Endogenous Corruption in Economic Development*

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Abstract

This paper presents an analysis of the joint determination of bureaucratic corruption and economic development. The analysis is based on a simple neo-classical growth model in which bureaucrats are employed as agents of the government to collect taxes from households. Corruption is reflected in bribery and tax evasion as bureaucrats conspire with households in providing false information to the government. Costly concealment of this activity leads to a loss of resources available for productive investments. The incentive for a bureaucrat to accept a bribe depends on economy-wide outcomes which, in turn, depend on the number of other bureaucrats who accept bribes. We establish the existence of multiple development regimes, together with the possibility of multiple, frequency-dependent equilibria. The predictions of our analysis accord strongly with recent empirical evidence.

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1 Introduction

Public sector corruption may be broadly defined as the illegal, or unauthorised, profiteering by public officials who exploit their positions in public office to make personal gains. To many observers, this type of behaviour

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is an inevitable aspect of state intervention in society. This is due to the fact that any such intervention entails some transfer of responsibilities from the government to a bureaucracy in a principal-agent type relationship. The government (the principal) delegates powers to the bureaucracy (the agent) in order to undertake various tasks in the implementation of policies. This transfer of authority endows the bureaucracy with administrative discretion that may be used to capture economic rents through side payments or bribes. These rents may be significant and the incentive to seize them may be tempered only mildly by imperfect mechanisms of prevention based on costly and imprecise monitoring, together with inadequate and inappropriate penalties.[1]

A considerable amount of research, in both economics and political science, has been devoted towards understanding in detail the causes and consequences of bureaucratic corruption. Most of this research has been partial equilibrium in nature, focusing on the microeconomic aspects of incentives, information and enforcement in motivating or deterring corrupt practices which influence efficiency and welfare (e.g., Banerjee 1997; Carrillo 1996; Klitgaard 1988, 1990, 1991; Mookherjee and Png 1994; Rose-Ackerman 1975, 1978, 1999; Shleifer and Vishny 1993). Much less research has been directed towards analysing the joint determination of corruption activities and economic outcomes within the context of fully-specified dynamic general equilibrium models. This is particularly notable given that the macroeconomic consequences of corruption have become an increasing concern to both economists and policy makers who have shared a deepening belief that a fundamental requirement for economic development is good quality governance.[2] In this paper we present an analysis of corruption and growth that lends general support to this presumption, subject to some important qualifications. The predictions of our analysis accord strongly with empirical observations.

By its nature, corruption is a clandestine activity which takes place away from the glare of publicity and which is difficult to measure empirically. Prior to the early 1980s, the lack of reliable data on corruption meant that little was known about the true effects (if any) of bureaucratic malfeasance on economic development. Conflicting views about these effects could neither

[1] In one sense, corruption is a victimless crime for which conventional deterrents may be largely ineffective. In addition, the perpetrators of this crime, as members of the political establishment, may have privelaged in-roads to the legal infrastructure.

[2] The connection between corruption and governance is two-way causal: corruption undermines good governance, while bad governance fosters corruption. For an appreciation of the importance of corruption to international policy makers, see the World Bank and IMF web-sites, www.worldbank.org/publicsector/anticorrupt and www.imf.org/external/np/exp/facts/gov. For some excellent reviews of the literature on corruption, see Bardhan (1997), Jain (2001), Rose-Ackerman (1998, 1999) and Tanzi (1998).

be supported nor refuted empirically since there was simply no hard evidence available. Given this, it was possible to entertain seriously the idea that corruption might actually be conducive to growth and prosperity. This idea - an application of the theory of the second-best - is based on the argument that corruption may help to circumvent cumbersome regulations (red tape) in the bureaucratic process. The classic example of this is when bribes are used as "speed money" to secure the assistance of bureaucrats in overcoming institutional rigidities that cause excessive delays and that work against efficiency (e.g., Huntington 1968; Leff 1964; Leys 1970).[3] While plausible at first glance, this view may be challenged on a number of conceptual grounds (e.g., Bardhan 1997). For example, although bribery may speed up individual transactions with bureaucrats, both the sizes of bribes and the number of transactions may increase so as to produce an overall net loss in efficiency. In addition, and more fundamentally, the distortions that bribes are meant to mitigate are often the result of corrupt practices to begin with and should therefore be treated as endogenous, rather than exogenous, to the bureaucratic process.

It is now generally accepted that efficiency-enhancing and growth-promoting corruption is very much the exception, rather than the rule. The contemporary wisdom is that the early majority view among international development experts was correct and that corruption is typically bad for development due to its adverse effects on the incentives, prices and opportunities that private and public agents face.[4] This consensus of opinion is based not only on theoretical arguments, but also on a large body of recent empirical evidence. Since the early 1980s, a number of organisations - most notably, Business International Corporation, Political Risk Services Incorporated and Transparency International - have published various cross-country data sets on measures of corruption, derived from survey questionnaires sent to networks of correspondents around the world. These corruption indices rank countries according to the extent to which corruption in public office is perceived to exist. While differing in their precise construction, the indices are very closely correlated with each other, lending support to the contention that they provide reliable estimates of the actual extent of corruption activity.[5] Their publication has given rise to a flurry of empirical investigations

[3] A more recent exposition of efficiency-enhancing corruption can be found in Lui (1985) who suggests that bribes may form part of a Nash equilibrium strategy in a non-cooperative game, where inefficiency in public administration is reduced by the minimisation of waiting costs.

[4] There is also an intermediate view which contends that corruption is neither beneficial nor harmful to efficiency and growth (e.g., Beck and Maher 1986; Lien 1986).

[5] For more detailed discussions, see Ades and Di Tella (1997), Jain (1998), Tanzi and

into the relationship between corruption, development and other phenomena. These investigations have yielded a number of important findings which we summarise briefly as follows.

First, there appears to be a robust (and significant) negative correlation between the level of corruption and economic growth. According to Mauro (1995), the principal mechanism through which corruption affects growth is a change in private investment: an improvement in the corruption index by one standard deviation is estimated to increase investment by as much as 3 percent of output. Others have found similar evidence of significant adverse effects of corruption on growth (e.g., Gyimah-Brempong 2000; Keefer and Knack 1997; Knack and Keefer 1995; Li *et al.* 2000; Sachs and Warner 1997). In a subsequent analysis, Mauro (1997) studies the implications of corruption for the allocation of public funds, presenting evidence which suggests that corruption distorts public expenditures away from growth-promoting areas (e.g., health and education) towards other types of project (e.g., infrastructure investment) that are less productivity-enhancing. The same considerations occupy the attention of Tanzi and Davoodi (1997) who find evidence of bureaucratic malpractice manifesting in the diversion of public funds to where bribes are easiest to collect, implying a bias in the composition of public spending towards low-productivity projects at the expense of value-enhancing investments. Thus the abuse of public office may not only reduce the volume of public funds available to the government (e.g., through corrupt practices in tax collection), but may also engender a misallocation of those funds.

