The Impact of Corruption on Economic Growth in Lebanon

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Abstract

This paper seeks to examine the direct and indirect effects of corruption on economic growth in Lebanon. We hypothesise that corruption reduces a country's standard of living as measured by the real GDP per worker. We argue that corruption deters economic growth, reduces the productivity of capital and decreases the effect of government expenditure on growth. Using a neoclassical model, we find empirical support indicating that corruption increases inefficiencies and reduces economic growth. Results also suggest that corruption does not alter the effect of foreign aid on output. They imply that the marginal benefit to output of reducing corruption outweighs virtually any other policy action. That is, unless corruption is reduced in Lebanon, efforts to improve private and public investment will have a minimal impact on per capita GDP.

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

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Preface

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Corruption is a major barrier to sound development, affecting a wide range of economies across the world. Measuring and explaining corruption is no easy task. The increased interest in such a phenomenon has produced a multitude of policy prescriptions, reform initiatives and international fora. Falling short of empirical evidence and profound experience, there is not even a theory available that allows us to put the various approaches into a comparative perspective. This thesis aims to study the impact of corruption on economic growth in Lebanon. The impact of corruption on investment, capital formation, government expenditure and foreign aid is examined in relation with the indirect effect it has on economic growth. This is followed by an empirical analysis of the theoretical model. Finally, the policy implications of results are discussed. The focus in this paper is on the last three chapter of my PhD thesis, that is, the theoretical model, estimation results and policy implications.

The thesis is structured as follows:

- Chapter 1: Introduction
- Chapter 2: Background
- Chapter 3: Previous research
- Chapter 4: Model and methodology
- Chapter 5: Results
- Chapter 6: Policy implications and conclusions
- Appendix

1. Introduction

Corruption poses a major threat to economic development for a number of reasons. It reduces public and private sector efficiency when it enables people to assume positions of power through patronage rather than ability. Productive resources that would ordinarily seek their highest return may be left idle or employed in less productive ventures. The current literature on the impact of corruption lacks a theoretical underpinning that incorporates the potential effect of corruption on output through its impact on the arguments of the production function and on economic growth. 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 potential aggregate impact of corruption on output. Hence, we develop a neoclassical economic growth model that explicitly includes human capital accumulation and the direct and indirect effects of corruption on economic growth. We empirically test this model, based on the available time series data, to study the corruptive behaviour in Lebanon. The focus will be on the direct and indirect effects of corruption on capital accumulation (investment), government expenditure, foreign aid, and economic growth. This study might help enhance public awareness about corruption as well as provide policy makers with possible policy options that can assist in combating corruption in Lebanon.

This paper will proceed by presenting some background information about the level of corruption in Lebanon identifying suppliers and demanders. Then, previous models of corruption are explored, highlighting the estimation methods and data used. Further, we will discuss the foundations of the theoretical model of corruption, presenting all the mathematical derivations, estimation equations, and data sources. Finally, we will present an overview of the results and their policy implications, in addition to some concluding comments and directions for future research.

2. 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 most often politically controlled. These conditions set the framework of post-war politics that dominated the public sphere for over 15 years (Deeb 2003). The unprecedented spread of corruption throughout the agencies of the state was a natural consequence. However, the major reason for the increase of corruption after the war was the growth of the state and its role in the economy (Stamp 2005). This growth took the form of capital expenditure on reconstruction, which was highly vulnerable to corruption because of the magnitude of the projects involved, the multitude of intermediaries, and the different phases of implementation. Hence, public administration in Lebanon became more bureaucratic and inefficient. A significant number of complex, restrictive regulations coupled with inadequate controls are characteristics that corruption helps to overpass (Rasmussen 2005). But to understand corruption, institutional analysis appears not enough. An economic analysis is required, focusing on the "market place" in terms of main actors (suppliers and demanders) and market equilibrium.

During the post war period, the government set out to borrow huge amounts of hard currency, thereby swelling the national debt from less than $1 billion in 1990 to nearly $22 billion at the end of the decade (Heard 2005). The borrowed hard currency induced a lot of opportunities for rent-seeking activities and corruption in both private and public sectors of the economy. These, in turn, changed Lebanese politics, as access to and manipulation of the government spending process has become the gateway to fortune (Pasko 2002). 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. Other examples include customs fraud, embezzlement of reconstruction funds and contract breach involving bodies such as the Port Authority of Beirut; embezzlement and fraud at the Ministry of Post and Telecommunication and its parallel government agency, the Telecommunication Managing Agency; and irregularities, over-spending, and illegal sales of statesubsidized oil at the Oil Ministry, in collaboration with private sector refineries and oil importers, that resulted in the arrest of Minister of Oil Resources on corruption charges (Al-Azar 2006).

The UN (2001) corruption assessment report on Lebanon was one of the earliest official documents that addressed the problem of corruption in Lebanon. It illustrated starkly the scale of corruption in the Lebanese political system and its devastating impact on the Lebanese economy. The report 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). Abdelnour (2001) adds 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. On the other hand, corruption did not stop with the top ministers and directors of various government agencies, but it grew within the entire government hierarchy. Therefore, corruption suppliers in Lebanon can be identified as the corrupt government officials along the hierarchy.

Adra (2006) argues that corruption in Lebanon became an enduring fact of life, it became an aspect of culture, that is, of social norms and practices. Sociological and cultural factors such as customs and family pressures on government officials constitute potential sources of corruption which has found acceptance in the social psyche and behaviour. Bribery, nepotism and favouritism have come to be accepted in the Lebanese society. In addition, the traditional values of gift-giving and tributes to leaders often lead to what Brownsberger (1983) describes as polite corruption. Yacoub (2005) argues that the great majority of Lebanese, regardless of religion, social status, location, political affiliations or wealth are unwilling to change the present system, not because they are ignorant of its hazards, but because they have developed a stake in maintaining it. In Lebanon today, corruption is widespread and part of everyday life. Society has learned to live with it, even considering it, fatalistically, as an integral part of its culture. 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. Hence, it is not surprising that the UN (2001, p. 3) reports that over 43% of foreign companies in Lebanon "always or very frequently" pay bribes and another 40 % "sometimes" do.

In summary, corrupt practices in Lebanon appear to be more deeply steeped in local tradition and culture. They are getting to the core of the political system to the extent that even the most optimally designed institutions can not prevent corruption as society's norms say it appears acceptable to take bribes and the country's elites regard politics as an arena for self-enrichment. It is within the context of this environment that we propose to undertake this study.

3. Previous research

A preliminary analysis of the literature shows that corruption is recognised largely as a complex phenomenon, as the consequence of more deep seated problems of policy distortion, institutional incentives and governance. Corruption is globally considered to be growth inhibitive in the economics literature. However, in the 1960s, a view that corruption might enhance an economy's growth process was advanced. Leff (1964), for example, argues that bureaucrats and political regimes aspire only to remain in political office and, therefore, their policies are devised with only that in mind and are economically inefficient. Huntington (1968) suggests that corruption is a by-product of modernisation, claiming that in the modernisation process, corruption serves to bypass unproductive and inefficient policies. 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. Lui (1996) arrives at the same conclusion and argues that corruption is optimal under the theory of second best.

On the other hand, the body of theoretical and empirical research that addresses the problem of corruption has been growing considerably in recent years (for example, Elliot 1997; Kaufman 1998; Shleifer 1998; Stasavage 1998; Tanzi 1998; Ades 1999; Lipset 1999; Stapenhurst 1999; Vittal 1999; Abed 2000; Acemoglu 2000; Chafuen 2000; Hors 2000; Treisman 2000; Wei 2000; Mo 2001; Alesina 2002; Thornton 2002; Gupta 2003; Klitgaard 2004; Johnston 2005). Corruption entered the economics literature with a microeconomics 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) uses a three sector production model and found two stable equilibria. The first equilibrium exists where there are no honest agents and corruption is rampant. The second equilibrium exists where there are no corrupt agents and the economy has highest level of output. Bardhan (1997) finds two stable, and one unstable equilibria in a corrupt economy. He notes that initial conditions are important. If the economy starts with a high average level of corruption, it will move toward the high-corruption stable equilibrium. However, if the average level of corruption is low, then the economy reverts to an honest economy. It is worth noting that the models above endogenise rent seeking and exogenise the enforcement of property right. Hence Leff's analysis holds in the context of Murphy *et al* (1993) in that corruption is a natural reaction to inefficient public policy. If the central government has economic development as a high priority, then corruption would not be so rampant, *ceteris paribus*.

