Impact of Corruption on Economic Development: Case of Tunisia

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Abstract: In this paper, we predict the economic development of Tunisia by applying the alpha (α) model. The model is first validated for ten countries which were qualified as the less corrupted countries worldwide using the classification of International Transparency during the period of 1995 to 2014. Five variables are considered in the model to predict the economic development: Fixed capital formation, GDP per capita, life expectancy, school enrollment and unemployment. A good agreement between measured and predicted economic development data is obtained for all the selected countries. However, for Tunisia, we find a gap between the real and the predicted GDP per capita, which represents the cost of corruption.

Keywords: Corruption, economic development, prediction, α-model.

1 Introduction

Corruption is more likely to be exposed in the more economically developed countries. Economic development increases the spread of education, literacy and depersonalized (arm's-length) relationships [1]. The "arms-length" principle requires that personal relationships shall play no role in economic decisions involving more than one party. Equality of treatment for all agents is essential for a well-functioning market economy. Rich countries are relatively efficient, where transactions have to be fast and transparent. Corruption is a break of the "arm's-length" principle and may make transactions inefficient, slow and unpredictable [2]. This insight can be expressed as follows: Seen from the perspective of households, honesty is good with high-income elasticity this means the demand for honesty increases with the income levels. Seen from the perspective of firms, honesty is a time-saving device that becomes more necessary as countries grow rich. Thus, honesty is hypothesized as a production factor [3]. An additional reason to expect that corruption might decrease with economic development is related to social stigma. Some scholars argue that the social stigma facing corrupt

officials if exposed, changes with economic development. Ekpo [4], for instance, suggests that in traditional societies, where the lines between public and private are less clearly drawn and where gift-giving is not clearly distinguished from bribery, the social stigma may be lower. Thus, the attempt to apply traditional norms to a complex, modern economy is a recipe for corruption. From this line of partially theoretical arguments and intuition, political scientists and economists have derived hypotheses regarding the relationship between corruption and economic development. In cross-country regression analyses, Paldam and Treisman [3] found that by far the most important determinant of corruption is the economic development, measured by real GDP per capita. Causality runs from economic development to lower corruption, and from corruption to lower economic development (measured by GDP per capita). However, a specific attention has been paid to the issues of a negative interaction between the level of growth and the level of corruption by organizations such as the World Bank and the International Monetary Fund. We particularly consider that in a country such as Tunisia ranked according to Transparency International as a medium

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corrupted country, its level of corruption adversely affects its level of economic development. To estimate the implicit cost of corruption on the level of development, we apply the alpha model, better known in the solar irradiance prediction [5]. In our context, in order to validate the alpha model to predict the economic development, we operate the test within weak level corrupted countries. To forecast the economic development, we use macroeconomic explicative variables qualified in literature as a determinant of economic development in a weak level of corruption. By analogy, we then applied the same model to the special case of Tunisia in order to test the existence of a gap between the real and the predicted GDP per capita. This paper is organized as follows: In the second section, we present the theoretical consideration of development and corruption. The third section provides the dataset description. Section four is dedicated to the methodology description. Section five deals with a brief presentation of the alpha model which will be used for the prediction of economic development. The alpha model implementation, results, and analysis are given in section six for less corrupted countries and for Tunisia.

2 Review of Corruption and Economic Development

2.1 Impact of the Corruption on the Economic Development

Numerous researchers [6],[7],[8],[9] have endeavored to find the relationship between corruption and economic growth. No matter the key performance indicators (KPI) or statistical variables used in these studies, a negative relationship between corruption and economic growth was found in the majority of the studies. For example, Kutan, Douglas [10] find that the corruption in public and private sectors of a country creates more bottlenecks in the operations and flow of the institutions and also make the financial monitoring intricate, both internally and externally. Thus, when the inflow and outflow of money and assets are not effectively monitored and measured, the operating efficiency of the institutions decreases, resulting in mounting debts and reduced profitability. Mo [7] used statistical measures to analyze the direct impact of corruption on the economy. It was found that 1% of an increase in estimated corruption level produces a decrease of economic growth by 0.72%. This leads to the hypothesis that less corrupted countries, i.e. the ones where practices of bribery are lower and higher transparency level in institutions, will enjoy greater economic development than the more corrupted countries. Tanzi and Davoodi [11] discus that corruption in a country can affect the overall economy on the country in multiple ways. Under a cross-country data analysis, it was found that the corruption causes higher public investment,

