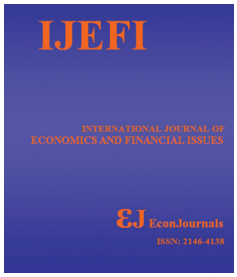

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Corruption and Economic Growth in Tunisia: Direct or Indirect Effects?

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ABSTRACT

In the post 2011 revolutionary period, Tunisia was engaged in a strategy of development despite the significant difficulties caused by economic growth and chronic corruption. In fact, an increased effectiveness of the said strategy thus calls for a better understanding of this impediment to the development characterized by corruption, in particular in terms of its implications for economic growth. The purpose of this study is therefore to perform an empirical analysis of the effects of corruption on economic growth in Tunisia. As part of formalization inspired by the theory of endogenous growth, and the time series data from BM and ICRG scores over the 1988/2017 period, using a error-correcting model, we estimated the different modalities of the effects of corruption on economic growth. In fact, the obtained results confirm the long-term existence of a direct negative relationship between corruption and economic growth, which implies that an increase of the level of corruption leads to a reduction of GDP. On the other hand, the estimates also revealed that, in the long term, corruption indirectly affects economic growth through different channels, namely the private capital stock, total public expenditure, and the number of students enrolled in primary schools. Our results also showed that corruption has no effect on economic growth in the short term, both directly and indirectly.

Keywords: Corruption, Economic Growth, Distortion, Time Series, Tunisia
JEL Classifications: D73, O4, C01, O5

1. INTRODUCTION

Studies on corruption in various countries regularly highlight the obstacles that corruption may create for the economic development processes in these countries. These obstacles are of various types and act according to different channels, such as investments, public spending and human capital.

Indeed, in corrupt countries, corruption impedes investment, distorts the distribution of public spending, as public funds are directed towards a type of spending that maximizes the rents to be captured instead of placing them and allocating them to productive projects, which hampers the formation of human capital, (Ehrlich and Lui, 1999). These distortions in public budgets are a drain on the resources needed to increase production, and thus a major blow to development efforts, (Olken, 2005, 2006). As a result, and despite their contributions to public resources through taxes, people see their efforts squandered and their human conditions tirelessly maintained underdeveloped.

This observation, which is made in various latitudes, is of a particular interest to a country, such as Tunisia. Indeed, although it is experiencing high corruption, this country has embarked on a long-term development program aiming at making itself an emerging country by the year 2035. It is therefore undeniable that good public resources and thus the efficiency of public spending allocation choices will be an inevitable condition of achieving the goal of emergence. However, the prevailing context of high corruption is a major risk to the quality of public spending, especially with regard to the optimality of the distribution of

public spending. In this perspective, we seek to know what effect corruption has on Tunisia's economic growth through these different channels. Thus, we will perform an empirical analysis of the distortions of corruption and their effects on economic growth.

In this regard, our work is structured as follows. The first section is devoted to presenting a review of the empirical literature. The second section focuses on an empirical study of the direct and indirect effects of corruption on economic growth in Tunisia, as part of an endogenous growth process, using an Error Correction Model (ECM) which enables to estimate the long and short-term effects. Then, the concluding section offers some recommendations for the fight against corruption.

2. A REVIEW OF THE EMPIRICAL LITERATURE

From an empirical point of view, some studies concluded that corruption has positive marginal effects, but only in countries with high institutional deficits (Houston, 2007, Méon and Weill, 2010; Lederman et al., 2005.). However, literature generally shows that corruption has a direct negative impact on economic growth and development but also an indirect effect on the economic efficiency of a country, through its impact on several factors that fuel economic growth, such as investment, taxation and the level of public expenses and their distribution and effectiveness. In fact, some economists, such as Mauro (1995), Tanzi (1997, 1998), Lambsdorff (1999), Treisman (2000) and Gupta et al. (2000), who have long recognized a number of channels through which corruption harms economic growth, showed that corruption distorts the motivations of economic actors and market forces, resulting in misallocation of resources. Moreover, some other studies found that corruption has a significant direct negative impact on economic growth as it can impede it(Ugur and Dasgupta, 2011).