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. Her results indicate that for any given level of import restriction, competition among rent seekers is Pareto-inferior to the tariff-equivalent restriction. These results are similar to Murphy *et al's* (1993) findings that bribes differ from taxes because bribes are illegal and must be kept secret. 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. Just as corruption is one form of rent seeking, there are various forms or institutions of corruption. Shleifer and Vishny (1993) analyse corruption in various organisational structures using a principal-agent model to determine the effects of corruption on development. It is worth noting that most of the microeconomics models predict a reduction in economic development with increases in corruption. However, microeconomic models can only examine the impact of corruption separately, ignoring the larger potential aggregate impact of corruption on output. 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. In their attempts to analyse the corruption's effect on an economy's macroeconomics variables, previous research (for example, Mauro 1995; Tanzi 1997; Ehrilich 1999; Leite 1999; Abed 2000; Mo 2001; Lambsdorff 2005) has used different economic growth models. Lambsdorff (1999) claims that corruption hampers economic growth, and undermines the effectiveness of investment and aid using a Keynesian model. Mo (2001) also finds that corruption reduces the share of investment, and the level of human capital. 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. On the other hand, Kaufman and Sachs (1998) argue that access to core social services can be easily restricted with the intention to make corrupt gains. They conclude that corruption has adverse effects on human development. Moreover, corruption may entice government officials to allocate public resources less on the basis of social welfare than according to opportunities for extorting bribes. Mauro (1998) argues that corruption also lowers the quality of infrastructure projects and pubic services. This will not only reduce economic growth and investment, but also affects the human development in such communities.

Oluwole and Bendardaf (1996) develop a complete Keynesian model and show that corruption has a negative effect on developing country's production, consumption, employment level, domestic investment, government spending, net exports, and money market. Bigsten and Moene (1996), using an endogenous growth model with overlapping-generations, find that the balanced growth path is negatively related to corruption. Along the balanced growth path, growth is reduced with increases in bribe payments. Presumably, corruption reduces the magnitude of investment, which reduces economic growth. On the other hand, in an infinite horizon growth model, it is assumed that in the presence of bureaucracy, entrepreneurs have to spend some of their time and human capital resources to deal with bureaucratic obstacles. Longer time required to cope with bureaucracy enables corrupt officials to extract more bribes. Hellman (2000) argues that requiring a large portion of time to deal with government officials may enable the officials to extract more bribes and result in wasting time and human capital.

Mauro (1995) argues that corruption discourages investment, limits economic growth, and alters the composition of government spending, often to the detriment of future economic growth. He studies the effects of corruption on various governmental expenditures, using ethno linguistic fractionalization as an instrument variable. He uses the method of two-stage least squares and argues that corruption causes lower economic growth through a reduction in the investment rate. However, according to Shleifer and Vishny (1993), bureaucrats who engage in corruption seek to invest public funds in large projects that make the receipt of kickbacks less identifiable. Although Mauro's findings shed light on a controversial topic, there are major shortcomings of his literary work as he provides new theoretical basis for his results. In contrast to Mauro, Leite and Weidmann (1999) endogenise corruption in a neoclassical growth model and claim that corruption negatively affects economic growth. In their model, a government agent has the option of taking bribes or to increase household income. The methodology used is typical of the literature on criminal activities. However, the assumptions arguably fall short of two points. The first, as Tirole (1996) points out, is that corruption is persistent. The decision to engage in corrupt activities is not only based on the probability of being caught. Secondly, there is a group bias that precludes individual behaviour. The reputation of predecessors has a direct impact on whether an individual becomes corrupt or not.

However, in all the above models, possible endogeneity bias should be taken into consideration. The potential source of endogeneity bias stemming from the use of subjective survey results as a proxy of corruption level in an economy can be eliminated through the use of better estimation techniques. The results may not be robust since they are very sensitive to sample size and what corruption index is being used in the analysis. This explains the limitation of this approach and points out some implications for further modelling through relying on less sensitive models in terms of sample size, proxies and indexes used. Moreover, all the above models examine the hypothesised influences of corruption separately, ignoring the aggregate impact of corruption on the factors of production and implications for long term growth. Hence, the current literature still lacks a theoretical framework that incorporates the potential effect of corruption on output through its impact on the arguments of the production function and on economic growth and development. Therefore, we develop a neoclassical economic growth model that explicitly includes human capital accumulation and the direct and indirect effects of corruption on economic growth. In developing a neoclassical theoretical model of economic growth we allow for the possibility that corruption influences the development of the Lebanese economy through its impact on government expenditure, foreign aid, and investment.

4. Model and methodology

4.1 The theoretical model

We make use of the work of Mankiw, Romer and Weil (MRW) (1992). The major findings of this research reveal that with the inclusion of human capital in the production function, the explaining power of the traditional Solow growth model is significantly improved. This research extends the Solow model to include corruption as a determinant of the multifactor productivity which is the government expenditure in our case; hence, our operational definition of corruption is the use of public office power for private benefit. 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 assure 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:

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

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 < α <1, 0 < β <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 the continuous variable (t). With the omission of the corruption term, the model yields standard neoclassical results. That is, the growth rate of output per worker 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 worker. The steady state equations are:

$$\frac{dK}{dt} = s_K Y_t - \delta_K K_t \quad (2)$$

$$\frac{dH}{dt} = s_H Y_t - \delta_H H_t \quad (3)$$

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. Moreover, 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 reveals:

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

As equation (4) reveals, steady state output per worker 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 worker can also be reported by differentiating with respect to time around the steady state level to obtain:

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

As corruption alters the effectiveness of government expenditure, upward movements in corruption have an inverse relationship with growth of output per worker. However, with the omission of the corruption term, equation (5) yields the standard neoclassical results. That is, the growth rate of output per worker 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 worker. In an effort to model the effect of corruption on multifactor productivity, a structural form for multifactor productivity will be assumed. Schleifer (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 every government agent in an economy will not leave the productive sector to become corrupt, some level of output will be produced. To allow 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 that we will use. Now 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 $\frac{d^2 G_t}{d\rho^2} > 0$. Equation (6) shows that 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 function 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 maximized. Equations (1), (2), and (3) can be expressed in intensive form:

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

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

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

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

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

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

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

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

Recall that $y_t^* = Y_t / (\tilde{G}_t L_t)$. Substituting this into equation (13), multiplying by $\tilde{G}_t$ and taking natural logs yields:

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

For simplicity, let us assume that human capital and physical capital depreciate at the same rate (δ). This 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 worker is increasing in 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 worker and the higher the growth rate of multifactor the higher the steady state output per worker, as well. The investment rates work themselves through equations (11) and (12). Higher investment rates increase the levels of physical and human capital per worker, which then increases output per worker through equation (8).

Output per worker, however, is decreasing in capital per worker 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 causes corruption to be output enhancing. Note that 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 Appendix A. 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 worker (k_0) cannot be maintained and the economy moves to a lower level of capital stock per worker (k_1). In this process, the economy faces negative growth as it moves to (k_1) along with a reduced level of output per worker.

4.1.1 Convergence to steady state

In keeping with MRW, approximating around the steady state level of output can derive 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:

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

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:

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

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 present in this model. There is a negative effect of exogenous parameters such as population growth and depreciation rate. Conditional convergence is captured with the negative relationship between initial level of output and the level of economic growth.

Corruption reduces economic growth by acting 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 worker. Lower levels of output necessitate a lower level of investments since investment rates $(s_K \,\&\, s_H)$ are fixed. This will result in a lower level of investment that further contributes to lower levels of output. Hence, there is a negative effect on the growth of output per worker. 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, note that a zero value of gamma reduces equation (18) to that of MRW.

An inherent contribution of equations (15) and (18) is that they can be tested directly using OLS. To do so, certain normality and other assumptions must be made about the data and the way they were generated.

4.1.2 Model extensions

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 organizations (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:

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

Recall equation (6), and replace G (government expenditure) with F (foreign aid), then we have:

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

γ_f determines the magnitude of the effect of corruption on foreign aid. Let us assume for now that the conventional foreign aid $\tilde{F}_t$ is exogenous and grow at the rate f ($\tilde{F}_t = F_0 e^{ft}$), where $\frac{dF_t}{d\rho} < 0$, and $\frac{d^2F_t}{d\rho^2} > 0$.

