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Title: Governance Regimes, Corruption and Growth: Theory and Evidence

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Governance Regimes, Corruption and Growth: Theory and Evidence.*

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Keywords: Growth; corruption; threshold models; governance.

JEL Classification: D72; D82.

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Abstract

We study the role of governance regimes in the determination of corruption and economic growth. Our model identifies two governance regimes and shows that the relationship between corruption and growth is regime specific. We use a threshold model to estimate the impact of corruption on growth and allow corruption to be endogenous. We identify two governance regimes, conditional on the quality of political institutions. In the regime with high quality political institutions, corruption has a negative impact on growth. In the regime with low quality institutions, corruption has no impact on growth.

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1 Introduction

Corruption, economic growth and the quality of political institutions are related through a complex web. As with many other social systems, the links among the variables within the corruption-growth-governance nexus are, due to feedback effects, thresholds and other nonlinear dynamics, unlikely to be simple linear relationships. To gain a better understanding of these links it is, therefore, necessary to allow for nonlinearity in the analysis. One interesting source of nonlinearity in the mapping from corruption to growth is the existence of multiple governance regimes and this is the focus of this paper. We argue that the quality of a society's political institutions relative to a threshold determines which governance regime the society belongs to and that the relationship between corruption and growth is specific to that regime. To support this argument, we, firstly, develop a political economy model that identifies two governance regimes and shows why the relationship between corruption and growth is regime specific. Secondly, treating corruption and growth as endogenous variables, we provide new evidence on the impact of corruption on growth. The novelty of the empirical contribution is that we estimate a nonlinear growth model that allows for threshold effects and multiple governance regimes. We show that the quality of political institutions determines in which of two possible governance regimes a country finds itself and estimate the regime specific impact of corruption on growth.

The theoretical model considers a society where rulers – interpreted as elected politicians or dictators depending on the context – extract rents from citizens by charging a fee for entry into the formal sector of the economy. Citizens can decide to shelter themselves from rent extraction in the informal sector, but at the cost of lower wages and the loss of access to valuable public services, such as the legal system. Citizens in the formal sector attempt to reduce corruption by threatening to replace a ruler that extracts rents too greedily. In a democracy, this usually takes place through orderly elections, while in autocracies replacement often takes place through coups, revolts or revolutions. Rulers are willing, up to a point, to reduce corruption today to avoid replacement and loss of future rents, but only where institutions are of a sufficiently high quality.

We make a distinction between two types of governance failures which we refer to as q- and p-failures. A p-failure arises when citizens cannot promise for sure to keep a ruler who behaved well in office. This type of problem, typically, arises in democracies with volatile voter turnout or general apathy among the electorate. A q-failure arises when citizens cannot replace under-performing politicians with certainty. This type of problem arises in countries with weak institutions, wide-spread electoral fraud, intimidation of the opposition by the ruling elite, or where the political power is concentrated in the hands of a dictator. Taken together, the two types of failure characterize exogenous aspects of the quality of governance institutions.

The model identifies two governance regimes. In regime G, institutions, as captured by p- and q-failures, are of a sufficiently high quality to allow citizens to use the threat of replacement to reduce corruption. In this regime, economic growth can reduce corruption by improving the incentives of rulers. This feature is novel and gives a new reason for reverse causality from growth to corruption. Conversely, the model also allows corruption to reduce growth. Together these two effects imply that economic growth and corruption are endogenous and self-reinforcing: high growth reduces corruption which, in turn, enhances the growth performance of the economy. This amplifies the (negative) impact of corruption on growth and can, under some special circumstances, lead to multiple equilibria. In regime B, institutions are deficient and citizens cannot control their rulers. Corruption is

at the maximum and growth no longer has a benign impact on the level of corruption.

The empirical analysis starts from the key predictions of the model, namely that there exist two governance regimes, that economic growth and corruption are jointly determined and that the relationship between the two is regime specific. We employ the threshold model proposed by Caner and Hansen (2004) to deal with these points. We use data on short and long run real GDP growth, various corruption perception indexes and political institutions from a cross-section of countries to estimate the resulting non-linear growth model. We argue that political institutions do not affect economic growth directly. The effect is indirect, through the regime choice and the impact on regime specific corruption levels. We, firstly, find two governance regimes. The threshold determining which regime a country belongs to is determined by the quality of political institutions. Secondly, we find that in the regime with high quality institutions, corruption has a large, negative impact on growth. In the regime with low quality institutions, corruption has, in contrast, no impact on growth.