lower government profitability, fewer assets and budget for operations and maintenance, and fewer assets for improving the economic and overall infrastructure of the country. The household expenses increase as civilians have to pay higher taxes; however, the tax money is not being capitalized and the economy of the country is not benefited to the same extent. Gupta and Verhoeven [12] state that healthcare is one of the sectors that consume a high level of government and private funding. Corruption in healthcare institutions means that the entire money planned for healthcare improvement is not utilized, thus resulting in a lower than expected level of administration quality and healthcare service, and overall infrastructure of the healthcare institution. It is for this reason that a number of researchers have used the factors of life expectancy and child mortality at birth as the indicators of corruption in a country or system. As the rate of child mortality increases, it draws more attention to the healthcare sector, thus, demanding more funds for improved healthcare system and services. It is evident that in the presence of corruption, the funds will again be misused, thus, hurting both the healthcare sector as well as other private and public sectors, which could not have been funded due to less priority. Comparing the GDP of the least with the most corrupt countries, Patton [13] determines that 19 out of the 21 most corrupt countries have an annual GDP of less than 100 billion, while only four least corrupt countries have an annual GDP below this mark. Popova and Podolyakina [14] state that when corruption is in play, people do not get equal opportunities, companies having a link with political parties are preferred and given more benefits by the government than the ones with no links, and investments are not channelized adequately in different sectors. Combining all these factors result in slow economic progression and reduced ability of the government to improve its economic infrastructure.

2.2 Impact of the Corruption on the Foreign Direct Investment

Economic growth of a country is closely related to the foreign direct investment (FDI); thus, the estimation of the impact of the corruption on FDI would give a better idea of the correlation of the former with economic development and sustainability of a country [15]. Previous studies have looked into the relationship of corruption and FDI from two standpoints of "grabbing-hand" and "helping-hand" [8][16]. The tenet of grabbing-hand claims corruption to negatively affect the profitability of firms and the country. When firms have to make illegal contracts, they have to bribe the government officials or other people who can help them in achieving their goals faster. In the short run, this practice of bribery put firms at high risk as illegal contracts can be overturned and they cannot be presented in the court.

Furthermore, it reduces the abilities of firms and institutions to invest in international companies or increasing their revenue channels [15]. As firms produce low revenues, at least on paper, their tax contribution decreases, and thus, the government revenue is affected proportionally. On the contrary, large firms might be amenable to pay a bribe in order to get permission for manufacturing plants, which could have taken years to get permission, following the standard procedures. In this way, corruption can be deemed to act as a helping-hand for inward FDI, when the plant's set-up will get mature and start producing large revenue for the firm and for the home country [15]. Another way to look at the relationship between the corruption and FDI is the amenability of foreign investors to direct their capital in the country for mutual gains. It has been found by Habib and Zurawicki [17] that countries with high level of corruption are deemed ambiguous by foreign investors in terms of profitable returns. Habib and Zurawicki state that corruption leads to unpredictable results, as the entire investment is not directed to where it is intended to be, thus, giving a sense of uncertainty and unreliability to the foreign investors. A number of African countries, where political corruption is rampant, a small number of foreign investors are motivated to invest in those countries [18]. This is one of the prime reasons for the stagnant financial growth of a number of African countries. Foreign investors look for options where they can get maximum benefits for their investment in low time, and given the conditions of stable environment and that of an unstable or unpredictable environment, the majority would choose the former. Collaer and Hines [19] found no significant relation between corruption and FDI until individual factors were taken into account. Corruption is not simply bribing for mutual gains or consuming public assets for private gains; it can have multiple forms. Corrupted institutions are found to have weak economic policies, weak policies for protection and property rights, and low emphasis on maximizing revenue channels and service innovation. It is for this reason that corrupted institutions are deemed vulnerable to economic and market fluctuations by the investors, and this visible lacking makes the foreign investors reluctant to invest in such firms.