Therefore, using the same mathematical manipulations that produced (equation 15), the following equation will be estimated using foreign aid data:

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

4.2 Data

As quality data for a broad sample of emerging markets are a prerequisite for a thorough analysis. The theoretical models (equations 15, 18 and 21) contain parameters for corruption, investment rate for physical capital, the saving rate for human capital, population growth, the depreciation rate and multifactor productivity (government expenditure, and foreign aid). To proxy these variables, several sources are utilized. The primary sources for the economic 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 merits and demerits. 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, 2000), Everhart and Sumlinski (2001), Knack (2001), and Rajkumar and Swaroop (2002), Abdiweli and Hodan (2003) and Seldadyo and Haan (2006), among others. However, ICRG as with most other indices of corruption suffers from the risk that "experts" appear biased in their opinions. The ICRG attempts to measure corruption by investigating whether 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. The ICRG provides a numeric measure ranging from 0 to 6 with 0 signifying the most corrupt. This data base has monthly ratings for over 100 countries dating back to 1984. Recall that the index of 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:

$$Crpt(\varsigma_t) = (1 - \varsigma_t/6) \qquad (22)$$

will be used for two reasons. First $CRPT(\varsigma_t)$ makes output a negative function of corruption. Second, 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, the corruption function will enter the production function both linearly and non-linearly. Therefore, ρ will take on two specific forms:

$$Crpt = (1 - \varsigma_t/6) \qquad (23)$$

$$Crptsq = (1 - \varsigma_t/6)^2 \qquad (24)$$

The table below is a list of the variables and parameters used in the analysis including their sources:

Table 1 – Data description

Variable	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 US Dollars) (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 percentage of GDP (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 US Dollars
LNFA	Derived using FA	LNFA = log (FA)
δ	IMF (2006)	Depreciation rate of capital assumed to be 4% (0.04)

4.3 Estimation equations

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 procedures in the following equation:

$$GDP_t = \beta_0 + \beta_1 GOV_t + \beta_2(\delta + POP_t) + \beta_3 INV_t + \beta_4 EDU_t + \varepsilon_t \qquad (25)$$

The differences in time period, sample size and sample selection may lead to different results from that of MRW. Then, we will add the corruption variable to the base model, i.e. we will estimate the following equation

$$GDP_t = \beta_0 + \beta_1 GOV_t + \beta_2(\delta + POP_t) + \beta_3 INV_t + \beta_4 EDU_t + \beta_5 Crpt_t + \varepsilon_t \qquad (26)$$

The results of this equation will provide evidence if a change in the level of corruption leads to a change in the steady state level of output per worker. Comparing the results of the base model (25) with equation (26), we will have support as to whether or not the corruption function does impact government expenditure, investment and the production function. Similarly, equation (27) will be used to examine the impact of corruption on foreign aid.

$$GDP_t = \beta_0 + \beta_1 FA_t + \beta_2(\delta + POP_t) + \beta_3 INV_t + \beta_4 EDU_t + \beta_5 Crpt_t + \varepsilon_t \qquad (27)$$

4.4 Limitations

Conceptually, it is often difficult to accept the many limitations of the various measures of corruption. Recall our operational definition of corruption: the use of public office power for private benefit. Clearly, there are varying degrees of abuse of this sort. Separating the annoying and low-cost corruption that permeates some governments from the “grand” or Mobutu-style corruption often referenced in the literature is not possible. Certainly, both are costly but how would one measure the impact or frequency of either type? Even if one could measure the immediate impact of corruption, how would we measure the subsequent impact as investors avoid situations where corruption is out of control? Perhaps even more costly are the foregone opportunities, as others fail to follow through with investment plans. Hence, the first limitation of this model is that it only considers the government corruption.

Secondly, the index of corruption (ICRG) that we will use in this analysis is a poll of polls, which they assert helps cleanse any surveyor-specific bias in the assessments provided by any individual source. Similar to other indices of corruption, ICRG attempts to capture perceptions of the degree of corruption as seen by business people, academics and risk analysts. The main drawbacks of this database is that it is based on subjective surveys, has a short time series (1985-2005), and far more troubling due to changing methodology from time to time. As the data are not consistent over time, it may be subject to unknown bias. Acknowledging the limitations of the available data on corruption are important for its proper use and may influence the shape of databases still in development. There exist some basic qualities, which make a corruption indicator more useful for most purposes. In general, a good corruption measure should be trustworthy. If the indicator is based on the personal opinion of one or a few persons, it is likely to be less credible, and hence less useful. The same would be the case if the people involved in creating the index could be suspected of having an interest in skewing the results either way. In addition, the measurement should be valid. For example, if one is interested in studying aspects related to corruption in general, measuring the number of corruption convictions would probably not be a good measure, since it is likely to reflect the effectiveness of judiciary institutions as much as actual corruption.

Accuracy and precision are another two key factors. If the index is prone to large measurement errors, it is bound to be less useful. The inaccuracy should be quantified by, say, a standard deviation. In surveys, the typical way of improving accuracy is to increase the number of respondents. On the other hand, a quantity is precise when everyone agrees on what the quantity measures, and it is imprecise or ambiguous when there are different opinions about what a specific number means. Precision in surveys is attained by asking questions that do not depend upon individual “standards”. Furthermore, in our model we are using government expenditure as the multifactor productivity, ignoring the effect of other factors (technology) on growth. This adds to the limitations of the theoretical model, and can be refined in a more sophisticated model in future research.

5. Results[†]

5.1 Estimation results

5.1.1 The base model without corruption

Table 14 in appendix C reports the results of the base model (equation 28) of GDP without corruption as an explanatory variable. In this specification, the adjusted R^2 is 0.55 and all the coefficients have the expected signs, and are statistically significant at the 5% level (with the exception of the constant). Equation (28) below represents the estimation output:

[†] Detailed regression tables are available upon request

LNGDP = 4.36 + 0.86 LNGOV + 0.66 LNPOP + 0.37 LNINV + 0.71 LNEDU (28)
(T-values) (1.76) (2.39) (2.40) (2.40) (2.41)

In an effort to estimate the elasticities of output (physical and human), the coefficients of investment (LNINV) and education (LNEDU) are 0.37 and 0.71 respectively. 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.

5.1.2 The base model with corruption

As we introduced a new variable (corruption) to the base model, we should check again for serial correlation and heteroscedasticity. As shown in table 16 in appendix C, the Durbin-Watson statistic is 2.7, indicating no serial correlation. As for heteroscedasticity, table 17 in appendix C shows that the white statistic is 12.41, which is less than the critical chi-square value (18.32) at 5% level of significance and 10 degrees of freedom, indicating homoscedastic disturbances. Moreover, table 15 in appendix C reports the results of the base model of GDP with corruption as an explanatory variable. With the exception of the constant and (LNPOP), all the variables have the expected sign, and are statistically significant at the 5% level. In this specification, the adjusted R^2 is 0.67, meaning that this specification explains 67% of the variances in real GDP per worker and adds a 12% explanatory power to the base line specification. Equation (29) below represents the estimation output:

LNGDP = 2.43 + 0.63 LNGOV + 0.34 LNPOP + 0.27 LNINV + 0.58 LNEDU – 1.77 Crpt (29)
(T-values) (1.08) (2.38) (1.32) (3.08) (2.52) (2.53)

The coefficient of corruption (CRPT) is statistically significant with a negative sign. This means that as corruption increases, the steady state level of output per worker is reduced. A close look at the specification reveals that CRPT is at the very least linearly related to output per worker. When corruption enters the model, the magnitude of the investment coefficient (LNINV) is reduced, indicating that corruption lowers the productivity of physical capital. These results confirm that corruption reduces the level of steady state per worker income. On the other hand, the magnitude of the government expenditure coefficient (LNGOV) and education coefficient (LNEDU) has decreased as we introduce corruption to the base model. This means that due to corruption, the effect of government expenditure on GDP is reduced, and the productivity of human capital is also reduced. This explains the inefficiency in corrupt governments, as corruption reduces the effectiveness of government expenditure. Moreover, the insignificance of the (LNPOP) is expected as we are using GDP per capita as the dependent variable meaning that its impact has already been captured.

