The impact of corruption on economic growth in Tunisia: application of ARDL approach

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Abstract

This study investigates corruption's impact on economic growth in Tunisia. Using time series data to obtain relationships of an empirical nature. The World Development Indicators 2019 helps to gather data from 1998 to 2018. The processing of time series data starts with checking individual series, and ADF and Zivot and Andrews tests help identify variables' stationarity. The mixed order of integration levels recommends using ARDL to obtain the long-run relationships between the variables. The estimation results confirm that corruption demoralizes and discourages private investment in the short and long run. In both the long and short run, the indirect impact of corruption is negative and insignificant for public spending. However, the interaction between human capital and the corruption perception index is positive and insignificant in the short run but negative and significant in the long run.

Key Words: *Corruption, Economic Growth, Tunisia,* Time Series, ARDL Approch

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1. Introduction

Tunisia has undergone a democratic transition characterized by a peaceful succession of governments and numerous political parties ranging from Islamists to liberals to perceived freedom of expression**.** According to the Global Democracy Rankings Report (2015), Tunisia gained points on the democracy scale (+32 points) between 2010 and 2014. However, the influence of democracies on economic growth remains a matter of debate (Barro 1997). In fact, political instability, which external shocks have reinforced, has contributed to the country's economic difficulties and has revealed the extent to which many problems have worsened. In addition, contagious corruption remains among Tunisia's main complications and is costing the country about 4% of its GDP.

In 2017, Tunisia obtained a score of 42/100 and occupied 74th place out of 180 countries in the world. It has gained one point compared to 2016. But it lost 15 places between 2010 and 2017, the day before the fall of the supposedly very corrupt Ben Ali regime. In contrast, the country has supposedly become a democracy, a democracy more corrupt than a dictatorship.

In this index edition, Denmark and New Zealand shared the first position and recorded a high score of 90. Tunisia arrives, thus, at the head of the Maghreb countries since Morocco is ranked 81st (40 points), Algeria points to 112th place (33 points), Mauritania the 143rd place (28 points) and Libya the 171st place (17 points) but, Syria (178th), South Sudan (179th) and Somalia (180th) close the march of this TI index. Transparency International (2018).

On the other hand, Meddeb (2018) stated that the proportion of citizens who report that corruption levels have increased "a lot" has risen from 42% in 2015 to 55% in 2018, an increase of 13% in three years. In 2019, With a score of 43, Tunisia remained at a standstill on the CPI.

The unclear situation that occupied Tunisia in 2019 indicates the extent of corruption that has plagued the country's machinery and public administrations that operate in an environment without control. The mismanagement, waste and all types of smuggling and trafficking occur within the "black market" and prevail in all areas.

Corruption is a major problem facing humanity, destroying lives and communities, destroying nations and institutions. Moreover, it can provoke popular anger, further destabilize society and fuel violent conflict.

The article is structured as follows: the first section reviews the literature on the effect of corruption on economic growth. The second section presents the specification of the models and methodological issues. The third section contains a critical discussion of the empirical results. Finally, the "Conclusions" section summarises the results and policy suggestions for future research.

2. Literature Review

Based on endogenous growth theory, several adverse effects of corruption on countries' economic growth are widely recognized in the economic literature. Corruption diverts investors, reduces the productivity of public spending, distorts the allocation of resources and reduces economic growth; the idea is confirmed in the publications of Pellegrini, L., & Gerlagh, R. (2004). and Méon, P. G., & Sekkat, K. (2005).

In this context, Mauro (1995) article considered the first empirical assessment highlighting corruption with many economic, social and political variables. In his article, Mauro explained, over a period from 1960 to 1985, the adverse effect of corruption on private investment. The idea is confirmed by Campos, N. F., Estrin, S., & Proto, E. (2010) , Zhou, J. Q., & Peng, M. W. (2012).

Similarly, Zakharov N. (2019) studied the relationship between corruption and fixed capital investment in Russian regions from 2004 to 2013. He addressed the problem of endogeneity of corruption using the instrumental variables approach. The results showed that the breakdown of investments by ownership type revealed that only private investments are affected by corruption, but not investments made by state-owned enterprises. The author concluded that the negative effect is larger for firms with full or partial foreign ownership.

In the case of African countries, Baliamoune Lutz and Ndikumana (2009) studied a panel of 33 sub-Saharan African countries from 1982-2001. The results show that corruption negatively affects

economic growth through investment. In the same context, Ouattara (2011) used time series data to obtain the impact of corruption on public and private investment in Côte d'Ivoire and its effect on GDP growth during 1998-2009. It estimated a simultaneous equation model using the double least squares (DLS) estimator. The estimation results show that corruption is an overestimating factor of private investment in Côte d'Ivoire and that corruption negatively affects GDP growth. On this basis, the author recommends that political and economic actors be made more aware of the harms of corruption.