international investments. The study found that as a firm matures financially, the likelihood of being engaged in unethical practices of bribery and illegal contracts decreases. Brady [6] elaborates that as the boundaries of a firm expands, the cost of expansion and relocation decreases, and firms gain greater ability to set-up plants and franchises with little efforts. Thus, the need for bribing and engaging in illegal activities for getting the work done decreases proportionally. [20] have used the variable of employment to measure an institution's growth and how it affects its bribery practices. As the rate of employment grows, indicating financial growth as well, institutions become more renowned with expanded networks, and thus, the chances of giving money or other benefits or having their work done declines. A 10% increase in a firm's employment was found to result in a 0.23%-point decrease in the bribe rate as a proportion of firm revenue. [20] have proposed a model to analyze how government bribe is affected by the growth in business. In the proposed model, the bribe money is also taken as tax, as it is the money that firms have to pay to the government in order to keep operating in the way they want to. Government officials are considered to be inclined towards higher bribery when a firm makes greater profits. In this way, firms with larger revenue have to give larger bribery to government officials, in corrupted countries, in order to avoid any sort of interference or allegations from the government. The model compares the increased bribe value with the risk of firm relocating in a region, where it has to pay a lower bribe or tax value to the government. It is more intricate for larger firms to relocate to other states or cities, as they have a larger employee base, machinery, and local networks, which all need to be relocated. For this reason, smaller firms are more inclined towards the decision of relocating to other regions, where it has to pay a lesser bribe to the government, while large companies tend to prefer paying more to the government. Forced with the increased tax/bribe value, companies then tend to increase the rate of their products or services, which impacts the expenses of common people and the overall economy of the country. Thus, it can be said that economic growth does not necessarily result in a reduction of corruption from a public or private institution.

2.3 Does Economic Growth Reduce Corruption?

Corruption is a discernible factor in affecting the economic growth of a country. However, it would be intriguing to find the inverse relation i.e. the relation of economic growth on corruption, and whether economic growth can help reducing corruption Bai, Jayachandran [20] in their study used the example of Vietnam, which has been experienced visible GDP growth after the 1980s, when private firms in Vietnam were allowed to make

3 Dataset Description

The database includes Life Expectancy (LE), Fixed Capital Formation (FCF), School Enrollment (SE), Unemployment Rate (UR), and GDP per capita (Y). The choice of the explanatory variables is based on the literature review. Life Expectancy (LE) refers, in the statistical sense, the expected number of years of life remaining at a given age. Fixed capital Formation (FCF) represents the process of a firm increasing its stock of fixed capital. The later are assets used in the productive process that a firm holds for over a year. School

Enrollment (SE), secondary school enrollment ratio is the number of children enrolled in the secondary level, regardless of age, divided by the population of the age group that officially corresponds to the same level. Unemployment Rate (UR) designs the unemployment rate is defined as the number of unemployed persons divided by the labor force, where the labor force is the number of unemployed and employed persons. Gross domestic product (GDP) is the market value of all officially recognized final goods and services produced within a country in a given period of time. Even if it is not a measure of personal income, it is often considered as an indicator of a country's standard of living. Under economic theory, GDP per capita exactly equals the gross domestic income (GDI) per capita. Here we use the nominal GDP per capita. The historical data used in this study related to the above variables were collected from the World Bank website for ten countries less corrupted worldwide during the period from 1995 to 2014. The included countries are Australia, Canada, Denmark, Finland, Netherlands, New Zeeland, Norway, Sweden, Singapore, and Switzerland. For Tunisia, our main case study, qualified as a medium corrupted country, the data related to the same variables were collected from Transparency International for the same period from 1995 to 2014. We wish to emphasize at this level that for subsequent use in the framework of the model, we calculated for each variable the mean, which we subsequently standardized.