5.1.2.1 The nonlinear relationship between corruption and output

In an attempt to check for the nonlinear relationship between corruption and output per worker, we added CRPTSQ to the above model. Table 20 in appendix C reports the results of this estimation (the base model of GDP with the inclusion of crpt and crptsq). In this specification, the adjusted R^2 is 0.74, adding a 19% explanatory power to the base model specification without corruption (28) and 7% to the base model with crpt only (29). Equation (30) below represents the estimation output:

$$\underset{(2.44)}{LNGDP = 7.88} + \underset{(2.36)}{0.66\,LNGOV} + \underset{(0.06)}{0.01\,LNPOP} + \underset{(3.84)}{0.25\,LNINV} + \underset{(2.21)}{0.61\,LNEDU} - \underset{(1.83)}{10.66\,CRPT} - \underset{(2.63)}{10.53\,CRPTSQ} \qquad (30)$$

(T-values) (2.44) (2.36) (0.06) (3.84) (2.21) (1.83) (2.63)

In the presence of high multicollinearity of CRPT and CRPTSQ, the coefficient of CRPT becomes insignificant. However, the coefficient of CRPTSQ is statistically significant at 5 % level. It should be noted that even though the coefficient of CRPT is statistically insignificant, jointly CRPT and CRPTSQ better explain differences in real GDP per worker. Similar to the previous specification (29), the LNPOP is insignificant. Thus, in this specification (30), all the variables (excluding CRPT and LNPOP) are statistically significant at the 5% level with the expected sign. The coefficient of CRPTSQ is -10.54, suggesting a strong nonlinear relationship between corruption and output per worker. Moreover, the magnitude of the investment coefficient (LNINV) is reduced further, confirming the negative direct effect of corruption on the productivity of capital. On the other hand, the magnitude of the government expenditure coefficient (LNGOV) and education coefficient (LNEDU) has also decreased in this specification, which supports our proposition that corruption induces inefficiencies in the government spending and reduces the productivity of human capital.

Furthermore, we dropped the CRPT variable from this specification and run the regression with CRPTSQ only. As shown in table 23 in appendix C, the results are very similar to the previous specification equation (30). All the variables (except for the intercept and LNPOP are significant with the expected sign). In this specification, the adjusted R^2 is 0.69 which is less than the R^2 obtained in the previous specification (5.3). Equation (31) below represents the estimation output of this specification:

LNGDP = 3.13 + 0.62 LNGOV + 0.24 LNPOP + 0.31 LNINV + 0.6 LNEDU - 1.6 CRPTSQ (31)
(T-values) (1.51) (2.52) (1.03) (3.33) (2.6) (2.83)

As corruption enters the model in a quadratic form only (31), the results are very similar to specification equation (29), where it enters the model only in a linear form. This affirms the nonlinear relationship between corruption and output. Hence, we will introduce corruption in a cubic form (CRPTQ) to examine this relationship further. As shown in table 24 in appendix C, as we introduce CRPTQ to specification equation (30), all the coefficients of CRPT, CRPTSQ, CRPTQ, LNGOV, LNPOP and the intercept become insignificant. Hence, we tried different specifications. Keeping CRPTQ and CRPT and dropping CRPTSQ didn’t change the significance. Also, keeping CRPTQ and CRPTSQ and dropping CRPT did not change the significance. But, 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) as shown in table 24 in appendix C. Equation (32) below represents the estimation output of this specification:

LNGDP = 3.58 + 0.69 LNGOV + 0.2 LNPOP + 0.32 LNINV + 0.63 LNEDU - 1.76 CRPTQ (32)
(T-values) (1.81) (2.41) (0.78) (3.54) (2.62) (3.07)

Table 25 in appendix C shows the results of this specification. The adjusted R^2 is 0.71 which is also less than that of specification equation (30). The results of this specification are very similar to the previous specifications equation (29) and equation (31) regarding the impact of corruption on output, investment, government expenditure and education expenditure with slight differences in the coefficient of corruption among these specifications. Therefore, specification equation (30) where corruption enters the model in both forms (linear and quadratic) has the highest adjusted R^2 (0.74) which means that jointly CRPT and CRPTSQ better explain differences in real GDP per worker, indicating both the linear and nonlinear relationship between corruption and output.

5.1.3 The modified model

The specifications discussed above are potentially subject to measurement errors, omitted variables, and simultaneity biases that can produce inconsistent and biased estimates. The measurement error biases that can potentially arise may be related to the time span covered by the variables in the regressions and/or to the corruption index. As the index we used (ICRG) is the one with the biggest set of observations about Lebanon as it starts in 1985, we can not perform the sensitivity analysis based on changing the corruption index or the time period. Alternatively, we have modified the theoretical model to use foreign aid instead of government expenditure as the multifactor productivity. This model modification allows us to test whether or not the results might change if we use a different explanatory variable as the multifactor productivity. It should be noted that the data on foreign aid, which are derived from the Lebanese Ministry of Finance, represents all the grants and aids given only to the Lebanese government (1985-2005) as of the effective date of the grant or aid. Hence, the data set excludes other grants or aids given to any other party in Lebanon (NGO's, firms, individuals, political parties, etc).

We will test for stationarity in the foreign aid series (LNFA), then check for autocorrelation and heteroskadactisity in the modified model. As shown in tables 26 and 27 in appendix C, LNFA has a unit root in levels but no unit root in the first difference (DLNFA). Hence we will use the stationary series DLNFA instead of LNFA in this analysis. As for heteroskadactisity, the white statistic is far below the critical chi-square value as shown in table 28 in appendix C, indicating homoscedastic disturbances. The Durbin-Watson statistic is not conclusive for this modified model. Hence, we will use the Kiviet test to check for autocorrelation. The results of this test, as shown in table 29 in appendix C, suggests autocorrelation. Thus, we will introduce lags of some of the independent variables in the model to correct for autocorrelation. As we introduce (DLNPOP), the first difference of LNPOP, to the model and run the Kiviet test again, the results as shown in table 30 in appendix C indicate that there is no autocorrelation in this model anymore. Therefore, we will add DLNPOP to the specifications of the modified model. Table 31 in appendix C shows the results of estimating the modified base model with no corruption. Equation (33) below represents the estimation output:

$$LNGDP = 9.33 + 0.39\ DLNFA + 1.14\ LNPOP + 0.35\ LNINV + 0.5\ LNEDU + 0.99\ DLNPOP \quad (33)$$

(T-values) (13.23) (2.75) (2.13) (3.23) (2.47) (3.2)

In this specification, the adjusted R^2 is 0.62 and all the coefficients have the expected signs, and are statistically significant at the 5% level (with the exception of the LNPOP). The insignificance of the LNPOP is expected due to the high multicollinearity with its lag (DLNPOP) which we have added to this model to correct for serial correlation. Similar to the same approach we took with the original base model, we will introduce corruption to this modified model to test its impact on the effects of the factors of production on output. As we introduced a new variable (corruption) to this modified model, we should check again for serial correlation and heteroscedasticity. As shown in table 33 in appendix C, the white statistic is far below the critical chi-square value indicating homoscedastic disturbances. Table 34 in appendix C shows the results of the Kiviet test for serial correlation in the modified model with corruption. The results suggest no serial correlation, which is expected as we have already corrected for serial correlation in the modified base model through introducing DLNPOP to this specification as well.

Table 32 in appendix C reports the results of the modified base model with corruption. With the exception of the LNPOP and DLNPOP, all the variables have the expected sign, and are statistically significant at the 5% level. In this specification, the adjusted R^2 is 0.69, suggesting that this specification explains 69% of the variances in real GDP per worker and adds a 7% explanatory power to the modified base line specification. Equation (34) below represents the estimation output:

$$LNGDP = 8.79 + 0.38\ DLNFA + 1.01\ LNPOP + 0.21\ LNINV + 0.32\ LNEDU + 0.87\ DLNPOP - 0.32\ CRPT \quad (34)$$

(T-values) (4.37) (3.19) (1.67) (2.41) (2.54) (1.55) (3.27)

Similar to the results obtained in estimating the original base model, as corruption enters the specification the population variable (as well as its lag in this specification) becomes insignificant, the coefficients of the education expenditure and the coefficient of investment are reduced. These results confirm our previous findings. Moreover, the foreign aid coefficient is slightly reduced from 0.39 to 0.38, as corruption enters the model. This insignificant change in the coefficient suggests that corruption does not impact the effect of foreign aid on GDP. It should be noted that the data on foreign aid used in this analysis cover only the grants/loans/aids given only to the Lebanese government. The donors of such aids are mainly governments of the developed countries and international organisations such as the Wold Bank and IMF. At the first meeting of the Lebanese government and international institutions (World Bank, European Investment Bank, European Commission) in Paris on 23 February 2001, the Lebanese government received over 500 million euros in aid, and presented its economic and financial reform policy. It was decided, in principle, that any future grants are conditional on the reform policy with increased government transparency and combating corruption as the highlights. This means that the aids and grants that the Lebanese government received after 2001 relied on the implementation of these reforms within the Lebanese public institutions (that is, combating corruption). This may explain the fragile negative relationship we found in our sample between corruption and foreign aid. Moreover, it should be noted that adding CRPTSQ to the estimation equation (34) increased the R^2 to 0.72, and produced similar results. This also supports the nonlinear relationship between corruption and output mentioned earlier.