Indeed, corruption can be a barrier for new investors due to the significant increase in entry and operating costs for multinational enterprises. As a result, Jingtao Yi et al. (2019) verified the results of previous studies, showing that corruption hurts FDI, as business activities in the host country lead to increased costs and uncertainties for multinational firms. For this reason, multinational firms always try to choose their locations strategically and not randomly; during the selection process, they must balance the costs and benefits of investing in a country with low corruption.

For his part, Cuervo-Cazurra, (2016) analyzed corruption in international trade; he argued that corruption creates a laboratory for expanding international trade studies because its illegal nature and the variation in the enforcement of anti-corruption laws across countries challenge some of the assumptions on which the arguments were based, namely that managers can choose appropriate actions without major legal implications.

Mallik and Saha (2016) examined the relationship between growth and corruption in a sample of 146 countries from 1984-2009 using the generalized method of moments (GMM). The estimated results show a negative relationship between corruption and growth.

The results of the empirical literature show that corruption does not always have a negative effect on growth. Indeed, for some countries, it contributes to increased growth, which supports the idea that corruption helps to "grease the wheels."

As Moser (2008) work on Madagascar shows, corruption decreases the quality of public investment. In this sense, the choice of public investment is guided by the personal gains expected by decision-makers and not by the public interest.

Finally, corruption also affects existing infrastructure, particularly its ability to be used optimally due to the lack of maintenance. For this reason, Tanzi and Davoodi (1997) have explained that increased capital expenditure automatically leads to a reduction in the resources available for operating expenditure, particularly for the maintenance of old investments, which nevertheless allow existing equipment to continue to function.

Tanzi and Davooodi (2000) and Gupta et al. (2002) confirm the idea of Gray and Kaufmann (1998), who showed that public sector corruption is the main obstacle to the growth of wealth in countries because it changes the composition of government spending and thus determines its growth.

As for Huang and al. (2015), fighting corruption theoretically leads to a decrease in capital investment and further affects economic growth.

Using cointegration and panel error correction models from 2002 to 2016, Song, C. Q.et al. (2021) studied the relationship between corruption, economic growth, and financial development in 142 countries in the long run. They used the FMOLS method to justify that corruption has a negative effect on economic growth. Thus, they relied on the VECM method to show the existence of long-run causal relationships between the variables in the model to be estimated.

Ghoneim and Ezzat (2016) studied the relationship between corruption and economic growth in the Arab world. To this end, they estimated a model with random effects panel data to determine the impact of corruption on economic growth in 15 Arab countries from 1998 - 2009. The study's results showed that corruption's direct impact on GDP growth depends strongly on other variables, including governance structure.

The study by Zangina, S. and Hassan, S. (2020) aims to analyze the time series from 1984 to 2017. They used the non-linear autoregressive distributed lag (NARDL) bounds test technique to investigate Nigeria's asymmetric relationship between corruption control and foreign direct investment (FDI). The estimation results show that corruption hinders the massive inflow of foreign direct investment and that corruption control has asymmetric effects on FDI inflow in Nigeria. In other words, strengthening corruption controls encourages FDI inflows to Nigeria, but decreasing corruption controls has a negligible effect.

Similarly, corruption destroys the vital purpose of education. Indeed, in an education system characterized by high levels of corruption, students are not provided with the skills and knowledge that will enable them to contribute expressively to their country's economy. However, over time, they learn that a lack of integrity is a permissible aspect that constantly develops into the social norm.

In this context, several studies have shown the negative effect of corruption on human capital. For example, Seka (2013) explained how corruption discourages young talent from pursuing a long education. Indeed, he developed a theoretical model that highlights the impact of detours that corruption had on students by forcing them to abandon long studies to find a job, but with a high bribe yield. This detour of skills reduces the availability of expertise needed for innovation to improve supply, increasing demand.

Padhan, Hemachandra, and al. (2022) examined how corruption can play an important role in the progress of the domestic economy in India and what the degree of response of foreign capital inflow to economic growth might be in the short and long run.

Therefore, the study examined the effects of foreign capital inflows on economic growth by controlling for corruption, government final consumption expenditure, and trade balance from 1995-96 to 2016-17. They used advanced econometric models such as autoregressive distributed lag (ARDL) and Bayer-Hank (B-H). The results showed that external capital inflows, corruption, trade balance, and government consumption expenditures are all associated with economic growth for long-term development.

Swaleheen, M. (2011) examined the effect of corruption on economic growth on panel data from 170 countries from 1984 to 2007. He based on the generalized method of moments. The estimation

results explain that corruption does not decrease GDP growth at all levels and can significantly increase it even at higher levels of corruption. Indeed, rejecting Shleifer and Vishny's (1993) hypothesis that corruption acts like sand in the wheels of growth seems important.

On the other hand, Murphy and al. (1991) observed that corruption diverts skills from productive sectors of the economy with low opportunity for bribes to less productive sectors with high potential for bribes. In other words, the ease of gain derived from corrupt practices in low-design administrative tasks attracts individuals with the potential to innovate, which slows down firms' ability to advance technologically. Based on a panel of 14 countries covering 2002 to 2018, Haseeb, M., & Azam, M. (2021). used the ARDL approach and showed that increased corruption discourages economic growth.