4 Methodology

In order to quantify the effect of the corruption on economic development, we adopted the "alpha" model; It's a successful forecasting model used mainly in the field of solar irradiance [5], air quality [21] and market finance [22]. The methodology is based on the prediction of a dependent variable under the existence of a set of variables. In order to do so, and in order to judge the predictive power of the model, we began with the prediction of economic development represented by the real per capita GDP of the top ten countries with relatively low levels of corruption, based on four variables: Gross fixed capital formation, life expectancy, enrollment rate and unemployment rate. Using an application based on an alpha model developed for the prediction of GDP per capita, we obtain two curves on the basis of the normalization factors and the coefficients of the variables, a curve representing the real GDP per capita and another for the predicted GDP per capita. The representation of these two curves allows us to judge the validity of the "alpha" model. The technique used for prediction consists in making a division of the data according to which one part is used for the representation of the real curve and the second one to represent the forecast curve. Once the "alpha" model has been validated, we use the same technique to compare the real

and predicted GDP per capita for the Tunisian case, under the constraint of the same explanatory variables. If a gap exists in the comparison, it would then constitute the "cost of corruption".

5 Model

As we have already indicated, the objective is to develop a model adapted to the prediction of economic development. The model proposed is the "alpha" model developed initially in the field of finance [22] and solar irradiation [5] in order to predict respectively the selling prices of shares and solar irradiations. The original model is developed to predict the final price (P_f) of the stock knowing its initial price (P_s). The relationship is set as follows:

$$\alpha = \frac{P_f}{P_s},\qquad(1)$$

where α is a parameter that represents the fraction of the final price P_f and the starting price P_s, used by the investor to decide whether to sell or to buy. By rearranging the above equation, it is equivalent to say the investor can predict the selling price while knowing the purchase price and the parameter α. By analogy, we develop an "alpha" model adapted to the prediction of economic development that will be applied to the ten least corrupt countries in the world according to the Corruption Perception Index (CPI) using four variables that can influence economic development for the period 1995-2014. In other words, we try to predict economic development in year $j+1$ knowing life expectancy LE, fixed capital formation FCF, school enrollment SE, and unemployment UR, measured on year j. In fact, α is the quotient of the predicted value Y_{j+1} to the actual value Y_j of economic development.

$$\alpha_{j+1} = \frac{Y_{j+1}}{Y_j},\qquad(2)$$

We proceed by analogy to predict economic development by using the most explicative parameters such as LE, FCF, SE, UR. Also is obtained by:

$$\alpha_{j+1} = \frac{(Y_j)^{2\beta_6}}{\left[(LE_j)_2^\beta + (FCFr_j)_3^\beta + (SE_j)_4^\beta + (UR_j)_5^\beta + \beta_1\right]^2},\qquad(3)$$

Where the parameters β_2, β_3, β_4, β_4, β_5 and β_6 represent the coefficient of the different variables in α-model which will be estimated by the historical data set. However, β_1 represents the impact of all other variables that are not included in the model, supposed to have weakly influence on our system.

Table 1: Prediction results

Obs.	Predicted	Real	MSE	RE
1	0.68795	0.75706	0.00478	0.06910
2	0.74414	0.69458	0.00246	0.04957
3	0.72465	0.70029	0.00059	0.02436
4	0.73735	0.71036	0.00073	0.02699
5	0.80677	0.68029	0.01600	0.12648
6	0.76634	0.62654	0.01954	0.13980
7	0.71956	0.68700	0.00106	0.03256
8	0.77623	0.85868	0.00680	0.08244
9	0.91307	0.98600	0.00532	0.07293
10	1.00482	1.00095	0.00002	0.00387
11	1.03463	1.07462	0.00160	0.03999
12	1.11402	1.23882	0.01557	0.12479
13	1.24811	1.29509	0.00221	0.04698
14	1.24844	1.07347	0.03062	0.17498
15	1.09550	1.20982	0.01307	0.11432
16	1.23435	1.38446	0.02253	0.15012
17	1.35528	1.32732	0.00078	0.02796
18	1.31897	1.40048	0.00664	0.08151
19	1.37945	1.36925	0.00010	0.01020
20	1.26126	1.12768	0.01784	0.13358