5.2 Causality

To date, there are two empirical tests of causality that relates corruption and economic growth. The first empirical test, performed by Mauro (1995), uses ethnolinguistic fractionalization (ELF) as the instrumental variable in a two-stage least squares model. The ELF statistic is a probability that two randomly selected individuals from a given country are not from the same ethnolinguistic group. The lower the ELF statistic, the less fragmented the country, ethnolinguisticly. The exogeneity of the variable arises from the assumption that the statistic is uncorrelated with economic variables. The result of Mauro's empirical test provides only weak evidence that corruption causes poor economic growth. On the other hand, Leite and Weidmann (1999) also attempt to establish causal relationship between the two variables with the application of two-stage least squares. They endogenize corruption and find that economic growth causes an increase in corruption. This positive relationship between corruption and economic growth is consistent when estimated, using a Tobit procedure with the corruption index as the regressand. The fact that the two-stage least squares method using dissimilar instrumental variables leads to conflicting results lends credibility to its sensitivity.

5.2.1 Corruption and economic growth

We will test for causality between corruption and economic growth using the Granger test. The test will be performed on the same data set (appendix B) of corruption from ICRG and the real per capita GDP from IMF. The Granger (1969) approach to the question whether a variable x causes another variable y is to see how much of the current y can be explained by past values of y, and then to see whether adding lagged values of x can improve the explanation. y is said to be Granger-caused by x if x helps in the prediction of y, or equivalently if the coefficients on the lagged x's are statistically significant. It should be noted that two-way causation is frequently the case; x Granger causes y and y Granger causes x. Moreover, it is important to note that the statement “Granger causes" does not imply that y is the effect or the result of x. Granger causality measures precedence and information content but does not by itself indicate causality in the more common use of the term. The output of this test reports the F-statistics which are the Wald statistics for the joint hypothesis; the first null hypothesis is that x does not Granger-cause y, and the second is that y does not Granger-cause x. The null hypothesis is rejected when the F value is significant.

Hence, we will run a causality test between economic growth and corruption. The first null hypothesis is that corruption does not cause economic growth, and the second is that economic growth does not cause corruption. As shown in table 21 in appendix C, the first null hypothesis can not be rejected since the F statistic is not significant. This means that there is no evidence that corruption causes economic growth, which is expected and consistent with the literature. On the other hand, the second hypothesis is rejected as the F statistic is significant at the 5% level. This suggests that economic growth causes corruption. In some countries, rapid growth may hamper the necessary structural adjustment by making it seem less crucial to replace “bad” policies, institutions and practices with “good” ones (that is, it creates wrong incentives). This might help establish elite in power and encourage corruption. For instance, the extended periods of rapid growth in the former Soviet Union after the Second World War without introducing the proper policies and improving their institutions lead to an increased level of corruption. In addition, the Asian crisis in the late 1990s shows that without proper institutional structures in place, rapid growth not only encourages corruption but also is vulnerable to crises.

5.2.2 Corruption and foreign aid

Wei (2000) argues that foreign aid tends to facilitate corruption. Attempts to improve accountability in foreign aid, albeit costly, are becoming more common, because simply disbursing aid to kleptocratic regimes has debased the institutions essential for economic growth and has entrenched corrupt elites. Hence, we will run a causality test between foreign aid and corruption. The first null hypothesis is that corruption does not “cause” foreign aid, and the second is that foreign aid does not “cause” corruption. As shown in table 35 in appendix C, the first and the second null hypotheses can not be rejected since the F statistic is not significant in both tests. This means that there is no evidence that corruption causes foreign aid, or foreign aid causes corruption. Its noteworthy that between 1960 and 2005, Africa received foreign aid worth more than 450 billion US$, despite the fact that African corruption has been getting worse, not better, over the last years (Sampford 2006). This explains how aids to Africa were not subject to the level of corruption, as the Elite in power used this aid to buy the allegiance of cronies and the military equipment to oppress their own people, not to mention being able to set up "retirement" accounts in Swiss banks (Abed 2002). Therefore, although results show that foreign aid does not cause corruption, but in some cases of a highly corrupt regimes, this aid can be used to benefit mostly the elite in power leading to an increase in the level of corruption.

5.3 Overview and comparison

In this analysis, a number of noteworthy results have been produced. Some were consistent with the literature and others have run counter to the conventional wisdom and evidence reported in the literature. First, the assumption of constant return to scale did not hold when we estimated elasticities. Hence, 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). On the other hand, 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. It should be noted that the high magnitude of the government expenditure’ coefficient (LNGOV) is due to the high contribution of the government spending’ as a percentage of the GDP in Lebanon as shown in the data set. In fact, during the civil war (1975-1990) the government expenditure accounted for more than half of the Lebanese GDP as Deeb (1985) indicates.

The results of the regression analyses indicate that corruption reduces Lebanon’s standard of living as measured by the real GDP per worker. A decrease in the index of corruption increases the steady state real GDP per worker, and helps its convergence to steady state level. These findings are also consistent with the theoretical arguments proposed in this paper and by Bigsten and Moene (1996), Bendardaf *et al* (1996), Wedeman (1997) and Rose Ackerman (1999). Results also suggest that corruption and economic growth are related in a nonlinear way. In addition, we find a statistically significant negative association between corruption and the productivity of capital. This confirms Mauro's (1997) findings of a negative direct effect of corruption on investment which is also consistent with (Schleifer 1993; Brunetti 1997; Leite 1999; Mo 2001). Hence, we conclude that corruption primarily affects the accumulation of capital and reduces its productivity.

Moreover, results indicate that corruption reduces the effect of government expenditure on output. In other words, it introduces inefficiencies to the factors of production. Corrupt officials may approve some public projects at a higher cost to the government if they get personal benefits from it. In other words, bribes paid by inefficient and incompetent firms to secure government contracts and licenses create additional hazards, benefit the corrupt officials, and add extra cost to the government. These results are 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 confirms Mauro's (1998) findings who suggest that corruption is negatively associated with government expenditure on education, since it provides more limited opportunities for rent-seeking than other items do. However, the education expenditure variable represents the human capital in our model. Hence, we conclude that corruption reduces the productivity of human capital. Mo (2001) also 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, as a consequence, their productivity is reduced

Furthermore, results indicate that corruption does not influence the effect of foreign aid on GDP. These results are consistent with the findings of Alesina and Weder (2002) who find no evidence that less corrupt government receive more aids. However Gupta *et al* (2003) argue that in countries plagued with high levels of corruption, any increase in aid would be fully offset by reduced revenue effort. Hence, we can not conclude that reducing the level of corruption will increase the level of foreign aid granted to Lebanon. The insignificant change in the coefficient of foreign aid, when we add the corruption variable to the estimation equation in the modified model is not sufficiently compelling for such conclusion.

