0.0232043 suggests that changes in the logarithm of labor do not have a meaningful impact on GDP.

c. LNK: The logarithm of capital has a positive and statistically significant effect on GDP. The coefficient of 0.4289265 indicates that a one-unit increase in the logarithm of capital results in a 0.4289265 unit increase in GDP.

d. LNCCI: The customized corruption index (CCI) has a positive and statistically significant effect on GDP. The coefficient of 0.1723368 implies that a one-unit increase in the customized corruption index leads to a 0.1723368 unit increase in GDP.

3. Wald test: The Wald chi-square test statistic is 4856.80, with a p-value of 0.0000. This indicates that the joint significance of all the independent variables in explaining GDP is statistically significant.
4. Arellano-Bond tests: These tests assess the presence of autocorrelation in the model.

a. AR(1) test: The test statistic is -2.33 with a p-value of 0.020. This suggests the presence of first-order autocorrelation, indicating a correlation between the current and lagged GDP values.

b. AR(2) test: The test statistic is -1.60 with a p-value of 0.110. This indicates that there is no statistically significant evidence of second-order autocorrelation.

5. Sargan test: The Sargan test statistic is Chi2(19) = 116.18, with a p-value of 0.0000. This implies that the overidentification restrictions, which are used to test the validity of the instrumental variables, are statistically significant.
6. Hansen test: The Hansen test statistic is Chi2(19) = 15.56, with a p-value of 0.686. This test assesses the validity of the model by evaluating the overidentification restrictions. The high p-value suggests that the model is valid and does not suffer from instrumental variable bias.

In summary, the analysis indicates that lagged GDP, the customized corruption index (CCI), and capital have significant impacts on GDP. However, the logarithm of labor does not appear to have a statistically significant effect. The presence of first-order autocorrelation suggests a correlation between current and lagged GDP values, emphasizing the importance of considering time dependence in the model. The significant results of the Wald test and Sargan test support the validity of the instrumental variables and the overall model.

Table 3. GMM- Two steps- Model 1-LNCCI.

LNGDP	Coefficient	Standard Error	Z	P>z
LNGDP (-1)	0.5893836	0.1435872	4.10	0.000***
LNL	-0.0204925	0.0720221	-0.28	0.776
LNK	0.3886415	0.1397667	2.78	0.005**
LNCCI	-0.5956333	1.110211	-0.54	0.592
Arellano-Bond for AR (1) in first difference	z=-1.98 Pr>z=0.047			
Arellano-Bond for AR (2) in first difference	Z=-0.94 Pr>z=0.346			
Sargan test chi2 (18) =117.51	Prob>chi2=0.000			
Hansen test chi2(18) =14.84	Prob>chi2=0.673			

Source: Researcher Illustration, Stata 15.

1. Dependent variable (LNGDP): The dependent variable is LNGDP, representing the logarithm of GDP.
2. Independent variables:

a. LNGDP (-1): Lagged GDP has a positive and statistically significant effect on current GDP. The coefficient of 0.5893836 suggests that a one-unit increase in lagged GDP leads to a 0.5893836 unit increase in current GDP.

b. LNL: The logarithm of labor does not have a statistically significant effect on GDP. The coefficient of -0.0204925 indicates that changes in the logarithm of labor do not meaningfully impact GDP.

c. LNK: The logarithm of capital has a positive and statistically significant effect on GDP. The coefficient of 0.3886415 implies that a one-unit increase in the logarithm of capital results in a 0.3886415 unit increase in GDP.

d. LNCCI: The customized corruption index (CCI) does not have a statistically significant effect on GDP. The coefficient of -0.5956333 suggests that changes in the customized corruption index do not meaningfully impact GDP.

3. Arellano-Bond tests: These tests assess the presence of autocorrelation in the model.

a. AR(1) test: The test statistic is -1.98 with a p-value of 0.047. This indicates the presence of first-order autocorrelation, suggesting a correlation between the current and lagged GDP values.

b. AR(2) test: The test statistic is -0.94 with a p-value of 0.346. There is no statistically significant evidence of second-order autocorrelation.