Nsor-Ambala, R. and Coffie, C.P.K. (2022) aim to observe corruption's effect on foreign direct investment (FDI) inflows in Ghana. They used a time series econometric model covering the period 1984-2019 based on the non-linear ADRL approach to estimate data from the World Bank and the International Country Risk Guide.

Anas, Judges et al. (2020) note the phenomenon of corruption in Tunisia in terms of its impact on economic growth. They used a distributed autoregressive model (ARDL) over a study period from 1995 to 2014. Empirical results show that corruption has a negative impact on economic growth in Tunisia. This direct effect of corruption is justified by the low level of long-term growth, by close to 1%, after a 1% increase in the level of corruption. The results also indicate that corruption has indirect effects via transmission channels, such as investment in physical capital, which is positively significant in the presence of corruption.

3. Empirical specification of the model

3.1. Variables and data sources

The study uses annual time series data from 1998 to 2018. It aims to study the impact of corruption on economic growth in Tunisia to know whether it is a direct or indirect effect.

The main variables of interest are:

A/ The dependent variable

GDP per capita: Economic growth is generally quantified as GDP per capita. The data is in current U.S. dollars. Therefore, it is noted as "GDP." This series is taken from the World Bank database (2018).

B/ The independent variables

- Total population: is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. It is noted as "POP". Numerous empirical studies (Barro and Sala-i-Martin, (2004) Sachs, (2008). Headey and Hodge (2009) and Dao (2012) have estimated that economic growth is negatively affected by increasing population growth. This series is taken from the World Bank (2018) database.
- Inflation: is measured by the annual growth rate of the implicit GDP deflator; it takes into account the qualitative aspect of policies implemented in the countries in question, noted "INF".

(Bruno, (1998), Kremer and Bick, (2013). Paldam (2002). This series is taken from the World Bank (2018) database.

- Human capital is measured by the gross enrollment ratio, the total enrollment in secondary education, regardless of age. It is rated "Kh". Among the empirical studies, human capital has a significant positive effect on economic growth. Lucas, (1990), Bergheim, (2005), Howitt, (2005), This series is taken from the World Bank (2018) database.
- Private investment: this is measured by the gross fixed capital formation in expenditure and is used to measure private sector investment. It is noted as "INVP. Seka (2013), Othmani. A et al., (2015), etc... This series is taken from the World Bank (2018) database.
- Government Expenditures: Government expenditures include all government payments in exchange for goods and services used to produce marketed and non-marketed goods and services. It is denoted as "PA". Gupta et al. (2002). This series is taken from the World Bank (2018) database.
- Corruption Perception Index: measures the perception of corruption in the public sector. This index varies between [0 and 10]: the closer it is to 10, the less corrupt the country, and the closer it is to 0, the more corrupt the country. It is denoted "CORR". (Gyimah-Brempong et al. 2006) (Agostino et al. 2016), Njoya, and Aman, N. (2017); Cieślik and Goczek 2018); Bação, 2019); Gründler et al, 2019). This series is taken from the non-governmental organization "Transparency International (2018).

The complete formulation of our econometric model is based on the following previous studies: Hemachandra Padhan et al. (2021), Tsanana et al. (2016), Gyimah-Cieślik and Goczek (2018)

We can write:

$$\mathbf{Log\ PIB}_{i,t} = \beta_0 + \beta_1 \mathbf{corr}_{i,t} + \beta_2 \mathbf{Z}_{it} + \mathbf{W}_{i,t}$$

β_0 , β_1, β_3: Represent the set of coefficients indicating the partial impact of explanatory variables on growth, the vector $Z_{i,t}$ reflects the direct impact of corruption on economic growth.

$$PIB_{i,t} = C_t + \beta_0 Invp_{i,t} + \beta_1 kh_{i,t} + \beta_2 inf_{i,t} + \beta_3 pop_{i,t} + \beta_4 dp_{i,t} + \beta_5 Corr_{i,t} + \varepsilon_t \quad (1)$$

Thus $W_{i,t}$ rreflects the indirect impact of corruption on each factor of production. (2)

Interaction between human capital and corruption

$$PIB_{i,t} = C_t + \beta_0 Invp_{i,t} + \beta_1 [Corr.kh_{i,t}] + \beta_2 inf_{i,t} + \beta_3 pop_{i,t} + \beta_4 dpt_{i,t} + V_t \quad (2.1)$$

Interaction between corruption and private investment

$$PIB_{i,t} = C_t + \beta_0 [Corr.Invp_{i,t}] + \beta_1 kh_{i,t} + \beta_2 inf_{i,t} + \beta_3 pop_{i,t} + \beta_4 dpt_{i,t} + V_t \quad (2.2)$$

Interaction between corruption and total public expenditure

$$\mathbf{PIB}_{i,t} = \mathbf{C_t} + \beta_0 \mathbf{Invp}_{i,t} + \beta_1 \mathbf{kh}_{i,t} + \beta_2 \mathbf{inf}_{i,t} + \beta_3 \mathbf{pop}_{i,t} + \beta_4 [\mathbf{Corr.dP}] + \mathbf{V_t} \quad (2.3)$$

Note that all variables are expressed in logarithm, except for the corruption.

