Unproductive Education in a Model of Corruption and Growth

by

M. Emranul Haque

Centre for Growth and Business Cycles Research, and Department of Economics, The University of Manchester, UK

Abstract:

This paper presents a dynamic general equilibrium analysis of education, public sector corruption and economic growth. In an economy with government intervention along with physical and human capital accumulation, state-appointed bureaucrats are responsible for procuring public goods, which contribute to productive efficiency. Corruption arises because of an opportunity for bureaucrats to embezzle public funds. Education has two opposing effects, a positive productivity enhancing effect and a negative corruption efficiency of bureaucrats. If the latter dominates the former, the incentive for bureaucrats to acquire education rises. The net effect may result in an insignificant (or even negative) effect of human capital on growth. Our results are straightforward. First, corruption and development are determined jointly in a relationship that is two-way causal: bureaucratic malfeasance both influences and is influenced by economic activity and human capital accumulation. Second, this two-way causality gives rise to threshold effects and multiple development regimes with very different equilibrium properties: in low stages of development there is a unique equilibrium with high corruption where higher human capital cannot get the economy out of poverty trap, in high stages of development there is a unique equilibrium with low corruption where human capital can exert its influence, and in intermediate stages of development there are both types of equilibrium. Third, transition between regimes may or may not be feasible and it is possible for a development trap to occur.

Keywords: Corruption, human capital, Public spending, Development

Author: M. Emranul Haque, Economic Studies, The University of Manchester, Arther Lewis Building, Oxford Road, Manchester M13 9PL, The United Kingdom. Tel: +44 (0) 161 275 4829; Fax: +44 (0) 161 275 4812; Email: emranul.haque@manchester.ac.uk

1. Introduction

The role of human capital in individual's productivity or earning is empirically well understood in microeconomic literature (please see Card, 1999) that followed Mincerian wage equation (Mincer, 1974). At a macro theoretical level, endogenous growth models (such as Lucas, 1988; Romer, 1990; Nelson and Phelps, 1966) also clearly suggest that human capital can generate growth that can be sustainable in the long run. Yet the empirical growth literature seems to give surprisingly mixed and conflicting messages while explaining the role of human capital on economic growth. Following the augmented neoclassical model of Mankiw, et. al., (1992), one strand of literature shows that human capital can explain a large part of growth by explicitly introducing it as an additional input in the production function. But the negative or insignificant results on the other strand of both cross sectional (Benhabib and Spiegel, 1994 and Pritchett, 2001, 2004, and 2006) and panel data studies (Kumar 2006; Bond, *et.al*, 2001; Caselli, *et.al.*, 1996; Islam 1995) gave rise to a great interest in exploring why this might be the case. The possible explanations, all of which are essentially empirical, include (i) measurement errors (Krueger and Lindahl, 2001), (ii) data quality (de la Fuente and Domenech, 2000 and 2002, Cohen and Soto, 2007, Bassanini and Scarpetta, 2001), (iii) the alternative estimation methodologies (Bassanini and Scarpetta, 2001, 2002; Freire-Serean, 2002), and (iv) the presence of few outliers but influential countries in a large sample of heterogeneous countries (Temple, 1999). However, to the best of our knowledge there is little or no macro-theoretical explanation on why such is the case[1]. We provide such a possible explanation on the link between human capital and growth by introducing the explicit role of corruption in a model of education, corruption and economic growth.

The motivation for our model comes from a recent interesting empirical paper by Rogers (2008) where he has shown corruption, black market premium and the extent of brain drain to be the possible channels through which education becomes unproductive and fails to produce the desired positive effect of human capital on growth in developing countries. For the role of corruption, he uses corruption 1996 index from Kaufmann et al (2005) to divide the full sample of 76 countries into sub-

[1] Eicher, *et.al.*, (2009) is an exception. But we differ from them in two accounts. First, they developed a model on the impact of education on income distribution due to corruption. Second, they relied on the arguments of increase in productivity due to human capital, which results in higher rental opportunity due to higher income of the economy. Whereas, in our model, we are looking into the interplay between human capital and corruption, along with the two opposing effects of human capital accumulation, due to which economy may end up with low growth trajectory along with the possibility of poverty trap.

samples of high and low corrupt countries for the growth period of 1960-2000. He concludes that human capital matters in the sample of low corrupt countries while it does not have an effect on growth in the sample of high corrupt countries.

The objective of this paper is to provide a theoretical explanation of the above phenomenon. In order to achieve the above, we utilize the literature on the detrimental effects of corruption on economic growth (Blackburn et. al., 2002; Mauro, 2004) along with the dual but opposing effects of education. While education makes an individual more productive in generating private sector output, at the same time it raises the efficiency of bureaucrats in stealing the public resources. According to this literature, the bureaucratic corruption may arise through different channels, for example, bribery and tax evasion (i.e., Blackburn, *et. al.*, 2006), stealing of government resources by public officials (Mauro, 2004) or by misinforming government about the costs and quality of public goods (Haque and Kneller 2009).

The detrimental effect of corruption on growth and development may take place through different channels, for example due to the bribery and tax evasion of public officials (bureaucrats), private agents or stealing of government resources by public officials, misinforming government about the costs and quality of public goods. Following the works of Ehrlic and Lui (1999) and Sarte (2000), the recent theoretical contribution is undertaken by Blackburn, *et.al.*, (2006). The study considers a dynamic general equilibrium model of growth for the joint determination of economic development and bureaucratic corruption. The similar mechanism was emphasized in Mauro (2004) and Blackburn, *et.al.*, (2002) through the existence of strategic complementarities where the corruption becomes inevitable. Another view is put forward by Haque and Kneller (2007) in their analysis that corruption may increase public investment but lowering its returns to public investment and hence retarding the economic development.

We consider two period overlapping generations (OLG) model with human capital externality in the spirit of Lucas (1988) model and productive use of government expenditures in the spirit of Barro (1990). According to the theoretical predictions of the model, impact of human capital may be retarded by the bureaucratic stealing efficiency. Education has two opposing effects on growth; it may increase the bureaucratic stealing efficiency that reduces the cost of concealment of illegal income or it may have positive productivity effects. If the negative effect of bureaucratic stealing dominates the positive productivity effects, education may retard or even lower growth.

In the first period of life, individuals decide whether to acquire education or work for the home production, supply skilled or unskilled labour and consumes when they are old. With more human capital the bureaucrats become efficient in reducing the cost of hiding their money as well as their corrupt identity. The concealment costs are the costs associated with hiding the illegal money earned through stealing of government resources. Because if caught the money will be confiscated by the government. In this manner human capital may have harmful effects on economic growth through increased bureaucratic stealing efficiency.

