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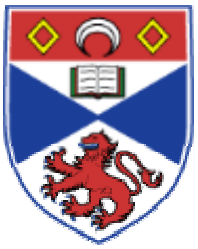

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Public Expenditures, Bureaucratic Corruption and Economic Development*

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ABSTRACT

This paper presents a dynamic general equilibrium analysis of public sector corruption and economic growth. In an economy with government intervention and capital accumulation, state-appointed bureaucrats are charged with the responsibility for procuring public goods which contribute to productive efficiency. Corruption arises because of an opportunity for bureaucrats to appropriate public funds by misinforming the government about the cost and quality of public goods provision. The incentive for each bureaucrat to do this depends on economy-wide outcomes which, in turn, depend on the behaviour of all bureaucrats. 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 on the causes and consequences of corruption in public office.

1 Introduction

Corruption has become the lead topic of debate among all major international development agencies. The World Bank, for example, has identified corruption as the single greatest obstacle to economic and social development, and has given priority to anti-corruption initiatives in its strategies

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for improving the quality of governance.[1] Of most concern is corruption within society's state institutions. Public officials - politicians, bureaucrats and legislators - hold unique positions of power and responsibility, the abuse of which can cause significant and long-lasting damage to many aspects of socio-economic development. Such individuals may have privelaged in-roads to the legal infrastructure, offering them the opportunity to avoid prosecution for any malpractice. Dishonest behaviour at one level in public office is often contagious and often supported by dishonest behaviour at other levels. For these and other reasons, public sector corruption is viewed as being especially harmful, especially pervasive and especially difficult to fight. While some countries have largely overcome these problems, many others appear to be trapped in a vicious circle of widespread poverty and wholesale misgovernance. This paper presents a simple model to explain the diversity and persistence of corruption around the world.[2]

A useful working definition of public sector corruption is the abuse of authority by public officials to make personal gains. One manifestation of this is when civil servants, or bureaucrats, exploit their powers of discretion, delegated to them by the government, to further their own interests by indulging in illegal, or unauthorised, activities.[3] These activities can take various forms, including bribery, embezzlement, extortion and fraud. The incentives to engage in them reflect the hierarchical structure of public organisations, within which there are almost inevitable conflicts of interest and asymmetries of information between superiors and subordinates. As a consequence, the objectives of the former may be compromised by the decisions of the latter to act strategically and dishonestly in pursuit of their own hidden agenda. The conceptual framework that is used to study this type of environment is the framework of principal-agent theory. For the most part, this theory has been applied within the context of partial equilibrium models for the purpose of understanding the microfoundations of corrupt behaviour, including the incentives that may motivate or deter such behaviour and the implications for efficiency and welfare in the event of the former (e.g., Baner-

[1] 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.

[2] The literature on corruption is extensive and includes contributions from all areas of social science using a variety of research methods. For some excellent reviews of the literature with a special emphasis on corruption and development, see Bardhan (1997), Jain (2001), Rose-Ackerman (1999) and Tanzi (1998).

[3] This is referred to as bureaucratic corruption, as distinct from political and legislative corruption which may also arise within the public sector (e.g., Jain 2001).

jee 1997; Carrillo 2000; Klitgaard 1988, 1990; Rose-Ackerman 1975, 1978, 1999; Shleifer and Vishny 1993). Much less research has been undertaken from a macroeconomic perspective with the view to modelling the dynamic general equilibrium interactions between public sector corruption and economic development. This is no doubt due to the complex, multi-dimensional nature of these interactions, the aggregation of which may be difficult to conceptualise. Nevertheless, economists are much better equipped today than they were in the past for rising to the challenge with tools and techniques that enable analytical rigour and precision.

Empirical work on corruption has flourished over recent years. This has been due to the publication of several cross-country data sets that are widely regarded as providing reliable measures of corrupt activity. These data sets, or corruption indices, have been compiled by various international organisations (most notably Business International Corporation, Political Risk Services Incorporated and Transparency International) using questionnaire surveys sent to networks of correspondents around the world. The surveys are designed to produce a ranking of countries in terms of the extent to which corruption is perceived to exist (e.g., the extent to which public officials are believed to accept bribes, to make fraudulent demands and to embezzle public funds). A major reason why the indices are taken seriously is that they all give very similar rankings, as reflected in the fact that they are all highly correlated with each other.[4] Of the many empirical findings, one of the most compelling is a strong negative relationship between corruption and development. This is reported in a number of different studies which yield predictions of significant adverse effects of corruption on growth (e.g., Gyimah-Brempong 2000; Li *et al.* 2000; Mauro 1995; United Nations 1989). These and other investigations also provide evidence on various ways in which corruption might take hold, such as lowering rates of investment (e.g., Mauro 1995), creating obstacles to doing business (e.g., World Bank 2002), reducing inflows of foreign capital (e.g., Lambsdorff 2003; Wei 2000) and causing misallocations of public expenditures (e.g., Mauro 1997; Tanzi and Davoodi 1997). In contrast, there is very little evidence to support the view that corruption might actually be good for growth by helping to circumvent cumbersome regulations (red tape) in the bureacratic process.[5] This is

[4] For more detailed discussions of the indices, see Jain (1998), Tanzi and Davoodi (1997) and Treisman (2000).

[5] This view, which may also be challenged on conceptual grounds, is based on the idea that bribes may act as "speed money" which bureaucrats accept in return for bypassing institutional hurdles (e.g., Huntington 1968; Leff 1964; Leys 1970). More recent expositions of efficiency-enhancing corruption can be found in Lui (1985) and Acemoglou and Verdier (1998). The former suggests that bribes may form part of a Nash equilibrium

true even for countries that are reportedly mired with such regulations (e.g., Ades and Di Tella 1997; Mauro 1995; Kauffman and Wei 2000). Another notable finding is that the relationship between corruption and development appears to be two-way causal. Thus it has been estimated that a significant proportion of the variations in corruption indices can be explained by variations in per-capita income levels (e.g., Ades and Di Tella 1999; Husted 1999; Montinola and Jackman 1999; Treisman 2000).[6] In addition, the idea that corruption and poverty may co-exist as persistent, rather than transient, phenomena, is suggested by the casual observation that many of the most poor and corrupt countries of the past are among the most poor and corrupt countries of today (e.g., Bardhan 1997; Sah 1988).[7] This conjures up the notion of poverty traps from which there may be no easy escape unless there are radical improvements in the quality of governance.