3.2. Estimation technique

In this subsection, we start with the analysis of the descriptive statistics of the variables, as well as the study of the stationarity and, finally, the estimation of the model.

A/ Descriptive statistics

Table 1 presents summary statistics on the variables in the model: the corruption index, economic growth and human capital, private investment, public expenditure, population, and inflation. The standard deviations are generally low for the different series. This observation can be explained by the logarithmic transformation of the series, which attenuates the variances between the values of the variables. Generally, the measure of corruption ranges from 0 to 10. From 1998-2018, Tunisia's corruption index is significantly more widespread, and its level varies between 5.2 (Maximum) and 3.8 (Minimum). Corruption has a mean of 4.495 and a standard deviation of 0.480, which shows that most of the population corruption is not far from the sample average, reflecting the severity of the corruption problem in Tunisia.

B/ Correlation study

To detect a possible relationship between the different variables, we will present the different correlation coefficients in ***Table 2.*** Generally, values greater than or equal to **0.50** indicate that the variables are strongly positively or negatively correlated depending on the effect of the variable under consideration on the other. Indeed, the simple correlation matrix between the variables below shows two significant correlations between the dependent variable (GDP) and the explanatory variables. In addition, there is a strong correlation between human capital, total population, and public expenditure on goods and services (0.85 > 0.50 and 0.63 > 0.50). It may be possible that the importance of human capital creates more opportunities for increased economic growth in our country. However, there are weakly correlated correlations and others that are negative between the explanatory and explained variables.

The descriptive statistics of the endogenous variable and the explanatory variables, as well as the correlations between the different variables, are presented in the following tables:

Table 1: Descriptive statistics of the data

	Maximum	Minimum	Average	Standard deviation
GDP	3.634191	3.344751	3.521790	0.105464
KH	1.967856	1.834421	1.929060	0.041270
INVP	1.403549	1.268106	1.349189	0.041876
INF	0.839322	0.323719	0.580891	0.128834
RFP	0.935077	0.639357	0.767452	0.107682
POP	7.063153	6.978174	7.018945	0.026037
CORR	5.300000	3.800000	4.495238	0.480079
CORR_KH	9.981450	7.393262	8.655616	0.768600
CORR_INVP	7.438812	4.931570	6.076029	0.775049
CORR_DP	4.930733	2.429557	3.489598	0.818594

Source: Author's estimate

Table 2: Correlation matrix

	GDP	*KH*	*INVP*	*INF*	*RFP*	*POP*	*CORR*	*CORR_KH*	*CORR_INVP*	*CORR_DP*

GDP	1									
KH	**0,906**	1								
INVP	0,456	-0,577	1							
INF	0,402	0,484	-0,552	1						
RFP	-0,675	**0,632**	**0,753**	-0,552	1					
POP	0,759	**0,856**	-0,825	0.594	-0,855	1				
CORR	-0,888	-0,846	0.579	-0,31	**0,806**	-0.846	1			
CORR_KH	-0,837	-0,763	0.552	-0,252	0,814	-0.763	0,990	1		
CORR_INV	-0,863	-0,854	0.725	-0,391	0,856	-0,913	0,981	0,965	1	
CORR_DP	-0,812	-0,766	0.703	-0,466	0,960	-0,891	0,936	0,935	0,955	1

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3.3. Unit root test

The stationarity of the series is examined using the ADF and AZ unit root test. The ADF tests were performed under the three possible specifications of the model, namely with constant, with constant and trend, and without constant and trend. The decision rule is that if the ADF or AZ value is less than the critical value, the null hypothesis of the presence of a unit root is rejected, and the hypothesis (H1) of the series stationarity is accepted. Otherwise, we accept the hypothesis of the non-stationarity of the series. The results are summarized in **Table 3**. This table shows that the statistical value of the ADF test associated with the different variables is higher than the critical value at the 5% threshold. Following the decision rule of the ADF and AZ test stated earlier, these results lead us to accept the null hypothesis of the presence of a unit root. This implies that our time series is non-stationary.

We note that public expenditure and the interaction variable between corruption and private investment are integrated of order 1 (stationary after the first difference). At the same time, inflation remains stationary at the level (without differentiation). But the other variables were differentiated twice to be stationary.

In this context, the variables are either integrated or stationary at different orders, allowing us to choose the ARDL approach for estimating our model.