For example, higher human capital leads to higher bureaucratic efficiency which can be used to embezzle government resources (e.g. stealing) resulting in loss of government revenue and hence retarding the economic growth. On the flip side of the argument is the view that human capital exerts positive effect on growth by raising production efficiency. As the individual is simultaneously working as well as acquiring education. Education has a direct positive effect on growth and it may further create positive externality to other co-workers by learning by doing and hence generating positive production effects of human capital. The effect of human capital on growth is contingent upon the relative shares of negative bureaucratic efficiency effects and positive production efficiency effects. If the negative bureaucratic efficiency effects surpass the positive production efficiency effects then in nutshell the human capital may retard or even have negative effects on growth.

The remaining of the paper is organized as follows. The section 2 presents the basic framework of the model economy that is prone to bureaucratic corruption. Section 3 analyses the incentive conditions for bureaucrats to engage in corruption. Section 4 examines the incidence of corruption, which is dependent on economic development and human capital accumulation. Section 5 contains a discussion on the equilibrium persistence of corruption and possibilities of transition. Section 6 studies the feedback of corruption on economic growth through its impact on human capital accumulation. Section 7 concludes.

2. Basic Framework

Time is discrete and indexed by $t = 0 \ldots \infty$. All the agents live for two-periods with constant population and belong to overlapping generations (OLG) of dynastic families. The agents of each generation are divided into two groups of citizens - households (or workers), and bureaucrats (or civil servants). To save notation, we normalize the size of each group to be a measure of unit mass. We suppose that all individual households are born with one unit of labour endowment and are liable to pay a lump-sum tax, τ_t. Bureaucrats are responsible for the administration of the public policy, which requires funding for public expenditures.

Households work for firms in the production of output in return for wage while bureaucrats work for government in implementing the public policy in return for salary. Public policy comprises of a package of taxes and expenditures designed to provide public goods and services which contribute to the efficiency of output production. Corruption arises from the incentive of bureaucrat to embezzle (steal) public resources thereby reducing the provision of public services. We assume that a fraction, $v \in (0, 1)$, of bureaucrats are corruptible while the remaining fraction, $1 - v$, are non-corruptible, with unobservable identity of the bureaucrats by government. All agents are risk neutral, acquiring education, working and saving only when young, and consuming only when old. All markets are perfectly competitive.

In order to determine the initial level of development, we also assume that the economy has level of physical capital k_0, human capital $h_0$and government infrastructure G_0. These effectively determine the initial wage rate w_0 that an agent faces while deciding his time allocation between acquiring education or home production. To attract an agent to acquire education, it is sufficient to assume that $w_0 > u$ if u is the income per unit of time allocated for home production.

2.1. The Government and Public Services

We consider that the government provides public goods and services that are used as productive inputs in private production (e.g., Barro 1990). The government expenditures consist of public goods (services) and bureaucrats' salaries. Any bureaucrat (corruptible or non-corruptible) can work for a firm by supplying one unit of labour to receive a non-taxable income equal to the market wage paid to households. Any bureaucrat who is willing to accept a salary less than this wage must be expecting to gain through appropriation of public resources and is immediately identified as being corrupt. As in other analyses (e.g., Acemoglu and Verdier 1998; Blackburn *et al.* 2006; Blackburn and Forgues-Puccio 2005), we assume that a bureaucrat who is discovered to be corrupt is subject to the maximum fine of having all of his legal income (salary) confiscated (i.e., he is fired without pay). Given this, no corruptible bureaucrat would ever expose himself in the way as discussed earlier. The government ensures complete bureaucratic participation and minimizes its costs by setting the salaries of all bureaucrats equal to the wage paid by firm to the households.

We assume that one unit of public spending is transformed into one unit of productive public service. Each bureaucrat is provided with public fund g. If the bureaucrat does not embezzle the fund, then he spends the whole amount that he has been allocated. In the case where all bureaucrats decide not to be corrupt (i.e., not to embezzle), then government can provide total public services that are equal to $\hat{G} = \mathrm{g}$. Conversely if all the corruptible bureaucrats embezzle a fraction, $\theta \in (0,1)$, of public fund that they are responsible for, then the total productive public services in the economy would be equal to $\tilde{G} = (1 - v\theta)\mathrm{g}$.

The government in each period finances its expenditures by running a continuously balanced budget. Its revenue consists of taxes collected from all agents, plus any fine imposed on bureaucrats who are discovered engaging in corruption. We assume that the households and bureaucrats are endowed with one unit of labour and are liable to taxation. We denote τ_t the lump-sum tax levied on each agent when they are young. We assume that government knows about the amount of tax revenue in the absence of corruption (as it knows the number of households), any shortfall of public funds below this amount reveals that some funds are being embezzled as considered in Blackburn and Forgues-Puccio (2005). Under this scenario, the government investigates the behaviour of bureaucrats using costless monitoring technology that implies a bureaucrat who is corrupt facing a probability, $p \in (0, 1)$, of being caught, and a probability, $1 - p$, of avoiding detection. We assume that more educated bureaucrats possess more efficiency in concealing their illegal income compared to the less educated ones and hence the monitoring costs to the government increases with education of bureaucrats.

2.2. Households

Each household of generation t saves all of its income, z_t^H to acquire a final wealth of $x_{t+1}^H = z_t^H(1 + r_{t+1})$, when it reaches old-age. Households consume all of this wealth when old (i.e., no altruism). Each household is born with 1 unit of labour endowment and has an opportunity to invest e_t proportion of it for acquiring education (i.e., schooling) by which he can accumulate human capital, h_t with the following simple technology:

$$h_t = Be_t^{\gamma} \qquad B > 0; \gamma \in (0,1) \qquad (1)$$

Where, B is the productivity of human capital production and γ is the positive but diminishing rate of return on schooling. As in Eicher, *et.al.*, (2009), education can be acquired immediately. So, the individual is employed in the first period with his acquired skill, h_t, supply this skilled labour and earns wages. There is an alternative home production technology, where he spends rest of his time $(1 - e_t)$ to get a fixed earning $u$per unit of time. As he has to pay a lump-sum tax τ_t along with his earning possibility only when young, his lifetime income or utility can be defined as

$$U_t = z_t^H = u(1 - e_t) + h_t w_t - \tau_t \qquad (2)$$

Evidently, the individual will ensure that he obtains the maximum lifetime income from allocating his time between acquiring education or home production. Substituting (1) in (2), and maximizing his utility, we find the optimal allocation of time for education as:

$$e_t = \left[\left(\frac{\gamma B}{u}\right) w_t\right]^{\frac{1}{1-\gamma}} \equiv e(w_t) \qquad e'(.) \geq 0;\ e''(.) \leq 0 \qquad (3)$$

It is straight-forward to see that given the current market wage, the optimal allocation of time for acquiring education depends positively on the productivity (B) and rate of return (γ) on investment (i.e., time spent) in human capital production, but negatively on the productivity of home production (u). The crucial for our analysis is that the optimal time for education depends positively on the current market wage rate at a diminishing rate. We shall see later that this wage rate in turn depends on the level of economy-wide corruption through reducing productive public services.

