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Abstract

This paper seeks to examine the impact of corruption on economic growth in Lebanon. Using a neoclassical model, we hypothesise that corruption reduces the country's standard of living as measured by real per capita GDP. We show that corruption deters growth indirectly through reducing the factor input productivity in a Cobb-Douglas production function. We provide empirical evidence suggesting that corruption increases inefficiencies in government expenditure and reduces investment and human capital productivity, leading to a negative impact on output. The implications of the analysis are explored.

Keywords: corruption, economic growth, investment, human capital, government expenditure, foreign aid.

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I. Introduction

Corruption poses a major threat to economic growth through reducing the public and private sector efficiency when it enables people to assume positions of power through patronage rather than ability. The current literature lacks a theoretical underpinning that incorporates the potential effect of corruption on aggregate output through its impact on the arguments of the production function. The literature to date (for example, Gill 1998; Kaufman 1998; Shleifer 1998; Stasavage 1998; Tanzi 1998; Rose Ackerman 1999; Stapenhurst 1999; Vittal 1999; Chafuen 2000; Mo 2001; Alesina 2002; Gupta 2003) has only examined the hypothesised influences separately, ignoring the larger impact of corruption on output. The purpose of this paper is to develop and test a neoclassical growth model that explicitly includes the direct and indirect effects of corruption on economic growth in Lebanon. The focus is on the impact of corruption on investment, human capital, government expenditure and foreign aid. The paper will not only help in enhancing public awareness on corruption, but also provide policy options that may assist in combating corruption in Lebanon.

The second section of the paper describes the level of corruption in Lebanon, and identifies the key players. The third section reviews the literature, and the fourth section discusses issues in formulating corruption models, including theory, data and empirical models. The fifth and sixth sections present the results and their policy implications. The paper ends with some concluding comments and directions for future research in section seven,

II. Background

The post-war deal in Lebanon, where fighting parties agreed to give up military power and reform government institutions, involved very few and weak institutional control mechanisms, which were often politically controlled. The unprecedented spread of corruption throughout the agencies of the state was a natural consequence. The expansion of the state role in the economy in the form of capital expenditure on reconstruction was highly vulnerable to corruption due to the magnitude of the projects involved, the multitude of intermediaries, and the different phases of implementation (Pasko 2002; Deeb 2003; Heard 2005; Rasmussen 2005). The borrowed money also induced more opportunities for rent-seeking activities and corruptive behaviour (Stamp 2005). These, in turn, changed Lebanese politics, as access manipulation of the government spending process became the gateway to fortune. Adwan (2004) names a few examples (that is, the central fund for the displaced, the Council of the South, and the Council for Development and Reconstruction) in which public institutions were turned into tools of nepotism and rent seeking, resulting in the arrest of two ministers (Oil Resources and Agriculture) on corruption charges (Al-Azar 2006). Corruption did not stop with the top ministers and directors of various government agencies, but it grew within the entire ruling hierarchy. Abdelnour (2001) claims that only 2.4% of the US$6 billion worth of projects contracted by various government bodies was formally awarded by the Administration of Tenders. The remainder did not go to the most qualified applicants, but to those willing to pay the highest bribes.

The UN (2001) corruption assessment report on Lebanon was one of the earliest documents that illustrated starkly the scale of corruption in the Lebanese Institutions and its devastating impact on the economy. It estimated that the Lebanese state squanders over US$1.5 billion per year as a result of pervasive corruption at all levels of government (nearly 10% of its yearly GDP). Corruption in Lebanon became an enduring fact of life, that is, of social norms and practices (Adra 2006). Sociological and cultural factors such as customs, family pressures and traditional values of tributes to leaders constitute potential sources of corruption which has found acceptance in the social psyche and behaviour (Brownsberger 1983). As a result, most Lebanese regardless of their religion, social status, location, political affiliations or wealth are unwilling to change the present system, not because they are ignorant of its consequences, but because they have developed a stake in maintaining it. On the other hand, the lack of government transparency and reliable contract enforcement ensured that private sector investors only entered a market if they had cut deals with governing elites (Yacoub 2005). It is not surprising that the UN (2001, p3) reports that over 43% of foreign companies in Lebanon "always or very frequently" pay bribes and another 40% "sometimes" do. Therefore, it appears that corrupt practices in Lebanon are at the core of the political system to the extent that even the most optimally designed institutions might fail in combating corruption as society’s norms appear to rationalise taking bribes, and the country’s elites regard politics as an arena for self-enrichment.

III. Previous studies

Corruption is globally considered to be growth inhibitive in the economics literature. It is recognised as a complex phenomenon, as the consequence of more deep-seated problems of distortion, institutional incentives and governance. Yet, the definition of corruption varies among societies and cultures. Notwithstanding this, some researchers (for example, Douie 1917; Leff 1964; Morgan 1964; Bayley 1966; Nye 1967; Huntington 1968) argue that it aids the economy, particularly in the case of cumbersome regulation, excessive bureaucracy, market restriction or inefficient policies. The resulting waiting costs would be effectively reduced if the payment of speed money could induce bureaucrats to increase their efforts. Ironically, however, corrupt officials might, instead of speeding up, actually cause administrative delays in order to attract more bribes. Lui (1985) demonstrates the efficiency-enhancing role of corruption via a queuing model, and concludes that the size of the economic agents' bribe reflects their opportunity cost, thereby allowing "better" firms to purchase less red tape. Alam (1989) refutes the pro-efficiency argument for corruption by contending that because bribery is usually illegal, bureaucrats will regulate entry into the bidding process to only those who can trust. Since trust is not a proxy for efficiency, there is no reason to believe that the highest bidder will necessarily be most efficient, although the body of theoretical and empirical research that addresses the problem of corruption is still growing (for example, Klitgaard 1987; Elliot 1997; Kaufman 1998; Shleifer 1998; Stasavage 1998; Tanzi 1998; Ades 1999; Lipset 1999; Stapenhurst 1999; Vittal 1999; Acemoglu 2000; Chafuen 2000; Hors 2000; Treisman 2000; Wei 2000; Alesina 2002; Thornton 2002; Gupta 2003; Johnston 2005).