Table 2: Prediction results

Obs.	Predicted	Real	MSE	RE
21	1.14354	1.08283	0.00369	0.06071
22	1.08980	0.93926	0.02266	0.15054
23	1.00243	0.96383	0.00149	0.03860
24	1.03889	0.94268	0.00926	0.09621
25	1.05601	0.87847	0.03152	0.17754
26	1.01891	0.89532	0.01527	0.12359
27	1.04532	0.96032	0.00722	0.08500
28	1.05709	1.11420	0.00326	0.05711
29	1.24234	1.23723	0.00003	0.00511
30	1.33756	1.27304	0.00416	0.06452
31	1.41333	1.33231	0.00656	0.08102
32	1.49962	1.46879	0.00095	0.03083
33	1.64032	1.67546	0.00123	0.03513
34	1.76698	1.61860	0.02202	0.14838
35	1.76048	1.72558	0.00122	0.03490
36	1.90588	2.04445	0.01920	0.13857
37	2.13152	1.93308	0.03938	0.19844
38	2.04708	1.96701	0.00641	0.08007
39	2.07697	1.98850	0.00783	0.08847

6 Results and Interpretations

6.1 Case of Non-Corrupt Countries

A set of 39 values is obtained in order to determine by estimating the equation (6). The results allow us to represent the real and forecast GDP per capita curves for all ten countries which are described in the Tables 1 and 2.

By calculating the mean of the MSE (Mean squared error) and RE (Relative error), we find respective values of 0.009529 and 0.069, both of which are very low and an R^2 of 97%, which allows us to plot the curves of the real and the predict economic development associated with the Tables 1 and 2.

The figure 1 shows that the two curves are almost superimposed, indicating the validity of the α-model. Since the predictive model has been validated, we can then apply the same methodology to the case of Tunisia, a moderately corrupted country according to TI. The difference between the estimated value using this model and the real value will constitute the cost of corruption.

**Table 3:** Corruption Perception Index (Tunisia)

	1998	1999	2000	2001	2002
CPI	5	5	5.2	5.3	4.8
Range	33	34	32	31	36
	2003	2004	2005	2006	2007
CPI	4.9	5	4.9	4.6	4.2
Range	39	39	43	51	61
	2008	2009	2010	2011	2012
CPI	4.4	4.2	4.3	3.8	4.1
Range	62	65	59	73	77
	2013	2014			
CPI	4.1	4			
Range	77	79			

Table 4: CGDP/Capita Real versus Predicted Tunisia

	Y real	*Y predicted*
1996	2154.987	2370.486
1997	2251.393	2562.674
1998	2336.084	2716.335
1999	2426.388	2946.812
2000	2247.913	3083.185
2001	2286.500	2999.779
2002	2373.836	3084.842
2003	2790.004	3200.348
2004	3139.537	3735.749
2005	3217.969	4163.933

Table 5: GDP/Capita Real versus Predicted Tunisia

	Y real	*Y predicted*
2006	3394.429	4432.742
2007	3805.153	4752.211
2008	4342.823	5226.727
2009	4162.510	5762.314
2010	4176.611	5651.051
2011	4298.092	5417.734
2012	4187.544	5548.038
2013	4309.992	5347.301
2014	4420.698	5467.419
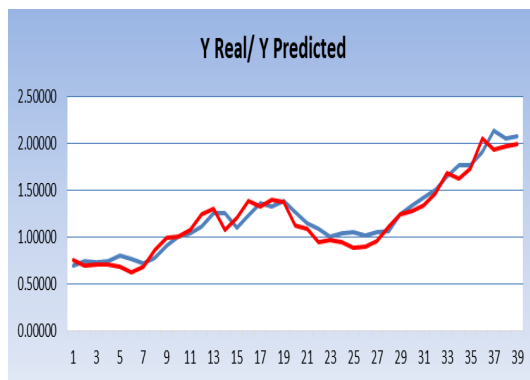
Fig. 1: GDP/ Capita Real versus Predicted (less corrupted countries)