Finally, results also suggest that economic growth causes, in the Granger sense, corruption similar to the findings of Leite and Weidmann (1999) indicating that rapid growth induces an increase in corruption. Klitgaard (2004) argues that corruption flourishes when someone has monopoly power over a good or service. In developed countries, big firms and corporations benefit from the country's economic growth to increase their market power and competitiveness in the world market, and some are already granted monopoly power. Klitgaard (2004) provides many examples from the United States, United Kingdom, Canada, and Australia showing the corruptive behaviour of such firms as they become the key players in the market (Enron, WorldCom, Salomon Smith Barney, Credit Suisse First Boston, Merrill Lynch, Morgan Stanley, Goldman Sachs, UBS Warburg, Chiquita, Australian Wheat board). On the other hand, in developing countries such as India and China where property rights, legitimate business practices, and other basic elements of market economics remain poorly-defined, corruption grows out of the incomplete nature of the reforms and their inconsistent application in practice (Johnston 2005). The rapid growth is such countries make the state and its bureaucrats more powerful players in the economy, even if in a more fragmented way than once was the case. Growth has created new interests and concentrations of economic power, but not legitimate channels of access between bureaucrats and entrepreneurs. On the other hand, we find no evidence that corruption causes foreign aid, or foreign aid causes corruption. These results are consistent with those of Alesina and Weder (2002) who find that multilateral aid, namely, aid coming from international organizations, does not discriminate against the level of corruption of the receiving country. Thornton (2002), for example, suggests that the US, a major aid donor for developing countries, seems to favour highly corrupt governments and democracies over dictatorships.

Therefore, we conclude that corruption reduces economic growth through several channels. It reduces the accumulation and productivity of capital, reduces output, creates increased inefficiencies in the government expenditure and education expenditure, and as a consequence, reduces economic growth. We ca n not conclude that corruption alters the effect of foreign aid on output. In addition, a decrease in the index of corruption increases the steady state real GDP per worker, and helps its convergence to steady state level.

5.4 Forecasting

The World Bank country assistance strategy unit (WBCASU) forecasts some key economic and social indicators for many countries including Lebanon. However, we will use the forecasts of the following independent variables (government expenditure as a percentage of GDP, population growth, depreciation, investment share of GDP and education expenditure as a percentage of GDP) that are generated by (WBCASU) and presented in appendix B. On the other hand, the corruption index employed in this analysis is generated yearly by the ICRG with no projections for future values. Hence, we will be generating such values. Forecasting will be based on three different scenarios: firstly, no change in the corruption index (that is, no change in the corruption index over the forecasting period), secondly: an increase in the corruption index (that is, increase in the level of corruption), and thirdly: a decrease in the corruption index. It should be noted that in all different scenarios, we will be forecasting the dependent variable (GDP per capita) based on the forecasts of all the independent variables (taken from WBCASU) and our forecasts of the corruption index.

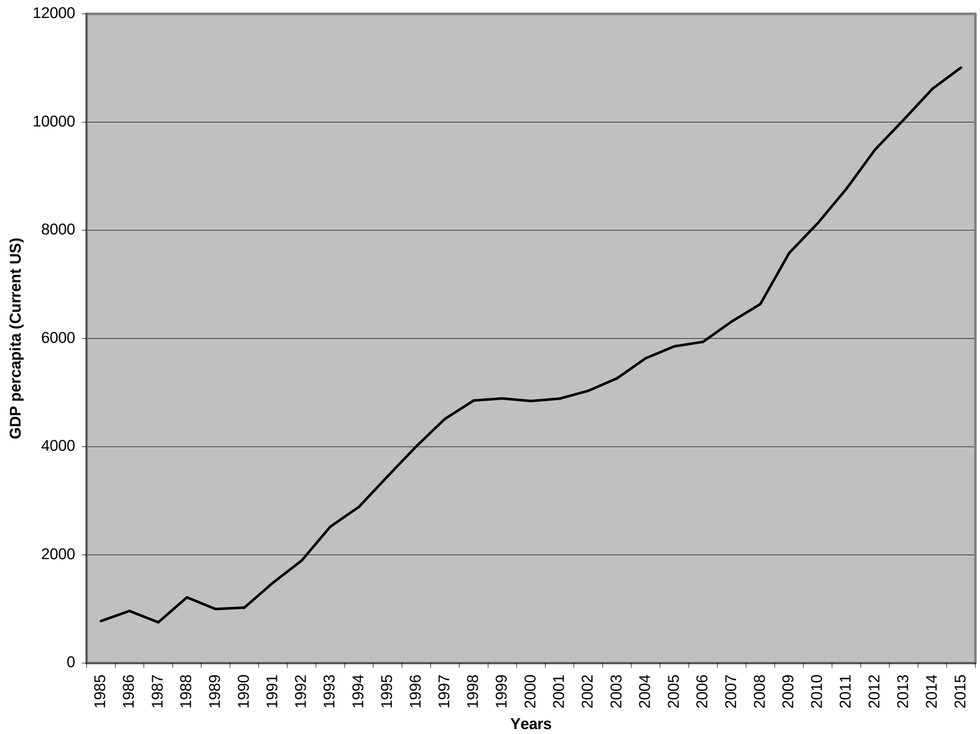
5.4.1 Forecasting without a change in the corruption level

As indicated previously, estimation equation (32) has the highest adjusted R^2 (0.74) where corruption is represented in a linear (CRPT) and non-linear (CRPTSQ) form. As the LNPOP and CRPT variables turned out to be insignificant in this specification, they will not be included in the forecasting equation. Hence, we will use the following equation in all forecasts:

$$LNGDP = 7.88 + 0.66\, LNGOV + 0.25\, LNIV + 0.61\, LNEDU - 10.53\, CRPTSQ \qquad (35)$$

In this first alternative, we assume that the corruption level does not change (CRPT = 0.77) during the forecast period (2006-2015).

Figure 1 – GDP percapita forecast assuming no change in corruption level

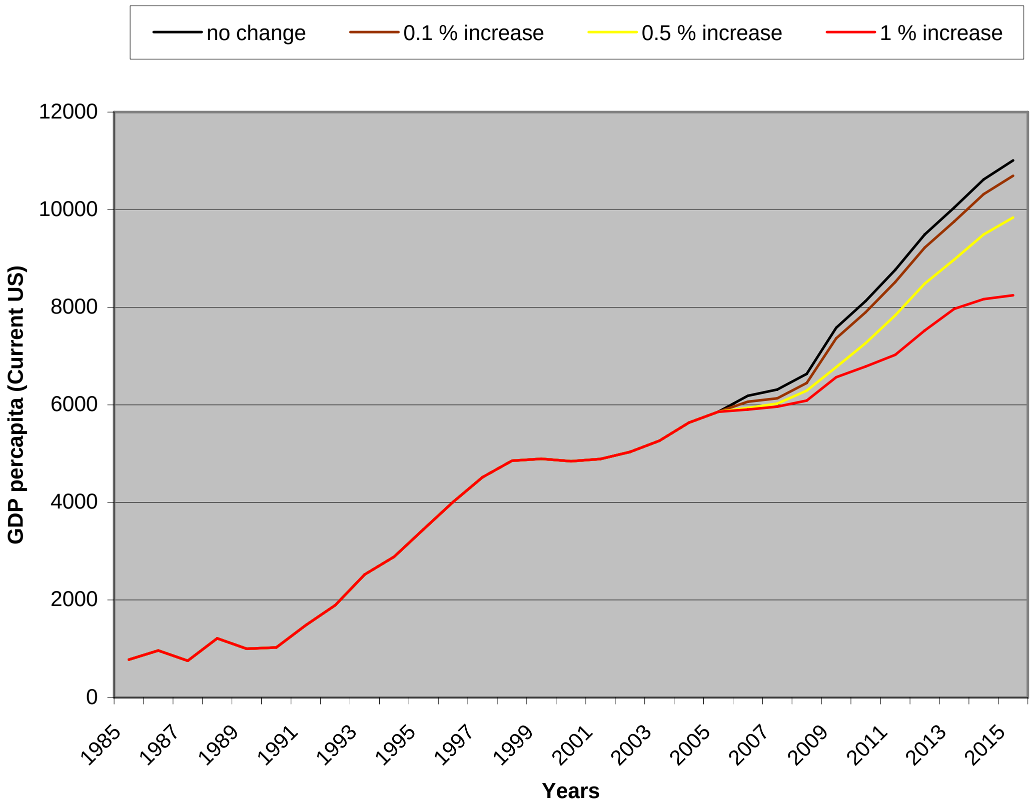


The figure above shows the GDP per-capita growth in Lebanon. Firstly, the slow growth period (1985-1990) shows the impact of the civil war. During the post civil war period, there was an initial high growth rate right after the civil war during the reconstruction period, and then a slower rate as of 1998 when there was a new government. It should be noted that this graph represents the actual GDP per capita values prior to 2005. In the forecast period (2006-2015), the graph continues to show the rate of growth assuming that the corruption level remains the same (as it was in 2005) throughout that period.