2.3. Bureaucrats

Each bureaucrat of generation t saves all of its income, z_t^B to acquire a final wealth of $x_{t+1}^B = z_t^B(1 + r_{t+1})$, when it reaches old-age. At the beginning of the period one, a bureaucrat acts with similar preference pattern as a household in choosing the amount of time to devote for acquiring education out of his one unit of labour endowment. This means that a bureaucrat is not exposed to any corruption activities until he joins the bureaucracy. As a consequence, the corruptibility issue does not come into the equation of his optimal allocation of time between acquiring education and home production. This assumption is quite realistic in the sense that as people mature in their life, they start getting exposed to real life and all its legal and illegal possibilities. This causes bureaucrats to choose optimal time allocation for education,e_t, as in equation (3).

The bureaucrats are designated as the agents for the government in the administration of the public policy. In performing this role, a bureaucrat is delegated with the responsibility for controlling the public funds. It is due to this designation of authority that corruption might occur as the bureaucrat may be interested to embezzle (steal) some of the public funds for himself. As indicated earlier, we assume that there are some public officials who are corruptible in this way, and others who are non-corruptible.

By definition a bureaucrat who is non-corruptible is never corrupt and will never participate in the appropriation (stealing) of public funds. The wage income of such a bureaucrat is $h_t w_t$. In contrast, a bureaucrat who is corruptible, upon discovering the opportunity for appropriation of public funds after joining the bureaucracy, he may or may not comply with the rules of public office. If he does, then his income is $h_t w_t$, as before. If he does not, then his income is uncertain and depends on the amount of fund he embezzles, the chances of being caught and the penalties incurred if he is exposed. Such a bureaucrat engages in appropriation of public funds. Although the bureaucrat receives 'g' in public funds, he spends and provides the economy with $(1-\theta)\mathrm{g}$ amount of public services. Thus '$\theta\mathrm{g}$' is the amount of funds that a bureaucrat may embezzle. The corrupt individuals may try to remain unobtrusive by concealing their illegal income in hiding instead of investing it in capital. In this way, the bureaucrat is assured of retaining illegal income whether he is caught or not and loses only his legal income when caught. By doing so, he can make sure that he can consume this illegal income when he is old. Due to the imprecise government monitoring with probability p, the bureaucrat may get caught and punished for his legal income (i.e., salary) and left with only the illegal income.

With probability$(1-p)$, the individual escapes detection and manages to save both legal and illegal income, a total of$h_t w_t + \theta_t \mathrm{g} - \mathrm{C}_t$, where C_t is the cost of concealment a corrupt bureaucrat has to incur for hiding the amount he embezzled from public funds. We assume here that the act of being corrupt is not entirely costless. For example, a bureaucrat may need to spend some resources for concealing his illegal activities. It is plausible to imagine that these costs are directly proportional to the embezzled fund and inversely related to the level of human capital. Thus the cost of concealment to the corrupt bureaucrat is $C_t = \left(\frac{\theta_t g}{h_t}\right)^{\delta}$, where $\delta > 1$.[2] Accordingly, his income when non-corruptible is $h_t w_t$ while that of corruptible is $\theta_t \mathrm{g} - \left(\frac{\theta_t g}{h_t}\right)^{\delta}$ with probability p, and $h_t w_t + \theta_t \mathrm{g} - \left(\frac{\theta_t g}{h_t}\right)^{\delta}$ with probability$(1-p)$. Given these outcomes, we may write the expected income of each type of bureaucrat as:

$$E(z_t^B|\theta) = \begin{cases} u(1-e_t) + h_t w_t & if \;\; \theta_t = 0 \\ u(1-e_t) + (1-p)h_t w_t + \theta_t \mathrm{g} - \left(\frac{\theta_t g}{h_t}\right)^{\delta} & if \; \theta_t > 0 \end{cases} \quad (4)$$

2.4. Firms

The representative firm combines $h_t$units of skilled labor with k_t units of capital to produce y_t units of output according to

$$y_t = A[h_t K_t]^{\alpha} k_t^{1-\alpha} G^{\alpha} \quad (5)$$

(A > 0, α∈(0,1)) where K_t denotes the aggregate stock of capital. The firm hires labour from households at the competitive wage rate w_t and rents capital from all agents at the competitive interest rate, r_t. Firm uses the economy-wide capital as in Romer (1986) and productive public good as in Barro (1990). Profit maximization implies that wage, $w_t = \alpha A h_t^{\alpha-1} K_t^{\alpha} k_t^{1-\alpha} G^{\alpha}$ and $r_t = (1-\alpha) A h_t^{\alpha} K_t^{\alpha} k_t^{-\alpha} G^{\alpha}$. Since $h = Be^{\gamma}$ and $k_t = K_t$ in equilibrium, we may write these conditions as

$$w_t = \alpha A \left(Be_t^{\gamma}\right)^{\alpha-1} G^{\alpha} k_t \quad (6)$$

$$r_t = (1-\alpha) A \left(Be_t^{\gamma}\right)^{\alpha} G^{\alpha} \quad (7)$$

3. The Incentive to be Corrupt

For obvious reasons, the corrupted bureaucrat would want to maximize his payoff from appropriation, out of his total expected income $E(z_t^B|\theta > 0)$ in equation (4). The size of such appropriation that would maximize his corrupt payoff (with respect to θ) would be:

$$(\theta_t g)^* = \left(\frac{h_t^{\delta}}{\delta}\right)^{\frac{1}{\delta-1}} \quad (8)$$

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[2] For our analysis, the sufficient condition is $\delta > \frac{1}{1-\gamma}$

Thus, each bureaucrat finds it optimal to increase the amount of appropriation the more educated he can be. This happens as his cost-efficiency in terms of concealment of illegal income increases along with education.