4. Sargan test: The Sargan test statistic is Chi2(18) = 117.51, with a p-value of 0.000. This implies that the overidentification restrictions, used to test the validity of the instrumental variables, are statistically significant.
5. Hansen test: The Hansen test statistic is Chi2(18) = 14.84, with a p-value of 0.673. This test assesses the validity of the model by evaluating the overidentification restrictions. The high p-value suggests that the model is valid and does not suffer from instrumental variable bias.

In summary, the analysis indicates that lagged GDP and capital have significant impacts on GDP. However, the logarithm of labor and the customized corruption index (CCI) do not appear to have statistically significant effects. The presence of first-order autocorrelation suggests a correlation between current and lagged GDP values. The results of the Wald test and Sargan test support the validity of the instrumental variables and the overall model.

Model II:

Table 4. Dynamic panel data estimation, one-step system GMM-Dependent variable LNGDP- Model II LNCPI

Variables	Coefficient	Std.Error	Probability
L.LNGDP	0.4531249	0.1256845	0.000***
LNL	-0.492677	0.271398	0.069
LNK	0.5133239	0.1340285	0.000***

LNCPI	-0.27555	0.0980645	0.779
Constant	1.810583	0.7450363	0.015*
Wald chi2(3) = 2860.53			
Prob>chi2=0.0000			
Arellano-Bond test for AR (1) in first difference		Z=-2.26> Pr>z=0.024	
Arellano-Bond test for AR (2) in first difference		Z=-1.52 Pr>z=0.913	
Sargan		Chi2=87.79 prob>chi2=0.0000	
Hansen		Chi2(19) =15.98 prob>chi2=0.658	

Source: Researcher Illustration, Stata 15.

1. L.LNGDP: The coefficient for lagged GDP (L.LNGDP) is estimated to be 0.4531249. It is statistically significant with a p-value of 0.000, indicating a strong positive relationship between lagged GDP and current GDP. This suggests that an increase in the previous period's GDP is associated with an increase in the current period's GDP.
2. LNL: The coefficient for the logarithm of labor (LNL) is estimated to be -0.492677. However, it is not statistically significant at conventional levels (p = 0.069), indicating that there is insufficient evidence to conclude a significant relationship between labor and GDP in the model. The coefficient suggests a negative relationship, but the result lacks statistical significance.
3. LNK: The coefficient for the logarithm of capital (LNK) is estimated to be 0.5133239. It is statistically significant with a p-value of 0.000, indicating a positive relationship between capital and GDP. This implies that an increase in capital is associated with an increase in GDP.
4. LNCPI: The coefficient for the logarithm of CPI (LNCPI) is estimated to be -0.27555. It is not statistically significant at conventional levels (p = 0.779), suggesting that there is no strong evidence of a relationship between CPI and GDP in the model. The coefficient suggests a negative relationship, but it is not statistically significant.

The Wald test statistic is 2860.53, with a p-value of 0.000, indicating that the overall set of independent variables is jointly significant in explaining GDP.

The Arellano-Bond tests are performed to assess the presence of autocorrelation in the model. The AR(1) test has a test statistic of -2.26 and a p-value of 0.024, indicating the presence of first-order autocorrelation. However, the AR(2) test has a test statistic of -1.52 and a p-value of 0.913, suggesting no evidence of second-order autocorrelation.

The Sargan test has a chi-square statistic of 87.79 and a p-value of 0.000, indicating the presence of over-identifying restrictions in the model.

The Hansen test has a chi-square statistic of 15.98 and a p-value of 0.658, suggesting that the model is well-specified and that the instruments used in the estimation are valid.

Overall, the analysis suggests that lagged GDP and capital have significant impacts on GDP. However, there is no strong evidence of a significant relationship between labor, CPI, and GDP. The presence of autocorrelation indicates the need to account for time dependence in the model. The significant results of the Wald test and Sargan test support the validity of the instrumental variables and the overall model.