5.4.2 Forecasting with an increase in the corruption level

The figure below shows the different growth rates of GDP per capita during the forecast period assuming an increase in the corruption level (i.e. increase in the corruption index). The black curve represents the base line, which is the growth assuming no change in the corruption level during the forecast period. The brown, yellow and red curves represent GDP growth assuming a 0.1, 0.5 and 1% increase in the corruption index from the base line, respectively. This graph shows how an increase in the corruption level slows down the GDP growth forecast.

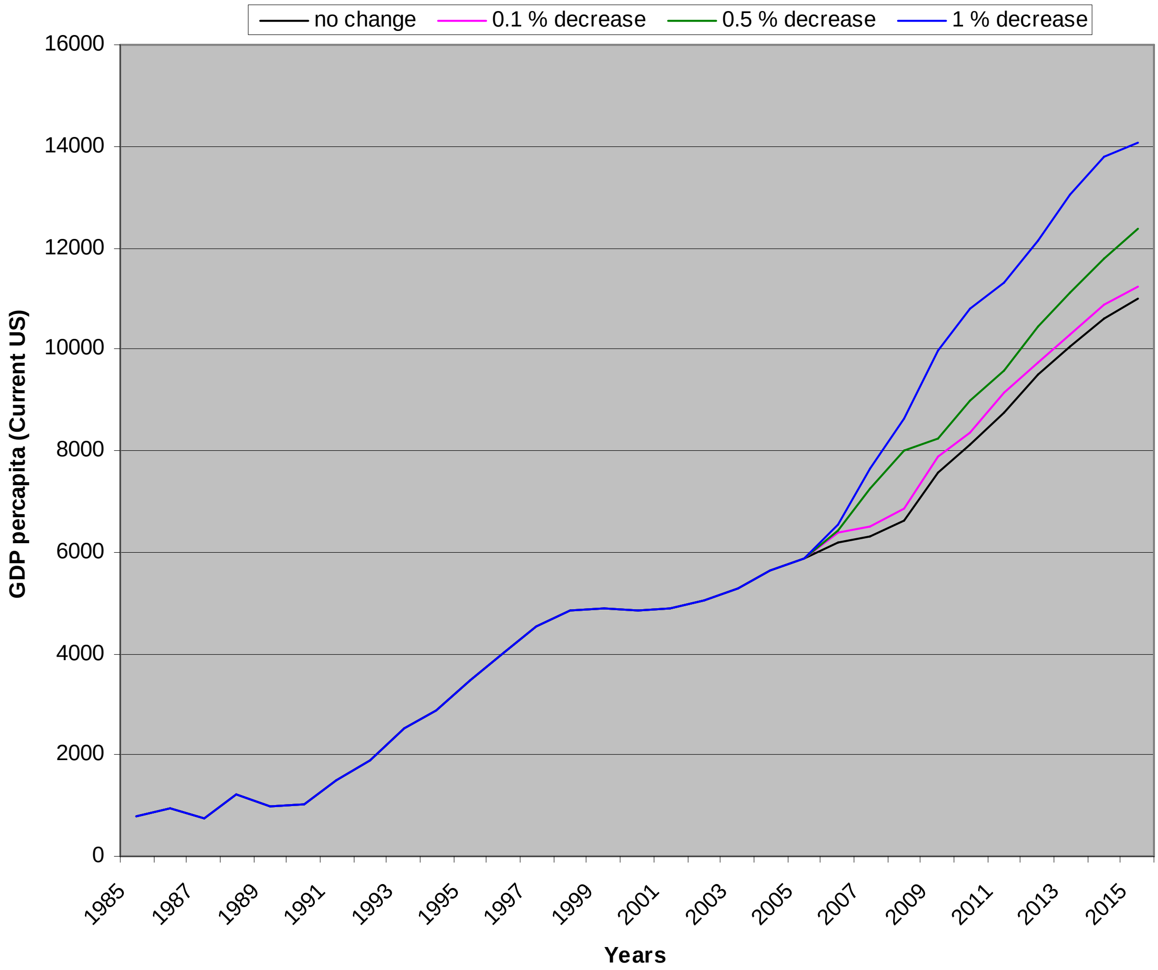
Figure 2 – GDP percapita forecast assuming an increase in corruption level



5.4.3 Forecasting with a decrease in the corruption level

The figure below shows the different growth rates of GDP per capita during the forecast period assuming a decrease in the corruption level (that is, decrease in the corruption index). The black curve represents the base line, which is the growth assuming no change in the corruption level during the forecast period. The purple, green and blue curves represent GDP growth assuming a 0.1, 0.5 and 1% decrease in the corruption index from the base line, respectively. This graph shows how a decrease in the corruption level enhances the GDP growth forecast.

Figure 3 – GDP percapita forecast assuming a decrease in corruption level



As shown in the diagram above, a small change in the level of corruption in Lebanon has a very significant impact on the growth of GDP per capita. For example, a 2% decrease in the corruption index of Lebanon doubles the growth rate of GDP per capita. That is, if there were no change in the corruption level in Lebanon, the GDP per capita forecasts in 2015 would be around 11000 US$ (increasing by 5000 US$ as compared with the actual GDP per capita in 2006, 6000 US$); however, with a 2% decrease in corruption the GDP per capita forecasts in 2015 would be around 16000 US$ (increasing by 10000 US$ as compared with the actual GDP per capita in 2006). Similarly, a 2% increase in the corruption level cuts down the GDP per capita growth in Lebanon by half. Hence, this shows how critical the impact of corruption is on economic growth in Lebanon. This implies that the marginal benefit to output of reducing corruption outweighs virtually any other policy action to enhance economic growth in Lebanon.

6. Policy implications and conclusions

A number of policy implications arise from this analysis. Since corruption is an exogenous variable in the production function, there is very little that individual firms can do to control its level. This might explain why corruption has emerged as a central focus for both developed and developing countries. In this paper, we argue that unless corruption is reduced first in Lebanon, efforts to improve private investment and public investment (government expenditure) will have a minimal impact on the per capita GDP. Corruption restrains the economy from reaching its potential. We have shown in our model that corruption affects long-run economic growth. Its impact permeates virtually every aspect of the production function either directly and/or indirectly. It is also significant, that the model so clearly points the future prospects. Efforts to improve capital productivity can be quickly offset by the impact of corruption. Thus, the returns to attempts aimed to stem corruption are undoubtedly quite high.

The negative relationship between corruption and the productivity of capital suggested in the results provides policy makers with powerful incentives to combat corruption. Private investors demand a return, and will direct their decision where they anticipate the highest return 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 these returns but the evidence presented here suggests that there is a positive return in terms of increased capital productivity associated with reduced corruption. This, in turn, yields additional benefits due to private investment's close and strongly positive relationship with economic growth.

Moreover, while corruption is likely to create increased inefficiencies in the government expenditure, it is likely to reduce the country's growth. Results show that corruption reduces the effect of government expenditure on output. One way in which corruption affects public investment is where corrupt high level officials or political agents steer the approval of investment projects towards particular domestic or foreign enterprises in exchange for bribes. Important cases of corruption exist also when political agents steer public investments towards their home districts or their ownland. In all these cases, the productivity of the government spending is reduced, thus hampering the growth rate of the country. Widespread corruption in the investment budget will not only reduce the rate of return to new public investment, but will also affect the rate of return that a country receives from its existing infrastructure. Therefore, a key implication of these findings is that economists should be more careful in their praise of high public sector investment spending, especially in such countries as Lebanon, where high level of corruption is a problem.

In addition, results suggest that corruption reduces the productivity of human capital. Corrupt officials spend more time and effort in seeking and accumulating political capital, which is not socially productive; as a consequence, their productivity is reduced. This implies that increasing the productivity of human capital in Lebanon would not only result from increasing the government spending on education, but also through reducing the level of corruption. This also suggests a positive return in terms of increased human capital productivity associated with reduced corruption. This, in turn, yields additional benefits due to human capital productivity's close and strongly positive relationship with economic growth. Hence, policy makers in Lebanon need to put more efforts on reducing corruption rather than increasing public investment on education in order to increase the productivity of human capital.