A corruptible bureaucrat will embezzle public funds if his expected utility is from doing so is no less than his utility from not doing so. From the preceding analysis, we may write this condition for an him as $E(z_t^B|\theta > 0) \geq E(z_t^B|\theta = 0)$, or $u(1-e_t) + (1-p)h_t w_t + \theta_t \text{g} - \left(\frac{\theta_t g}{h_t}\right)^{\delta} \geq u(1-e_t) + h_t w_t$. For the case where he will choose the level of appropriation optimally in accordance with equation (8), the condition can be written as:

$$p h_t w_t \leq (\delta - 1)\left(\frac{h_t}{\delta}\right)^{\frac{\delta}{\delta-1}} \qquad (9)$$

Intuitively, a bureaucrat is more likely to be corrupt the more he expects to gain in illegal income if he evades the detection and less he expects to lose his legal income if he gets caught. The key features of the incentive condition (9) are that it depends on the economy-wide variable, w_t and his initial decision on acquiring human capital, h_t. The wage is determined by current event in the economy, which in turn is a function of the aggregate level of corruption. This reflects that higher wages of the agents imply higher punishments (i.e., costs) to bureaucrats if they are caught. This means that the motivation for each corruptible bureaucrat to be corrupt depends on the number of other bureaucrats who are expected to be corrupt. Consequently, bureaucratic decision-making entails strategic interactions, which may result in multiple equilibria.

What makes the analysis more interesting is that this incentive condition also depends on initial human capital accumulation by the bureaucrat himself that rewards him if he wants to be corrupt. Higher education implies higher efficiency in pilfering the resources of the economy. This means that higher the education a bureaucrat acquire at the early stage of his life, higher his incentive to be corrupt would be when he would observe the corruption opportunity. The "punishment effect" that comes from losing the salary if caught, should result in lower incidence of corruption in terms of less number of bureaucrats being corrupt, and the "reward effect" in terms of higher embezzlement ability due to higher human capital accumulation should attract more bureaucrats to be corrupt. While the "reward effect" here is coming solely from the individual's level of acquired human capital, the "punishment effect" not only comes from the economy-wide wage rate but also the level of economy-wide human capital accumulation. Therefore on the one hand, economy-wide human capital raises individual household's (i.e., labour) productivity at the firm level, the individual's human capital exposes the bureaucrats to more advantageous position to pilfer the economy's resources.

The ultimate result of human capital accumulation will depend on which effect from above dominates. If the "punishment effect" dominates, which would gain more and more upper hand to the "reward effect" as the economy advances and after crossing a certain threshold level of economic development (k_t), it will gain complete dominance over "reward effect". From that threshold level onward, more human capital accumulation should generate lower incidence of corruption and higher economic growth unambiguously. This is why the literature has found unambiguous significant effect of human capital on economic growth for developed economies, but not for the developing ones (Benhabib and Spiegel, 1994 and Pritchett, 2001, 2004, and 2006; Kumar 2006; Bond, *et.al*, 2001; Caselli, *et.al.*, 1996; Islam 1995).

4. Incidence of Corruption:

Recall in equilibrium, $h_t = h = Be^{\gamma}$ and from (6), we get $w_t = \alpha A\left(Be_t^{\gamma}\right)^{\alpha-1} G^{\alpha} k_t$. Thus as mentioned earlier, w_t is determined by human capital, h_t due to the individuals' decisions on acquiring education, along with the level of capital stock, k_t, and total public service, G, both of which are determined by the aggregate level of corruption.

Just to recap, the sequence is the following. Individual agents decide on allocating their time to acquire education based on the current market wage rate they face. After acquiring education in no time they enter the job market where households work for the firm as skilled labourers and bureaucrats join the bureaucracy to deliver public services. When bureaucrats come across corruption opportunity, the corruptible bureaucrats would like to embark on it depending on if being corrupt is more gaining than not being corrupt according to inequality (9). The right hand side of this inequality depends on individual corruptible bureaucrat's human capital accumulation while on the left hand side, wage is dependent on aggregate human capital, physical capital stock and aggregate level of corruption. Notice that both individual and aggregate human capital accumulation is h_t, as we normalized the number of households to unity.

Equation (9) reveals that as education increases, it raises the expected punishment if the bureaucrat gets caught, but at the same time it raises the expected gain out of corruption if he can evade. It is the net effect of these two that would determine the incidence of corruption. In order to get this net effect, we take both aggregate punishment effect and individual's reward effect of human capital accumulation for corruption to the right hand side of the inequality (9). This can be written as follows:

$$p\Omega k_t \leq \Phi B^{\frac{1-(\delta-1)(1-\alpha)}{\delta-1}} e_t^{\frac{\varphi}{\delta-1}} \tag{10}$$

Where, $\Omega = \alpha A G^{\alpha} = \Omega(G)$, $\Phi = \left(\frac{\delta-1}{\delta^{\frac{\delta}{\delta-1}}}\right)$, $\varphi = \gamma[\delta(1-\alpha)+\alpha]$, and $e_t = e(G, k_t)$

It is straight forward to see from equation (10) the followings. First, the left hand side of the inequality is a linear function of $k_t$with a slope of $p\Omega$, while its right hand side is a concave function of e_t since $\varphi < (\delta - 1)$. Therefore, there exists a unique critical level of capital, k_t as they must intersect on a unique point, given the aggregate level of corruption, which is reflected in total public services, *G*. Second, as the economy develops, as shown by left hand side, the more a bureaucrat stands to lose if he gets caught and hence less number of bureaucrats would be corrupt. Third, the right hand side of the inequality shows that more educated a bureaucrat is along with other agents in the economy, the higher he expects to gain in the net if he can evade. This would result in more bureaucrats finding it beneficial to be corrupt. Finally, both of these effects depend on the aggregate level of corruption. Higher incidence of corruption in the economy would dampen both the functions downward. This means that the motivation for each corruptible bureaucrat to be corrupt depends on the number of other bureaucrats who are expected to be corrupt. Consequently, bureaucratic decision-making entails strategic interactions, which may result in multiple equilibria.

In Figure 1, we show these by taking two polar scenarios, where no corruptible bureaucrat is corrupt in one case while in the other case all corruptible bureaucrats are corrupt. In the first case, aggregate public service is $\hat{G} = g$ as all bureaucrats will spend all the resources they are responsible for and hence the economy will utilize the maximum possible public services as productive input in aggregate production. Under such circumstance, (10) becomes

$$p\hat{\Omega} k_t \leq \Phi B^{\frac{1-(\delta-1)(1-\alpha)}{\delta-1}} \hat{e}_t^{\frac{\varphi}{\delta-1}} \equiv \hat{h}(k_t) \tag{11}$$

Where, $$\hat{e}_t = \left(\frac{\gamma B^{\alpha}\widehat{\Omega}}{u}\right)^{\frac{1}{1-\alpha\gamma}} k_t^{\frac{1}{1-\alpha\gamma}} \quad (12)$$

$$\widehat{\Omega} = p\alpha A\widehat{G}^{\alpha} = p\alpha Ag^{\alpha} \quad (13)$$

The expression in (11) is the condition for an individual corruptible bureaucrat to be corrupt, given that no other corruptible bureaucrat is corrupt.