Corruption models entered the economics literature taking different approaches. Using a microeconomic perspective, Murphy *et al* (1993) analyse the rent seeking effect on growth, and show that there are possibilities for the existence of three equilibria in an economy. Mandapaka (1995) employs three sector production model and comes up with two stable equilibria. Bardhan (1997) finds two stable, and one unstable equilibria in a corrupt economy. The models listed above endogenise rent seeking and exogenise the enforcement of property right. Corruption is also analysed in the context of a tax or tariff. Krueger (1974) suggests that corruption, more specifically rent seeking, is more costly to an economy than a tariff. However, Krueger's rent seeking model can only be applied to the developing countries where there is income inequality between government and non-government workers. Shleifer and Vishny (1993) analyse corruption in various organisational structures, using a principal-agent model, and show the negative effect of corruption on development. Most of the microeconomic models predict a reduction in economic growth with increases in corruption. However, microeconomic models can only examine the impact of corruption separately, ignoring the larger potential impact of corruption on growth. While the potential influence of corruption on output is not one of the conventional arguments for anti-corruption efforts, ignoring this potential effect would inject *a priori* bias into the model. Hence, these models fail to quantify the potential tradeoffs between the direct and indirect effects of combating corruption.

While the economics literature is somewhat exhaustive of principal – agent models and other microeconomics models, the macroeconomics literature is not so replete. There have been several attempts to analyse the effect of corruption on macroeconomics variables using different models (for example, Mauro 1995; Tanzi 1997; Ehrilich 1999; Leite 1999; Abed 2000; Hellman 2000; Mo 2001; Lambsdorff 2005). Using a Keynesian model, Bendardaf *et al* (1996) argue that corruption leads to a negative effect on developing country's production, consumption, employment level, domestic investment, government spending, net exports, and money market. Lambsdorff (1999) also claims that corruption hampers economic growth, and undermines the effectiveness of investment and aid, using a Keynesian model. Brunetti (1997) finds that the impact of corruption on investment is negative and significant, while the impact on growth is insignificant, using a lucas type growth model. The differences in these findings appear to be due to differences in sample size, sample period and corruption proxies used. Bigsten and Moene (1996), employing an endogenous growth model with overlapping-generations, find that the balanced growth path is negatively related to corruption. Leite and Weidmann (1999) endogenise corruption in a neoclassical growth model and claim that corruption negatively affects economic growth.

In summary, the literature still lacks an overriding theoretical framework that helps investigate the indirect aggregate impact of exogenous corruption on output through affecting the productivity of the factor inputs. We develop a neoclassical model that explicitly includes human capital and allow for the possibility that corruption influences economic growth through its impact on government expenditure, investment, human capital, and foreign aid. A cross country analysis may give misleading results due to the substantial differences in the corruption definition among countries. We test the model empirically to trace the corruptive behaviour in Lebanon, and define corruption as the use of public office power for personal benefit.

IV.Models and methods

IV.I Theoretical model

Mankiw, Romer and Weil (MRW) (1992) show that with the inclusion of human capital in the production function, the explanatory power of the traditional Solow growth model is significantly improved. We use the MRW work and extend the Solow model to include corruption as a determinant of the multifactor productivity. For simplicity, we will consider an economy that produces only one good. Output is produced with a well-behaved neoclassical production function with positive and strictly diminishing marginal product of physical capital. The Inada conditions ensure that the marginal products of both capital and labor approach infinity as their values approach zero, and approach zero as their values go to infinity. The functional form of the production function is Cobb-Douglas:

$$Y_t = K_t^{\alpha} H_t^{\beta} \left[G_t \left(\rho \right) L_t \right]^{1-\alpha-\beta} \tag{1}$$

where Y_t is the aggregate level of real income, K_t is the level pf physical capital, H_t is the level of human capital, L_t is the amount of labor employed, G_t is the level of government expenditure, and ρ is the level of corruption in the country; where $G'(\rho) < 0$. Let $0 < \alpha < 1$, $0 < \beta < 1$ and $\alpha + \beta < 1$. These conditions ensure that the production function exhibits constant returns to scale and diminishing return to each point. Time is indexed by a continuous variable (t). With the omission of the corruption term, the model yields standard neoclassical results. That is, the growth rate of output per capita is accelerated with increases in investments in physical capital and decreases in population growth, depreciation rate of capital, and the initial level of output per capita. The steady state equations are:

$$\frac{dK}{dt} = s_K Y_t - \delta_K K_t \tag{2}$$

$$\frac{dH}{dt} = s_H Y_t - \delta_H H_t \tag{3}$$

where S_K, S_H, δ_H and δ_K are parameters that represent, respectively, shares of income that are allocated to human and capital investment, and depreciation rate of human and physical capital. Further, population is exogenously determined and defined as $L_t = L_0 e^{nt}$ so that population growth is constant over time $(\frac{dL}{dt}) \big/ L_t = n$. Assumption of full employment implies that labor force growth rate is also given by n. Solving for the steady state reduced equation yields:

$$\ln(Y_t/L_t) = \ln(G_0) + gt + [\alpha/(1-\alpha-\beta)]\ln[S_k/(n+\delta_k+g)] + [\beta/1-\alpha-\beta]\ln[S_H/(n+\delta_H+g)] + G_t(\rho) \quad (4)$$