Second, there is evidence that the relationship between corruption and growth is two-way causal: bureaucratic rent-seeking not only influences, but is also influenced by, the level of development. In a thorough and detailed study by Treisman (2000), rich countries are generally rated as having less corruption than poor countries, with as much as 50 to 73 percent of the variations in corruption indices being explained by variations in per capita income levels. These findings, supported in other studies (e.g., Ades and Di Tella 1999; Fisman and Gatti 2002; Montinola and Jackman 1999; Paldam 2002; Rauch and Evans 2000), suggest that cross-country differences in the incidence of corruption owe much to cross-country differences in the level of prosperity.[6]

Third, there is very little empirical support for the "speed money" hypothesis. In Mauro (1995) it is found that the correlation between corruption

Davoodi (1997) and Treisman (2000).

[6] Other factors that appear to be significant in determining corruption are the colonial heritage, religious tradition, legal system, federal structure, democratisation and openness to trade of a country.

and growth remains consistently negative in sub-samples of countries where bureaucratic regulations are reported to be particularly cumbersome: this contradicts the prediction of a positive correlation based on the argument that corruption provides a way of by-passing such regulations. Similar findings are obtained by Ades and Di Tella (1997) who conclude that there is little evidence of any beneficial effects of corruption in countries mired with red tape. In addition, Kauffman and Wei (2000) offer empirical support to the argument (alluded to above) that the use of bribes to speed up individual transactions with bureaucrats is largely self-defeating as the number of transactions tends to increase.

By way of illustrating the relationship between corruption and development, we present some summary statistics in Table 1, constructed on the basis of the World Bank's income classification of countries, together with the corruption indices of Business International Corporation (BIC), International Country Risk Guide (ICRG) and Transparency International (TI). The Table provides information about the corruption ratings among different groups of countries for various periods over the past twenty years, including four consecutive recent periods.[7] A compelling feature of the data is the much higher corruption rating of poor countries than rich countries, irrespective of which index is used and which period is looked at. This is indicative of the negative correlation between corruption and development that has been reported in many empirical studies. Another notable feature - one that has received very little publicity - is the much greater diversity in corruption levels among middle-income countries, for which the range of each index is significantly larger than the range for either low-income or high-income countries in all of the periods. A comparison of the variances of the indices across different income groups gives the same impression: the variance for the middle-income group is consistently higher than the variance for either the low- or high-income groups, in spite of the denser and larger sample of the middle-income group. These observations suggest that there is more to the relationship between corruption and development than has been revealed so far in empirical studies. Whichever way one looks at it, the picture that emerges is one of considerable diversity in the incidence of corruption among middle-income countries, compared to the uniformly high levels of corruption among low-income countries and the uniformly low levels of corruption among high-income countries.[8]

[7] The most widely-used and most regularly updated measure of corruption is the Corruption Perception Index of Transparency International.

[8] This picture is also revealed by other investigations undertaken, where we use the coefficient of variation and rolling standard deviation of an index to identify the different corruption characteristics of different groups of countries.

In contrast to the burgeoning empirical literature, there remains relatively little theoretical research on the macroeconomics of misgovernance with the view to explaining the above evidence. Of the research that exists, Ehrlich and Lui (1999) and Sarte (2000) are credited with providing two of the first contributions.[9] The former develop a model in which corruption opportunities in public office offer the prospects of economic rents that create incentives for individuals to compete for the privelage of becoming bureaucrats. These incentives lead to a diversion of resources away from growth-promoting activities (investments in human capital) towards power-seeking activities (investments in political capital). The latter presents a framework in which rent-seeking bureaucrats restrict the entry of firms into the formal sector of the economy which has a better system of property rights and law enforcement than the informal sector. When the costs of informality are high, growth is reduced relative to the free-entry case. The main purpose of each of these analyses is to explain why bureaucratic corruption is likely to be detrimental to economic development without delving too deeply into the questions of what gives rise to corruption to begin with and what causes corruption to either persist or decline over time. In view of the recent empirical evidence, however, there is clearly a need to understand both the mechanism by which corruption affects the endogenous forces of development of an economy and the mechanism by which these forces, in turn, affect the incidence of corruption. In Blackburn *et al.* (2005) we endeavour to make progress in this direction by modelling more fully the dynamic general equilibrium interactions between rent-seeking behaviour and economic activity. We show how these interactions lead to threshold effects and multiple development regimes, and how the limiting outcome of an economy may depend crucially on initial conditions. The present paper goes further than this, providing an account of the corruption-development feedback nexus for the purpose of explaining why the incidence of corruption is not only higher in poor countries than in rich countries, but also more variable among middle-income countries.

Our analysis is based on a simple neo-classical growth model in which public agents (bureaucrats) are delegated the responsibility for collecting taxes from private individuals (households) on behalf of the political elite (the government). Bureaucrats have the opportunity to engage in corrupt practices which are difficult to monitor by the government. Specifically, bureaucrats may exploit their powers of public office to collude with households in bribery and tax evasion: a bribe to a bureaucrat holds the promise that

[9] In a purely static context, Acemoglu and Verdier (1998, 2000) conduct a general equilibrium analysis of how corruption may form part of an optimal allocation in which market failure is traded off against government failure.

the income of a household will be reported falsely and exempt from any tax. Thus our model incorporates the essential features that government intervention requires public officials to gather information and administer policies, and that at least some of these officials are corruptible in the sense of being willing to misrepresent information at the right price.

A key implication of our analysis is that the incentive for a bureaucrat to engage in corruption depends on economy-wide outcomes which, in turn, depend on the behaviour of all other bureaucrats. As a consequence, bureaucratic decision making entails strategic interactions that are capable of producing multiple, frequency-dependent equilibria associated with different (low and high) incidences of corruption. In general, such non-uniqueness is explained by appealing to the notion that, for one reason or another, individuals are more likely to be corrupt when others are corrupt and *vice versa*. For example, the more corrupt people there are, the less might be the probability that each one of them will be caught, the less might by the penalty that each one of them may incur and the less might be the moral costs, or stigma, that each one of them feels. These ideas have been incorporated into several partial equilibrium models of corruption. Typical of these are the models of Andvig and Moene (1990) and Cadot (1987) in which multiple equilibria arise because a bureaucrat's expected punishment for being corrupt is a decreasing function of the number of other corrupt bureaucrats.[10] In a slightly different vein, Tirole (1996) establishes multiple equilibria that are history dependent due to group reputation effects, whereby good or bad behaviour in the past motivates good or bad behaviour in the present. Our own account of the phenomena stands in sharp contrast to these analyses and centres around the surplus that accrues to households and bureaucrats as a result of their illegal profiteering. *Ceteris paribus*, the greater is the level of corruption the higher are the taxes that households must pay if the government is to balance its budget. In order to evade these higher taxes, households are willing to cede more in bribes which reinforces the rent-seeking incentives of bureaucrats. The upshot is that a bureaucrat's expected gain from being corrupt depends positively on the number of other bureaucrats who are corrupt - hence the possibility of frequency-dependent behaviour and, with this, multiple equilibria. We emphasise that this is only a possibility since there are circumstances in our model where such behaviour does not arise and there exists a unique equilibrium. Significantly, these circumstances relate to the level of economic development, as determined by the process of