By way of illustrating the relationship between corruption and development, we present Table 1 which is 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 data reveal considerable diversity in the incidence of corruption, with poor countries having a much higher corruption rating than rich countries, irrespective of which index is used. This is indicative of the negative correlation between corruption and development that has been reported in recent empirical studies. In addition to this, there is another notable feature of the data that has received much less exposure - namely, the diversity in corruption levels among countries within the same income group. This is especially pronounced among middle-income countries, for which the range of each corruption index is significantly larger than the range for either low-income or high-income coun-

strategy in a non-cooperative game, where inefficiency in public administration is reduced by the minimisation of waiting costs. The latter suggest that some degree of corruption may be part of an optimal allocation in the presence of incomplete contracts since public officials, though corrupt, can help in the enforcement of property rights. A similar idea is expressed in Acemoglou and Verdier (2000) who argue more generally that corruption may be the necessary price to pay for correcting market failures.

[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. There is also evidence that corruption is influenced by gender, with males being the more corruptible of the sexes (e.g., Husted 1999; Swamy *et al.* 2001). Confidence in the success of corrupt deals appears to be an important factor in fostering the spread of corruption (e.g., Lambsdorff 2002).

[7] Examples include Bangladesh, Cameroon, India, Indonesia, Kenya, Nigeria, Pakistan and Uganda. According to the data from Transparency International, these belong to a set of countries that have displayed little, or no, improvement in their corruption and growth records since the early 1980s.

tries. A comparison of the variances of the indices across different groups of countries 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. Whichever way one looks at it, the picture that emerges is one of high levels of corruption among poor countries, low levels of corruption among rich countries and varying levels of corruption among middle-income countries.

As indicated earlier, there exists relatively little theoretical work on the relationship between corruption and development. Two recent exceptions are the analyses of Ehrlich and Lui (1999) and Sarte (2000).[8] The former develop a model in which opportunities to profit from bureaucratic malpractice create incentives for individuals to compete for the privelage of holding public office. 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 constructs 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. These analyses are revealing about the way in which corruption can have adverse effects on the prospective fortunes of an economy. They are less clear about why corruption may arise in the first place, why corruption may persist or decline over time, and why corruption may vary across otherwise similar economies. We seek to provide answers to these questions in the present paper.

The specific focus of our analysis is on corruption in public procurement. In general, corruption can affect both the volume and composition of public expenditures in ways that undermine development and foster inequality. Public funds earmarked for vital areas of spending may simply go missing and never be reclaimed. Purchases of goods and services may be based on who offers the best kickbacks, rather than who offers the best price-quality combination. Entire public programmes may be chosen more for their capacity to generate illegal income than for their potential to improve standards of living. Empirical studies suggest that corruption is, indeed, associated with a misallocation and misappropriation of public expenditures which are often inflated as a result.[9] Gupta *et al.* (2000) find that corruption has the effect of

[8] See also Rivera-Batiz (2001) who studies the relationship between corruption, growth and financial liberalisation.

[9] In general, the incentives and opportunities to engage in corruption are greatest in areas of public procurement that involve large-scale expenditures, complex technologies and monopolistic power. For example, purchases of miltary hardware (specialised, high technology goods produced by a limited number of firms) offer greater scope for rent-

reducing the provision of education and health care, and of increasing infant mortality. Mauro (1997) presents evidence that corruption distorts public expenditures away from growth-promoting areas (like education and health) towards other types of project (e.g., infrastructure investment) that are less productivity-enhancing. In a similar vein, Tanzi and Davoodi (1997) find that corruption leads to a diversion of public funds to where bribes are easiest to collect, implying a bias in the composition of public spending towards low-productivity projects (e.g., large-scale construction) at the expense of value-enhancing investments (e.g., maintenance of the existing infrastructure). The same authors conclude that, as a result of corruption, the amount of public investment tends to rise, while the quality of this investment tends to fall. There is almost a limitless supply of anecdotal evidence as well.[10] Abbott (1988) reports the instance in Haiti when a prominent member of the Duvalier regime had 150 kilometres of railtrack pulled up and sold for scrap metal, pocketing the proceeds for himself. Hardin (1993) recounts the case of the Turkwell Gorge Dam project in Kenya, the final cost of which was more than double the amount of initial estimates due to the recoupment of bribe payments by the French contractor. Rose-Ackerman (1999) tells of the millions of dollars of non-existent stationary that was "purchased" by the Government Press Fund in Malawi, and describes how telephone specifications in another African country contained the useless requirement that the equipment must be robust to freezing temperatures (a requirement that could be satisfied by only one telephone manufacturer from Scandinavia). These, and countless other, examples bear testimony to the problems that face many developing countries. The scale of the offences and the ingenuity of those behind them are often quite staggering, and it is difficult not to be shocked by the insidiousness of individuals in extracting public resources from an already deprived nation to which they, themselves, belong.[11]

The model that we use for our analysis describes an overlapping generations economy in which the government instructs bureaucrats to provide public goods that function as inputs to private production and that are fi-

seeking than purchases of medical supplies (standardised products sold in open markets by a large number of firms).

[10] The single most extensive source of evidence is the World Bank's web-site, referred to in footnote 1. For a particularly perplexing account of the experiences of many African countries, see also www.freeafrica.org.

[11] This is not to say that similar offences are never committed in developed economies. For example, Rose-Ackerman (1999) describes a recent episode in Italy (a country with a consistently high corruption rating) when the costs of several major construction projects fell dramatically after various anti-corruption investigations: the cost of a subway fell by $130 million per kilometre, of a rail link by $28 million per kilometre, and of an airport terminal by $1.9 billion in total.

nanced from taxes on households. A public good yields productive services of either low-quality or high-quality, and is procured at either low-cost or high-cost. The true characteristics of goods are known only to bureaucrats, implying an informational asymmetry that may motivate corrupt behaviour. In particular, bureaucrats may be tempted to deceive the government by claiming to deliver goods of high-quality at high-cost when they are actually providing goods of low-quality at low-cost. By doing this, bureaucrats inflate (artificially) the amount of public funds that must be raised and allow themselves an opportunity to embezzle some of these funds.[12] Such behaviour is risky since there is always a possibility that the government will detect it, in which case a bureaucrat will be dismissed from his job without pay. Such behaviour is costly for society because it reduces capital accumulation through which growth and development take place.