On the other hand, some other authors refuted the existence of a direct link between corruption and economic growth and also effective indirect effects of corruption through different channels, such as private investment, public spending, human capital and etc … (Peligrini and Gerlagh, 2004). However, a third current of research rejects any relationship between corruption and economic growth (Li et al., 2000) and (Abed et Davoodi , 2002).

The empirical analysis of the effect of corruption on economic growth has recorded an unprecedented development since the mid-1990s. In the wake of the work undertaken in this context, a consensus has been reached in recent years stating that if corruption is likely to affect economic growth, its effect will be mainly exerted indirectly on the main determinants of growth. In fact, it is in this perspective that this article is inserted with the objective of explaining the channels of transmission of the effect of corruption on economic growth.

In most cases, these channels have resulted in a negative impact of corruption on economic growth, which seems in conformity with what Mauro (1995) revealed in his seminal study. In fact, this cross-sectional regression, which was conducted on a total of 58 countries, revealed a negative and significant effect of corruption on the per capita real GDP growth rate for the period 1960-1985. Moreover, it showed that a decrease in standard deviation of the corruption index is associated with an increase of the growth rate by 0.8%.

Therefore, this result is consistent with those of Knack and Keefer (1995), Mauro (1997), Leite and Weidmann (1999), Tanzi and Davoodi (2001), Gyimah-Brempong (2002), Gupta et al (2000) and Méon and Sekkat (2005), which all showed that there is a significant negative relationship between corruption and economic growth.

3. RESEARCH AND METHODOLOGY

In the framework of this work, we have opted for an empirical evaluation based on the theoretical model of endogenous growth of Barro (1990), which is redesigned to introduce a variable representing corruption. Subsequently, the econometric approach itself made us select the variables and data that help us perform the various tests required on our data series before proceeding to the estimations using the technique of the Error Correction Model (ECM). The results obtained from the estimates can then be interpreted.

3.1. The Empirical Model and the Selected Variables

The taking account of the different effects in the expression of endogenous growth helps express the development of the per capita production depending on factors of production, corruption (direct effect) and interactions of corruption on the factors of production (indirect effect), so that we can write:

$$\ln y_t = \alpha_0 + \alpha_1 Z_t + \alpha_2 corr_t + \alpha_3 W_t \quad (1)$$

where y_t represents the production in year t. In an objective way, a phenomenon influencing the level of production of a year de facto influences economic growth, which is defined as the variation of the level of production between two periods. Expression (1) therefore provides information on growth technology, $corr_t$ represents the direct effect of corruption on economic growth, Z_t a vector representing a set of factors of production, W_t a vector representing the interactions between corruption and each considered factor of production, which is equivalent to the indirect effects of corruption.

According to Barro model (1990), vector Z, which is made up of variables that explain economic growth, is generally accepted by the endogenous growth theory. Thus, $Z = \{\ln GFCF_t, \ln PE_t, \ln HC_t\}$, where $\ln GFCF_t$ represents the natural logarithm of the fixed gross capital formation, which accounts for the capital factor in the technology of economic growth, $\ln PE_t$ is the logarithm of total public expenditure, which takes into account the externalities of public expenditure in the generation of economic growth. Besides, we included the variable $\ln HC_t$, as the logarithm of the number of students enrolled in primary school, which takes into account the formation of human capital in the growth process.

$W = \{(corr_t \times \ln GFCF_t), (corr_t \times \ln PE_t), (corr_t \times \ln HC_t)\}$, where product $(corr_t \times \ln GFCF_t)$ is the interaction between corruption and the private sector investment, which accounts for the indirect effects of corruption via private capital. Then, product ($Corr_t$

× $\ln PE_t$) is the interaction between corruption and total public spending, which accounts for the indirect effects of corruption through public spending. On the other hand, product ($corr_t \times \ln HC_t$) is the interaction between corruption and the level of enrollment in the primary school, which accounts for the indirect effects of corruption through the formation of human capital. Thus, the expression can be decomposed as presented by the empirical models below:

Equation 1: Direct effect of corruption:

$$\ln y_t = C_t + \alpha_0 \ln GFCF_t + \alpha_1 \ln PE_t + \alpha_2 \ln HC_t + \alpha_3 corr_t + \varepsilon_t \quad (2)$$