[10] The incidence of crime has been explained in a similar way. In Sah (1991), for example, an individual is more (less) likely to engage in criminal activity if there are many (few) others engaged in such activity because the chances that he will be caught are lower (higher).

capital accumulation. This is another distinguishing feature of our analysis. Upto now, the question of how an economy may move from one equilibrium to another has been addressed largely on the basis of comparative static exercises (i.e., studying the effects of exogenous changes in parameter values). In our case the selection of an equilibrium is partly endogenous, being linked to an economy's position along its development path.

The precise effect of corruption in our model is to reduce the amount of resources available for productive investments as bureaucrats seek other (less conspicuous, but costly) ways of disposing of their illegal income. In this way, our analysis allows for the joint, endogenous determination of corruption and development in a relationship that is fundamentally two-way causal: on the one hand, the selection of an equilibrium with a particular incidence of corruption is governed, in part, by aggregate economic activity; on the other hand, growth in economic activity through capital accumulation is determined by the equilibrium level of corruption.

According to our results, an economy may find itself in one of three distinct types of development regime: the first, a low development regime, is characterised by a unique equilibrium associated with a high incidence of corruption; the second, a high development regime, is also characterised by a unique equilibrium but one that entails a low incidence of corruption; the third, an intermediate development regime, is characterised by multiple equilibria with varying incidences of corruption. The existence of multiple equilibria means that different levels of corruption may be displayed by countries at similar stages of development. Consequently, and in accordance with the empirical evidence, our analysis is able to explain not only why there is more corruption in poor countries than in rich countries, but also why there is more diversity in corruption among middle income countries. It is also able to account for persistence in both corruption and income inequalities across countries: transition from a low development (high corruption) regime to a high development (low corruption) regime is not inevitable in our model, and it is possible for an economy to become trapped in a vicious circle of widespread poverty and wholesale misgovernance unless fundamental changes take place.

The remainder of paper is organised as follows. In Section 2 we describe the economic environment in which agents make decisions. In Section 3 we study the incentives of agents to engage in corruption. In Section 4 we establish the existence of alternative equilibria in which the level of corruption depends on the level of development. In Section 5 we demonstrate how development, itself, is influenced by corruption. In Section 6 we offer some concluding remarks.

2 The Environment

Time is discrete and indexed by $t = 0, .., \infty$. There is a constant population of two-period-lived agents belonging to overlapping generations of dynastic families. Agents of each generation are divided into two groups of citizens - private individuals (or households), of whom there is a fixed measure of mass m, and public servants (or bureaucrats), of whom there is a fixed measure of mass $n < m$.[11] Households are differentiated according to differences in their labour endowments which determine their relative incomes and their relative propensities to be taxed. Specifically, we suppose that a fraction, $\mu \in (0, 1)$, of households are endowed with $\lambda > 1$ units of labour and are liable to pay tax, while the remaining fraction, $1 - \mu$, are endowed with only one unit of labour and are exempt from paying tax. Taxes are lump-sum and are collected by bureaucrats on behalf of the government which requires funding for public expenditures. We assume, for convenience, that each bureaucrat has one unit of labour endowment (which exempts him from taxation) and that each bureaucrat has jurisdiction over the same number, $\frac{\mu m}{n}$, of taxable households. Corruption arises from the incentive of a bureaucrat to conspire with a household in concealing information (the household's income) from the government. In doing this, the bureaucrat expects to gain from his acceptance of a bribe and the household expects to gain from its evasion of tax. We imagine that a fraction, $\eta \in (0, 1)$, of bureaucrats are corruptible in this way, while the remaining fraction, $1 - \eta$, are non-corruptible, with the identity of each bureaucrat being unobservable by the government.[12] All agents are risk neutral, working (and saving) only when young and consuming only when old. Production of output is undertaken by firms, of which there is a continuum of unit mass. Firms hire labour from households and rent

[11] We assume that agents are differentiated at birth according to their abilities and skills. A population of m agents lack the skills necessary to become bureaucrats, while a population of n agents possess these skills. The latter are induced to become bureaucrats by an allocation of talent condition established below. Thus, as in other analyses (e.g., Blackburn *et al.* 2005; Ehrlich and Lui 1999; Sarte 2000), we abstract from issues relating to occupational choice. In doing so we are able to simplify the analysis by not having to consider possible changes in the size of the bureaucracy and possible changes in the level of corruption that may result from this.

[12] This assumption may be thought of as capturing differences in the propensities of bureaucrats to engage in corruption, whether due to differences in proficiencies at being corrupt or differences in moral attitudes towards being corrupt (e.g., Acemoglu and Verdier 2000; Besley and McLaren 1993; Blackburn *et al.* 2005; Tirole 1996). The main purpose of the assumption is to allow us to determine the wages of bureaucrats in a relatively straightforward way that does not demand additional assumptions about how public sector pay is determined. In fact, all we need for this purpose is that there be at least one bureaucrat who is non-corruptible - all other bureaucrats may well be potential transgressors.

capital from all agents. All markets are perfectly competitive.