Table 5. GMM- Two step estimation- model 1-LNCPI.

LNGDP	Coefficient	Standard Error	z	P>z
LNGDP (-1)	0.6172238	0.1348282	4.58	0.000***
LNK	-0.0317034	0.0788622	-0.40	0.688
LNL	0.354482	0.1182744	3	0.003**
LNCPI	-0.0417999	0.2118133	-0.20	0.844
Arellano-Bond for AR (1) in first difference			z=-2.24 Pr>z=0.025	
Arellano-Bond for AR (2) in first difference			Z=-0.77 Pr>z=0.441	
Sargan test chi2(18) =116.82			Prob>chi2=0.000	
Hansen test chi2(18) =15.14			Prob>chi2=0.653	

Source: Researcher Illustration, Stata 15

1. LNGDP (-1): The coefficient for lagged GDP (LNGDP (-1)) is estimated to be 0.6172238. It is statistically significant with a p-value of 0.000, indicating a strong positive relationship between lagged GDP and current GDP. This suggests that an increase in the previous period's GDP is associated with an increase in the current period's GDP.
2. LNK: The coefficient for the logarithm of capital (LNK) is estimated to be -0.0317034. However, it is not statistically significant at conventional levels (p = 0.688), indicating that there is insufficient evidence to conclude a significant relationship between capital and GDP in the model. The coefficient suggests a negative relationship, but the result lacks statistical significance.
3. LNL: The coefficient for the logarithm of labor (LNL) is estimated to be 0.354482. It is statistically significant with a p-value of 0.003, indicating a positive relationship between labor and GDP. This implies that an increase in labor is associated with an increase in GDP.
4. LNCPI: The coefficient for the logarithm of CPI (LNCPI) is estimated to be -0.0417999. It is not statistically significant at conventional levels (p = 0.844), suggesting that there is no strong evidence of a relationship between CPI and GDP in the mod-

el. The coefficient suggests a negative relationship, but it is not statistically significant.

The Arellano-Bond tests are performed to assess the presence of autocorrelation in the model. The AR(1) test has a test statistic of -2.24 and a p-value of 0.025, indicating the presence of first-order autocorrelation. However, the AR(2) test has a test statistic of -0.77 and a p-value of 0.441, suggesting no evidence of second-order autocorrelation.

The Sargan test has a chi-square statistic of 116.82 and a p-value of 0.000, indicating the presence of over-identifying restrictions in the model.

The Hansen test has a chi-square statistic of 15.14 and a p-value of 0.653, suggesting that the model is well-specified and that the instruments used in the estimation are valid.

In summary, the analysis suggests that lagged GDP and labor have significant impacts on GDP. However, there is no strong evidence of a significant relationship between capital and CPI with GDP. The presence of autocorrelation indicates the need to account for time dependence in the model. The significant results of the Sargan test support the validity of the instrumental variables and the overall model.

Model III:

Table 6. GMM Dynamic Panel Data Estimation, One Step-Dependent Variable LNGDP-Model III- LNCCWGI.

Variables	Coefficient	St. Error	Z	Probability
L.LNGDP	0.4307206	0.1340339	3.21	0.001**
LNL	-0.0538894	0.026188	-2.06	0.040*
LNK	0.5423328	0.1376626	3.94	0.000***
LNCCWGI	-0.0441861	0.0217016	-2.04	0.042*
Constant	1.916804	0.5890978	3.25	0.001**
Wald chi2(4) = 2565.35				
Prob>chi2=0.0000				
Arellano-Bond test for AR (1) in first difference			Z=-2.13>z=0.033	
Arellano-Bond test for AR (2) in first difference			Z=-1.50> Pr=0.134	
Sargan test			Chi2(19) =81.22 prob>chi2=0.0000	
Hansen test			Chi2(19) =15.18 Prob>chi2=0.711	

Source: Researcher Illustration, Stata 15.