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 existing stock of capital and the behaviour of all other bureaucrats. This leads to the following observations. First, corruption and development are determined jointly in a relationship that is two-way causal. This relationship shows how the quality of governance not only influences, but is also influenced by, the level of economic activity. Second, bureaucratic decision making entails strategic interactions that may give rise to multiple, frequency-dependent equilibria associated with different (high and low) incidences of corruption. In general, such non-uniqueness is explained by appealing to the notion that, for one reason or another, an individual is more likely to be corrupt if 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 will 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 equilib-

[12] Embezzlement - the theft by an individual of resources that he is supposed to administer - is an especially difficult offence to deal with when it entails the misappropriation of public funds. While everyone in society may be affected, the fact that no private property is stolen or exchanged means that individuals have no legal rights by which to protest and seek compensation. This type of non-collusive corruption may pose just as many problems as more collusive forms (where benefits accrue to all parties involved), and there is evidence that both types are pervasive in developing countries (e.g., Foellmi and Oechslin 2003). Indeed, in many of the most corrupt countries, embezzlement is a major aspect of public sector misconduct, often more important than bribery. As it happens, our model could be reformulated as one in which bribery, rather than embezzlement, is the means by which bureaucrats extract resources. This would involve specifying a separate sector of producers from whom bureaucrats procure goods and with whom bureaucrats may conspire in deceiving the government. We choose the present formulation for simplicity.

rium models of corruption, typical of which are the frameworks of Andvig and Moene (1990) and Cadot (1987), where non-uniqueness arises because a bureaucrat's expected punishment for being corrupt is a decreasing function of the number of other corrupt bureaucrats.[13] In a slightly different vein, Tirole (1996) shows how group reputation effects may lead to multiple equilibria that are history-dependent in the sense that good or bad behaviour in the past motivates good or bad behaviour in the present. Our own account of the phenoemena stands in contrast to these analyses and relates to the impact of corruption on aggregate economic outcomes that influence individual decision making. *Ceteris paribus*, the higher is the level of corruption the lower are the levels of wages and interest rates. Since incomes are lower as a result, a bureaucrat who is corrupt stands to lose less if he is caught so that the incentive to be corrupt is stronger. In this way, a bureaucrat's compliance in corruption may depend critically on the compliance of others - hence the possibility of contagious behaviour and, with this, multiple equilibria. We emphasise that this is only a possibility in our model for there are circumstances where such behaviour disappears and a unique equilibrium exists. Significantly, these circumstances relate to the level of development. This is another distinguishing feature of our analysis. Up to 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 capital accumulation path.

The above features of our model imply the existence of threshold effects and multiple development regimes. Below some critical level of capital, there is a low development regime that displays a unique equilibrium in which the incidence of corruption is high. Above some other critical level of capital, there is a high development regime that displays a unique equilibrium in which the incidence of corruption is low. And in between the two thresholds, there is an intermediate development regime that displays both types of equilibria. Accordingly, our analysis is able to explain two of the most prominent aspects of the data, alluded to earlier - namely, the higher levels of corruption in poor countries than in rich countries, and the diverse levels of corruption among middle-income countries. The precise way in which corruption takes hold in our model is by distorting both the amount and composition of public expenditures: as a consequence of bureaucrats' malfeasance, these expendi-

[13] 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).

tures are not only excessive but also misallocated towards the provision of low-quality public goods. This concurs with empirical evidence as well. Additionally, we establish the result that, depending on circumstances, transition between development regimes may or may not be feasible. In the case of the latter, the limiting outcome of the economy hinges crucially on initial conditions. Most notably, if the economy is poor and corrupt to begin with, then it will be destined to remain poor and corrupt unless fundamental changes take place. In this way, our analysis also provides an account of why poverty and corruption may co-exist as persistent phenomena, as they clearly have done in many countries.

The remainder of the paper is organised as follows. In Section 2 we describe the economic environment. In Section 3 we identify conditions under which an individual bureaucrat will be corrupt. In Section 4 we establish the existence of alternative equilibria. In Section 5 we analyse the implications for public expenditures and capital accumulation. In Section 6 we make a few concluding remarks.

2 The Model

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 are m, and public servants (or bureaucrats), of whom there are $n < m$.[14] All agents are risk neutral, working only when young and consuming only when old. Households work for firms in the production of output, while bureaucrats work for the government in the administration of public policy. Public policy consists of a programme of taxes and expenditures designed to make available public goods and services which contribute to the efficiency of output production. Corruption arises from the incentive of a bureaucrat to appropriate public funds by falsifying information to the government. We assume that a fraction, $\nu \in (0, 1)$, of bureaucrats are corruptible in this way, while the remaining fraction, $1-\nu$, are non-corruptible, with the identity of a bureaucrat being unobservable by the government.[15] Firms, of which there is a unit mass, hire labour from households and rent capital from all agents in perfectly competitive markets.

[14] 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 posess these skills. The latter are induced to become bureaucrats by an allocation of talent condition established below.

[15] 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 be-

2.1 The Private Sector

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

$$y_t = A(l_t K_t)^{\alpha} k_t^{1-\alpha} G^{\beta}, \quad A > 0,\ \alpha, \beta \in (0,1) \tag{1}$$

where K_t denotes the aggregate stock of capital and G denotes the aggregate quality of public goods and services.[16] 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 yields $w_t = \alpha A l_t^{\alpha-1} k_t^{1-\alpha} K_t^{\alpha} G^{\beta}$ and $r_t = (1-\alpha) A l_t^{\alpha} k_t^{-\alpha} K_t^{\alpha} G^{\beta}$. In equilibrium $l_t = l$ (the fixed supply of labour) and $k_t = K_t$ so that we may write these conditions as

$$w_t = \alpha A l^{\alpha-1} G^{\beta} k_t \equiv w(k_t), \tag{2}$$

$$r_t = (1-\alpha) A l^{\alpha} G^{\beta} \equiv r \tag{3}$$

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

Each young household of generation t is endowed with $\lambda > 1$ units of labour (implying $l = \lambda m$) which it supplies inelastically to firms in return for a wage of w_t. Each household also receives an inheritance of b_t and is liable to pay taxes of τ_t. A household saves its entire net income at the market rate of interest r to obtain a final level of wealth of $(1+r)(\lambda w_t - \tau_t + b_t)$ when it reaches old-age. It then consumes part of this wealth and bequeaths the remainder to its own offspring. The lifetime utility of a household is given by $u_t = (1+r)(\lambda w_t - \tau_t + b_t) - b_{t+1} + v(b_{t+1})$, where $(1+r)(\lambda w_t - \tau_t + b_t) - b_{t+1}$ is consumption and $v(\cdot)$ is a strictly concave function that satisfies the usual Inada conditions.[17] It follows that utility is maximised by setting $v'(\cdot) = 1$, implying an optimal fixed size of bequest from one generation to the next: that is, $b_{t+1} = b$ for all t. Changes in household incomes are therefore governed by changes in wages and changes in taxes.[18]

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ing corrupt or differences in moral attitudes towards being corrupt (e.g., Acemoglou and Verdier 2000; Besley and McClaren 1993; Tirole 1996).

[16] As in other models of growth, we incorporate the aggregate stock of capital to capture the positive externalities associated with learning-by-doing (e.g., Romer 1986). As in other models as well, we treat public goods as providing productive services which raise the efficiency of other inputs in private production (e.g., Barro 1990).