Equation 2: Indirect effect of corruption, interaction on gross fixed capital formation:

$$\ln y_t = C_t + \beta_0 \left[corr_t \left(\ln GFCF_t \right) \right] + \beta_1 \ln PE + \beta_2 \ln HC + \nu_t \quad (3)$$

Equation 3: Indirect effect of corruption, interaction on public expenditure:

$$\ln y_t = C_t + \theta_0 \ln GFCF_t + \theta_1 \ln \left[corr_t \left(\ln PE_t \right) \right] + \theta_2 \ln HC + \mu_t \quad (4)$$

Equation 4: Indirect effect of corruption, interaction on human capital:

$$\ln y_t = C_t + \delta_0 \ln GFCF_t + \delta_1 \ln PE_t + \left[corr_t \left(\ln HC_t \right) \right] + \phi_t \quad (5)$$

3.2. Data and Analysis

The data for our study are annual collected from several sources. The first source, which is used to obtain the majority of the macroeconomic series, is the database of the World Bank, more precisely, the World Development Indicators Database in its version of 2018. Thus, we were able to extract the following data: GDP/capita in current dollars to approximate production; private sector gross fixed capital formation to measure private investment (GFCF); the sum of the final consumption expenditure of the administrations and the public GFCF to account for the total public expenditure (PE); the number of students enrolled in primary school for the human capital formation (HC) variable. Following our model, we will apply the Neperian logarithm to each of the data sets mentioned above.

Then, the data about corruption were obtained from the International Country Risk Guide (ICRG) database. This source assesses investment risks in different countries according to various indicators, including corruption. The data are measured based on the scores on the various indicators that have been published since 1980 by a private organization[1] covering more than 130 nations. These scores obtained according to the "country risks" calculation approach for international investors. In fact, Knack and Keefer (1995) were the first to use this database for scientific purposes.

From a methodological point of view, the risks assessed using the ICRG are grouped into three main groups, particularly political risks, representing 50% of the total measure of total risk then, economic and financial risks each representing 25% global risk[2]. One of the political risks is the "corruption" risk, which is translated into the likelihood of illegal payments being requested by the government for granting authorization or enforcing the law. This indicator is measured from 0 to 6. The closer the score is to 0, the greater the risk of corruption.

However, in order to make an easy interpretation of the results, we will standardize this indicator and re-parameterize it intuitively so that a high score corresponds to a high risk of corruption and a low score corresponds to a low risk of corruption. Thus, we define the corruption variable (corr) as follows:

$$corr_t = 1 - \left(score\, ICRG_t \Big/ ICRG_{\max} \right)$$

$$equivalent\ to\ \ corr_t = 1 - \left(score\, ICRG_t \Big/ 6 \right) \quad (6)$$

This reformulation, which was used by several previous researchers such as (Dzumaschev, 2009; Adenike, 2013) then applied to all observations in the series, does not change the value of the collected data.

The series relating to the interaction variables were obtained by multiplying each series of explanatory variables by the variable corr. The construction of the operational databases and their processing were carried out using the Windows-Excel 2010 software. All the used data cover the period from 1988 to 2017. The descriptive statistics of all the series are presented in the Table 1.

The table shows that the standard deviations are generally low for the different series. This observation can be explained by the logarithmic transformation of our series, which has the effect of attenuating the variances between the values of the variables. With the empirical model, the variables and the now specified data, the appropriate estimation method should now be adopted.

4. ESTIMATION AND DISCUSSION OF THE RESULTS

4.1. The Stationarity Test

The stationarity of the series is examined using the augmented Dickey Fuller (DFA) unit root test, the tests of which were performed under three possible model specifications, namely a model with a constant, with a constant and a trend, and without a constant or a trend. The decision rule is that if the DFA value is less than the critical one, then the null hypothesis of the presence of a unit root is rejected and the alternative hypothesis of stationarity of the series is accepted. In the opposite case, we accept the hypothesis of non-stationarity of the series. At the end

1 The ICRG was originally published by the editors of a weekly magazine in the world of finance named "International Reports," which has been being published since 1992 by the "Political Risk Service Group" which is a private group offering paid country analysis services to investors.