Our empirical investigation contributes to the literature on the growth consequences of corruption.[1] Most of the studies in this literature assume that the relationship between corruption and growth (or its constituents) is linear.[2] To our knowledge there are only two recent studies that introduce nonlinearities into the corruption/growth relationship. Méndez and Sepúlveda (2006) argue that the relationship between corruption and growth is non-monotonic (quadratic) and present evidence that corruption has a beneficial impact on long-run growth at low levels of incidence but is harmful at high levels of incidence. Méon and Sekkat (2005) propose an interesting test of the "greasing the wheels" versus "sand in the wheels" hypothesis of corruption. Using interactions between indictors of the quality of institutions and corruption, they report that corruption is most harmful to growth where governance is weak. We differ from these studies by focussing on the possibility of multiple governance regimes, by considering both short and long run growth

[1] See, for example, the surveys by Rose-Ackerman (1999), Bardhan (1997) or Svensson (2005).

[2] See, for example, Mauro (1995), Mo (2001), Gyimah-Brempong (2002), Wie (2000), Paldam (2002) and Lambsdorff (2003). It is, however, an open question how robustly related corruption is to growth in *linear* growth models (see Sala-i-Martin et al., 2004).

rates and by using instrumental variables to deal with the problem of omitted variables and reverse causality.[3] The seminal empirical paper on multiple regimes in the neoclassical growth model is the study by Durlauf and Johnson (1995).[4] In contrast to this study, we focus on regimes that are identified by the quality of political institutions rather than by the level of income. Moreover, we use a different statistical technique to identify the regimes. This technique takes into account the joint determination of growth and corruption.

The paper is organized as follows. In Section 2, we set out the model. In Section 3, we study the impact of (exogenous) growth on corruption and highlight a new channel through which economic growth can reduce corruption. In Section 4, we specify a simple endogenous growth mechanism that allows corruption to affect growth. In Section 5, we study equilibrium configurations of the overall model. In Section 6, we discuss our empirical specification. In Section 7, we present the empirical results. In Section 8, we discuss the findings and conclude.

2 The Model

2.1 The Economy

We consider a society populated by a continuum of individuals with measure 1. Individuals are indexed by i and live for ever. Each individual has one unit of labour each period that is inelastically supplied to either the formal or the informal sector. In the formal sector, there is a competitive labour market and individuals are either employed by private firms or in the public sector. Private firms produce a consumption good, c_t, with constant returns to scale using labour as the only input and pay the competitive wage $w_t = a_t$, where a_t is productivity. The consumption good is traded internationally at a fixed price, normalized to 1. The public sector produces public services, y_t. The production technology is $y_t = a_t x_t^{\alpha}$, with $\alpha \in (0, 1)$, where x_t is the labour input devoted to the production of public services. The labour market in the formal sector clears at the competitive wage

[3] Méndez and Sepúlveda (2006) report results from a short panel. This enables them to control for omitted country specific fixed effects and in that way to address the endogeneity problem.

[4] See Azariadis and Drazen (1990) and Blackburn et al. (2006) for theoretical underpinnings.

$w_t = a_t$ and employees in the private and public sector receive the same wage.

To operate in the formal sector, individuals have to pay a fee τ_t, leaving them with net income $a_t(1-\tau_t)$. The cost of providing public services, $w_t x_t$, is financed out of current fee revenue. In the informal sector, individuals can avoid the fee, but their income is only a fraction of their income in the formal sector. We denote income earned in the informal sector by $\theta_i w_t$, where $\theta_i \in [0, \theta]$ is the productivity of individual i in that sector.[5] Productivity in the informal sector is distributed according to the cumulative distribution function $F(\theta_i)$. We require that F is differentiable and (weakly) concave. All income, net of fees, is spent on private consumption each period. Only individuals employed in the formal sector have access to public services, as in Johnson et al. (1997). Instantaneously utility is $c_{it} + \upsilon_i y_t$ where $\upsilon_i = 1$ if individual i is employed in the formal sector and $\upsilon_i = 0$ otherwise. Utility is discounted with the factor $\beta \in (0, 1]$.