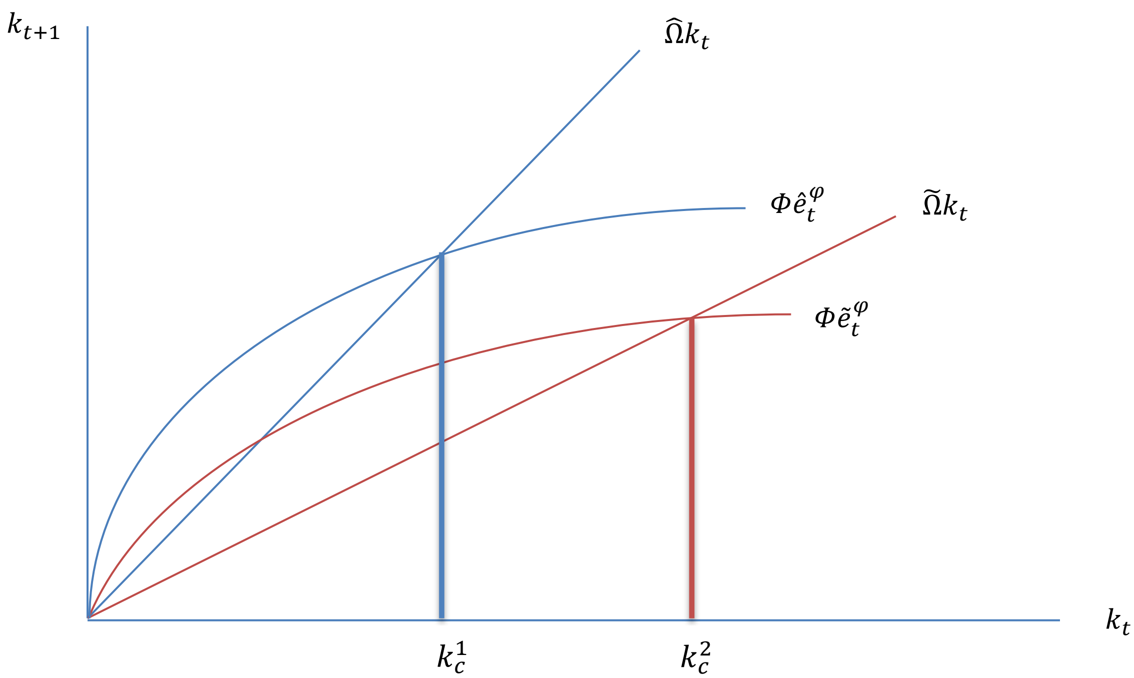

Figure 1: Incidence of corruption, human capital accumulation and Development

For the case of where all corruptible bureaucrats who are of v proportion of all bureaucrats are corrupt, will embezzle θg amount of public resources while $(1 - v)$ proportion of bureaucrat who are non-corruptible, will spend all resources they are responsible to deliver. This will result in $\widetilde{G} = (1 - v\theta)$g amount of aggregate public services. Under such circumstance, (10) becomes

$$p\widetilde{\Omega}k_t \leq \Phi B^{\frac{1-(\delta-1)(1-\alpha)}{\delta-1}} \tilde{e}_t^{\frac{\varphi}{\delta-1}} \equiv \tilde{h}(k_t) \quad (14)$$

Where, $$\tilde{e}_t = \left(\frac{\gamma B^{\alpha}\widetilde{\Omega}}{u}\right)^{\frac{1}{1-\alpha\gamma}} k_t^{\frac{1}{1-\alpha\gamma}} \quad (15)$$

$$\widetilde{\Omega} = p\alpha A\widetilde{G}^{\alpha} = p\alpha A(1 - v\theta)^{\alpha} g^{\alpha} \quad (16)$$

The expression in (14) is the condition for an individual corruptible bureaucrat to be corrupt, given that all other corruptible bureaucrats are corrupt.

Observe that, since $(1 - v\theta) < 1$, (13) and (16) imply $\widetilde{\Omega} < \widehat{\Omega}$, while (12) and (15) imply $\tilde{e} < \hat{e}$; that is, for any given stock of capital, k_t, wages and education are lower under corruption than under non-corruption. This follows from the fact that corruption reduces the aggregate productive public services, $\tilde{G} < \hat{G}$. In doing so, it also reduces the productivity of both physical and human capital in output production. As indicated earlier, our analysis becomes more interesting for the fact that the lower productivity of human capital should reduce the incentive of corruption, which may turn out to be beneficial for generating higher growth. This may mean that in the presence of corruption, higher level of human capital may result in lower economic growth, though as the economy develops with more and more physical capital this situation would eventually reverse through rise in productivity of human capital net of growth-retarding corruption efficiency.

5. Equilibria:

The foregoing analysis sets out the conditions for an individual corruptible bureaucrat to be either corrupt or non-corrupt, given that all other corruptible bureaucrats are either corrupt or non-corrupt. The analysis also reveals the extent to which the aggregate level of corruption along with individual and aggregate human capital influence aggregate economic outcomes—in particular, wages, time allocation for acquiring education and the public goods provision. We now proceed to study how the incidence of corruption, itself, is determined. As we shall see, whether or not corruption forms part of equilibrium depends on the level of development and human capital of the economy. In this way, our model predicts a relationship between corruption and development, and corruption and human capital that are fundamentally two-way causal.

The crucial conditions for determining equilibrium behaviour are given in (11) and (14). Note that both $\hat{h}(k_t)$ and $\tilde{h}(k_t)$ are increasing in k_t. Note also that $\hat{h}(k_t) > \tilde{h}(k_t)$ for all k_t as $\widehat{\Omega} > \widetilde{\Omega}$. Given these observations, we may identify two critical levels of capital, k_1^c and k_2^c, in accordance with the following.