2.1 The Government

We envisage the government as providing public services which contribute to the efficiency of output production (e.g., Barro 1990). For simplicity, we assume that expenditure on these services is fixed at the amount g.[13] The government also incurs expenditures on bureaucrats' salaries which are determined as follows. Any bureaucrat (whether corruptible or non-corruptible) can work for a firm, supplying one unit of labour to receive a non-taxable income equal to the wage paid to households. Any bureaucrat who is willing to accept a salary less than this wage must be expecting to receive compensation through bribery and is therefore immediately identified as being corrupt. As in other analyses (e.g., Acemoglu and Verdier 1998), we suppose that a bureaucrat who is discovered to be corrupt is subject to the maximum fine of having all of his income confiscated (i.e., he is dismissed without pay). Given this, then no corruptible bureaucrat would ever reveal himself in the way described above. As such, the government can minimise its labour costs, while ensuring complete bureaucratic participation, by setting the salaries of all bureaucrats equal to the wage paid by firms to households.[14]

The government finances its expenditures each period by running a continuously balanced budget. Its revenues consist of the taxes collected by bureaucrats from high-income households, plus any fines imposed on bureaucrats who are caught engaging in corruption. We denote by τ_t the lump-sum tax levied on each high-income household. Since the government knows how much tax revenue is due in the absence of corruption (since it knows the number of taxable households and since it is responsible for setting taxes), any shortfall of revenue below this amount reveals that corruption is occurring. Under such circumstances, the government investigates the behaviour of bureaucrats using an imprecise monitoring technology. This technology implies that a bureaucrat who is corrupt faces a probability, $p \in (0, 1)$, of avoiding detection, and a probability, $1 - p$, of being found out. The tax-evading household with whom the bureaucrat conspires faces the same probabilities of remaining anonymous and being exposed. In the event of the latter, the

[13] More generally, we might assume that these expenditures vary with the level of output in some way. It is straightforward to show that our results can be re-established under such an extension of the model.

[14] This has the usual interpretation of an allocation of talent condition. The government cannot force any of the n potential bureaucrats to actually take up public office, but it is able to induce all of them to do so by paying what they would earn elsewhere.

household is forced to pay its full tax liability.[15]

2.2 Households

Each young household of generation t saves all of its income to acquire a final level of wealth of x_{t+1} when it reaches old-age. A household consumes part of this wealth and bequeaths the remainder to its offspring. Its lifetime utility is given as $U_t = x_{t+1} - q_{t+1} + u(q_{t+1})$, where $x_{t+1} - q_{t+1}$ is consumption, q_{t+1} is the bequest and $u(\cdot)$ is a strictly concave function that satisfies the usual Inada conditions.[16] It follows that utility is maximised by setting $u'(\cdot) = 1$, implying an optimal fixed size of bequest from one generation to the next: that is, $q_{t+1} = q$ for all t. Given this, then the expected utility of a household is fully determined once its expected wealth is determined.

Each household, when young, is paid a wage, w_t, from supplying inelastically its labour endowment to a firm. A household endowed with one unit of labour earns an income from working of w_t and is exempt from paying taxes. Obviously, such a household has no incentive to engage in tax evasion and its final wealth is simply $(1 + r_{t+1})(w_t + q)$, where r_{t+1} is the rate of interest on savings. A household endowed with λ units of labour earns an income from working of λw_t and is obliged pay taxes of τ_t. This type of household may or may not conspire with a bureaucrat in bribery and tax evasion. If not, then its final wealth is $(1 + r_{t+1})(\lambda w_t + q - \tau_t)$. If so, then its wealth is uncertain and depends on the amount of bribe paid and the chances of being caught. Let b_t denote the bribe. With probability p, the household and bureaucrat succeed in their conspiracy and the household acquires a wealth of $(1 + r_{t+1})(\lambda w_t + q - b_t)$. With probability $1 - p$, their collusion is exposed, meaning that the household is forced to pay its full tax liability so that its final wealth is $(1 + r_{t+1})(\lambda w_t + q - \tau_t - b_t)$.[17] Given these outcomes, we may

[15] We assume that monitoring is costless for the government. The model could be extended to allow for costly monitoring (and perhaps to allow p to be a function of monitoring expenditures) without altering its main implications. To a large extent, our results would be strengthened in the sense that there would be an additional loss of resources from corruption. Likewise, our results would not change substantially if one were to assume that, in addition to paying its tax liability, a household is fined or punished in some other way if it is caught trying to evade taxes. Again, we choose not to include this for simplicity.

[16] This function captures the 'warm-glow', or 'joy-of-giving' motive for making bequests. We choose this simple way of modelling altruism since the main role of bequests in our model is merely to ensure the existence of a well-defined steady state equilibrium.

[17] Throughout our analysis, we assume appropriate restrictions on parameter values to ensure positive net incomes for all high-income household.

write the expected utility of each high-income household as

$$E(U_t|b_t) = \begin{cases} (1+r_{t+1})(\lambda w_t + q - \tau_t) + Q & \text{if } b_t = 0, \\ (1+r_{t+1})[\lambda w_t + q - (1-p)\tau_t - b_t] + Q & \text{if } b_t > 0. \end{cases} \quad (1)$$

where $Q = -q + u(q)$.[18]

2.3 Bureaucrats

Each young bureaucrat of generation t saves all of its income to obtain a final level of wealth z_{t+1} during retirement. For simplicity, we assume that a bureaucrat consumes all of this wealth (i.e., is non-altrustic), deriving lifetime utility of $V_t = z_{t+1}$. As above, therefore, a bureaucrat's expected utility is fully determined once his expected wealth is determined.

Each bureaucrat, when young, is paid the salary w_t from supplying inelastically his unit labour endowment to the government. By definition, a bureaucrat who is non-corruptible is never corrupt and will never participate in bribery and tax evasion. The final wealth of such a bureaucrat is simply $(1+r_{t+1})w_t$. In contrast, a bureaucrat who is corruptible may or may not be corrupt, and may or may not engage in rent seeking. If not, then his wealth is $(1+r_{t+1})w_t$, as before. If so, then his wealth is uncertain and depends on the bribes that he receives, the chances that he will be caught and the penalties incurred if he is exposed. In general, corrupt individuals may try to remain inconspicuous by hiding their illegal income, by investing this income differently from legal income and by altering their patterns of expenditure.[19] For the purposes of the present analysis, we make the simple assumption that a bureaucrat who is corrupt must store his illegal income in hiding (rather than invest it in capital) if he is to stand any chance of not being caught. Such a bureaucrat acquires a final wealth of $(1+r_{t+1})w_t + \left(\frac{\mu m}{n}\right)b_t$ with probability p and of zero with probability $1-p$. It follows that the expected utility of each corruptible bureaucrat is

$$E(V_t|b_t) = \begin{cases} (1+r_{t+1})w_t & \text{if } b_t = 0, \\ p[(1+r_{t+1})w_t + \left(\frac{\mu m}{n}\right)b_t] & \text{if } b_t > 0. \end{cases} \quad (2)$$

[18] As we shall see, r_{t+1} is constant in equilibrium and is therefore known at time t.

[19] It is even possible that income from corruption at one level is used to foster corruption at other levels (e.g., to ensure non-interference from the legal authorities). Discussions of these issues can be found in Rose-Ackerman (1996) and Wade (1985), among others.