As equation (4) indicates, steady state output per capita is an increasing function of initial level of government expenditure and its growth rate, physical and human savings and government expenditure. An expression for the growth of output per capita can also be derived by differentiating with respect to time at the steady state level:

$$\ln y_t - \ln y_0 = (1-e^{-\lambda t})\{\ln(G_0) + gt - [(\alpha+\beta)/(1-\alpha-\beta)]\ln(n+\delta+g) + [\alpha/(1-\alpha-\beta)]\ln(S_K) + [\beta/(1-\alpha-\beta)]\ln(S_H) + G_t(\rho)\} - (1-e^{-\lambda t})\ln y_0 \quad (5)$$

As corruption alters the effectiveness of government expenditure, upward movements in corruption have an inverse relationship with growth of output per capita. However, with the omission of the corruption term, equation (5) yields the standard neoclassical results. That is, the growth rate of output per capita is accelerated with increases in investments in physical and human capital and decreases in population growth, depreciation rate of capital, and initial level of output per capita. In an effort to model the effect of corruption on multifactor productivity, a structural form for multifactor productivity will be assumed. Schleifer and Vishny (1993) and Mandapaka (1995) show that the effect of corruption on the economy is nonlinear and bounded by a corrupt-free output and a subsistence level of output. Since no government agent in an economy will leave the productive sector to become corrupt, some level of output will be produced. For specificity in the government expenditure function, let:

$$G_t(\rho) = \tilde{G}_t e^{-\gamma\rho} \quad (6)$$

where $0 \le \rho \le 1$, and $\tilde{G}_t = G_0 e^{gt}$ (7)

The parameter ρ is the index of corruption in this model, and γ determines the magnitude of the effect of corruption on government expenditure. Conventional government expenditure $\tilde{G}_t$ is exogenous and grows at rate g. We assume that $\frac{dG_t}{d\rho} < 0$, and $\frac{d^2G_t}{d\rho^2} > 0$. According to equation (6), if there is no corruption $(\rho = 0)$, then $\tilde{G}_t = G_t$. The same holds true for $\gamma = 0$. Since corruption does not affect all production in the same way, a higher value of γ increases the effect of corruption. *Ceteris paribus,* as γ approaches zero, the corruption function approaches unity and output is maximised. Equations (1), (2), and (3) presented above can be expressed in intensive form:

$$y_t^* = e^{-\gamma\rho} k_t^{*\alpha} h_t^{*\beta} \tag{8}$$

$$\frac{dk_t^*}{dt} = s_k y_t^* - (n + \delta_k + g) k_t^* \tag{9}$$

$$\frac{dh_t^*}{dt} = s_h y_t^* - (n + \delta_h + g) h_t^* \tag{10}$$

where y=Y/L, k=K/L, h=H/L, $y_t^* = y_t / \tilde{G}_t$ (output per capita per government expenditure), $k_t^* = k_t / \tilde{G}_t$ (physical capital per capita per government expenditure) and $h_t^* = h_t / \tilde{G}_t$ (human capital per capita per government expenditure). At the steady state, equations (9) and (10) are equal to zero. Thus, setting them equal to zero, equations (8), (9) and (10) constitute a system of three equations in three unknowns. The steady state levels of physical and human capital are as follows:

$$k_t^* = [s_K/(n + \delta_k + g)]^{(1-\beta)/(1-\alpha-\beta)} [s_H/(n + \delta_H + g)]^{(\beta)/(1-\alpha-\beta)} e^{-\gamma\rho} \tag{11}$$

$$h_t^* = [s_K/(n + \delta_k + g)]^{(\alpha)/(1-\alpha-\beta)} [s_H/(n + \delta_H + g)]^{(1-\alpha)/(1-\alpha-\beta)} e^{-\gamma\rho} \tag{12}$$

Substituting (11) and (12) into (8) results in a steady state equation for output per capita:

$$y_t^* = [s_K/(n + \delta_k + g)]^{(\alpha)/(1-\alpha-\beta)} [s_H/(n + \delta_H + g)]^{(\beta)/(1-\alpha-\beta)} e^{-\gamma\rho} \tag{13}$$

Substituting this into equation (13), multiplying by $\tilde{G}_t$ and taking natural logs yields:

$$\ln(Y_t/L_t) = \ln(G_0) + gt + [\alpha/(1-\alpha-\beta)]\ln[s_K/(n+\delta_K+g)] + [\beta/(1-\alpha-\beta)]\ln[s_H/(n+\delta_H+g)] - \gamma\rho \tag{14}$$

Assuming that human capital and physical capital depreciate at the same rate δ, yields:

$$\ln(Y_t/L_t) = \ln(G_0) + gt - [(\alpha+\beta)/(1-\alpha-\beta)]\ln(n+\delta+g) + [\alpha/(1-\alpha-\beta)]\ln(s_K) + [\beta/(1-\alpha-\beta)]\ln(s_H) - \gamma\rho \tag{15}$$

Equation (15) shows that steady state output per capita is increasing in the initial level of multifactor productivity, its growth (gt), and physical and capital investment rates. Higher initial levels of multifactor productivity increases steady state output per capita and the higher the growth rate of multifactor the higher the steady state output per capita, as well. The investment rates work themselves through equations (11) and (12). Higher investment rates increase the levels of physical and human capital per capita, which then increases output per capita through equation (8). Output per capita, however, is decreasing in capital per capita depreciation $(n+\delta+g)$ and corruption. The effect of corruption depends on the value of γ. A positive value of γ means that corruption is output debilitating, while a negative value causes corruption to be output enhancing. A value of zero reduces the steady state output level equation to that of MRW. The effect of corruption on a country's steady state level and economic growth is depicted in Figure 1. An increase in corruption reduces the productivity of capital by rotating the production function to the right. At the point A, the initial level of capital stock per capita (k_0) cannot be maintained and the economy moves to a lower level of capital stock per capita (k_1). In this process, the economy faces negative growth as it moves to (k_1) along with a reduced level of output per capita.