[17] 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 non-degenerate steady state equilibrium along a linear (rather than concave) capital accumulation path.

[18] Appropriate restrictions on parameter values ensure that the after-tax income of a household is always positive.

2.2 The Public Sector

The objective of the government is to provide public goods and services which function as inputs to private production. The government demands g amount of these goods and delegates the task of procuring them to bureaucrats, while running a continuously balanced budget.[19] In return for his services, a bureaucrat is paid a salary which is determined as follows. Any bureaucrat (whether corruptible or non-corruptible) can work for a firm to receive an 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 some form of malpractice and is therefore immediately identified as being corrupt. We assume that a bureaucrat who is discovered to be corrupt is fined by an amount at least equal to his salary (i.e., he is dismissed without pay) and that any remaining (illegal) income in his possession is strictly less than the wage that he would have received by working for firms.[20] 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.[21] Against this background, the government keeps a check on bureaucratic behaviour 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. For convenience, we assume that monitoring is costless.[22]

Each bureaucrat is charged with the responsibility for procuring $\frac{g}{n}$ units of public goods using whatever public funds are allocated to him. A public good may be of either high-quality or low-quality and may be procured at either high-cost or low-cost. One unit of a high-quality good yields 1 unit of productive service, while one unit of a low-quality good yields $\gamma < 1$

[19] Bureaucrats are also responsible for the collection of taxes, an activity that may also be open to abuse in the form of bribery and tax evasion. This does not arise in our model because all households have the same income and are subject to same tax liability.

[20] As we shall see, the latter assumption amounts merely to a restriction on initial conditions - in particular, the initial capital stock which determines the initial wage. The assumption would be irrelevant if one was to suppose that the bureaucrat is fined the full amount of his legal and illegal income.

[21] This has the same interpretation as the allocation of talent condition in Acemoglou and Verdier (2000). 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.

[22] The model could be extended straightforwardly to allow for costly monitoring 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.

units of productive service. The cost of the former is a random variable which we assume to be identically and independently distributed, and to take the value of 1 unit of output with probability $q \in (0,1)$ and the value of $\phi > 1$ units of ouptut with probability $1-q$. The cost of the latter is $\theta < 1$ units of output with certainty.[23] Corruption is made possible due to informational asymmetries between bureaucrats and the government as a consequence of the delegation of duties by the latter to the former. It is bureaucrats who evaluate public goods in terms of their cost and quality, and who supply the government with information on which to base decisions. By falsifying this information, a bureaucrat may be able to enrich himself through the appropriation of public funds. More precisely, we assume that only bureaucrats are informed about the true cost and quality of public goods. All that the government knows is that a public good may be of high-quality or low-quality, and that the per unit cost of any high-quality good is 1 or ϕ. Given this state of affairs, the government instructs each bureaucrat to maximise public good quality per unit of expenditure. For a high-quality good, there is an upper value and a lower value of this, as given by 1 and $\frac{1}{\phi}$, respectively. For a low-quality good, the value is $\frac{\gamma}{\theta}$. We confine our attention to the case in which $\frac{1}{\phi} > \frac{\gamma}{\theta}$. Under such circumstances, the government will always demand high-quality goods, whatever their alleged cost.

A bureaucrat, when young, is endowed with one unit of labour which he supplies inelastically to the government to earn a salary of w_t. For simplicity, we assume that bureaucrats have no other source of legal income and are exempt from paying any taxes.[24] Like all households, all bureaucrats save their entire income at the rate of interest r in order to finance retirement consumption. By definition, a bureaucrat who is not corrupt abides fully by the government's instructions for providing public goods. Such a bureaucrat procures $\frac{g}{n}$ units of goods at a true total cost of $\frac{g}{n}$ or $\phi\left(\frac{g}{n}\right)$ and a true total quality of $\frac{g}{n}$. The final wealth of a non-corrupt bureaucrat is $(1+r)w_t$. In contrast, a bureaucrat who is corrupt pursues his own hidden agenda which conflicts with the interests of the government. Such a bureaucrat engages in deception by procuring low-quality public goods at low-cost, while claiming that the goods are of high-quality and high-cost. Although the quantity of each good is still $\frac{g}{n}$, the quality is only $\gamma\left(\frac{g}{n}\right)$, and although the bureaucrat claims $\phi\left(\frac{g}{n}\right)$ in public funds, he spends only $\theta\left(\frac{g}{n}\right)$. Thus $(\phi-\theta)\left(\frac{g}{n}\right)$ is the

[23] As indicated earlier, the effect of corruption in our model is that public goods are provided at a lower overall quality but greater total expense. The latter result is due to the variability in cost of high-quality goods. The former result prevails regardless of this assumption.

[24] The fact that bureaucrats have only one unit of labour (as opposed to λ units) may be used to justify this assumption.

amount of funds that a bureaucrat is able to embezzle by misleading the government. In general, corrupt individuals may try to remain inconspicuous by concealing their illegal income, by investing this income differently from legal income and by altering their patterns of expenditure. 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. In doing this, the bureaucrat is assured of retaining his illegal income whether he is caught or not, and of losing only his legal income in the event of the former.[25] Accordingly, the bureaucrat's final wealth is $(1+r)w_t + (\phi-\theta)\left(\frac{g}{n}\right)$ with probability p, and $(\phi-\theta)\left(\frac{g}{n}\right)$ with probability $1-p$, implying an expected wealth of $p(1+r)w_t + (\phi-\theta)\left(\frac{g}{n}\right)$.

3 The Incentive to be Corrupt

A corruptible bureaucrat will embezzle public funds if his expected payoff from doing so is no less than his payoff from not doing so. From the preceding analysis, we may state this condition as $p(1+r)w_t + (\phi-\theta)\left(\frac{g}{n}\right) \geq (1+r)w_t$, or

$$\frac{(\phi-\theta)g}{n} \geq (1-p)(1+r)w_t. \tag{4}$$

Intuitively, a bureaucrat is more likely to be corrupt the more he stands to gain in illegal income and the less he expects to lose in legal income if he is caught. The key feature of the condition in (4) is that it depends on the economy-wide variables r and w_t. Both of these variables - the interest rate and the wage rate - are determined by current events in the economy. In particular, they are both functions of the aggregate level of corruption at time t, as we shall see below. This means that the motivation for each corruptible bureaucrat to be corrupt depends on the number of other such bureaucrats who are expected to be corrupt. Consequently, bureaucratic behaviour entails strategic interactions which may result in multiple, frequency-dependent equilibria. We begin to explore this possibility by first studying the individual incentives of a corruptible bureaucrat to engage in corruption under two opposite scenarios - one in which no other corruptible bureaucrat is corrupt and the other in which all other corruptible bureaucrats are corrupt. In doing so, we make use of the results in (2) and (3), where G is recalled to measure the aggregate quality, or total productive services, of public goods.