2.4 Firms

The representative firm combines l_t units of labour with k_t units of capital to produce y_t units of output according to

$$y_t = A l_t^{\alpha} k_t^{1-\alpha} K_t^{\alpha}, \tag{3}$$

($A > 0, \alpha \in (0,1)$) where K_t denotes the aggregate stock of capital.[20] Implicit in this technology is the assumption that A depends on g, reflecting the idea that productive efficiency is enhanced by the provision of public goods and services. The firm hires labour at the competitively-determined wage rate w_t and rents capital at the competitively-determined rental rate r_t. Profit maximisation implies $w_t = \alpha A l_t^{\alpha-1} k_t^{1-\alpha} K_t^{\alpha}$ and $r_t = (1-\alpha) A l_t^{\alpha} k_t^{-\alpha} K_t^{\alpha}$. In equilibrium, where $l_t = l = (1 - \mu + \mu\lambda)m$ and $k_t = K_t$, these conditions become

$$w_t = \alpha A l^{\alpha-1} k_t, \tag{4}$$

$$r_t = (1-\alpha) A l^{\alpha} \equiv r. \tag{5}$$

Thus the equilibrium wage is proportional to the capital stock, while the equilibrium interest rate is constant.

3 The Incentive to be Corrupt

Corruption occurs if a high-income household and a corruptible bureaucrat find it mutually advantageous (or non-disadvantangeous) to conspire with each other in concealing information from the government. Under such circumstances, there is bribery and tax evasion. In the analysis that follows we study the individual incentives of private and public agents to behave in this way.

A high-income household is willing to pay a bribe if its expected utility from doing so is no less than its expected utility from not doing so: that is, if $E(U_t|b_t > 0) \geq E(U_t|b_t = 0)$. The maximum bribe that such a household is willing to concede is determined by strict equality of this condition. From (1), this maximum bribe payment is deduced as

$$b_t = p\tau_t. \tag{6}$$

Intuitively, the household is prepared to bribe a bureaucrat by no more than what it expects to save in taxes.

[20] This aggregate externality - a common feature of endogenous growth models - allows us to work with a simple AK technology, where the social returns to capital are constant. Our results would be unchanged were we to assume diminishing returns to capital instead.

Similarly, a corruptible bureaucrat is willing to accept a bribe if he expects to be no worse off from doing this than from not doing this: that is, if $E(V_t|b_t > 0) \geq E(V_t|b_t = 0)$. From (2), this requires that

$$\frac{p\mu m b_t}{n} \geq (1-p)(1+r_{t+1})w_t \tag{7}$$

Intuitively, the bureaucrat demands a higher bribe payment the more he expects to lose in legal income if he is caught.

For corruption to take place, both (6) and (7) must be satisfied simultaneously. This yields the condition

$$\frac{p^2\mu m\tau_t}{n} \geq (1-p)(1+r_{t+1})w_t. \tag{8}$$

The key feature of this condition is that it depends on the current level of taxes, τ_t, which is determined by current events in the economy. In particular, τ_t is a function of the aggregate level of corruption at time t, as we shall see below. This means that the incentive for each corruptible bureaucrat to engage in rent seeking depends on the number of other such bureaucrats who are doing this. Consequently, bureaucratic decision making entails strategic interactions which may result in multiple, frequency-dependent equilibria. We begin to explore this possibility by first studying the incentives of an individual corruptible bureaucrat to be corrupt under two opposite scenarios - one in which no other such bureaucrat is corrupt and the other in which all other such bureaucrats are corrupt. In doing this, we make use of our earlier results in (4) and (5).

Consider, then, the case in which corruption is absent, meaning that the condition in (8) is violated. Each and every bureaucrat, of whom there are n, collects the maximum amount of tax revenue, $\left(\frac{\mu m}{n}\right)\tau_t$, from those high-income households under his jurisdiction and returns all of this revenue to the government. The total proceeds from taxation are used by the government to finance its total expenditures on the salaries of bureaucrats, nw_t, and public goods, g. The level of taxes that each high-income household pays, denoted $\widehat{\tau}_t$, is determined from the government's budget constraint as

$$\mu m\widehat{\tau}_t = nw_t + g. \tag{9}$$

Given this tax, an individual household would be willing to pay a maximum bribe of $\widehat{b}_t = p\widehat{\tau}_t$ in accordance with (6). Substitution of (9) into (8) yields

$$\frac{p^2 g}{n} \geq [(1-p)(1+r) - p^2]\alpha A l^{\alpha-1}k_t \equiv \widehat{f}(k_t), \tag{10}$$

where we assume that $[\cdot] > 0$. This is the condition for an individual corruptible bureaucrat to be corrupt, given that no other such bureaucrat is corrupt.

Now consider the case in which corruption exists as a result of the condition in (8) being satisified. The total population of corrupt bureaucrats is ηn, of whom a fraction, p, evade detection by the government, while the remaining fraction, $1-p$, are caught. The government's tax receipts are zero from each of the former and $\left(\frac{\mu m}{n}\right)\tau_t$ from each of the latter who is also fined the amount $w_t + \left(\frac{\mu m}{n}\right)b_t$. From each non-corrupt bureaucrat, of whom there are $(1-\eta)n$, the government receives $\left(\frac{\mu m}{n}\right)\tau_t$ in tax revenue. Total expenditures by the government are again comprised of expenditures on bureaucrats' salaries, nw_t, and expenditures on public goods, g. As above, the level of taxes imposed on each high-income household, denoted $\widetilde{\tau}_t$, may be computed from the government's budget constraint as

$$(1-p^2\eta)\mu m\widetilde{\tau}_t = [1-(1-p)\eta]nw_t + g - (1-p)\eta\mu m\widetilde{b}_t \tag{11}$$

The maximum bribe that a household would be willing to pay is deduced from (6) to be $\widetilde{b}_t = p\widetilde{\tau}_t$. Given this, then substitution of (11) into (8) produces

$$\frac{p^2 g}{n} \geq [(1-p)(1+r) - p^2 - (1-p)p^2\eta r]\alpha A l^{\alpha-1}k_t \equiv \widetilde{f}(k_t), \tag{12}$$

where we similarly assume that $[\cdot] > 0$.[21] This is the condition for an individual corruptible bureaucrat to be corrupt, given that all other such bureaucrats are corrupt.

Observe from (9) and (11) that $\widehat{\tau}_t < \widetilde{\tau}_t$: taxes are lower in the absence of any corruption than in the presence of complete corruption.[22] Intuitively, the prospect of lost tax revenues under corruption means that the government must raise taxes on high-income households in order to satisfy its budget constraint. This more than offsets the additional revenue from fines.

4 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. We now proceed to determine the circumstances under which corruption may or may not emerge as an equilibrium outcome.

[21] Obviously, this is sufficient to ensure that $[\cdot] > 0$ in (10).