Table 3: Unit root test

Variables	ADF	Zivot and Andrews (1992)		Stationarity
	t-stat	t-stat	Time break	
GDP	-3.541	-6.626	2009	I(2)
KH	-4.964	-5.449	2014	I(2)
INVP	-6.595	-6.758	2014	I(2)
INF	-3.565	-5.499	2007	I(0)
RFP	-6.041	-6.228	2015	I(1)
POP	-8.118	-9.155	2016	I(2)
CORR	-5.583	-6.784	2007	I(2)
CORR_KH	-5.580	-8.114	2010	I(2)
CORR_INV	-6.062	-7.404	2014	I(1)
CORR_DP	-6.151	-7.544	2011	I(2)

Source: Authors' calculation

3.4. Testing Co-Integration

To test cointegration, it is important to: determine the optimal lag (AIC, SIC) and use Fisher's test to test for cointegration between series.

A/ Optimal shift and ARDL model estimation

We will use the Schwarz Information Criterion (SIC) to select the optimal ARDL model that provides statistically significant results with the least parameters.

Table 4 shows globally significant results. For this, we assume that the selected ARDL approach is appropriate to avoid the uncertainties created by the unit root test and can obtain better estimates on small sample sizes (optimal estimation) to make the series stationary in the same order.

Thus, we find that the coefficients associated with the recall force or the adjustment coefficients in all the estimated models are statistically significant and carry negative signs. This guarantees the existence of an error correction mechanism that increases the possibility of finding long-term relationships between the variables. But the adjustment coefficients in the sub-model3 are positive and insignificant even at the 10% threshold. This weakens the possibility of finding long-run relationships between corruption and human capital.

B/ Short-term dynamics

Table 4: *Impact of corruption on short-term economic growth*

Variables	Model 1	Model 2	Model 3	Model 4
GDP	0.695401	1.130366	0.581293	0.637429
	0.0003***	0.0000***	0.0008***	0.0002***
KH	(1.584203)		(1.287194)	(1.558594)
	0.0162**	-	0.0304**	0.0100**
INVP	(-0.592274)	0.160284		(-0.440519)
	0.0607*	0.6778	-	0.0676*
INF	(-0.149629)	(-0.234081)	(-0.164916)	(-0.151739)
	0.0095***	0.0462**	0.0055***	0.0036**
RFP	(-0.311148)	(-0.396019)	(-0.240816)	
	0.0206**	0.1187	0.0707*	-
POP	(-2.541027)	0.900029	(-1.931148)	(-0.440519)
	0.0085***	0.4703	0.0187**	0.0676*
CORR	0.036878			
	0.3749			
CORR_KH		0.034521		
		0.3119		
CORR_INV			-0.010370	
			0.7044	
CORR_DP				(-0.037429)
				0.0288**
R^2	0.987923	0.969886	0.981211	0.984759
R^2 *ajusté*	0.974505	0.942783	0.967547	0.973675
F-stat	73.62312	35.78549	71.80717	88.84411
Probability	0.000000	0.000002	0.000000	0.000000
Durbin-Watson	2.605102	1.657213	2.004048	2.645234

	F-statistics	F-statistics	F-statistics	F-statistics
ECM t-1	-0.304599	0.130366	-0.418707	-0.362571
	(0.0350)	(0.4419)	(0.0071)	(0.0105)
Specification	1.277	3.5306	4.604	0.776
	[2911]	[0.0635]	[0.0575]	[0.398]
Autocorrelation	1.755	0.298	0.064	4.034
	[0.2053]	[0.5978]	[0.8051]	[0.072]
Heteroscedasticity	1.755	0.644	0.2434	0.697
	[0.2053]	[0.7395]	[0.972]	[0.6886]
Normality	0.0850	0.919	0.971	0.636
	[0.958]	[0.631]	[0.615]	[0.727]

Source: *Authors' calculation of ARDL model using Eviews9*

Note*: Values in parentheses represent the coefficients of the estimated parameters, ***, **, * represent the significance of the coefficients at 1%, 5% and 10%, respectively. F-statistic values of the ARDL model. Appropriate lag length (k) is chosen for each model.*

The results of the short-term coefficient study are interpreted in the following paragraphs.

C/ Robustness tests of the estimated ARDL models

To test the robustness of our model, it is important to apply tests that help diagnose the estimated ARDL models: the error autocorrelation test, the heteroskedasticity test, the error normality test, and the Ramsey test.

Based on the results found, the Ramsey specification test reveals that the probabilities and Fisher statistics associated with the four models are greater than 5%, so we accept the null hypothesis, which means that there is no lack of variables and the models are well specified.

The normality test of the errors reveals that the probabilities associated with the models presented are greater than 5%, which implies accepting the null hypothesis and showing that the errors of the four models follow the normal distribution.

On the other hand, time series often carry error autocorrelation, so the Breusch-Godfrey autocorrelation test is necessary. The displayed results indicate that the probabilities of all the models presented in our study are higher than 5%. Then we accept the null hypothesis of the absence of autocorrelation.

Statistically, the null hypothesis is accepted for all these tests. Thus, the models are validated.