2 All risks are measured on a scale of 100, where a score between 80 and 100 means that the investment is of low risk and a score between 0 and 49.9 reflects high risks.

of our estimates in e-views 9.5, the significant results at 5% level are summarized in the following table:

From the Table 2, we notice that at 5% threshold for all the variables, the values of the DFA statistics are below the critical ones of the Mac Kinnon table. Following the decision rule of the DFA test stated above, these results lead us to reject the null hypothesis of the presence of a unit root and therefore, accept the alternative hypothesis of the stationarity of the variables. The probabilities (P-values) associated with the different variables are all less than 5%, thus reflecting the significance of each of the results.

On the other hand, the same table made us notice that no variable is stationary in level but rather in first difference. The variables are therefore stationary and all integrated of the same order I(1), which made us predict, according to Bourbonnais (2005), that there is a cointegrating vector.

4.2. Cointegration Tests

Since the unit root test results have shown that all the variables are integrated in the same order as I(1), the Engle Granger co-integration test (1987) is applied. This test is in fact related to the first stage of the ECM developed by Engle and Granger, which generally consists in estimating the relationship between the variables by means of the ordinary least square method (OLS) and testing the stationarity of the residue. In other words, if the residue is stationary, then the variables are cointegrated and there is a long-term relationship between the retained variables. In our case, it is a question of successively estimating the four equations of our model. The results of the OLS estimates of the different models are summarized in the following Table 3.

Table 1: Descriptive analysis of variables

Descriptive statistics	LNGDP	LHC	LGFCF	LPE	CORR	CORR LNGFCF	CORR LNPE	CORR LNHC
Mean	7.870479	14.04139	22.50617	22.18880	0.466897	10.50806	10.35988	6.55588
Median	7.778645	14.09746	22.46914	22.10621	0.490000	11.00987	10.83204	6.90775
Maximum	8.368715	14.20874	23.10562	22.90971	0.530000	12.24597	12.14214	7.53063
Minimum	7.134708	13.84025	21.45293	21.23865	0.380000	8.15211	8.07068	5.25929
Std. Dev.	0.400730	0.137750	0.468815	0.536342	0.045364	2.617216	2.650486	0.334978
Skewness	0.239349	–0.258104	–0.527069	–0.171842	–0.583883	–0.620666	–0.657047	–0.563971
Kurtosis	1.780349	1.422873	2.483250	1.744469	1.942575	2.013655	2.204410	2.053300
Jarque-Bera	2.074346	3.327510	1.665369	2.047492	2.998869	3.645636	3.465247	3.236653
Probability	0.354455	0.189426	0.434880	0.359247	0.223256	0.167604	0.158970	0.178751
Sum	228.2439	407.2004	652.6790	643.4752	13.54000	448.8413	469.9998	80.18423
Sum Sq. Dev.	4.496371	0.531299	6.154058	8.054571	0.057621	200.1150	180.9321	5.611266
Observations	30	30	30	30	30	30	30	30

Table 2: Unit root test (DFA)

Variables	DFA level statistics	Mac Kinnon's critical values (at 5%)	Probabilities (P-value)	Order of integration
Gross domestic product (GDP)	–5.1548	–2.9718	0.0004	I(1)
Private investments (GFCF)	–4.1209	–2.9718	0.0036	I(1)
Total public expenditure (PE)	–3.6862	–2.9718	0.0102	I(1)
Human capital formation (HC)	–4.1148	–2.9718	0.0037	I(1)
Corruption (corr)	–3.5036	–2.9718	0.0155	I(1)
Corruption-private investment interaction (corr × GFCF)	–3.4575	–2.9718	0.0173	I(1)
Corruption-total public expenditure interaction (Corr × PE)	–3.4768	–2.9718	0.0165	I(1)
Corruption - human capital formation interaction (corr × HC)	–3.4557	–2.9718	0.0174	I(1)