[22] This result can be established by writing $\mu m\widetilde{\tau}_t = \mu m\widehat{\tau}_t + \eta[p^2\mu m\widetilde{\tau}_t - (1-p)nw_t]$ and noting that $[\cdot] > 0$ by virtue of (8).

The crucial conditions for determining equilibrium behaviour are given in (10) and (12). Note that both $\widehat{f}(\cdot)$ and $\widetilde{f}(\cdot)$ are increasing monotonically (linearly) in k_t. Note also that $\widehat{f}(\cdot) > \widetilde{f}(\cdot)$ for all k_t. Given these observations, we may define two critical levels of capital, k_1^c and k_2^c, such that the following hold: $\widehat{f}(k_1^c) = \frac{p^2 g}{n}$, with $\widehat{f}(\cdot) < \frac{p^2 g}{n}$ for all $k_t < k_1^c$, and $\widehat{f}(\cdot) > \frac{p^2 g}{n}$ for all $k_t > k_1^c$; and $\widetilde{f}(k_2^c) = \frac{p^2 g}{n}$, with $\widetilde{f}(\cdot) < \frac{p^2 g}{n}$ for all $k_t < k_2^c$, and $\widetilde{f}(\cdot) > \frac{p^2 g}{n}$ for all $k_t > k_2^c$. Evidently, $k_1^c < k_2^c$. We are now in a position to establish some key results.

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 $\widetilde{f}(\cdot) > \frac{p^2 g}{n}$ and $\widehat{f}(\cdot) > \frac{p^2 g}{n}$, 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 corruptible bureaucrats are corrupt is an equilibrium outcome since no bureaucrat has an incentive to deviate from corrupt behaviour. Conversely, the case in which all corruptible bureaucrats are non-corrupt is not an equilibrium outcome since each bureaucrat 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.

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 $\widehat{f}(\cdot) < \frac{p^2 g}{n}$ and $\widetilde{f}(\cdot) < \frac{p^2 g}{n}$, implying that it pays each corruptible bureaucrat to be non-corrupt, irrespective of whether other corruptible bureaucrats are non-corrupt or corrupt. The case in which all corruptible bureaucrats are non-corrupt is an equilibrium outcome since no bureaucrat has an incentive to deviate from non-corrupt behaviour. Conversely, the case in which all corruptible bureaucrats are corrupt is not an equilibrium outcome since each bureaucrat has an incentive to deviate from corrupt behaviour. ■

This result demonstrates that high levels of development are associated with low (zero) levels of corruption.

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

Proof. Suppose that $k_t \in (k_1^c, k_2^c)$. Then $\widetilde{f}(\cdot) > \frac{p^2 g}{n}$ but $\widehat{f}(\cdot) < \frac{p^2 g}{n}$, 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 corruptible bureaucrats are corrupt is an equilibrium outcome since no bureaucrat has an incentive to deviate from corrupt behaviour. Likewise, the case in which all corruptible bureaucrats are non-corrupt is also an equilibrium outcome since no bureaucrat 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.

We illustrate the above results in Figure 1, from which 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. 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. 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. The intuition is as follows.

Each corruptible bureaucrat chooses to be corrupt or non-corrupt according to whether the condition in (8) is satisified or violated. This condition depends on taxes and wages, both of which depend on the existing aggregate stock of capital (measuring the level of development) and the former of which depends also on the aggregate incidence of corruption (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 bureaurcrats are behaving: 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 (8) is satisfied. As such, a corruptible bureaucrat will always be corrupt, irrespective of what others around him may be doing. 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 (8) 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 (8) is satisfied if corruption is widespread but is violated if corruption is absent. A corruptible bureaucrat will now be corrupt or non-corrupt according to whether other such bureaucrats are corrupt or non-corrupt. Consequently, there are two candidate equilibria that are frequency-dependent and that are equally likely to arise.

As mentioned previously, our account of multiple equilibria is quite different from other accounts that currently exist. In our case, multiplicity arises because, *ceteris paribus*, the joint surplus of a household and a bureaucrat from colluding with each other is higher (lower) when corruption in total is higher (lower). This follows from our earlier result that, for any given level of capital, a higher (lower) incidence of corruption is associated with a higher (lower) level of taxes as the government strives to maintain budget balance. Higher (lower) taxes means that households are willing to pay larger (smaller) bribes which, in turn, means that each bureaucrat has a stronger (weaker) incentive to engage in rent-seeking. In this way, both good and bad behaviour can be contagious as a bureaucrat's compliance in corruption may depend critically on the compliance of others. Significantly, however, this is not always the case and there are circumstances where the osmosis effects of corruption disappear. These circumstances relate to the level of development which may dictate the selection of a unique equilibrium.

The predictions of our model accord well with the empirical observations highlighted earlier: the high incidence of corruption among poor countries is reflected in the unique equilibrium at low levels of development; the low incidence of corruption among rich countries is reflected in the unique equilibrium at high levels of development; and the diverse incidence of corruption among middle income countries is reflected in the multiplicity of equilibria at intermediate levels of development. We are unaware of any other analysis that produces a similar set of results. In the few related studies that currently exist, priority is given to explaining the existence of a generally negative correlation between corruption and growth (e.g., Ehrlich and Lui 1999; Sarte 2000). The same broad relationship is predicted by our own analysis, but for different reasons which also explain why the relationship may be tenuous in some circumstances. In fact, the diversity of outcomes at intermediate levels of development is greater than what we have suggested so far. Each of the equilibria that has been constructed is a pure strategy equilibrium in which all corruptible bureaucrats are either corrupt or non-corrupt. But there also exists a mixed strategy equilibrium in which bureaucratic behaviour is heterogenous - that is, an equilibrium in which a fraction, $\epsilon \in (0,1)$, of corruptible bureaucrats are corrupt, while the remaining fraction, $1-\epsilon$, are

non-corrupt. We establish this in an Appendix by demonstrating that, for each $k_t \in (k_1^c, k_2^c)$, there exists an ϵ such that the condition in (8) holds with equality. It is therefore possible for a middle income country to be in one of three equilibria where the incidence of corruption is high, low or somewhere in between. To many observers, it is not surprising that the relationship between corruption and development may sometimes be a little fragile. Indeed, there is a widely-held view that, at least in the first instance, development may do little to reduce (and may even foster) corruption as the process of modernisation (including economic, political and social reforms) brings with it new incentives and new opportunities for public agents to engage in corrupt practices. For example, it is often alleged that this has been true in countries undergoing transition from controlled to more market-oriented economies (e.g., Bardhan 1997; Basu and Li 1998).

5 Capital Accumulation

We have seen how the incidence of corruption depends on the level of development. We have yet to study how the development process, itself, is affected by corrupt activity. This process is described by the path of capital accumulation, obtained from the equilibrium condition that the total demand for capital is equal to the total supply of savings (except for any savings that are hidden). In showing how this path is affected by rent seeking behaviour, we establish the result that corruption and development are mutually dependent phenemona, being linked in a relationship that is two-way causal.