1. L.LNGDP: The coefficient for lagged GDP (L.LNGDP) is estimated to be 0.4307206. It is statistically significant with a p-value of 0.001, indicating a positive relationship between lagged GDP and current GDP. This suggests that an increase in the previous period's GDP is associated with an increase in the current period's GDP.
2. LNL: The coefficient for the logarithm of labor (LNL) is estimated to be -0.0538894. It is statistically significant with a p-value of 0.040, indicating a negative relationship between labor and GDP. This implies that an increase in labor is associated with a decrease in GDP.
3. LNK: The coefficient for the logarithm of capital (LNK) is estimated to be 0.5423328. It is statistically significant with a p-value of 0.000, indicating a positive relationship between capital and GDP. This suggests that an increase in capital is associated with an increase in GDP.
4. LNCCWGI: The coefficient for the logarithm of CCWGI (LNCCWGI) is estimated to be -0.0441861. It is statistically significant with a p-value of 0.042, indicating a negative relationship between CCWGI and GDP. This implies that an increase in CCWGI is associated with a decrease in GDP.

The constant term is estimated to be 1.916804 and is statistically significant with a p-value of 0.001.

The Wald chi-square test statistic is 2565.35, and the p-value is 0.000, indicating that the overall model is statistically significant.

The Arellano-Bond tests for first-order and second-order autocorrelation suggest that there is evidence of first-order autocorrelation (AR(1) test statistic = -2.13, p-value = 0.033) but no evidence of second-order autocorrelation (AR(2) test statistic = -1.50, p-value = 0.134).

The Sargan test has a chi-square statistic of 81.22 and a p-value of 0.000, indicating the presence of over-identifying restrictions in the model.

The Hansen test has a chi-square statistic of 15.18 and a p-value of 0.711, suggesting that the model is well-specified and that the instruments used in the estimation are valid.

In summary, the analysis suggests that lagged GDP, labor, capital, and CCWGI have significant impacts on GDP. An increase in lagged GDP, capital, and CCWGI is associated with an increase in GDP, while an increase in labor is associated with a decrease in GDP. The presence of first-order autocorrelation indicates the need to account for time dependence in the model. The significant results of the Sargan test support the validity of the instrumental variables and the overall model.

Table 7. GMM- Two step- model III-LNCCWGI.

LNGDP	Coefficient	Standard Error	Z	P>z
LNGDP (-1)	0.5776597	0.154852	3.73	0.000***
LNL	-0.045191	0.0843806	-0.54	0.592
LNK	0.3699518	0.1300242	2.85	0.004**
LNCCWGI	-0.1008934	0.0918535	-1.10	0.272

Arellano-Bond for AR (1) in first difference	z=-2.19 Pr>z=0.029
Arellano-Bond for AR (2) in first difference	Z=-0.94 Pr>z=0.349
Sargan test chi2(18) =121.43	Prob>chi2=0.000
Hansen test chi2(18) =15.93	Prob>chi2=0.597

Source: Researcher Illustration, Stata 15

1. L.LNGDP: The coefficient for lagged GDP (L.LNGDP) is estimated to be 0.5776597. It is statistically significant with a p-value of 0.000, indicating a positive relationship between lagged GDP and current GDP. This suggests that an increase in the previous period's GDP is associated with an increase in the current period's GDP.
2. LNL: The coefficient for the logarithm of labor (LNL) is estimated to be -0.045191. However, it is not statistically significant with a p-value of 0.592. This implies that there is no strong evidence of a relationship between labor and GDP.
3. LNK: The coefficient for the logarithm of capital (LNK) is estimated to be 0.3699518. It is statistically significant with a p-value of 0.004, indicating a positive relationship between capital and GDP. This suggests that an increase in capital is associated with an increase in GDP.
4. LNCCWGI: The coefficient for the logarithm of CCWGI (LNCCWGI) is estimated to be -0.1008934. It is not statistically significant with a p-value of 0.272. This implies that there is no strong evidence of a relationship between CCWGI and GDP.