[25] An alternative way of modelling this is to assume that bureaucrats must consume their illegal income immediately if they are to stand any chance of avoiding detection.

For the case in which no corruptible bureaucrat is corrupt, G is given by $\widehat{G} = g$ since all bureaucrats procure only high-quality public goods (yielding total services of $n\left(\frac{g}{n}\right)$). Under such circumstances, (4) becomes

$$\frac{(\phi - \theta)g}{n} \geq (1-p)(1+\widehat{r})\widehat{w}_t \equiv \widehat{h}(k_t), \tag{5}$$

where

$$\widehat{r} = (1-\alpha)Al^{\alpha}g^{\beta}, \tag{6}$$

$$\widehat{w}_t = \alpha Al^{\alpha-1}g^{\beta}k_t \equiv \widehat{w}(k_t). \tag{7}$$

The expression in (5) is the condition for an individual corruptible bureaucrat to be corrupt, given that no other corruptible bureaucrat is corrupt.

For the case in which all corruptible bureaucrats are corrupt, G is determined as $\widetilde{G} = (1-\nu+\gamma\nu)g$ since only non-corrupt bureaucrats procure high-quality public goods (yielding total services of $(1-\nu)n\left(\frac{g}{n}\right)$), while corrupt bureaucrats procure low-quality public goods (yielding total services of $\nu n\gamma\left(\frac{g}{n}\right)$). As such, (4) becomes

$$\frac{(\phi - \theta)g}{n} \geq (1-p)(1+\widetilde{r})\widetilde{w}_t \equiv \widetilde{h}(k_t), \tag{8}$$

where

$$\widetilde{r} = (1-\alpha)Al^{\alpha}(1-\nu+\gamma\nu)^{\beta}g^{\beta}, \tag{9}$$

$$\widetilde{w}_t = \alpha Al^{\alpha-1}(1-\nu+\gamma\nu)^{\beta}g^{\beta}k_t \equiv \widetilde{w}(k_t). \tag{10}$$

The expression in (8) is the condition for an individual corruptible bureaucrat to be corrupt, given that all other corruptible bureaucrats are corrupt.

Observe that, since $1-\nu+\gamma\nu < 1$, (6) and (9) imply $\widetilde{r} < \widehat{r}$, while (7) and (10) imply $\widetilde{w}(\cdot) < \widehat{w}(\cdot)$: that is, for any given stock of capital, k_t, interest rates and wages are lower under corruption than under non-corruption. This follows from the fact that corruption reduces the aggregate quality of public goods, $\widetilde{G} < \widehat{G}$. In doing so, it also reduces the productivity of other inputs (capital and labour) in output production.

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. The analysis also reveals

the extent to which the aggegate level of corruption influences aggregate economic outcomes - in particular, interest rates, wages and the quality of 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 an equilibrium depends on the level of development of the economy. In this way, our model predicts a relationship between corruption and development that is fundamentally two-way causal.

The crucial conditions for determining equilibrium behaviour are given in (5) and (8). Note that both $\widehat{h}(\cdot)$ and $\widetilde{h}(\cdot)$ are increasing monotonically (linearly) in k_t. Note also that $\widehat{h}(\cdot) > \widetilde{h}(\cdot)$ for all k_t. Given these observations, we may identify two critical levels of capital, k_1^c and k_2^c, in accordance with the following.

Definition 1 *k_1^c is the unique value of k_t which satisfies $\widehat{h}(k_1^c) = \frac{(\phi-\theta)g}{n}$ such that (i) $\widehat{h}(\cdot) < \frac{(\phi-\theta)g}{n}$ for all $k_t < k_1^c$, and (ii) $\widehat{h}(\cdot) > \frac{(\phi-\theta)g}{n}$ for all $k_t > k_1^c$.*

Definition 2 *k_2^c is the unique value of k_t which satisfies $\widetilde{h}(k_2^c) = \frac{(\phi-\theta)g}{n}$ such that (i) $\widetilde{h}(\cdot) < \frac{(\phi-\theta)g}{n}$ for all $k_t < k_2^c$, and (ii) $\widetilde{h}(\cdot) > \frac{(\phi-\theta)g}{n}$ for all $k_t > k_2^c$.*

Evidently, $k_1^c < k_2^c$. These threshold levels of capital represent boundaries between regions where the incentive conditions in (5) and (8) are either satisfied or violated. We are now in a position to establish some key results which we illustrate in Figure 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 $\widetilde{h}(\cdot) < \frac{(\phi-\theta)g}{n}$ and $\widehat{h}(\cdot) < \frac{(\phi-\theta)g}{n}$, 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 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.

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 $\widehat{h}(\cdot) > \frac{(\phi-\theta)g}{n}$ and $\widetilde{h}(\cdot) > \frac{(\phi-\theta)g}{n}$, 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 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.

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 $\widetilde{h}(\cdot) < \frac{(\phi-\theta)g}{n}$ but $\widehat{h}(\cdot) > \frac{(\phi-\theta)g}{n}$, 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 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.

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. 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 (4) is satisified or violated. This condition depends on economy-wide outcomes (wages and interest rates) which, in turn, depend on the existing aggregate stock of capital (measuring the level of development) and the total quality of 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 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 (4) 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 (4) 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 (4) 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 indicated earlier, our explanation for this non-uniqueness is different from other accounts and relates to the effects of corruption on both wages and interest rates. These variables determine the legal incomes of bureaucrats and are increasing functions of the quality of public goods provision. The lower is this quality (i.e., the more corruption there is) the lower is the amount of income that a corrupt bureaucrat stands to lose if he is caught and so the lower is the expected punishment for being corrupt. In this way, a bureaucrat's expected gain from wrong-doing depends positively on the number of other wrong-doers - hence the possibility of multiple equilibria. As we also indicated, our analysis has the further distinction of showing how this possibility is inextricably linked to an economy's stage of development: only at intermediate stages is behaviour contagious; at other stages - both lower and higher - individuals act independently of others.

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; 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 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. Like other analyses, we are able to account for a broadly negative relationship between corruption and development. Unlike other analyses, we are also able to explain why this relationship may be rather tenuous in some circumstances. In fact, the results obtained above do not exhaust the full set of outcomes that are possible at intermediate stages of development. In studying this case, we have confined our attention to the two pure strategy equilibria that manifest at low and high stages of development - that is, equilibria in which all corruptible bureaucrats behave in exactly the same way. Yet there is also a mixed strategy equilibrium in this case - that is, an equilibrium in which bureaucratic behaviour is heterogeneous. More precisely, this equlibrium entails a fraction, $\eta \in (0,1)$, of corruptible bureaucrats who are corrupt and a remaining fraction, $1-\eta$, of such bureaucrats who are not corrupt. We show this in an Appendix by establishing that, for each $k_t \in (k_1^c, k_2^c)$, there exists an η such that the incentive condition in (4) holds with equality. This means that a middle-income country could find itself in any one of three possible equilibria with an incidence of corruption that is high, low or somewhere in between. The idea that, for some countries, development might be associated with an increase in corruption has been argued by a number of observers who point to the potential for modernisation and liberalisation to create new incentives and new opportunities for agents to engage in corrupt practices. The experiences of several transition economies appear to bear testimony to this (e.g., Bardhan 1997; Basu and Li 1998).