Source: Estimated results from the software e-views 9.5

Table 3: Estimation using the OLS method

Variables	Equation 1	Equation 2	Equation 3	Equation 4
C_t	–14.42635 (–2.872544)**	–14.90832 (–3.034594)**	–14.89215 (–3.021340)*	–14.89561 (–3.012088)**
$lnGFCF_t$	0.353384* (5.959051)	0.342561* (5.592962)	0.351789* (5.921095)	0.351789* (5.921095)
$lnPE_t$	1.509223 (4.558720)*	1.515370 (4.605651)**	1.528560 (4.671365)*	1.514736 (4.572523)*
$lnHC_t$	0.546163 (1.724024)***	0.539031 (1.711071)***	0.541662 (1.713198)***	0.630263 (1.887458)***
$corr_t$	–0.491255** (–2.286507)			
$corr_t$*$lnGFCF_t$		–0.021566** (–2.386033)		
$corr_t$*$lnPE_t$			–0.022007** (–2.359259)	
$corr_t$*$lnHC_t$				–0.020107** (–2.319259)
Observations	30	30	30	30
R2	0.910729	0.910924	0.910686	0.910379
F-Statistic	63.76152	63.91510	63.72781	63.48826
Prob (F-Statistic)	0.000000	0.000000	0.000000	0.000000
Durbin Watson stat.	1.257148	1.255965	1.255621	1.253032

*. **. ***Represent the significance of the coefficients respectively at 1%, 5% and 10%. The values in parentheses below the coefficients are the values of the student statistics (t-statistics)

The interpretation of the results obtained by means of the OLS presented above, requires first to test the stationarity of the residuals of each estimate to ensure that the relationships studied are not misleading and thus confirm the existence of a relationship cointegration between variables. Indeed, if the residue is stationary, the variables are cointegrated and the long-term relationship between the dependent variable and the independent variables is confirmed. In the opposite case, we are in the presence of a fallacious relation, not being able to be estimated by the ECM.

Thus, the DFA test is applied to the residues of each of the equations. In addition to the Mc Kinon critical value decision rule at 5%, the residue stationarity is confirmed by comparing the DFA value with the critical value of the Engle and Granger table, which is -3.04. The hypothesis of stationarity is accepted if, in absolute value, the value DFA is greater than the critical value of Engle and Granger at 10%. The results of stationarity tests conducted on the residues in our case are as follows in Table 4.

The Table 4 shows that the DFA values are all greater than the critical value of Engle and Granger at 10% in absolute value. The residuals of each of the equations are therefore all stationary, thus confirming that the different estimated relationships are actually cointegrating relationships. These conclusions allow us to move on to the second step of estimating the ECM. The ECM is applied to each equation of the model. For this purpose, we take each regression by differentiating the variables. The residue of each equation is denoted u (–1) in the syntax we enter in e-views. The results of the estimates by the ECM are summarized in Table 5.

Table 4: Stationarity test on residues

Stationarity tests	DFA value	Critical value McKinon at 5%	Critical value of engle and granger at 10%	Stationary yes/no
Residue Equation 1 (ε_t)	–5.464	–2.972	–3.04	Yes
Residue Equation 2 (υ_t)	–5.464	–2.972	–3.04	Yes
Residue Equation 3 (μ_t)	–5.456	–2.972	–3.04	Yes
Residue	–5.426	–2.972	–3.04	Yes

Source: Author's estimates

The above results relate to short-term relationships. That said, before any interpretation, it is advisable to check the properties of the restoring force denoted by u (–1) in each equation in order to confirm the effectiveness of a short-term dynamic adjustment error correction mechanism to that of long term. In our case, the specification of the different residues at the end of the ECMs can be summarized as follows in Table 6.

The preceding table shows that the parameters associated with the restoring force in each of the equations are negative and significant. This confirms the existence of an error correction mechanism that readjusts the short-term to the long-run dynamics, and thus confirms the long-term relationships between the variables to which cyclical dynamics are reduced. The values of u (–1) in all the equations are globally close to 0.61 or 61%, meaning that in the event of a short-term imbalance, economic growth returns to its equilibrium path following a convergence speed of 61.0%. This being the case, it is now appropriate to comment on the different results obtained with regard to the long and short-term estimates.

4.3. Discussion of the Results

The interpretations of the results will be carried out equation by equation according to the long and short term relationships with the expected signs of the literature and the formulated hypotheses.