Approximating at the steady state level of output can yield the speed of convergence to steady state. The speed of convergence is represented by the first order linear differential equation:

$$\frac{d \ln y_t}{dt} = \lambda (\ln y^{ss} - \ln y_t) \tag{16}$$

where $\lambda = (n + \delta + g)(1 - \alpha - \beta)$. To find a solution to equation (16), we can rewrite this as $e^{-\lambda t}[(dy_t / dt) + \lambda \ln y_t] = e^{-\lambda t}(\ln y^{ss})$ which leads to:

$$\ln y_t = (1 - e^{-\lambda t}) \ln y^{ss} - (1 - e^{-\lambda t}) \ln y_0 \tag{17}$$

where y_0 is the initial level of output of the economy. Subtracting left and right hand sides of equation (17) by ln y^{ss} with equation (15) yields an equation for convergence:

$$\ln y_t - \ln y_0 = (1 - e^{-\lambda t})\{\ln(G_0) + gt - [(\alpha + \beta)/(1 - \alpha - \beta)]\ln(n + \delta + g) + [\alpha/(1 - \alpha - \beta)]\ln(s_K) + [\beta/(1 - \alpha - \beta)]\ln(s_H) - \gamma\rho\} - (1 - e^{-\lambda t})\ln y_0 \tag{18}$$

Since the speed of convergence (λ) is a constant, equation (18) states that economic growth is a function of the initial level of multifactor productivity and its growth rate, population growth rate, physical and human capital investment rates, the level of corruption and the initial level of output. As before, the trivial factors are the positive relationships between the time trend and the initial level of technology. Additionally, the traditional Solow neoclassical results are contained in this model. There is a negative effect of exogenous parameters such as population growth and depreciation rate. Conditional convergence is captured in the negative relationship between initial levels of output and economic growth. Corruption reduces economic growth by serving as an opposing force to the efficiencies obtained through improvements in multifactor productivity. Corruption reduces the effectiveness of physical and human capital and output per capita. Lower levels of output necessitate a lower subdued level of investment since investment rates $(s_K \,\&\, s_H)$ are fixed. This will lead to a lower level of investment, further contributing to lower levels of output. Hence, there is a negative effect on the growth of output per capita. As with the level equation (15), the sign of gamma determines if corruption is either output-enhancing or output-debilitating. A positive gamma produces a negative effect on multifactor productivity, while a negative gamma produces output-enhancing results. For consistency, a zero value of gamma will reduce equation (18) to that of MRW. An inherent contribution of equations (15) and (18) is that they can be tested directly. To do so, certain normality and other assumptions must be made about the data and the way they were generated.

The model presented above is designed to capture the effect of corruption on economic growth via incorporating corruption with the multifactor productivity in a Cobb-Douglas production function. This will capture the corruptive behaviour within government officials in allocating the government resources. But, those officials not only have control over the government's expenditure, but also interfere in allocating resources (funds) coming from other sources such as international organisations (for example, World Bank, International Monetary Fund, and United Nations), foreign governments, and other non-governmental organisations in the form of a foreign aid. Hence, this model can be modified to examine how the level of corruption slows the economic growth, not only through affecting the government expenditure level, but also via affecting the level of foreign aid. Therefore, equation (1) can be reproduced in another form:

$$Y_t = K_t^{\alpha} H_t^{\beta} \left[F_t(\rho) L_t \right]^{1-\alpha-\beta} \qquad (19)$$

Replacing G (government expenditure) in equation (6) with F (foreign aid) will yield:

$$F_t(\rho) = \tilde{F}_t e^{-\gamma_f \rho} \qquad (20)$$

γ_f determines the magnitude of the effect of corruption on foreign aid. The conventional foreign aid $\tilde{F}_t$ is assumed to be exogenous and to grow at the rate f ($\tilde{F}_t = F_0 e^{ft}$), where $\frac{dF_t}{d\rho} < 0$, and $\frac{d^2 F_t}{d\rho^2} > 0$. Therefore, using the same mathematical manipulations that produced equation (15), the following equation will be estimated using foreign aid data:

$$\ln(Y_t/L_t) = \ln(F_0) + ft - [(\alpha + \beta)/(1-\alpha-\beta)]\ln(n+\delta+f) + [\alpha/(1-\alpha-\beta)]\ln(s_K) + [\beta/(1-\alpha-\beta)]\ln(s_H) - \gamma_f \rho \tag{21}$$

IV.II Data

Several sources are used to proxy the variables of this model. Table 1 lists the variables used, including their sources. The primary sources for data are the International Monetary Fund (IMF), World Bank, World Penn Tables, Bank of Lebanon and the Lebanese ministry of finance. As for the index of corruption, there are several sources for information on corruption where each has some strengths and weaknesses. While no index of corruption is perfect, we have chosen the one with the longest time series available on Lebanon, which is the corruption index from Political Risk Service's International Country Risk Guide (ICRG). Based on the high correlation with other indices of corruption (Knack 2001), the ICR index apparently contains much information contained in the indexes of their competitors. This data base is used extensively for research in corruption, appearing recently in the works of Knack and Keefer (1995), Tanzi and Davoodi (1997), and Seldadyo and Haan (2006), among others. However, ICRG as with most other indices of corruption suffers from the risk that business experts may be biased in their opinions. The ICRG attempts to measure corruption by investigating whether or not high-ranking government officials are likely to demand special payments and if illegal payments are generally expected in lower levels of government. These payments typically take the form of bribes connected with import-export licenses, exchange controls, tax assessment, police protection, or loans.