Furthermore, results indicate that corruption does not alter the effect of foreign aid on output. We can not conclude that reducing the level of corruption will increase the level of foreign aid granted to Lebanon or enhance the effect of foreign aid on output. 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 compelling for such a conclusion. Yet, such findings point out a new potential avenue via which economic growth can indirectly be reduced due to corruption. Therefore, economic growth in Lebanon may be slowing down due to corruption through several channels (that is, output levels, effectiveness of government expenditure, productivity of capital, and steady state level of per worker income). Hence, unless the levels of corruption are reduced in Lebanon, improvements in any of these channels might not lead to the desired increase in growth

Finally, results suggest that economic growth may cause corruption. Rapid growth may hamper necessary structural adjustment by making it seem less crucial to replace “bad” policies, institutions and practices with “good” ones (that is, it creates wrong incentives). In developing countries such as Lebanon, where legitimate business practices, and other basic elements of market economics remain poorly-defined, corruption emanates from the incomplete nature of the reforms and their inconsistent application in practice. The rapid growth in these countries makes the state and its bureaucrats more powerful players in the economy, even if in a more fragmented way than once was the case. Hence, growth creates new interests and concentrations of economic power, but not legitimate channels of access between bureaucrats and entrepreneurs. Therefore, proper policies, institutions and reforms are essential during periods of economic growth to counter the increased corruption.

Appendix

Appendix A: Mathematical Derivations

A1 – Proof of negative effect of corruption on physical capital and output for general production function

It was noted in chapter four that there are negative relationships between corruption and steady state level of output per worker and corruption and economic growth and investment. These results were obtained using a Cobb-Douglas production function. The intent of this appendix is to show that these results also hold for general production function.

Let's begin with an aggregate production function

(A1) Y=f [K, G (ρ) L]; where Y is aggregate output, G is government expenditure, ρ is a measure of corruption as defined in the body text and L is labour. $G_\rho < 0$, $f_k > 0$, $f_G > 0$, and (d (G)/ dt)/G=g. Output per worker is then defined as

(A2) y=f [k, G (ρ)]; where y is output per worker and k is capital per worker. The capital accumulation equation is described as

(A3) dk/dt = sf [k, G (ρ)] – (n+ δ +g) k; where s is the nation's saving rate, δ is the capital stock depreciation rate and g is the growth rate of government expenditure. At steady state, dk/dt=0 and equation (A3) is rewritten as

(A4) sf [k, G (ρ)] = (n+ δ +g) k

Totally differentiating with respect to k and ρ yields

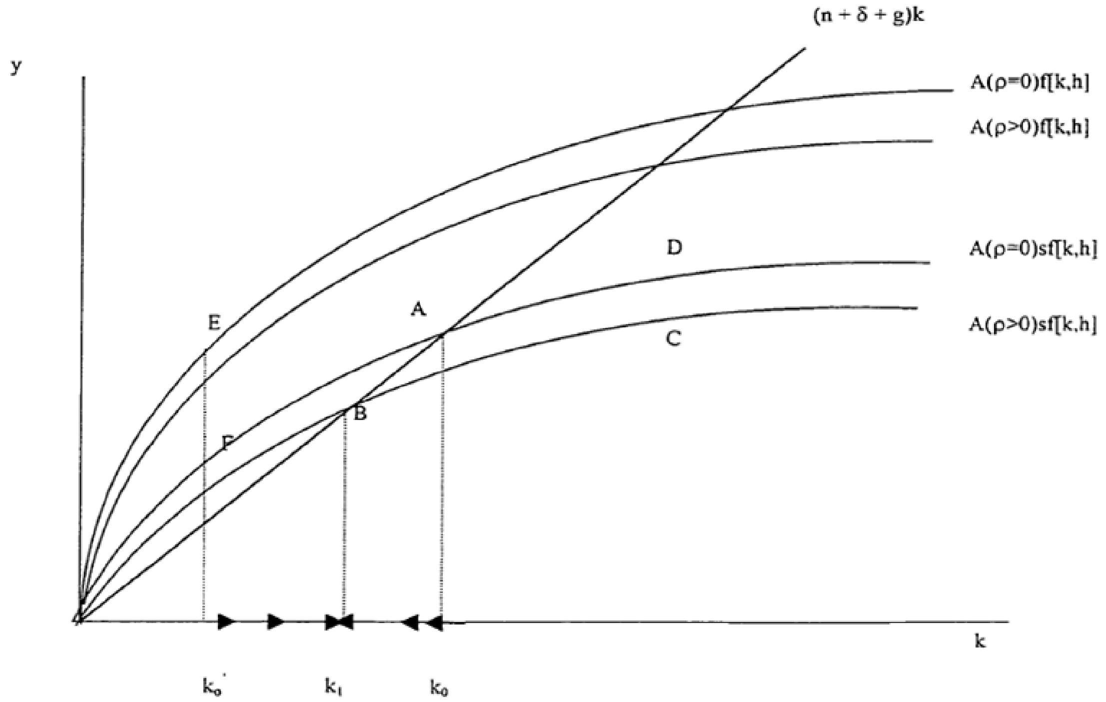
(A5) $sf_k dk + sf_G G_\rho d\rho = (n+\delta+g)\, dk$

This reduces to

(A6) $dk / d\rho = (-) \{[sf_G G_\rho] / [sf_k - (n+\delta+g)]\}$

Since stability requires that $[sf_G G_\rho] / [sf_k - (n+\delta+g)] < 0$ in equation (A3), it follows that $dk / d\rho < 0$ at steady state, it also follows that $dy/ d\rho < 0$ at steady state since $f_k > 0$.

A2 - Dynamics of Corruption on physical capital and output



The economy begins with a corruption-free level of production and savings function as denoted by subscript ρ. As the level of corruption increases, the sustainable level of capital falls from k_0 to k_1 and output falls accordingly. Therefore, increases in corruption reduce economic growth and output per worker.

Appendix B: Research data

B1 - Data used for estimation

Year	GDP per capita (current US)	Government expenditures as a % of GDP	Population growth + depreciation	Investment share of GDP	Education expenditure as a % of GDP	Corruption index (Crpt)	Foreign aid (current US)
1985	776.3697	43.1	-0.0255	3.6563	3.45	0.5023	3124084
1986	962.5845	38.2	-0.0049	3.1256	2.14	0.5125	3569513
1987	754.2935	36.2	0.1211	2.9856	1.02	0.5632	3798157
1988	1214.5152	19.2	0.2531	1.4526	0.44	0.5421	8222980
1989	999.3509	39.1	0.3893	2.4562	3.24	0.7638	10040000
1990	1025.5778	39.4	1.3258	3.9856	3.08	0.8333	10907670
1991	1483.1837	28.9	1.4709	8.6523	2.68	0.7777	78238548
1992	1893.7076	23.4	0.8798	19.4638	2.17	0.6667	55720180
1993	2521.3233	23.4	1.0385	21.4731	1.92	0.5694	56026410
1994	2886.8815	35.1	1.2020	21.2648	2.07	0.3333	55281575
1995	3451.6487	35.2	1.3602	21.3319	2.73	0.3333	55466293
1996	4006.7199	37.9	1.4415	17.2483	2.58	0.7083	48364342
1997	4514.3503	33.8	1.4466	14.5401	2.23	0.8423	46500513
1998	4854.2427	32.3	1.4449	11.8743	2.19	0.8333	43562259
1999	4893.0104	34.1	1.4369	10.1610	2.04	0.8845	44266596
2000	4844.7247	42	1.4228	10.2315	2.02	0.8321	46264351
2001	4890.1462	34.5	1.4110	13.7734	2.96	0.8219	106402897
2002	5033.8515	36.4	1.3997	11.5573	2.66	0.8365	79139914
2003	5262.7431	35.5	1.3792	11.8098	2.63	0.8563	74224804
2004	5634.0013	32.1	1.0539	11.4856	2.57	0.8333	66414345
2005	5856.2456	30.7	1.2124	10.8562	2.42	0.8346	57900633

B2 - Data used for forecasting

Year	Government expenditures as a % of GDP	Investment share of GDP	Education expenditure as a % of GDP
2006	30.2	11.4652	2.57
2007	31.1	11.9523	2.63
2008	32.2	12.1614	2.66
2009	32.8	12.9652	2.96
2010	33.4	13.7758	3.08
2011	33.9	14.5621	3.24
2012	34.2	15.3345	3.45
2013	34.5	16.5264	3.56
2014	34.8	17.6523	3.68
2015	35.1	18.5623	3.74

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