- Equation 1: Direct effect of corruption on GDP growth

The results obtained through the ordinary least square (OLS) estimates presented in Table 3 show that private investments have a positive and significant coefficient at 1% level. This coefficient remains positive and significant by considering the ECM estimates in Table 5. These results mean that both in the long and short run, the private sector investments have an effect on the GDP growth.

Therefore, this result corroborates our expectations about the path of economic growth as theorized by the models of capital accumulation of companies (Domar, 1946, Malinvaud, 1980). From an empirical point of view our results are in conformity with those of Mlambo and Oshikoya (1999) who found a positive effect of private investment on economic growth in a sample of 18 African countries.

Table 5: Estimation by ECM

Models	Equation 1	Equation 2	Equation 3	Equation 4
c_t	–0.525648 (–1.247583)	–0.025686 (–1.250505)	–0.025665 (1.248559)	–0.025669 (1.247728)
$lnGGFCF_t$	0.314833* (5.959051)	0.301652* (5.592962)	0.319871* (5.921095)	0.318791* (5.921095)
$lnPE_t$	0.805794 (2.424210)**	0.802622 (2.422472)**	0.812141 (2.459979)*	–0.803059 (2.413163)**
$lnHC_t$	–0.028263 (–0.061835)	0.032378 (–0.070870)	–0.031705 (–0.069364)	0.005253 (0.011327)
$corr_t$	–0.317687 (–0.976418)			
$corr_t \times lnGFCF_t$		–0.011970 (–1.019077)		
$corr_t \times lnPE_t$			–0.011774 (–0.989217)	
$corr_t \times lnHC_t$				–0.070590 (–0.991306)
u(–1)	–0.610831 (–3.841101)*	–0.612527 (–3.846355)*	–0.610974 (–3.841343)*	–0.610119 (–3.834495)*
Observations	30	30	30	30
R^2	0.495608	0.496443	0.495710	0.494861
F-Statistic	4.519890	4.535005	4.521731	4.506410
Prob (F-Statistic)	0.000537	0.005051	0.005127	0.005215
Durbin Watson stat	1.866823	1.864976	1.865981	1.864077

Source: Author's estimates

Table 6: ECM recall forces

U(–1)	Equation1	Equation 2	Equation 3	Equation 4
Coefficient	–0.610831	–0.612527	–0.610831	–0.610119
t-statistic	–3.841101	–3.846354	–3.841343	–3.844495
p-value	0.0008	0.0008	0.0008	0.0008

Source: Author's estimates

Moreover, when considering public expenditure, we notice that the coefficient is positive and significant both with the OLS and the ECM estimations. Therefore, we can conclude that in both the long and short term, the total public spending in Tunisia is positively related to economic growth. The public sector and its externalities therefore constitute a factor of growth in the Tunisian economy, whatever the horizon. This result is consistent with that of Barro's theory (1990) besides, it is in line with the conclusions of Aschauer's (1987) empirical work, as well as with those of Morley and Perkidis (2000).

Moreover, in terms of the human capital formation coefficient, we notice that it is positive and significant at 10% threshold according to the OLS method. On the other hand, considering the ECM, one notes that the coefficient becomes negative and non significant. This implies that, in the long term, the training of young people in the primary school is positively linked to economic growth however in the short term. this relationship is not significant. Therefore, this result is consistent with the theories developed by Romer (1987) and Lucas (1990) who identified the formation of human capital and its externalities as true sources of long-term growth.

That said, one of the most important findings about the purpose of our study relates to the coefficient of corruption. Indeed, considering the estimations by the OLS, we notice that corruption presents a negative and significant coefficient. However, when observing the estimates with the ECM, we notice that although remaining negative, the parameter of corruption becomes insignificant even at the threshold of 10%. These findings suggest three important implications for the relationship between corruption and economic growth in the case of Tunisia:

- The coefficient obtained using the OLS means that, in the long term, corruption and economic growth are negatively linked, which implies that an increase of the level of corruption causes a reduction of GDP
- However, the non-significant coefficient obtained by the ECMs revealed that in the short term, corruption has no direct effect on economic growth
- These estimates therefore confirm the existence of a direct negative effect of corruption on economic growth however, this effect is only in the long term.