5 Public Finance and 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. To determine how corruption affects savings, it is necessary to consider how corruption affects public finances since the state of the government's balance sheet dictates the level of taxes required to maintain budget balance. In conducting our analysis, we appeal to the law of large numbers to replace probabilistic events at the individual level by actual outcomes at the aggregate level. Thus $p\ (1-p)$ is understood to be a measure of corrupt bureaucrats who succeed (fail) in their illegal profiteering, while $q\ (1-q)$ is understood to be a measure of high-quality public goods that have low (high) cost.

Consider the case in which no corruptible bureaucrat is corrupt. Each and

every bureaucrat, of whom there are n, claims the truthful amount of public funds that he requires to procure high-quality public goods. The total value of claims for low-cost procurement is $nq\left(\frac{g}{n}\right)$, and the total value of claims for high-cost procurement is $n(1-q)\phi\left(\frac{g}{n}\right)$. Accordingly, $[q+(1-q)\phi]g = \Phi g$ is the overall amount of resources that the government allocates to public goods provision. The government also incurs expenditures of $n\widehat{w}_t$ on bureaucrats' salaries. On the revenue side, the government receives tax payments from households of $m\widehat{\tau}_t$. The value of $\widehat{\tau}_t$ is determined from the government's budget constraint as

$$m\widehat{\tau}_t = \Phi g + n\widehat{w}_t. \tag{11}$$

Total savings in the economy comprise the savings of households, $m(\lambda\widehat{w}_t - \tau_t + b)$, plus the savings of bureaucrats, $n\widehat{w}_t$. Using (7) and (11), it follows that capital accumulation takes place according to

$$\begin{aligned}\widehat{k}_{t+1} &= l\widehat{w}_t - \Phi g + mb \\ &= \alpha A l^{\alpha} g^{\beta} k_t - \Phi g + mb \equiv \widehat{f}(k_t).\end{aligned} \tag{12}$$

Consider, next, the case in which all corruptible bureaucrats are corrupt. These bureaucrats, of whom there are νn, make bogus claims on public funds by pretending to procure high-quality public goods at high-cost (when the opposite is true). The total value of these claims is $vn\phi\left(\frac{g}{n}\right)$. Non-corruptible bureaucrats, of whom there are $(1-\nu)n$, behave truthfully as above, claiming $(1-\nu)nq\left(\frac{g}{n}\right)$ and $(1-\nu)nq\phi\left(\frac{g}{n}\right)$ in public funds. Accordingly, $\{(1-\nu)[q+(1-q)\phi]+\nu\phi\}g = [\Phi + q\nu(\phi-1)]g$ is the aggregate amount of resources that the government now allocates to public goods provision. Added to this is $n\widetilde{w}_t$, expenditures on bureaucrats' salaries. Revenues for the government comprise the tax income from households, $m\widetilde{\tau}_t$, plus the value of fines imposed on corrupt bureaucrats who are caught, $(1-p)\nu n\widetilde{w}_t$. From the government's budget constraint, the value of $\widetilde{\tau}_t$ is deduced as

$$m\widetilde{\tau}_t = [\Phi + q\nu(\phi-1)]g + [1-(1-p)\nu]n\widetilde{w}_t. \tag{13}$$

As above, total savings by households amount to $m(\lambda\widehat{w}_t - \tau_t + b)$. Total savings by bureaucrats consist of the savings by non-corruptible bureaucrats, $(1-\nu)n\widetilde{w}_t$, plus the savings of corruptible bureaucrats, $p\nu n\widetilde{w}_t$. Using (10) and (13), we may write the capital accumulation process in this case as

$$\begin{aligned}\widetilde{k}_{t+1} &= l\widetilde{w}_t - [\Phi + q\nu(\phi-1)]g + mb \\ &= \alpha A l^{\alpha}(1-\nu+\gamma\nu)^{\beta} g^{\beta} - [\Phi + q\nu(\phi-1)]g + mb \equiv \widetilde{f}(k_t).\end{aligned} \tag{14}$$

Assuming that $\alpha A l^{\alpha} g^{\beta} \in (0,1)$ and $mb > [\Phi + qv(\phi-1)]g$, both of the transitions paths in (12) and (14) exhibit stationary points associated with

the steady state levels of capital $\widehat{k}^* = \frac{mb-\Phi g}{1-\alpha A l^\alpha g^\beta}$ and $\widetilde{k}^* = \frac{mb-[\Phi+q\nu(\phi-1)]g}{1-\alpha A l^\alpha (1-\nu+\gamma\nu)^\beta g^\beta}$, 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. There are two reasons for this. First, by reducing the total quality of public goods, corruption produces a fall in the productivity of labour, a fall in wages and a fall in savings. Second, by raising the total cost of public goods, corruption leads to greater public expenditures which also results in lower savings.[26] In short, corruption affects both the quality and quantity of public spending in ways that compromise growth. This spending is not only misallocated (towards low-quality public goods) but is also inflated (by an artificial amount). This is another prediction of the model that concurs with empirical observation.

As well as accounting for cross-country differences in corruption, our analysis is able to explain why some countries may become saddled with persistent poverty and misgovernance. We illustrate this in Figure 2 which depicts the two development 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 development path, $\widetilde{f}(\cdot)$, for $k_t < k_1^c$, the high development path, $\widehat{f}(\cdot)$, for $k_t > k_2^c$, and either of the paths for $k_t \in (k_1^c, k_2^c)$. At the steady state level of capital $\widetilde{k}^*$, there is a poverty trap equilibrium: 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 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 parameter that alters the transition function and/or the threshold, itself, such that $k_1^c < \widetilde{k}^*$. 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. In addition, for a given distribution of economies below k_1^c, it is those in the upper tail (i.e., close to k_1^c) that are most likely to be affected, while those in the lower tail remain as they are. For these reasons, we are led to conclude that the divisions between poor and rich, corrupt and

[26] Observe from (11) and (13) that taxes may be higher or lower under corruption than under non-corruption. This is because corruption, while resulting in greater public expenditures, leads to lower payment of salaries to bureaucrats (since some bureaucrats are dismissed from their jobs). Whether corruption exists or not, bureaucrats' salaries do not contribute to aggregate savings since they are completely offset by the taxes used to pay for them. Over and above this, taxes fund public expenditures which are higher under corruption.

non-corrupt, countries are unlikely to vanish quickly, if at all.