In order to be more precise, by transforming e_t (or in other words, h_t) into functions of k_t by utilizing (6) and (3) and substitute them into equation (11) and (14) respectively to get two critical levels, k_1^c and k_2^c, below which corruption would be beneficial for both respective cases.

$$k_t \leq \frac{\Psi}{\widehat{\Omega}} \equiv k_1^c \quad (17)$$

$$k_t \leq \frac{\Psi}{\widetilde{\Omega}} \equiv k_2^c \quad (18)$$

Where, $\Psi = \left(\frac{\Phi}{p}\right)^{\frac{(\delta-1)(1-\alpha\gamma)}{\delta(1-\gamma)-1}} B^{\frac{1-(\delta-1)(1-\alpha)(1-2\alpha\gamma)}{(\delta-1)(1-\alpha\gamma)}} \left(\frac{\gamma}{u}\right)^{\frac{\varphi}{\delta(1-\gamma)-1}}$

Definition 1: k_1^c is the unique value for k_t which satisfies $p\widehat{\Omega}k_t = \hat{h}(k_t)$ such that (i) $p\widehat{\Omega}k_t < \hat{h}(k_t)$ for all $k_t < k_1^c$, and (ii) $p\widehat{\Omega}k_t > \hat{h}(k_t)$ for all $k_t > k_1^c$.

Definition 2: k_2^c is the unique value for k_t which satisfies $p\widetilde{\Omega}k_t = \tilde{h}(k_t)$ such that (i) $p\widetilde{\Omega}k_t < \tilde{h}(k_t)$ for all $k_t < k_2^c$, and (ii) $p\widetilde{\Omega}k_t > \tilde{h}(k_t)$ for all $k_t > k_2^c$.

We observe that there are two threshold levels, and among them clearly, $k_1^c < k_2^c$. These represent the regions where the incentive conditions in (11) and (14) are satisfied or violated. With this, we are now in a position to establish some key results which we illustrate in Fig. 1.

Proposition 1: For $k_t < k_1^c$, there exists a unique equilibrium in which all corruptible bureaucrats are corrupt.

Proof: Suppose that $k_t < k_1^c$. Then $p\widehat{\Omega}k_t < \hat{h}(k_t)$ and $p\widetilde{\Omega}k_t < \tilde{h}(k_t)$, implying that it pays each corruptible bureaucrat to be corrupt, irrespective of whether other corruptible bureaucrats are corrupt or non-corrupt. The case in which all such bureaucrats are corrupt is an equilibrium outcome since none of them has an incentive to deviate from corrupt behaviour. Conversely, the case in which all such bureaucrats are non-corrupt is not an equilibrium outcome since each of them has an incentive to deviate from non-corrupt behaviour.

This result demonstrates that low levels of development are associated with high (maximum) levels of corruption where increase in human capital damages economic development by raising the “reward effect” of corruption that dominates its “punishment (or, productivity) effect”.

Proposition 2: For $k_t > k_2^c$, there exists a unique equilibrium in which no corruptible bureaucrat is corrupt.

Proof: Suppose that $k_t > k_2^c$. Then $p\widehat{\Omega}k_t > \hat{h}(k_t)$ and $p\widetilde{\Omega}k_t > \tilde{h}(k_t)$, implying that it pays each corruptible bureaucrat to be non-corrupt, irrespective of whether other corruptible bureaucrats are corrupt or non-corrupt. The case in which all such bureaucrats are non-corrupt is an equilibrium outcome since none of them has an incentive to deviate from non-corrupt behaviour. Conversely, the case in which all such bureaucrats are corrupt is not an equilibrium outcome since each of them has an incentive to deviate from corrupt behaviour.

This result demonstrates that high levels of development are associated with low (zero) levels of corruption where increase in human capital increases the level of economic development by raising the “punishment (or, productivity) effect” of corruption that dominates its “reward effect”.

Proposition 3: For $k_t \epsilon (k_1^c, k_2^c)$, there are multiple equilibria in which all corruptible bureaucrats are either corrupt or non-corrupt.

Proof: Suppose that $k_t \epsilon (k_1^c, k_2^c)$, . Then $p\widehat{\Omega}k_t > \hat{h}(k_t)$ and $p\widetilde{\Omega}k_t < \tilde{h}(k_t)$implying that it pays each corruptible bureaucrat to be either corrupt or non-corrupt, depending on whether other corruptible bureaucrats are corrupt or non-corrupt. The case in which all such bureaucrats are corrupt is an equilibrium outcome since none of them has incentive to deviate from corrupt behaviour. Likewise, the case in which all such bureaucrats are non-corrupt is also an equilibrium outcome since none of them has an incentive to deviate from non-corrupt behaviour.

This result demonstrates that intermediate levels of development may be associated with either low or high levels of corruption. Here, the incidence of corruption becomes unrelated with level of economic development; instead corruption and human capital accumulation affect each other. For example, the case in which all other bureaucrats are corrupt, human capital reinforces the corrupt behaviour by making the “reward effect” dominant. Conversely, the case in which no corrupt bureaucrat is corrupt, human capital discourages any new bureaucrat to be corrupt by making the “punishment (productivity) effect dominant.

Based on the foregoing analysis, we are led to distinguish between three types of development regime for the economy. The first—a low-development regime—is one in which the incidence of corruption is always at its maximum for any given level of capital below the lower threshold level, k_1^c, where increase in human capital would further increase the incidence of corruption. The second—a high-development regime—is one in which the incidence of corruption is always at its minimum for any given level of capital above the upper threshold level, k_2^c, where increase in human capital would be deterrent to the incidence of corruption. And the third—an intermediate-development regime—is one in which the incidence of corruption may be either at its maximum or at its minimum for any given level of capital between the two thresholds, where increase in human capital would increase or deter the incidence of corruption depending on how other bureaucrats are behaving. The intuition is as follows. Each corruptible bureaucrat chooses to be corrupt or non-corrupt according to whether the condition in (10) is satisfied or violated. This condition depends on economy-wide outcomes (wages and aggregate human capital) and individual's already acquired human capital which, in turn, depend on the existing aggregate stock of capital (measuring the level of development) and the total public goods provision (reflecting the behaviour of all other bureaucrats). At sufficiently low or sufficiently high levels of development, a bureaucrat's incentive to behave in one way or another is unaffected by how other bureaucrats are behaving but affected by individual's and aggregate human capital. Above all, what matters most is the level of development, itself.

For capital stocks below k_1^c, wages are always low enough to ensure that the condition in (10) is satisfied. As such, a corruptible bureaucrat will always be corrupt, irrespective of what others around him may be doing and further human capital accumulation would worsen the scenario. Since this is true for all such bureaucrats, then the only equilibrium from which there is no incentive to deviate is one in which corruption is the unique choice of strategy.

Conversely, for capital stocks above k_2^c, wages are always high enough such that the condition in (10) is violated. In this case a corruptible bureaucrat will never be corrupt, regardless of what others may be up to. Being true for all such bureaucrats, this means that the only equilibrium from which defection will not occur is one in which non-corruption is the singular choice of action. In contrast to these scenarios, a bureaucrat's incentive to transgress at intermediate stages of development depends critically on the exploits of others. For any given stock of capital between k_1^c and k_2^c, the condition in (10) is satisfied if corruption is widespread but is violated if corruption is absent.