As indicated previously, corruption in equation (1) is expressed as ρ. We will convert the raw corruption data (ς_t) from ICRG to an index ranging from "0" to "1" (the higher the index the higher the average corruption). As its proxy, the function:

$$Crpt(\varsigma_t) = (1 - \varsigma_t/6) \tag{22}$$

will be used for two reasons. Firstly $CRPT(\varsigma_t)$ makes output a negative function of corruption. Secondly, since (ς_t) is bounded by 0 and 6, therefore, $CRPT(\varsigma_t)$ is bounded by 0 and 1. As a test of linearity of corruption, it will enter the production function both linearly and non-linearly. Therefore, ρ will take on two specific forms in the empirical analysis:

$$Crpt = (1 - \varsigma_t / 6) \tag{23}$$

$$Crptsq = (1 - \varsigma_t / 6)^2 \tag{24}$$

IV.III Empirical models and procedures

The base model of real GDP level without corruption will be used to estimate the elasticities of output (physical and human capital) using ordinary least squares as the estimating method in the following equation:

$$\ln GDP_t = \beta_0 + \beta_1 \ln GOV_t + \beta_2 \ln POP + \beta_3 \ln INV_t + \beta_4 \ln EDU_t + \varepsilon_t \tag{25}$$

Then, we will add the corruption variable to the base model in various forms and estimate the following equations:

$$\ln GDP_t = \beta_0 + \beta_1 \ln GOV_t + \beta_2 \ln POP + \beta_3 \ln INV_t + \beta_4 \ln EDU_t + \beta_5 Crpt_t + \varepsilon_t \tag{26}$$

$$\ln GDP_t = \beta_0 + \beta_1 \ln GOV_t + \beta_2 \ln POP + \beta_3 \ln INV_t + \beta_4 \ln EDU_t + \beta_5 Crpt_t + \beta_6 Crptsq_t + \varepsilon_t \tag{27}$$

$$\ln GDP_t = \beta_0 + \beta_1 \ln GOV_t + \beta_2 \ln POP + \beta_3 \ln INV_t + \beta_4 \ln EDU_t + \beta_5 Crptsq_t + \varepsilon_t \tag{28}$$

$$\ln GDP_t = \beta_0 + \beta_1 \ln GOV_t + \beta_2 \ln POP + \beta_3 \ln INV_t + \beta_4 \ln EDU_t + \beta_5 Crptq_t + \varepsilon_t \tag{29}$$

The results of these equations will provide evidence if a change in the level of corruption leads to a change in the steady state level of output per capita. Comparing the results of equation (25) with equation (26), will provide support as to whether or not corruption impacts on government expenditure, investment, human capital productivity and the aggregate output. Equations (27, 28 and 29) are estimated to explore further the nonlinear relationship between corruption and output. Similarly, equation (30 and 31) will be estimated to examine the impact of corruption on foreign aid.

$$\ln GDP_t = \beta_0 + \beta_1 D \ln FA_t + \beta_2 \ln POP + \beta_3 \ln INV_t + \beta_4 \ln EDU_t + \varepsilon_t \tag{30}$$

$$\ln GDP_t = \beta_0 + \beta_1 D \ln FA_t + \beta_2 \ln POP + \beta_3 \ln INV_t + \beta_4 \ln EDU_t + \beta_5 Crpt_t + \varepsilon_t \tag{31}$$

Equations (25) to (31) will help in providing empirical support for the various hypothesised influences of corruption on aggregate output as postulated in the theoretical model.

V. Results and discussion

Empirical analyses of corruption and economic growth tend to employ ordinary least squares (OLS) estimates (for example, Everhart 2001; Knack 2001; Rajkumar 2002; Abdiweli 2003). If the assumptions underlying the OLS estimator are violated, however, the results maybe biased. Hence, we have examined whether stationarity, cointegration, multicollinearity, functional form specification, serial correlation, and heteroskadactisity were potential problems and corrected for them, where necessary. Table 2 presents the regression results of all the estimation equations.

In an effort to estimate the elasticities of output (physical and human), we estimate equation (25) that represents the base model without corruption as an explanatory variable. All variables except the corruption index are used in log form based on the results of the RESET test and the Akaike and Schwarz criterion. The coefficients of investment (LNINV) and education (LNEDU) are 0.37 and 0.71, respectively, in estimation equation (25). Recall equation (15), then $\alpha/(1-\alpha-\beta)$ is 0.37, and $\beta/(1-\alpha-\beta)$ is 0.71. Solving these two equations yields the estimates of elasticities to be 0.18 and 0.34 for the physical and human capital, respectively. The assumption of constant return to scale did not hold. Hence, these results do not coincide with that of MRW, but are similar in many other aspects (convergence to steady state output is enhanced by increases in physical and human capital saving rates as represented by the positive and statistically significant coefficients of LNINV and LNEDU, respectively). The differences can be attributed to several factors: (1) differences in the sample size, (2) differences in time period, and (3) differences in sample selection. The high magnitude of the government expenditure' coefficient (LNGOV) is due to the significance of the contribution of government spending as a percentage of the GDP in Lebanon. In fact, during the civil war (1975-1990) the government expenditure accounted for more than half of the Lebanese GDP (Deeb 1985).