6 Final Remarks

In seeking to understand how countries develop (or not), economists have become increasingly aware of the need to integrate the economic, social and political aspects of individual decision making, policy formulation and institutional design. There has also been growing recognition that many issues in development are difficult, if not impossible, to address without departing from the standard economic paradigm of honest, law-abiding agents whose pursuit of what is best for themselves entails no malevolence towards others. To many observers, there is a much harsher, more cynical reality, where agents are often devious, predatory and even cruel. When holders of public office are like this, the consequences can be particularly devastating and tragic. Corruption on the part of public officials may mean a world of difference between what policies are good for a nation and what policies are actually implemented. The latter may have much less to do with the promotion of growth and reduction of poverty, and much more to do with the personal enrichment of a privelaged few following their own hidden agenda.

In spite of the above, there exists relatively little theoretical research on the macroeconomics of misgovernance. Our objective in this paper has been to make a contribution towards filling this gap. The model that we have used contains the essential ingredients that public policy is implemented by subordinate officials whose interests conflict with superiors and whose pursuit of these interests entails corrupt practices that impose costs on society as a whole. Our specific focus of attention has been on corruption in public procurement, where bureaucrats exploit their powers of discretion in providing public goods to falsify information and embezzle public funds. The main results of our analysis may be summarised as follows. 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, in high stages of development there is a unique equilibrium with low corruption, 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 unless fundamental changes take place. Fifth, corruption distorts both the quantity and quality of public expenditures: these expenditures are not only inflated, but also misdirected towards the provision of low-quality public goods.

The above results do well in explaining a number of empirical observations: 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. Based on these insights, we view our analysis as a promising step towards understanding an issue that is dominating the international development arena.

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, $\eta \in (0,1)$ $(1-\eta)$, of corruptible bureaucrats who are corrupt (non-corrupt). Proceeding in the usual way, we may derive the following expressions for interest rates and wages:

$$\overline{r} = (1-\alpha)Al^{\alpha}[1-\eta\nu(1-\gamma)]^{\beta}(sg)^{\beta}, \tag{A1}$$

$$\overline{w}_t = \alpha Al^{\alpha-1}[1-\eta\nu(1-\gamma)]^{\beta}(sg)^{\beta}k_t \equiv \overline{w}(k_t), \tag{A2}$$

The condition for a corruptible bureaucrat to be corrupt is

$$\frac{(\phi-\theta)sg}{n} \geq (1-p)(1+\overline{r})\overline{w}_t \equiv \overline{h}(k_t), \tag{15}$$

It is straightforward to verify that, for a given k_t and a given $\eta \in (0,1)$, $\widehat{r} > \overline{r} > \widetilde{r}$ and $\widehat{w}_t > \overline{w}_t > \widetilde{w}_t$ so that $\widehat{h}(\cdot) > \overline{h}(\cdot) > \widetilde{h}(\cdot)$. In terms of Figure 1, the curve $\overline{h}(\cdot)$ always lies between the curves $\widehat{h}(\cdot)$ and $\widetilde{h}(\cdot)$. It follows that, within the region (k_1^c, k_2^c), there is a single intersection between $\frac{(\phi-\theta)sg}{n}$ and $\overline{h}(\cdot)$. Consequently, for any given $k_t \in (k_1^c, k_2^c)$, there exists an $\eta \in (0,1)$ such that $\frac{(\phi-\theta)sg}{n} = \overline{h}(\cdot)$, implying that each corruptible bureaucrat is indifferent between being corrupt and non-corrupt. This η 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]	1.00-10.00	1.00-6.00	0.00-10.00
Year	1980-83	1991-97	2001
Number of Countries			
Total[2]	59	113	87
Low income	5	33	19
Middle income	37	59	47
Lower middle income	21	43	28
Upper middle income	16	16	19
High income	17	21	21
Range of index			
Low income	1.00-4.00	1.44-4.00	0.40-3.5
Middle income	1.50-10.00	1.03-5.00	2.00-7.50
Lower middle income	1.50-8.75	1.03-5.00	2.00-6.00
Upper middle income	3.25-10.00	1.05-5.00	2.80-7.50
High income	7.50-10.00	4.38-6.00	6.60-9.90
Variance of index			
Low income	2.00	0.55	0.57
Middle income	4.07	0.79	1.40
Lower middle income	4.41	0.67	1.08
Upper middle income	3.44	1.14	1.21
High income	0.33	0.34	0.93

1. Greater levels of corruption are indicated by lower values of the indices.
2. To facilitate comparisons between the indices, oil-exporting countries have been excluded from the BIC and ICRG data sets. Other countries excluded from the BIC index are India, Iraq and Sri Lanka due to questions about the reliability of the data. Italy, which is a major outlier among high-income countries, has been excluded from all indices.