The predictions of our model are consistent with the empirical observations highlighted earlier: the unique equilibrium at low levels of development accords with the situation of most poor countries in which the incidence of corruption is generally high even with higher level of human capital; the unique equilibrium at high levels of development matches the position of most rich countries in which the incidence of corruption is typically low and human capital is high; and the multiplicity of equilibria at intermediate levels of development fits with the diverse experiences of middle-income countries in which the incidence of corruption is varied where human capital is generally on the rise. Like other analyses, we are able to account for a broadly negative relationship between corruption and development along with rather tenuous relationship in some circumstances. Unlike other analyses, we are able to account for the possibility of insignificant or negative effect of human capital in developing countries where accumulation of human capital and incidence of corruption foster each other.

6. Public Finance and Capital Accumulation

So far we have discussed that the extent of corruption depends on the level of development but it is also true that the development process itself is affected by corrupt activity. This process is described by the path of capital accumulation that can be obtained from the equilibrium condition that the total demand for capital is equal to the total supply of savings. To study how corruption affects savings, it is essential to know how corruption affects public finances as the government decides the level of taxes required to maintain balance budget. Recall that $v(1-v)$ is the fraction of bureaucrats who are corruptible (non-corruptible) and that all corrupt bureaucrats face the probability of $p(1-p)$ of getting caught (avoiding detection).

Consider the economy when corruption is absent. Under this circumstance, all bureaucrats will spend all resources they are allocated and produce the maximum possible productive public services. In return, all of them will get their efficiency (i.e., human capital weighted) wage, $\hat{h}_t\hat{w}_t$. As we normalized the number of households and bureaucrats each to one, the government obtains the tax revenue $\hat{\tau}_t$which is used to finance its expenditures on public services (g) and bureaucratic salaries, $\hat{h}_t\hat{w}_t$.

$$\hat{\tau}_t = \mathrm{g} + \hat{h}_t\hat{w}_t \qquad (19)$$

Total savings in the economy comprise the savings of households, $u(1-\hat{e}_t) + \hat{h}_t\hat{w}_t - \hat{\tau}_t$, plus the savings of bureaucrats, $u(1-\hat{e}_t) + \hat{h}_t\hat{w}_t$. Simultaneously using (3), (6), (12) and (19), total capital accumulation takes place according to

$$\hat{k}_{t+1} = 2u - g - 2u\hat{e}_t + \hat{h}_t\hat{w}_t$$

$$= [2u-g] + \Psi g^{\frac{\alpha}{1-\alpha\gamma}} k_t^{\frac{1}{1-\alpha\gamma}} \qquad (20)$$

Where, $\Psi = \left(\frac{\alpha A}{u^{\alpha\gamma}}\right)^{\frac{1}{1-\alpha\gamma}} \left[(\gamma)^{\frac{\alpha\gamma}{1-\alpha\gamma}} \left(\frac{1}{B}\right)^{\frac{1}{1-\alpha-\alpha\gamma}} - 2(\gamma B^{\alpha})^{\frac{1}{1-\alpha\gamma}} \right]$

Now consider the case in which all corruptible bureaucrats are corrupt. We assume that there exists a fraction of corruptible (non-corruptible) bureaucrats $v(1-v)$ in the economy with probability $p(1-p)$ of being detected (escaped). As indicated earlier, the government investigates the corrupt activities of bureaucrats by employing an imprecise monitoring technology. For the purpose of simplicity, we assume this to be costless.[3] Under this scenario, the tax revenue of the government $(\tilde{\tau}_t)$ is used to finance the expenditures on public services, g, the salaries of non-c orruptible bureaucrats $(1-v)\tilde{h}_t\tilde{w}_t$, the salaries of the corruptible bureaucrats who escape detection $v(1-p)\tilde{h}_t\tilde{w}_t$ and a positive monitoring cost, μg .

$$\tilde{\tau}_t = (1+\mu)\mathrm{g} + (1-vp)\tilde{h}_t\tilde{w}_t \tag{21}$$

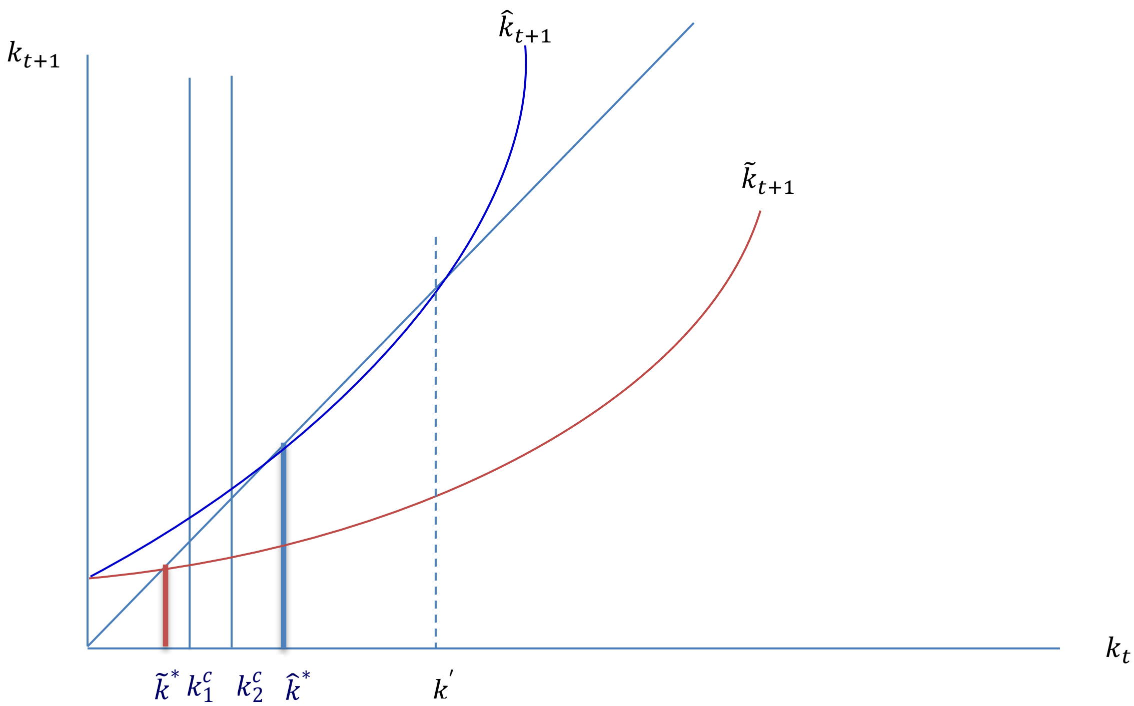

Figure 2: Capital accumulation and Development

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[3] If there is a positive monitoring cost, the economy will lose more investible resources. This will make our analysis even stronger as the economy will then grow with even lower growth trajectory.