Consider the case in which corruption is absent. Total savings in the economy comprise the savings of low-income households, $(1-\mu)m(w_t+q)$, of high-income households, $\mu m(\lambda w_t + q - \widehat{\tau}_t)$, and of bureaucrats, nw_t. Collecting these terms together, and exploiting (9), we arrive at the following expression for capital accumulation:

$$\begin{aligned} \widehat{k}_{t+1} &= lw_t - g + mq \\ &= \alpha A l^{\alpha} k_t - g + mq \equiv \widehat{F}(k_t). \end{aligned} \tag{13}$$

Now consider the case in which corruption is present. Total savings of households comprise the savings of low-income households, $(1-\mu)m(w_t+q)$, of high-income housholds that do not bribe, $(1-\eta)\mu m(\lambda w_t + q - \widetilde{\tau}_t)$, and of high-income households that do bribe, $\eta\mu m[\lambda w_t + q - \widetilde{b}_t - (1-p)\widetilde{\tau}_t]$. Total savings of bureaucrats consist of the savings of non-corruptible bureaucrats, $(1-\eta)nw_t$, and of corruptible bureaucrats, $p\eta nw_t$. Together with (11) and (6), these expressions yield the following process governing capital accumu-

lation:

$$\begin{aligned}\widetilde{k}_{t+1} &= lw_t - g - p\eta\mu m\widetilde{b}_t + mq \\ &= \left\{1 - \frac{p^2\eta[1-(1-p)\eta]n}{(1-p^2\eta)l}\right\}\alpha A l^{\alpha}k_t - \frac{g}{1-p^2\eta} + mq \equiv \widetilde{F}(k_t). \quad (14)\end{aligned}$$

Under appropriate parameter restrictions, both of the transition functions in (13) and (14) exhibit stationary points associated with the steady state levels of capital $\widehat{k}^* = \widehat{F}(\widehat{k}^*)$ and $\widetilde{k}^* = \widetilde{F}(\widetilde{k}^*)$, respectively. Evidently, $\widetilde{k}^* < \widehat{k}^*$ which follows from the fact that, for any given k_t, $\widetilde{F}(\cdot) < \widehat{F}(\cdot)$. Thus capital accumulation is lower under corruption than under non-corruption, which is to say that corruption has an adverse effect on economic development. The extent to which this occurs is given by the term $p\eta\mu m\widetilde{b}_t$ in (14) which measures the amount of illegal income that is successfully concealed by corrupt public officials. As a consequence of this subterfuge, less resources are available for productive investments, implying a fall in capital accumulation and growth.

Given the above, our analysis is able to explain why corruption and poverty may co-exist as persistent, rather than transient, phenomena. We illustrate this in Figure 2 which shows the two capital accumulation paths, $\widehat{F}(\cdot)$ and $\widetilde{F}(\cdot)$, 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 transition path, $\widetilde{F}(\cdot)$, for $k_t < k_1^c$, the high transition path, $\widehat{F}(\cdot)$, for $k_t > k_2^c$, and either of the paths for $k_t \in (k_1^c, k_2^c)$. What transpires from this scenario is a poverty trap equilibrium at $\widetilde{k}^*$. In other words, if the economy is poor and corrupt to begin with (e.g., if its initial capital stock is k_0), then it will be destined to remain poor and corrupt unless fundamental changes take place so as to dictate otherwise. For example, exogenous shifts in the stock of capital may cause a switch in development regime by pushing the economy above the lower threshold level, k_1^c. Alternatively, changes in the values of structural parameters may produce a similar turn of events by altering the transition function and the threshold, itself, such that $\widetilde{k}^* > k_1^c$. In both cases a switch in regime is more likely to occur the closer is an economy to k_1^c to begin with. Accordingly, should circumstances change in these ways, then it is those countries at the upper end of the distribution below k_1^c that are most likely to feel the effects, while those in the lower tail remain as they are. Even for the former, however, there is no guarantee that the result would be low corruption and high growth, nor any assurance that the upper threshold, k_2^c, would also be breached. These observations suggest that the divisions between poor and rich, corrupt and non-corrupt, economies are unlikely to vanish quickly or easily, if at all.

6 Conclusions

Public sector corruption is pervasive throughout the world. In one form or another, and to a lesser or greater degree, it has existed, and continues to exist, in all societies. Over the past few years, there has been a growing concern among the academic community and international organisations about the causes and consequences of corrupt behaviour within government bureaucracies. This has been motivated by a strengthening conviction that good quality governance is essential for sustained economic development and that corruption in the public sector is a major impediment to growth and prosperity. Recent innovations at the empirical level have allowed this conviction to be tested, and there is now a large body of evidence to support it. By contrast, there remains relatively little by way of formal theoretical analysis that would lend rigour and precision to the arguments involved. Our objective in this paper has been to provide such an analysis.

We have defined public sector corruption in the usual way as the abuse of authority by bureaucratic officials who exploit their powers of discretion, delegated to them by the government, to further their own interests by engaging in rent-seeking activities. We have also addressed the archetypal form of public sector corruption, whereby a bureaucrat is bribed by a private individual to conspire in the concealment of valuable information from the government. Of course, to the extent that bribery entails a transfer of resources between agents, there need not be any net social costs associated with such behaviour. As with any type of illegal or unauthorised activity, however, there are costs to both individuals and society of deception and secrecy, on the one hand, and detection and prosecution, on the other. In our case corruption results in a loss of resources available for investment such that capital accumulation is depressed. It has been suggested elsewhere that corruption may also result in a misallocation of resources towards inefficient investments with similar consequences. Either way, the costs of corruption are potentially significant, especially since it takes only small changes in the growth rate to produce substantial cumulative gains or losses in output and welfare.

Our analysis respects the notion that bureaucratic corruption not only influences, but is also influenced by, economic development. This two-way causality is reflected in the existence of threshold effects and multiple equilibria which allow us to explain why the incidence of corruption may vary markedly across countries, even if countries share essentially the same structural characteristics. At any point in time, an economy may be located in a low development regime, a high development regime or an intermediate development regime. Cross-country variations in the level of corruption may occur both across and within these regimes. For example, two otherwise

identical economies may end up with very different levels of corruption if one of them is in the low regime and the other is in the high regime, or if both of them lie in the intermediate regime. The predictions that follow from this accord well with the empirical observations of a high incidence of corruption among low income countries, a low incidence of corruption among high income countries and a diverse incidence of corruption among middle income countries. The results are also consistent with the idea of persistence in corruption since transition from one regime to another is not inevitable but requires the crossing of a threshold that may be prohibitive. Of course, there are many other factors - besides economic considerations - that may help to explain why corruption levels differ across countries. The recent empirical literature suggests a number of intriguing possibilities. Yet even after controlling for these factors, economic development remains highly significant and is undoubtedly a major determinant.