As we introduced the corruption variable to the base model, the coefficient of corruption (CRPT) became statistically significant with a negative sign in equation (26), indicating that the steady state level of output per capita is reduced as corruption increases. A close look at the specification reveals that CRPT is at the very least linearly related to output per capita. When corruption enters the model, the magnitude of the investment coefficient (LNINV) is reduced, suggesting that corruption lowers investment. Further, the magnitude of the government expenditure coefficient (LNGOV) and education coefficient (LNEDU) decreased as we introduced corruption to the base model. This means that due to corruption, the effectiveness of government expenditure and the productivity of human capital are reduced. This explains the inefficiency in corrupt governments. The insignificance of the (LNPOP) is expected as we are using GDP per capita as the dependent variable implying that its impact has already been captured.

In an attempt to check for the nonlinear relationship between corruption and output per capita, we introduced a new explanatory variable, CRPTSQ. In the presence of high multicollinearity of CRPT and CRPTSQ (equation 27), the coefficient of CRPT becomes insignificant. However, the coefficient of CRPTSQ is statistically significant at 5 % level. Although the coefficient of CRPT is statistically insignificant, CRPT and CRPTSQ jointly better explain differences in real GDP per capita. The coefficient of CRPTSQ is -10.54, suggesting a strong nonlinear relationship between corruption and output per capita. Moreover, the magnitude of the investment coefficient (LNINV) is reduced, augmenting the negative association between corruption and investment. The magnitudes of the government expenditure coefficient (LNGOV) and education coefficient (LNEDU) have also decreased in this specification, supporting the proposition that corruption induces inefficiencies in the government spending and hampers the productivity of human capital. We dropped the CRPT variable from this specification and run the regression with CRPTSQ only (equation (28)). Results are very similar to previous specifications, with lower R^2. This affirms the nonlinear relationship between corruption and output. As we introduced corruption to the model in a cubic form (equation (29)), all the coefficients of CRPT, CRPTSQ, CRPTQ, LNGOV, LNPOP and the intercept became insignificant. However, when we dropped CRPT and CRPTSQ and kept only CRPTQ, the coefficient of CRPTQ became significant as well as the remaining variables (excluding LNPOP and the intercept). The results are clearly very similar to the previous specifications regarding the impact of corruption on output, investment, government expenditure and human capital.

We then modified the theoretical model to use foreign aid instead of government expenditure as the multifactor productivity. This modification allows us to test whether or not the results might change if we use a different explanatory variable as the multifactor productivity. The data on foreign aid represent all the grants and aids given only to the Lebanese government (1985-2005) as of the effective date of the grant or aid. The data set excludes other grants or aids given to any other party in Lebanon (for example, NGO’s, firms, individuals and political parties). In equation (30), the insignificance of the LNPOP is expected due to the high multicollinearity with its lag (DLNPOP) which we added to this model to correct for serial correlation. The stationary series DLNFA was used instead of non-stationary LNFA series in this analysis. Similar to the previous approach, we introduced the corruption variable to this version of the model to examine its impact on the factor inputs. In equation (31), the coefficients of the education expenditure and investment are reduced as corruption variable is added, confirming our previous findings. However, the foreign aid coefficient is slightly reduced from 0.39 to 0.38, as corruption enters the model. This insignificant change in the coefficient implies that corruption does not alter the effectiveness of foreign aid. It should be noted that adding CRPTSQ to the estimation equation (31) resulted in an increase in the R^2 to 0.72, and produced similar results. This also supports the nonlinear relationship between corruption and output. The coefficient of corruption in the modified model estimation equation (31) is 0.32, which is much smaller than 1.77, the coefficient of the corruption in the base model estimation equation (26). This shows that when corruption is incorporated into government expenditure, it will have a more significant negative impact on output than when it is incorporated into foreign aid. Transparent international donors often monitor the budget of the funded projects which reduce the opportunities for rent seeking behaviour unlike government budgets.

The results of the regression analyses indicate that corruption reduces Lebanon’s standard of living as measured by the real GDP per capita. A decrease in the index of corruption increases the steady state real GDP per capita, and helps its convergence to steady state level. These findings are consistent with the theoretical arguments proposed previously in Bigsten and Moene (1996); Bendardaf *et al* (1996); Wedeman (1997) and Rose Ackerman (1999). They suggest that corruption and economic growth are not only linearly related but also non-linearly. In addition, we find a statistically significant negative association between corruption and investment, confirming Mauro’s (1997) findings of a negative direct effect of corruption on investment which is consistent with other findings (for example, Schleifer 1993; Brunetti 1997; Leite 1999; Mo 2001).

Moreover, results indicate that corruption reduces the effect of government expenditure on output, lowering its effectiveness. In other words, it introduces inefficiencies in government spending. Corrupt officials may approve public projects at a higher cost to the government if they get personal benefits from them. In other words, bribes paid by inefficient and incompetent firms to secure government contracts and licenses create additional hazards, benefit the corrupt officials, and impose additional costs on the economy. These results are also consistent with the findings of Della Porta and Vannucci (1999) who argue that corruption leads to higher levels of public investment but reduces its effectiveness, and Tanzi and Davoodi (1997) who show that political corruption increases public investment, while lowering maintenance and operation and reducing the quality of infrastructure.