3.5. Study the Cointegration of Pesaran et al. (2001)

Following the automatic procedure on Eviews 9, the Pesaran et al. (2001) cointegration test requires that the ARDL model be estimated beforehand. The computed test statistic will be compared to the critical values (which form bounds) as follows:

- If Fisher value > upper bound; Co integration exists
- If Fisher value < lower bound; Co integration does not exist

Level of significance	Lower bounds	Upper bounds
1%	3.15	4.43
5%	2.45	3.61
10%	2.12	3.23

F-Stat	4.104056

Table 5: *Results of the Pesaran et al. (2001) cointegration test*

The results of the Co-integration test confirm the existence of a Co-integration relationship between the variables studied. The F-calculated (4.104056) is higher than the largest value of Pesaran et al. (2001) at 5% (3.61).

A/ Long-term elasticities

The long-run elasticities between corruption and the other variables are summarized in the table below.

Table 6: *Impact of corruption on long-term economic growth*

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
KH	(6.169752)		(3.643377)	(3.925773)
	0.0263**		0.0025***	0.0015***
INVP	-0.867588	-1.229487		(-1.214986)
	0.3775	0.7043		0.1519
INF	(-0.797980)	2.593905	(-0.509017)	(-0.491307)
	0.1170	0.3721	0.1058	0.0741*
RFP	(-1.021499)	1.096080	-0.575143	
	0.0734*	0.5355	0.0732*	
POP	(-8.342198)	-6.903853	(-4.612172)	(-7.372888)
	0.0558*	0.5592	0.0157**	0.0298**
CORR	**0.121071**			
	0.4612			
CORR_KH		**-0.424738**		
		0.2902		
CORR_INV			**-0.024768**	
			0.6950	
CORR_DP				**(-0.103233)**
				0.0116* **

Note*: Values in parentheses represent estimated parameter coefficients, ***, **, * represent significance of coefficients at 1%, 5%, and 10% respectively.*

The results will be interpreted model by model, following the short-term and long-term relationships.

4. Discussions and recommendations

4.1. Corruption and Economic Growth

One of the most important results for our study is the link between corruption and economic growth and the corruption coefficient. Indeed, considering the ARDL estimates, we note that :

The coefficient on human capital **is** positive and significant at the 5% level. Indeed, this factor, represented by the total enrollment in secondary education, is one of the explanatory variables of the increase in economic magnitudes. Thus, in this context, Lucas (2015) claims the need to place human capital at the centre of economic growth since it contributes to increasing the GDP in the long and short run. This result is also consistent with the theories developed by Romer (1987) and Lucas (1988), who

identify human capital formation and its externalities as the true sources of economic growth in the long run.

The coefficient associated with the population growth rate (POP) is negative (-2.54102) and significant at the 1% level (0.0085) in the short term as well as in the long term. The estimation results show that in Tunisia, when the population increases by 1%, all other things being equal, the economic growth rate decreases by 0.08% in the short term and by 0.05% in the long term, and vice versa. This value is highly significant at the 10% and 5% threshold. The sign obtained is consistent with our expectations and has been found in the work of Bloom, Canning Malaney, Dao (2012) and (Barro and Sala-i-Martin (2004) Sachs (2008). As a result, Headey and Hodge (2009) and others have revealed that an increase in population leads to a decrease in the level of capital per worker, negatively affecting economic growth.

In Tunisia, population growth during the period 1998-2018 had a negative impact on GDP per capita. This result is explained by the fact that investments in physical capital do not follow population growth. In addition, unemployment rates are still very high in our country. Therefore, it will be necessary to facilitate possible measures and conditions for investment in the private sector so that this high population growth positively impacts economic growth.

Generally speaking, for population growth to stimulate economic growth in Tunisia, the public authorities must facilitate the creation of private enterprises (which reduces unemployment and the dependence of the population), as well as make FDI more attractive (more flexible tax policy to facilitate the establishment of companies),. Etc.

All these measures would contribute to the acceptable use of a qualified workforce and a great improvement of the economic wealth of Tunisia.

Second, private investment has a negative and significant coefficient at the 10% level in the short run. But negative and significant in the long run. In other words, private sector investment does not affect GDP, which implies that investment by private firms does not contribute to economic growth in Tunisia. This conclusion is contrary to our predictions. From an empirical point of view, our results contradict those of Mlambo and Oshikoya (1999), who find a positive effect of private investment on economic growth in a sample of 18 African countries. However, these results confirm the observations of the WB reports on economic growth in the world, echoed by Sackey (2007). These reports show that Africa is the slowest growing region in the world because private capital investment is low and does not contribute to growth. In the case of Tunisia, this observation could be explained by the weakening of commodity prices, which has led to a decline in investment in countries that export these products. In addition, the ambiguity related to economic decisions and the political game can contribute to the decline of private investment in Tunisia. And the concomitant slowdown of economic activity following idiosyncratic shocks. (2008 crisis, and 2011 revolution).