6.2 Case of Tunisia

Corruption is a phenomenon that has worsened over the last few years affecting all sectors of the Tunisian economy, which can be explained by the change in the perception of corruption index (Table 3). Indeed, during the last decade, Tunisia's score has deteriorated from 5.3 in 2001 to 4 in 2014 to become among the countries where the perception of the corruption is increasingly high. By sweeping the results of "Transparency International" we note that the best results recorded were between 2000 and 2001 with respective scores of 5.2 and 5.3 whereas after January 14, 2011 where everyone expected a better situation on The economic, political and social plan, the perception of corruption index continues to deteriorate to reach 4 (40 out of 100) in 2014 and a

ranking of 79 against a ranking of 31 in 2001. Corruption has worsened, but Tunisia remains among the moderately corrupt countries.

For the same period 1995-2014, we calculate the annual gap between the real per capita GDP officially declared by the national authorities and provided by the World Bank and the real GDP per capita in the absence of the corruption estimated from the alpha model. The results are reported in Tables 4 and 5 and represented in figure 3.
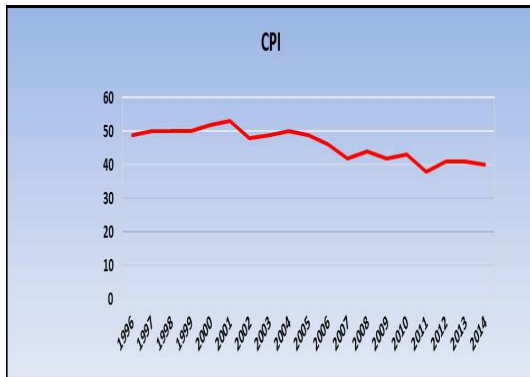

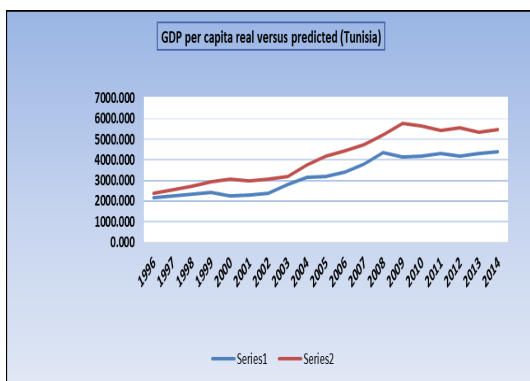**Fig. 2:** Corruption Perception Index (Tunisia)

Fig. 3: GDP/ Capita Real versus Predicted- Tunisia

At the opposite of the less-corrupted countries, the two curves of real and forecast GDP per head for the case of Tunisia are not superimposed (figure3), a time-varying gap exists, what we presume to be the cost of corruption. Indeed, when we compare this gap with the trend of the curve that represents Tunisia's perception of corruption index (figure2), we note that the latter vary in an opposite direction. We must recall at this level that an increase in the CPI reflects a decrease in the perceived corruption, which corresponds in the case of our model to a reduction

in the cost of corruption. This is the case for example for the period 2002-2004, the CPI has been improved, while the gap has decreased. At the opposite, between 2009 and 2013, the CPI has been aggressively deteriorated however the gap has increased. For the whole period 1995 to 2014, the average cost is 25.2%.

7 Conclusion

In this paper, we have validated the predictive power of the alpha model of economic development in a set of uncorrupted countries according to the classification of Transparency International during the period 1995-2014. Indeed, we found a correlation coefficient of 97% between measured and predicted economic development. Four determinant variables of the economic development were selected: life expectancy, fix capital formation, school enrollment, and unemployment rate. This step was crucial for estimating the cost of corruption in the case of other corrupt countries. The study of the Tunisian case allowed us, in fact, to estimate the average cost of corruption around 25.2% over the period 1995-2014.

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