In addition, results suggest that corruption reduces the effect of education expenditure on output. This coincides with the findings of Mauro (1998) who suggest that corruption is negatively associated with government expenditure on education, providing more limited opportunities for rent seeking than otherwise would be the case. However, the education expenditure variable represents the human capital in our model. Hence, we conclude that corruption reduces the productivity of human capital. This is consistent with the findings of Mo (2001) who provides evidence that corruption reduces human capital productivity. Ehrilich (1999) also suggests that corrupt officials spend a substantial amount of time and effort in seeking and accumulating political capital, which is not socially productive, and as a consequence, their productivity is reduced.

Finally, results indicate that corruption does not influence the effect of foreign aid on output. In other words, there is no compelling evidence supporting the proposition that corruption alters the quality or level of foreign aid. Hence, we conclude that reducing the level of corruption is unlikely to increase the level or quality of foreign aid granted to Lebanon. The insignificant change in the coefficient of foreign aid, when we add the corruption variable to our estimation equation in the modified model is not sufficiently convincing for such a conclusion. These results are also consistent with the findings of Alesina and Weder (2002) who find little evidence that less corrupt government receive more aids.

VI. Policy implications

It appears that corruption restrains the economy from reaching its potential. Its impact permeates virtually every aspect of the production function either directly and/or indirectly. Results show that corruption reduces the country’s standard of living, increase inefficiencies in government spending, lowers investments, decreases the human capital productivity, and hampers economic growth. Efforts to improve the factors input efficiency may be offset by the impact of corruption. Thus, the returns to attempts aimed to stem corruption are undoubtedly significant. The marginal benefit to output of reducing corruption outweighs any other policy actions.

Corruption will not only limit new investments, but also reduce the level of capital stock per capita, as the economy faces slower negative growth. The negative association between corruption and investment provides policy makers with powerful incentives to combat corruption. Private investors desire returns, and will direct their decisions where they anticipate the highest returns to investment with the least variance. Clearly, corruption adds uncertainty to these returns. When private investors contemplating new investments perceive one country's level of corruption to be lower than another's, *ceteris paribus*, low corruption country wins the project. Evaluating the potential returns to lessening corruption is generally difficult. It is doubtful if one could determine the magnitude of the returns. But the evidence presented here suggests that there are likely to be positive returns in terms of higher investments associated with reduced corruption. This, in turn, yields additional benefits from the investments' close and strong positive relationship with economic growth.

Corruption tends to hamper economic growth also through creating increased inefficiencies in the government expenditure. In other words, it lowers the effectiveness of public investment. Corrupt officials steer the approval of projects towards particular domestic or foreign enterprises in exchange for bribes, imposing additional costs on the government budget. Important cases of corruption exist also when political agents steer public investments towards their home districts, diverting public funds. In all these cases, the productivity of the government spending is reduced, thereby hampering the growth rate of the country. Widespread corruption in government budgets will not only reduce the rate of return to new public investment, but also affect the rate of return that a country receives from its existing infrastructure. Corruption increases the cost of operations and maintenance in public institutions. This enhances inefficiency in public institutions, and raises the prices of public and social services, potentially increasing inflation rates in countries such as Lebanon, where government spending accounts for a high percentage of its GDP. Hence, economists should be more careful in their praise of high public sector spending to enhance economic growth, especially in such countries as Lebanon. Efficient government spending caused by reduced corruption promotes economic growth more effectively.

The negative correlation between corruption and the productivity of human capital provides additional incentives to combat corruption. Corrupt officials spend more time and effort in seeking and accumulating political capital, which is socially unproductive; as a consequence, their productivity is reduced. Corruption also decreases government spending on corruption proof items as education, further reducing human capital productivity. The positive return in terms of increased human capital productivity associated with reduced corruption provides a new approach to enhancing human capital productivity. This, in turn, yields additional benefits due to human capital productivity's close and strongly positive relationship with economic growth. Therefore, higher human capital productivity requires reduced corruption together with increases in education expenditure.

The modified model provides a new potential avenue via which economic growth might indirectly be reduced. Yet, results fail to provide sufficient ground supporting the proposition that corruption alters the quality or level of foreign aid. The small decrease in the coefficient of foreign aid when we introduce the corruption variable to the estimation equation in the modified model is not sufficiently profound to draw such a conclusion. However, international donors are focusing more on transparency in implementing projects that they fund. This may limit foreign aid levels in the future to countries with high levels of corruption. Although results do not imply that Lebanon might receive more foreign aid if corruption level is reduced, the new sentiment in international circles provides a strong incentive to foster transparency among government institutions.

VII. Conclusion

This paper provides empirical evidence implying that corruption tends to slow down economic growth in Lebanon. A decrease in the index of corruption increases the steady state real GDP per capita, and helps its convergence to steady state level. Corruption reduces Lebanon's standards of living, investment and human capital productivity. It creates increased inefficiencies in the government expenditure, and as a consequence, reduces its effectiveness. However, there is insufficient ground suggesting that corruption alters the quality of foreign aid. Yet, the index of corruption, which is generated from subjective surveys, together with the small sample size, constitutes the main limitations of this study. High quality data, coupled with more sophisticated theoretical and econometric as well as simulation models should probably yield more compelling results. While results imply that the returns to attempts aimed at stemming corruption are significant, the question of how they are distributed is beyond the scope of the current analysis, and emerges as an interesting avenue for further research.