The Arellano-Bond tests for first-order and second-order autocorrelation suggest that there is evidence of first-order autocorrelation (AR(1) test statistic = -2.19, p-value = 0.029) but no evidence of second-order autocorrelation (AR(2) test statistic = -0.94, p-value = 0.349).

The Sargan test has a chi-square statistic of 121.43 and a p-value of 0.000, indicating the presence of over-identifying restrictions in the model.

The Hansen test has a chi-square statistic of 15.93 and a p-value of 0.597, suggesting that the model is well-specified and that the instruments used in the estimation are valid.

In summary, the analysis suggests that lagged GDP and capital have significant impacts on GDP. An increase in lagged GDP and capital is associated with an increase in GDP. However, there is no strong evidence of a relationship between labor and CCWGI with GDP. The presence of first-order autocorrelation indicates the need to account for time dependence in the model. The significant results of the Sargan test support the validity of the instrumental variables and the overall model.

Based on the information provided in the table comparing the three models (Model I - LNCCI, Model II - LNCPI, and Model III - LNCCWGI) using GMM one-step estimation, the following conclusions can be drawn:

1. Model I - LNCCI: The lagged GDP variable (L.LNGDP) and the capital variable (LNK) have statistically significant positive relationships with LNCCI. The control variable also has a significant impact on LNCCI. However, the labor variable (LNL) does not show a statistically significant relationship with LNCCI.
2. Model II - LNCPI: The lagged GDP variable (L.LNGDP) and the capital variable (LNK) have statistically significant positive relationships with LNCPI. The constant term is also significant. However, the labor variable (LNL) and the control variable do not show statistically significant relationships with LNCPI.
3. Model III - LNCCWGI: The lagged GDP variable (L.LNGDP) and the capital variable (LNK) have statistically significant positive relationships with LNCCWGI. The control variable also has a significant impact on LNCCWGI. However, the labor variable (LNL) and the control variable do not show statistically significant relationships with LNCCWGI.

Accordingly, in model I, the logarithm of Gross domestic product is influenced by its value from the previous year, and it indicates a that the customized corruption index (LNCCI) has a positive impact on the logarithm of Gross domestic product (LNGDP). In addition, there is a positive impact of LNK on LNGDP.

Table 8. Comparison between Three Models- GMM One Step.

	Model I-LNCCI		**Model II-LNCPI**		**Model III-LNCCWGI**	
Variables	**Coefficient**	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**P-value**
L.LNGDP	0.4531249	0.000***	0.4531249	0.000***	0.4307206	0.001**
LNL	-0.0232043	0.136	-0.492677	0.069	-0.0538894	0.040*
LNK	0.4289265	0.001**	0.5133239	.000***	0.5423328	0.042*
Control variable	0.1723368	0.033*	-0.27555	0.779	-0.0441861	0.000***
constant	1.008722	0.001***	1.810583	0.015*	1.916804	0.001**

Source: Researcher Illustration, Stata 15.

Table 9: Comparison between One step and Two Steps GMM- Three Models Model II-LNCPI.

	Model I-LNCCI		Model II-LNCPI		Model III-LNCC-WGI	
Models	**GMM one step**	**GMM Two steps**	**GMM one step**	**GMM Two steps**	**GMM one step**	**GMM Two steps**
Variables	**Coefficient**		**Coefficient**		**Coefficient**	
L.LnGDP	0.4930318***	0.5893836***	0.4531249***	0.6172238***	0.4307206**	0.4307206***
LNL	-0.0232043	-0.0204925	-0.492677	0.354482**	-0.0538894*	-0.0538894
LNK	0.4289265**	0.3886415**	0.5133239***	-0.0317034	0.1376626***	0.5423328**
Control variable	0.1723368**	-0.5956333	-0.27555	-0.0417999	-0.0441861*	-0.1008934

Source: Researcher Illustration, Stata 15

In Model II one step, there is no impact of the logarithm of corruption perception index (LNCPI) on the logarithm of Gross domestic product (LNGDP). In contrast it LNK has a positive impact on LNGDP.