Therefore, the confirmation of the direct effect of corruption on economic growth in the case of Tunisia coincides with what was revealed by several empirical studies, such as those of Gyimah-Brempong et al. (2006) or Dzumashev (2009).

- Equation 2: Indirect effect of corruption on GDP growth through private investment

The regression performed here seeks to examine the presence of indirect effects of corruption through private investment. To this end, we monitor the direct effect of corruption and introduce an interaction variable between the level of corruption and private investment.

The obtained results made us notice that the coefficient associated with private investments is also positive and significant either with the MCO or the ECM methods. Therefore, even under this specification, our results show that there is a significant relationship between private capital and Tunisia's economic growth in both the short and long term. In fact, the coefficients associated with public expenditures remain significantly positive regardless of the considered estimator. Moreover, under this specification, public spending contributes to both long and short-term GDP growth. We can also notice that the human capital formation parameter is significantly positive in the OLS estimates but becomes insignificant in the ECM. This result also shows that training young people in primary education is beneficial to economic growth only in the long term.

That said, the results we are particularly interested in are those related to the interaction variable. Indeed, in the OLS estimation, we find that the interaction variable has a negative and significant coefficient at 5% threshold. On the other hand, the significance of this parameter vanishes in the estimates by the ECMs although the coefficient remains negative. This implies that:

- The coefficient obtained using the OLS shows that the interaction between corruption and private capital has a negative effect on GDP in the long run
- As a result, the influence of corruption on private initiative tends to reduce the GDP in the long run
- However, the ECM estimate, for its part, revealed that the interaction between corruption and private capital has no effect on the short-term economic growth
- Thus, there is a negative indirect effect of corruption on economic growth in the long term.

However, the most important implication of this regression is the highlighting of another modality of indirect impact of corruption on economic growth through private investments. This result is consistent with the expected signs and also with what was found by several studies, such as those of Mauro (1995), Anoruo and Braha (2005) or Everhart et al. (2009).

- Equation 3: Indirect effect of corruption on GDP growth through public spending

Then, the third regression seeks to test the hypothesis of the indirect effects of corruption on Tunisia's economic growth through total public expenditure. From this perspective, we make estimates by controlling the direct effect of corruption and introducing an interaction variable between corruption and total public expenditure. The results show that, with respect to the variables of private investment, of public spending and of human capital formation, the signs of the parameters and their significance are the same as those of the previous equations, both in the long and short term.

Therefore, we notice that the interaction variable has a negative and significant coefficient at 5% threshold in the estimate of the long-term relationship. On the other hand, although remaining negative, the parameter of the same variable is nonetheless significant in the short-term estimate. These results mean that:

- The coefficient obtained using the OLS method shows that the interaction between corruption and public spending has a negative effect on GDP in the long term Delavallade (2006)
- As a result, the impact of corruption on public spending leads to a reduction of the GDP in the long run
- However, the ECM estimate revealed that the interaction between corruption and public spending has no effect on the short-term economic growth
- Therefore, there is a negative indirect effect of corruption on economic growth through public spending in the long run.

This regression thus confirms centrally the existence of a negative indirect effect of corruption on the GDP growth, via public expenditure. In fact, corruption hinders the positive externalities of the public sector on economic growth. This result seems to be consistent with the expected signs and close to the conclusions of Tanzi and Davoodi (1997), Mauro (1998), Agostino et al. (2012), Gorodnichenko and Peter (2007) and Blackburn et al. (2002).

- Equation 4: Indirect effect of corruption on the GDP growth through the formation of human capital.

To this end, we perform the regression test by controlling the direct effect of corruption and then introduce an interaction variable between corruption and the number of students enrolled in the primary school. The results showed once again that with respect to the variables of private investment, public spending and human capital formation, the signs of their parameters and significance are the same as those of the previous equations, either in the long or short term.