Figure 1
Equilibrium Corruption

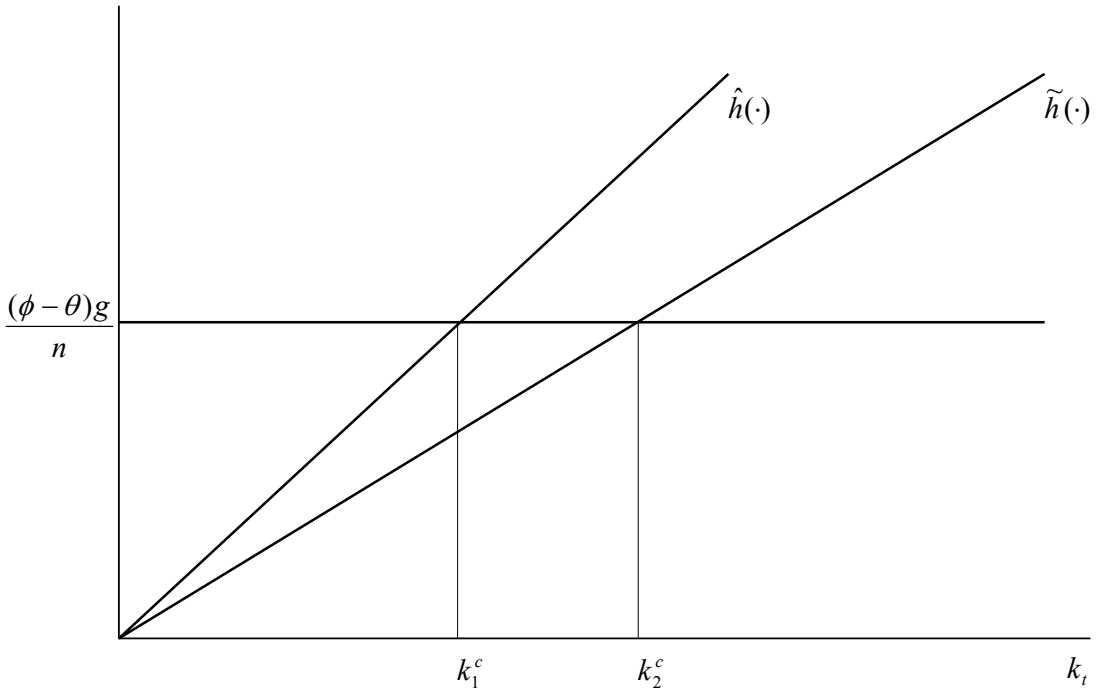
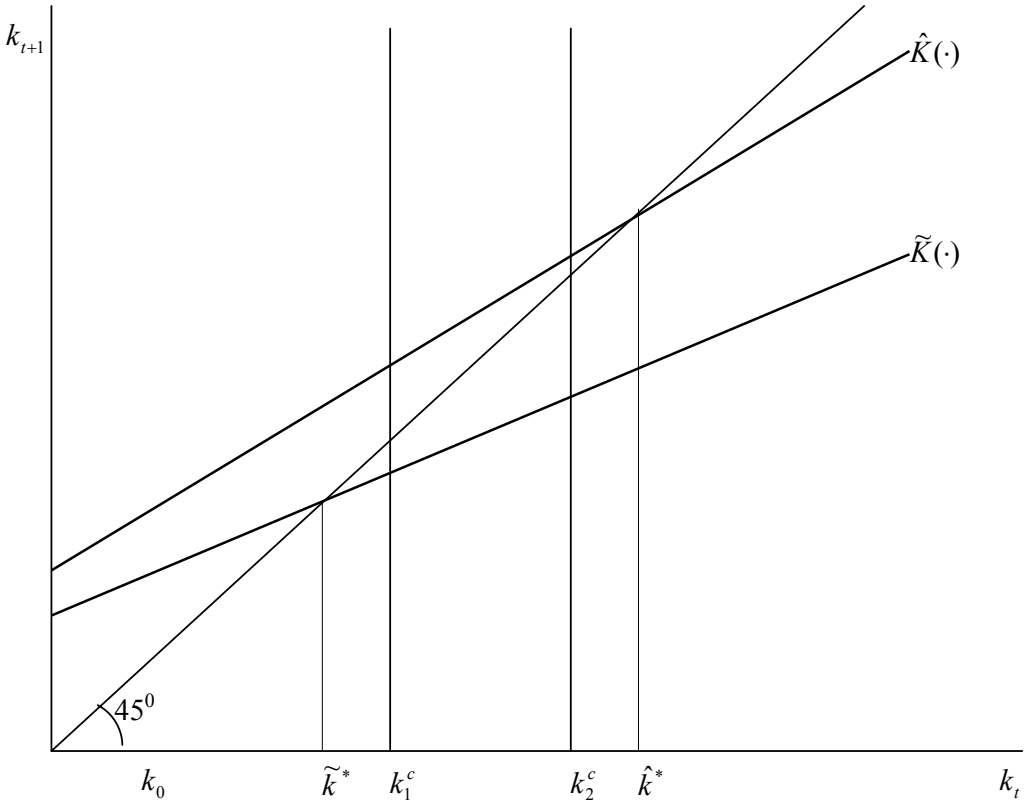


Figure 2
Capital Accumulation



ABOUT THE CDMA

The **Centre for Dynamic Macroeconomic Analysis** was established by a direct grant from the University of St Andrews in 2003. The Centre funds PhD students and a programme of research centred on macroeconomic theory and policy. Specifically, the Centre is interested in the broad area of dynamic macroeconomics but has a particular interest in a number of specific areas such as: characterising the key stylised facts of the business cycle; constructing theoretical models that can match these actual business cycles; using these models to understand the normative and positive aspects of the macroeconomic policymakers' stabilisation problem; the problem of financial constraints and their impact on short and long run economic outcomes. The Centre is also interested in developing numerical tools for analysing quantitative general equilibrium macroeconomic models (such as developing efficient algorithms for handling large sparse matrices). Its affiliated members are Faculty members at St Andrews and elsewhere with interests in the broad area of dynamic macroeconomics. Its international Advisory Board comprises a group of leading macroeconomists and, ex officio, the University's Principal.

THE CDMA INAUGURAL CONFERENCE 2004

The Inaugural CDMA Conference was held in St. Andrews on the 17th and 18th of September 2004. The list of delegates attending, and the group photo, can be found here.

PAPERS PRESENTED AT THE CONFERENCE, IN ORDER OF PRESENTATION:

Title	Author(s) (presenter in bold)
A Critique of rule-of-thumb/indexing Microfoundations for inflation persistence	**Richard Mash (Oxford)**
Fiscal and Monetary Policy Interactios in a New Keynesian Model with Liquidity Constraints	**V. Anton Muscatelli (Glasgow)**, Patrizio Tirelli (Milano-Bicocca) and Carmine Trecroci (Brescia)
Inflation Persistence as Regime Change in a Classical Macro Model	**Patrick Minford (Cardiff and CEPR)**, Eric Nowell (Liverpool), Prakriti Sofat (Cardiff) and Naveen Srinivasan (Cardiff)
Habit Formation and Interest Rate Smoothing	**Luisa Corrado (Rome 'Tor Vergata')** and Sean Holly (Cambridge)
A Model of Job and Worker Flow	**Nobuhiro Kiyotaki (LSE)** and Richard Lagos (FRB of Minneapolis and New York)
The Specification of Monetary Policy Inertia in Empirical Taylor Rules	**John Driffill (Birkbeck, London)** and Zeno Rotondi (Ferrera and Capitalia)
Inequality and Industrialization	**Parantap Basu (Durham)** and Alessandra Guariglia (Nottingham)
Public Expenditures, Bureaucratic Corruption and Economic Development	**Keith Blackburn (Manchester)**, Niloy Bose (Wisconsin) and M. Emanrul Haque (Nottingham)
On the Consumption-Real Exchange Rate Anomaly	Gianluca Benigno (LSE and CEPR) and **Christoph Thoenissen (St Andrews)**
The Issue of Persistence in DGE Models with Heterogeneous Taylor Contracts	**Huw Dixon (York)** and Engin Kara (York
Performance of Inflation Targeting Based on Constant Interest Rate Projections	**Seppo Honkapohja (Cambridge)** and Kaushik Mitra (Royal Holloway, London)

See also the CDMA Working Paper series.