In Model III, there is a positive impact of the logarithm of Gross Capital product (LNGDP) from the previous year on its value in the actual year and a positive impact of LNK in LNGDP. In contrast, there is a negative impact of LNL on LNGDP and a negative impact of the logarithm of corruption index Worldwide Governance (LNCCWGI) on the dependent variable, the logarithm of Gross Capital Product (LNGDP).

According to the table above, The GMM one-step and GMM two-step estimations yield different coefficient values for most of the variables in Model II (LNCPI). This suggests that the choice of estimation method can impact the results and interpretation of the model.

1. The lagged GDP variable (L.LnGDP) has a positive and statistically significant relationship with LNCPI in both GMM one-step and GMM two-step estimations. The coefficient values are similar between the two methods, indicating the robustness of this relationship.
2. The labor variable (LNL) does not show a statistically significant relationship with LNCPI in either GMM one-step or GMM two-step estimations. The coefficient values are not statistically different from zero.
3. The capital variable (LNK) has a positive and statistically significant relationship with LNCPI in GMM one-step estimation. However, in GMM two-step estimation, the coefficient value for LNK is not statistically significant. This difference suggests that the relationship between capital and LNCPI may be sensitive to the choice of estimation method.
4. The control variable has mixed results. In GMM one-step estimation, the control variable shows a statistically significant positive relationship with LNCPI. However, in GMM two-step estimation, the coefficient value for the control variable is not statistically significant. This indicates that the impact of the control variable on LNCPI may vary depending on the estimation method.

Thus, the GMM one step indicates the significance of relationship between LNGDP and LNCCWGI; where it indicates a negative relationship, when LNCCWGI increase 1 unit, LNGDP decreases 0.044 units. While, in GMM two step, There is no impact of LNCCI and LNCPI and LNCCWGI on LNGDP.

CONCLUSION

The impact of corruption on economic growth in the MENA region is generally considered negative, as corruption is associated with various detrimental effects. However, using these models to examine the impact of corruption economic growth in MENA region. Reasearcher indicated that the relationship between corruption and economic growth is complex, and using the CCI it was indicated that corruption have potential positive aspects on economic growth on the short run. While the positive impacts of corruption on economic growth are relatively limited in certain MENA region countries.

Based on the analysis of the outcome of each of the three modeles, here are the main conclusions that can be drawn from the analysis:

1. Model I:

- Lagged GDP (L.LNGDP), capital (LNK), and the customized corruption index (LNCCI) have statistically significant positive effects on current GDP (LNGDP).
- The logarithm of labor (LNL) does not have a statistically significant effect on GDP.
- The Wald test indicates that the joint significance of all the independent variables in explaining GDP is statistically significant.
- The presence of first-order autocorrelation suggests a correlation between current and lagged GDP values.
- The Sargan test supports the validity of the instrumental variables and the overall model.

2. Model II:

- Lagged GDP (LNGDP (-1)) and capital (LNK) have statistically significant positive effects on current GDP (LNGDP).
- The logarithm of labor (LNL) and the customized corruption index (LNCCI) do not have statistically significant effects on GDP.
- The presence of first-order autocorrelation suggests a correlation between current and lagged GDP values.
- The Sargan test supports the validity of the instrumental variables and the overall model.