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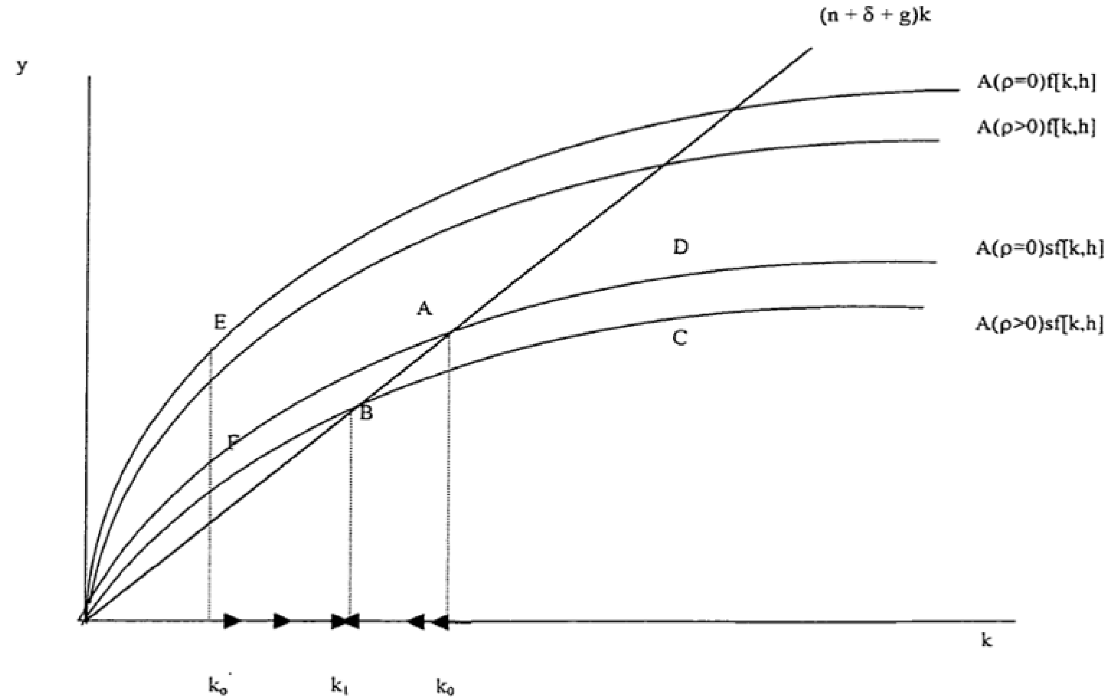

Figure 1 Dynamics of corruption on physical capital and output

Table 1 Data sources and description

Variable name	Source	Description
ς_t	ICRG – Compiled by Political Risk Services	Average corruption from 1985-2005 for Lebanon. Corruption survey data ranging from "0" to "6", where "6" relates to the least corrupt country.
$Crpt$	Derived using raw corruption variable, ς_t	Using equation 2, we convert raw corruption data to an index ranging from "0" to "1". the higher the index the higher the average corruption
$Crptsq$	Derived using raw corruption variable, ς_t	Crptsq =Crpt *Crpt
GDP	IMF; Bank of Lebanon	Real per capita GDP (current prices USD) (1985-2005)
LNGDP	Derived using GDP	LNGDP = log (GDP)
INV	World Bank	Real investment share of GDP (1985-2005)
LNINV	Derived using INV	LNINV = log (INV)
EDU	World Bank	Education expenditure as a GDP percentage (1985-2005)
LNEDU	Derived using EDU	LNEDU = log (EDU)
POP	Penn World Table (2006)	Population growth (1985-2005)
LNPOP	Derived using POP and δ	LNPOP = log (pop + δ)
GOV	IMF; Bank of Lebanon	Government expenditure in current US prices derived from the government expenditure percentage of GDP (1985-2005)
LNGOV	Derived using GOV	LNGOV = log (GOV)
FA	Lebanese Ministry of Finance	Foreign aid (1985-2005) in current USD
LNFA	Derived using FA	LNFA = log (FA)
δ	IMF (2006)	Depreciation rate of capital assumed to be 4% (0.04)

Table 2 Estimation results *

Eq		Intercept	LNGOV	LNINV	LNEDU	LNPOP	DLNPOP	DLNFA	CRPT	CRPTSQ	CRPTQ	R^2
(25)	LNGDP	4.36	0.86	0.37	0.71	0.66	NA	NA	NA	NA	NA	0.55
		(1.76)	(2.39)	(2.4)	(2.41)	(2.4)						
(26)	LNGDP	2.43	0.63	0.27	0.58	0.34	NA	NA	-1.77	NA	NA	0.67
		(1.08)	(2.38)	(3.08)	(2.52)	(1.32)			(2.53)			
(27)	LNGDP	7.88	0.66	0.25	0.61	0.01	NA	NA	-10.66	-10.53	NA	0.74
		(2.44)	(2.36)	(3.84)	(2.21)	(0.06)			(1.83)	(2.63)		
(28)	LNGDP	3.13	0.62	0.31	0.6	0.24	NA	NA	NA	-1.6	NA	0.69
		(1.51)	(2.52)	(3.33)	(2.6)	(1.03)				(2.83)		
(29)	LNGDP	3.58	0.69	0.32	0.63	0.2	NA	NA	NA	NA	-1.76	0.71
		(1.81)	(2.41)	(3.54)	(2.62)	(0.78)					(3.07)	
(30)	LNGDP	9.33	NA	0.35	0.5	1.14	0.99	0.39	NA	NA	NA	0.62
		(13.23)		(3.23)	(2.47)	(2.13)	(3.2)	(2.75)				
(31)	LNGDP	8.79	NA	0.21	0.32	1.01	0.87	0.38	-0.32	NA	NA	0.69
		(4.37)		(2.41)	(2.54)	(1.67)	(1.55)	(3.19)	(3.27)			

* t-statistics are reported in parentheses.