The last regression verifies the assumption of indirect effects of corruption on the Tunisian capital formation where the signs of the parameters and their significance are the same as those of the previous equations, both in the long and short-term. However, we notice that the interaction variable has a significant negative coefficient at 5% threshold using the OLS estimation. On the other hand, considering the estimate through the ECM method, one can notice that the coefficient of the variable of interaction loses its significance. Thus, we can conclude that:

- The interaction between the level of corruption and the number of pupils enrolled in primary schools reduces the GDP in the long term but not in the short term.

These findings also indicate the long-term existence of an indirect effect of corruption on the GDP growth, which leads to the training of primary school pupils. In fact, corruption hampers Tunisia's economic growth through its effect on the training of human resources. These results are consistent with the expected signs.

Moreover, another indication as to the significance of the relations can be obtained by comparing the values of the coefficients of determination with the values of the statistics of Durbin Watson (DW). In case of a superiority of the DW values, we can reject the hypothesis of a fallacious relationship. Considering our results, we can notice both for short-term and long-term estimates that the R^2 values are always lower than those of the DW statistics. Thus, neither long-term nor short-term relationship is a fallacious relationship, which further confirms the significance of the model. Moreover, considering Fisher's test, we notice that the P-values are 0.0000 in all estimates through the OLS method and therefore below the threshold of 5%. The decision rule therefore makes us reject the hypothesis of global non-significance and accept the significance of long-term relationships. The obtained estimators are therefore consistent. With regard to the estimates through the ECM method, the conclusions are the same because, despite slight increases in the P-values, they remain below 5% threshold for each equation, which also attests the significance of the short-term relations. Finally, the quality of our estimate can also be assessed with respect to the normality of the distribution of residues, notably using the Jarque-Bera statistics. Indeed, with respect to this criterion, the ECM estimator is consistent when the residuals are distributed according to the normal distribution. The decision rule of the residue normality test would require the assumption of normality of the residues when the P-value of the Jarque-Bera statistics is greater than 5% threshold. In our case, the results of this test are summarized as follows in Table 7.

Table 7: Residue normality test

u	Equation1	Equation 2	Equation 3	Equation 4
Jarque-Bera	0.1975	0.1884	0.1937	0.1960
P-value	0.9206	0.9247	0.9223	0.9164

Source: The author's estimate in E-views 9.5

The table shows that the P-values of the different equations are all above 5% threshold, which makes us conclude that there is a normal distribution of the residuals for each of the estimates. In sum, the specified model is globally significant in terms of several evaluation criteria, thus reinforcing the results that can be obtained from the estimates of this model.

5. CONCLUSION AND RECOMMENDATIONS

The question of the impact of corruption on economic growth is the heart of the researchers' analytical thinking, since it has been shown that if countries fail to achieve development, it is for a good part due to corruption that diverts productive investment and undermines their administrations. Since the famous work of (Mauro, 1995), which shows that corruption reduces the GDP by reducing the investment rate, it is considered by (Tanzi and Davoodi, 2000, Pelligrini and Gerlagh, 2004) that the least developed countries benefit from important investment flows that stimulate their growth and development, while the most corrupted countries suffer from the lack of investment (FDI first) and therefore growth.

As a consequence, anti-corruption policies consistently rely on the support of international actors in this area. In fact, the fight against corruption has become one of the main problems of current governments in both emerging and developing countries.

Therefore, they took various measures sometimes concrete and sometimes rhetorical. This fight against corruption, which has become the heart of development policies, has been stimulated by the international community through donors, non-governmental organizations (NGOs) and international cooperation since the late 1990s. Loans, often diverted, are more and more conditioned to this struggle. These actors provide technical assistance and know-how for the purpose of reducing corrupt practices. There are many international partnerships which offred strategies to teach western standards. The development of such partnerships promotes the dissemination of good practices and allows the emergence of new behaviors. The active participation of the international community reflects in particular its willingness to be not only an adviser but also a more direct partner in the development of countries. Since the problem with the majority of the developing countries is that aid in general, as in the fight against corruption, is frequently diverted and dispersed in the informal networks, or ends up in the pockets of unscrupulous governments, donors have the responsibility to manage their aid in order to eliminate the practices of corruption (Gatti, 2000; Rose-Ackerman, 1999, 2004).

In fact, all the international actors in the fight against corruption play a crucial role not only in financing this fight but also in monitoring the progress in the commitments made by the governments.

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