The relationship between corruption and development is an issue on which much has been written but about which there is still much to learn. To a large extent, measurement remains ahead of theory, though there are signs that the gap is being closed. Our intention in this paper has been to take a futher step in this direction.

Appendix

We establish the existence of a mixed strategy equilibrium in the intermediate development regime. Suppose that, for $k_t \in (k_1^c, k_2^c)$, there is a fraction, $\epsilon \in (0,1)$ $(1-\epsilon)$, of corruptible bureaucrats who are corrupt (non-corrupt). Proceeding in the usual way, we may derive the following expression for taxes:

$$(1-p\epsilon\eta)\mu m\overline{\tau}_t = [1-(1-p)\epsilon\eta]nw_t + g - (1-p)\epsilon\eta\mu m\overline{b}_t \tag{15}$$

The condition for a corruptible bureaucrat to be corrupt is

$$\frac{p^2 g}{n} \geq [(1-p)(1+r) - p^2 - (1-p)p^2\epsilon\eta r]\alpha A l^{\alpha-1}k_t \equiv \overline{f}(k_t) \tag{16}$$

It is straightforward to verify that, for a given k_t and a given $\epsilon \in (0,1)$, $\widehat{f}(\cdot) > \overline{f}(\cdot) > \widetilde{f}(\cdot)$. In terms of Figure 1, the curve $\overline{f}(\cdot)$ always lies between the curves $\widehat{f}(\cdot)$ and $\widetilde{f}(\cdot)$. It follows that, within the region (k_1^c, k_2^c), there is a single intersection between $\frac{p^2 g}{n}$ and $\overline{f}(\cdot)$. Consequently, for any given $k_t \in (k_1^c, k_2^c)$, there exists an $\epsilon \in (0,1)$ such that $\frac{p^2 g}{n} = \overline{f}(\cdot)$, implying that each corruptible bureaucrat is indifferent between being corrupt and non-corrupt. This ϵ is the fraction of corrupt corruptible bureaucrats that supports a mixed strategy equilibrium.

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Table 1
Corruption Across Countries

Index	BIC	ICRG	TI			
Total range[1]	1.0-10.0	1.0-6.0	0.0-10.0			
Year	1980-83	1991-97	2001	2002	2003	2004
Number of Countries						
Total[2]	59	113	85	94	121	133
Low income	5	33	20	24	36	43
Middle income	37	59	45	50	65	70
Lower middle income	21	43	23	29	38	40
Upper middle income	16	16	22	21	27	30
High income	17	21	20	20	20	20
Range of index						
Low income	1.0-4.0	1.4-4.0	1.0-3.4	1.2-3.9	1.3-3.3	1.5-3.6
Middle income	1.5-10.0	1.0-5.0	2.0-7.5	1.7-6.5	1.6-7.4	1.9-7.4
Lower middle income	1.5-8.8	1.0-5.0	2.0-5.3	1.7-5.7	1.6-4.9	1.9-5.3
Upper middle income	3.3-10.0	1.1-5.0	2.8-7.5	2.5-6.5	2.1-7.4	2.3-7.4
High income	7.5-10.0	4.4-6.0	6.6-9.9	6.3-9.7	6.9-9.7	6.9-9.7
Variance of index						
Low income	2.00	0.55	0.33	0.36	0.23	0.24
Middle income	4.07	0.79	1.39	1.47	1.39	1.56
Lower middle income	4.41	0.67	0.96	0.93	0.69	0.69
Upper middle income	3.44	1.14	1.22	1.50	1.59	1.84
High income	0.33	0.34	0.95	1.09	0.88	0.80

1. Greater levels of corruption are indicated by lower values of the indices.
2. To facilitate comparison between the indices, oil exporting countries have been excluded from the sample. In particular instances, certain other countries have also been excluded due to questions about the reliability of the data.

Figure 1
Equilibrium Corruption

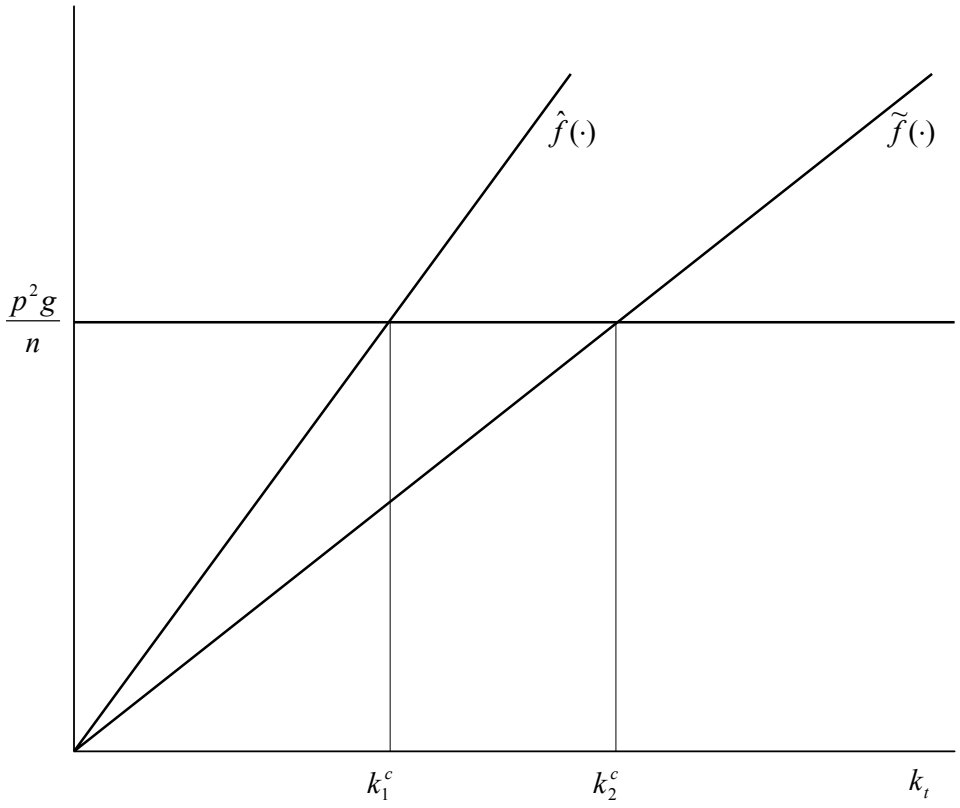

Figure 2
Capital Accumulation