Total savings in the economy comprise the savings of households, $u(1-\hat{e}_t)+\tilde{h}_t\widetilde{w}_t-\tilde{\tau}_t$, plus the savings of bureaucrats, $u(1-\tilde{e}_t)+(1-vp)\tilde{h}_t\widetilde{w}_t$. Simultaneously using (3), (6), (15) and (19), total capital accumulation takes place under this scenario according to

$$\tilde{k}_{t+1} = 2u-(1+\mu)g-2u\tilde{e}_t+\tilde{h}_t\widetilde{w}_t$$

$$= [2u-g]+\Psi[(1-vp)g]^{\frac{\alpha}{1-\alpha\gamma}}k_t^{\frac{1}{1-\alpha\gamma}} \qquad (22)$$

It is evident from (20) and (22) that $\hat{k}_{t+1}>\tilde{k}_{t+1}$. This confirms that a corruption-prone economy will experience a lower growth trajectory than a more corruption-free economy. This will happen due to the scope of human capital to contribute its net positive productivity effect in a corruption-free economy than corruption-prone economy.

6.1 Existence of Steady States:

Based on the foregoing analysis, now we turn to identify the possibility of poverty traps of higher corruption with low development where higher human capital accumulation cannot help economy to get out; rather it may worsen the situation. At the same time, we examine whether this trap is of transitory or permanent nature. Assuming $2u>(1+\mu)g$, both of the transition paths in (20) and (22) have a positive intercept as in Figure 2, along with a slope less than one, which ensure stationary points associated with the steady-state levels of physical capital, $\hat{k}^*$and $\tilde{k}^*$.[4] According to (12) and (14), these correspond to $\hat{e}^*$and $\tilde{e}^*$ respectively. Evidently, $\hat{k}^*>\tilde{k}^*$ (and correspondingly, $\hat{e}^*>\tilde{e}^*$). Thus the economies converge to a lower physical and human capital under corruption than under non-corruption in the steady-state. There are two reasons for this. First, by reducing the total productive public services, corruption produces a fall in the productivity of labour, a fall in wages and a fall in savings. Second, under corruption scenario, any increase in human capital leads to more corruptible bureaucrats facing incentive to be corrupt. This causes further reduction in productivity of labour by reducing productive public services. In short, corruption affects both the productive public spending and the net impact of human capital in ways that compromise growth. This is another prediction of the model that concurs with empirical observation.

[4] As the functions are convex, there are two possible non-stationary equilibrium, one of which corresponds with *k*'. These may be further explored. But for our present analysis, we explain the stationary equilibriums.

Along with accounting for cross-country differences in corruption, our analysis is also able to explain why some countries may become trapped with persistent poverty and misgovernance even when the human capital rises. We illustrate this in Fig. 2 which depicts the two development paths, $\hat{k}_{t+1}$ and $\tilde{k}_{t+1}$, together with the two threshold levels of capital, k_1^c and k_2^c, for a particular configuration of parameter values. The economy is on the low development path, $\tilde{k}_{t+1}$, for $k_t < k_1^c$, the high development path, $\hat{k}_{t+1}$, for $k_t > k_2^c$, and either of the paths for $k_t \in (k_1^c, k_2^c)$. At the steady-state level of capital $\tilde{k}^*$, there is a poverty trap equilibrium: if the economy is poor and corrupt to begin with, then it will be destined to remain poor and corrupt even if human capital increases in the economy unless there is a radical turn of events to dictate otherwise. One such event is a windfall increase in the stock of capital that produces a leap over the lower threshold, k_1^c. Another is a change in the value of some key parameters that alters the transition function and/or the threshold, itself, such that $\tilde{k}^* > k_1^c$. Even in these instances, however, there is no guarantee that the upper critical boundary, k_2^c, will be breached, in which case the economy will have just as much chance of settling in a good equilibrium as settling in a bad equilibrium.

7. Conclusion

The literature on the impact of human capital on economic growth often reports insignificant and even negative coefficient on human capital. Many researchers came up with alternative explanations, which are of empirical nature, such as quality of data, econometric technique etc. According to the best of our knowledge no study has introduced the role of governance in terms of corruption in a macro-theoretical framework. But on empirical front, a recent interesting empirical study by Rogers (2008) uses the corruption index to obtain the sub-sample of high and low corrupt countries and suggest that the impact of human capital is higher in the sub-sample of low corrupt countries as compared to the sub-sample of high corrupt countries. There is no theoretical work explaining the link of corruption for the heterogeneous effect of human capital on economic growth. In this paper we considered a two period overlapping generations model with two groups of agents – households and bureaucrats. The households pay lump-sum tax while the bureaucrats hold the public office and are responsible for collecting taxes and procuring public services. Corruption arises through embezzlement of public funds by the bureaucrats.

We consider the dynamic general equilibrium model where the decision of corruptible bureaucrat affects the public finances and hence both human and physical capital accumulation in the economy. It is also shown that the human capital accumulated by the corrupt bureaucrat increases the corruption efficiency by raising their ability to embezzle more. Our results are straightforward. First, corruption and development are determined jointly in a relationship that is two-way causal: bureaucratic malfeasance both influences and is influenced by economic activity. Second, this two-way causality gives rise to threshold effects and multiple development regimes: there is a low-development regime, a high-development regime and an intermediate-development regime. Third, the equilibrium properties of these regimes are very different: in low stages of development there is a unique equilibrium with high corruption where higher human capital cannot get the economy out of poverty trap, in high stages of development there is a unique equilibrium with low corruption where human capital can exert its influence, and in intermediate stages of development there are both types of equilibrium. Fourth, transition between regimes may or may not be feasible and it is possible for a development trap to occur: corruption and poverty may become permanent fixtures of an economy even if more human capital is accumulated unless fundamental changes take place. Fifth, corruption distorts both forms of capital and productive public expenditures.

The above results do well in explaining a number of empirical observations. For example, corruption is higher in poor countries than in rich countries; corruption is more varied among middle-income countries; corruption can be persistent and may be alleviated only slowly by development; corruption can compromise development by distorting public expenditures, and reducing the physical capital accumulation; and the most importantly, human capital accumulation may not exert its desired effect on the economy to come out of poverty trap where corruption is high. Based on these insights, we view our analysis as a promising step towards understanding an issue that is dominating the international development arena.

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