We also note that the coefficient of inflation in the short run is negative (-0.14962) and significant at the 1% threshold (0.0095); thus, in the long run, this coefficient remains negative (-

0.797980) but not significant. In many empirical studies, the results suggest that the inflation rate has a negative impact on economic growth. In this context, a high level of inflation leads to an arbitrary distribution of public wealth. In addition, it increases the level of corruption in the country, which increases volatility and uncertainty, resulting in a shift to less productive activities. At this level, the results are consistent with the findings of Paldam (2002), Khan and Senhadji (2001), Burdekin et al. (2004) and Kremer and Bick (2013). However, Inflation is considered the main threat to the Tunisian economy; it was established at 7.5% for the whole year 2018, 6.4% in 2017, and 4.2% in 2016.

Indeed, due to these main factors, the competitiveness of the Tunisian economy is deteriorating, and foreign trade is penalized because of the fall in the price of imported products compared to the rise in the price of local products. Thus, inflation penalizes savings through the loss of the value of the money saved, which subsequently hinders the increase of economic growth.

Concerning public expenditure, we can conclude that in the long term as well as in the short term, the coefficient of total public expenditure on goods and services is negative and significant at the 5% threshold. Thus, we note that public spending is negatively related to economic growth in Tunisia, so that a decrease of 1%, all things being equal, in spending on goods and services leads to a decrease of 0.07% of GDP per capita in the long run and a decrease of 0.02% in the short run. At this level, the public sector and its external factors do not effectively constitute a factor of growth of the Tunisian economy as in other countries because the main failure of public finance management lies in the lack of control of public spending. Thus, the control system overspending and budgetary procedures play an important role in the fiscal adjustment process. However, in practice, Tunisia has not yet been able to put in place an effective system because of administrative restrictions and the lack of better allocation of state resources.

Finally, the link between corruption and economic growth is one of the most important results for the purpose of our study relates to the coefficient on corruption. Indeed, considering the estimates by the ARDL approach, we note that corruption presents a positive and insignificant coefficient even at the 10% threshold in the short run than in the long run. These results suggest that the coefficient obtained means that in the long run, corruption and economic growth are positively related so that an increase in the level of corruption causes an increase in GDP per capita. On the other hand, both the short-run and long-run estimates demonstrate the absence of a direct effect of corruption on economic growth.

At this stage, the findings of modelling the direct effect of corruption on economic growth in Tunisia are also consistent with the results found by Huang (2016), who studies the effect of corruption on economic growth in 13 Asia Pacific countries over a period from 1997 to 2013. Thus, the same results are found by Tsanana et al. (2016) and Ondo, A. (2017).) However, these findings are in contrast to the work of other authors who found different results, namely Gyimah-Brempong et al. (2006) or Gründler and Potrafke (2019) and, Cieślik and Goczek (2018), d'Agostino et al. (2016), Bação (2019).

To conclude, we note that corruption does not directly affect economic growth in Tunisia. Still, it can be passed through human capital, private investment or public spending to indirectly explain the negative impact on the dynamics of GDP in Tunisia.

The coefficient of determination (R2) is of the order of 0.987923, indicating a very strong positive relationship between the dependent variable (GDP) and the explanatory variables and that the model explains 98.8%.

Furthermore, a brief look at the adjusted R-squared value (97.45%) indicates that after removing the insignificant effect of the estimator (explanatory variable), about 1.14% of the variation in real GDP is still accounted for by the independent variables.

The Durbin-Watson statistic is a statistic used to detect the presence of autocorrelation. Generally, if DW is less than 2, the successive error terms are correlated; if DW is greater than 2, there is no autocorrelation. For our case, the value of the Durbin-Watson statistic for the model is 2.605102, so there is no autocorrelation.

4.2. Corruption and economic growth through human capital

This regression tests the hypothesis of the existence of an indirect effect of corruption on economic growth in Tunisia through human capital formation. To this end, we start from the idea that human capital is one of the determinants of economic growth, in line with the literature (Becker 1993, Lucas 1988). We, therefore, seek to quantify the indirect impact of corruption on this variable.

In the long run, the results show once again that the signs of the parameters and their significance are not the same as those in the short run for government spending and inflation. However, we note that the interaction variable has a positive and insignificant coefficient even at the 10% level. Moreover, after estimating the ARDL method, the interaction between the level of corruption and the number of students enrolled in secondary school reduces GDP in the long run. Still, it has no effect in the short run. These latter findings, therefore, also indicate the absence of an indirect effect between corruption and human capital in the short run; this result is consistent with the results found by (Njoya, N., & Aman, N. (2017) in a study conducted on Cameroon.

In the same context, Outtara (2007) clarified how corruption could handicap human capital formation by distressing and discouraging young people from undertaking too long an education, which could have a negative impact on long-term growth. Similarly, Chkir and Allaoui (2010) presented an empirical application in panel data on a sample of 25 developing countries from 1984 to 2005. The results found by the latter show that corruption negatively affects the accumulation of human capital, hindering the growth of these countries. Seka (2013), Othmani. A et al., (2015), etc...

Indeed, the prevalence of corruption in our country may be due in part to the number of students who leave universities prematurely without having a complete and appropriate education that will enable them to obtain decent work. Therefore, to reduce corruption in education, it is necessary to focus on the cult of completion in school and the best possible reward for intellectual effort to increase the incentives

for skill acquisition and the reduction of poverty so that families find the means to enrol their children in school.