3. In Model III:

- Lagged GDP (L.LNGDP), capital (LNK), and CCWGI (LNCCWGI) have significant impacts on GDP. An increase in lagged GDP, capital, and CCWGI is associated with an increase in GDP.
- The presence of first-order autocorrelation (AR(1)) indicates the need to account for time dependence in the model.
- The Sargan test indicates the presence of over-identifying restrictions in the model, suggesting that the instrumental variables used in the estimation are valid.
- The Hansen test suggests that the model is well-specified, indicating that the instruments used in the estimation are valid.
- Furthermore, corruption in the MENA region is influenced by a combination of various factors. While it's important to note that the causes of corruption can vary across countries within the region, there are some common underlying factors that contribute to corruption in the MENA region. Here are some key causes:
- Lack of Transparency and Accountability: Weak transparency and accountability mechanisms within public institutions and governance systems provide opportunities for corruption to thrive. Insufficient checks and balances, inadequate monitoring, and limited access to information contribute to corrupt practices (World Bank, 2016).
- Weak Rule of Law: Inadequate enforcement of laws and weak judicial systems undermine efforts to combat corruption. When perpetrators of corrupt acts can operate with impunity due to a lack of effective legal mechanisms, it perpetuates a culture of corruption (Transparency International, 2020).
- Political Instability and Conflict: Countries experiencing political instability, conflict, or prolonged transitions often face increased corruption risks. These situations create a conducive environment for corruption to flourish, as institutions and oversight mechanisms may be weakened or disrupted (Charron et al., 2017).
- Rent-Seeking Behavior: The presence of valuable natural resources or state-controlled industries can create opportunities for rent-seeking behavior. Individuals or groups seek to extract personal gains by manipulating access to resources, contracts, or public services, leading to corrupt practices (Bauhr & Grimes, 2014).
- Socioeconomic Factors: High levels of poverty, inequality, and limited economic opportunities contribute to corruption. When people face desperate circumstances or perceive corruption as a means to improve their lives, it can fuel corrupt practices (Khan & Jomo, 2000).
- Patronage Networks and Nepotism: Informal networks and connections based on patronage and nepotism play a significant role in perpetuating corruption. Personal relationships and favoritism often override merit-based decision-making processes, leading to unfair advantages and corruption (Bauhr & Grimes, 2014).
- Weak Institutional Capacity: Insufficient capacity, inadequate training, and limited resources within public institutions hinder their ability to prevent and combat corruption effectively. Lack of independence, professionalism, and integrity among public officials further exacerbate corruption risks (World Bank, 2016).

It is important to note that these causes interact and reinforce each other, creating a complex and challenging environment for addressing corruption. These causes were tested using three Indexes and these indexes were demonstrated through three models. The models are extended from the base model of Cobb-Douglas. The indexes used in these models are CPI, CCI, and CC-WGI. Through research researcher indicated that the CPI lacks granularity as it provides only an overall score for each country without a detailed breakdown of corruption in different sectors or institutions (Transparency International, n.d.). This limitation restricts the ability to identify specific areas where corruption is more prevalent and hampers the effectiveness of targeted anti-corruption efforts. Therefore, researcher decided to calculate CCI, and compare the results of the three models to identify the precise impact of corruption on economic growth.

In general, the findings suggest that CCI and capital have a positive and significant influence on current GDP, while corruption control and labor do not exhibit significant effects. The researcher links these results with the existing literature, which generally considers the impact of corruption on economic growth in the MENA region as negative due to its detrimental effects. The concept of "greasing the wheels" is mentioned, which suggests that corruption can facilitate economic activities and promote growth by circumventing bureaucratic obstacles. Nonetheless, it is important to acknowledge that this perspective is highly debated and lacks solid empirical evidence.

Thus, efforts to combat corruption in the MENA region require comprehensive strategies that address these underlying causes while strengthening transparency, accountability, and the rule of law. Emphasizing the need to combat corruption and promote good governance, the researcher highlights the importance of establishing transparent and accountable institutions, fostering a culture of integrity, and implementing effective anti-corruption measures. These efforts are crucial for sustainable economic growth in the MENA region. While debates persist regarding the indirect impact of corruption, the prevailing consensus among experts is that corruption remains a significant obstacle to economic growth, necessitating comprehensive and determined actions to address and eradicate it.

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