The hypothesis that corruption affects growth through its negative effect on human capital formation is at the heart of several articles and is even a secondary objective to achieve our main goal, which is summarized in the above theoretically and empirically. But in our study on Tunisia, this hypothesis is rejected in the short run and accepted in the long run.

4.3. Corruption and economic growth through private investment

The regression conducted elsewhere attempts to examine the presence of indirect effects of corruption through private investment. To this end, we test for the direct effect of corruption and slip an interaction variable between the level of corruption and private investment.

The results allow us to understand that the coefficients associated with public spending are negative and significant at the 10% level in the long run. Thus, we notice that the parameter of human capital formation is positive and significant at the 1% level. This implies that a 1% increase in total secondary school enrollment, all else being equal, increases the economic growth rate by 0.02% and vice versa. Inflation also negatively affects economic growth through a 0.1% decline in the country's GDP in the event of a 1% increase in the inflation rate.

In both the short and long run, the coefficients associated with the interpreted variables have the same signs and are all significant. The results we are particularly interested in are related to the influence of corruption on private investment and growth. In this context, the coefficient obtained by the ARDL approach shows that the interaction between corruption and private investment has a negative sign (-0.010370) and is not significant even at the 10% level. In other words, investment in the private sector does not affect the increase in the country's GDP.

However, corruption is high in private firms and negatively affects their performance through bribes and bureaucratic inefficiency, as well as the political risks that exist in the country.

As a result, the influence of corruption on private initiatives tends to reduce GDP in the long run, indicating a negative indirect effect of corruption on economic growth through the level of the private capital stock.

The results of our estimation attest to the fact that corruption demoralizes and discourages private investment, suggesting that it increases costs for firms while intensifying uncertainty about the perceived return on investment. Our findings support the idea that corruption undermines the level of economic growth. This result is consistent with the expected signs and aligns with several works. Campos, Estrin, and Proto (2010), Zhou and Peng (2012), Jingtao Yi et al., (2019) and N. Zakharov (2019).

4.4. Corruption and economic growth through public spending

The last regression seeks to test the hypothesis of indirect effects of corruption on economic growth in Tunisia through public spending.

To this end, we carry out the estimations controlling for the direct effect of corruption and introduce an interaction variable between corruption and public spending on goods and services. The

results show that in the long and short run, the signs of all the variables included in the latter model are consistent with the expected signs already reported in the literature.

However, we note that the interaction variable has a negative coefficient of (-0.440519) and is significant at the 5% level in the short run; the estimation shows that the coefficient obtained reveals that the interaction between corruption and public spending also has a negative effect of (-0.103233) on GDP and significant at 1%. Thus, the impact of corruption on public spending leads to a reduction in GDP in the long run. However, there is a negative indirect effect of corruption on economic growth through the interaction between the level of corruption and public spending.

We build on the idea of Scott (1972) to certify that the increase in the proportions of corruption is greater when the size and scope of the public sector are more important questions in the economic circuit. This regression thus centrally confirms the existence of a negative indirect effect of corruption on Tunisia's GDP per capita. Corruption impedes the positive externalities of the public sector on economic growth. This finding is consistent with the expected signs and close to the findings of Tanzi and Davoodi (1997), Mauro (1998), d'Agostino, Dune, and Pieroni (2012). Njoya, and Aman, N. (2017).

5. Conclusion

In this empirical study, we tried to contribute to the resolution of the fundamental question: is there a link between the corruption of a country and the economic growth it achieves? To solve this problem, we have used an endogenous growth model in the case of Tunisia from the period 1998-2019. Furthermore, in the same context, we tested our variables' stationarity, Co-integration and the long-run relationship from this empirical study.

Finally, based on the estimation of the time series data of Tunisia, which are related to the period 1996-2019, and the use of the ARDL method,The use of this type of model aims to study the existence of a long-term relationship between the dependent variables as well as the direct and indirect impact of corruption on economic growth in Tunisia the key findings from this empirical analysis reveal the following conclusions:

Our estimation results attest that corruption demoralizes and discourages private investment in the short and long run, suggesting that it increases costs for firms while intensifying uncertainty about the perceived return on investment.

The results also reveal that in the long and short run, the indirect impact of corruption is negative and insignificant for public expenditures. The results found in this study consolidate the conclusion reached in the empirical literature by several authors. However, the interaction between human capital and the corruption perception index is positive and insignificant in the short run but negative and significant in the long run.

We conclude, without confirming, that the analysis of this article has allowed us, even partially, to show the absence of a direct effect and then that it is a positive relationship between corruption and economic growth. Indeed, after detecting certain channels through which the effects of corruption on the

performance of the Tunisian economy could pass, we note that it is an indirect effect transmitted through public spending and private investment.

This way, we will proceed with the analyses conducted in the following articles. But the following idea will attempt to empirically analyze the role of governance in the fight against corruption and improving economic growth in Tunisia.

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