The fee and the public service play an important role in the allocation of resources between sectors: a high τ_t or a low y_t encourage individuals to work in the informal sector. The fee should be interpreted broadly as the cost that individuals face when operating in the formal economy, i.e., a formalization fee. This, of course, includes tax payments, but also, depending on the context, the cost of getting the necessary permits to operate in that sector.[6] Public services should be interpreted as law and order, legal services and so on that individuals have access to only if they are formally integrated in the economy. For example, individuals in the informal sector of a less developed country would not be able to use the legal system to enforce contracts, nor would a carpenter working in the black economy of a developed country. More generally, y_t is also intended to capture other benefits of formalization such as, for example, access to publicly financed infrastructure (Dessy and Pallage, 2003) or participation in the formal credit market (Straub, 2005).[7]

[5] Since a large fraction of the informal sector in less developed countries is made up of micro-enterprises many of whom fail (Maloney, 2004), it is reasonable to assume heterogeneity among individuals working in that sector. It is clear, however, that firms in the formal sector also differ. For simplicity, we ignore that, but note that the model can easily be extended in that direction.

[6] De Soto (1990) and Djankov et al. (2002) have shown that this is an important consideration in many less developed countries.

[7] In reality, individuals working in the informal sector of the economy may have access to some public services such as road and public health, but, typically, not to all. It is straight forward to modify the

Individual i decides to work in the formal sector if, and only if $a_t(1-\tau_t)+a_t x_t^a \geq \theta_i a_t$.[8] The fee revenue at time t accordingly is

$$T_t = w_t \tau_t F(1 - \tau_t + x_t^a). \tag{1}$$

Productivity grows over time, due to technological progress $a_{t+1} = a_t(1 + g_t)$ with $g_t \geq 0$ and $a_0 > 0$.[9] We restrict attention to constant growth paths with $g_t = g$ for all t. We notice that, for given τ_t and x_t, total revenue increases over time, in line with productivity, as does (recorded) national income, $Y_t = w_t F(1 - \tau_t + x_t^a)$, and potential national income, $Y_t^P = a_t = w_t$. We return to how productivity growth is determined along a constant growth path in Section 4 but take g as being exogenously given for now.

2.2 The Political System

The society is governed by a ruler. Depending on the context, the ruler may be a democratically elected politician, a dictator or someone in between. The ruler oversees the production of public services, collects fees, and extracts rents from citizens by choosing τ_t and x_t subject to the budget constraint $w_t x_t \leq T_t$ as he likes. The "rent" extracted in period t is denoted by z_t and corresponds to the difference between current revenues and expenditures:[10]

$$z_t = T_t - w_t x_t. \tag{2}$$

We assume that actual and potential rulers care only about their "consumption" of z_t and that rents can only be extracted if in office.[11] We shall think of z_t as a measure of

model to allow individuals in the informal sector to have access to some, or even all, public services. The results are essentially unaffected.

[8] In less developed countries the informal sector is sometimes seen as a disadvantaged residual of a segmented labour market where workers are queuing up to get "high quality" jobs in the formal sector. In this conception, some individuals are forced to work in the informal sector. In a detailed review of the literature, Maloney (2004) challenges this view and argues that between 60 and 70 per cent of urban informal sector workers and entrepreneurs in Latin America are, in fact, in the informal sector by choice. Similar figures are found for the U.S. We, therefore, find it reasonable to follow Dessy and Pallage (2003), Ihrig and Moe (2004) and many others and model the sector choice as being voluntary.

[9] To insure that discounted utility is bounded, we assume that $\beta(1 + g) \leq 1$.

[10] This formulation is used extensively by Persson and Tabellini (2000).

[11] We assume that there is an infinite supply of potential rulers all of whom care only about extracting rents, and that rulers who are not holding office get zero utility. More generally, rulers could also care about public services and pay fees. This complicates the analysis but does not alter the results.

rent extraction.[12] The rent can also be interpreted as income from corruption: the ruler is charging for access to the formal sector in excess of what is required to finance public services. This accords with the standard definition of corruption as "misuse of public office for private gain".[13]

In the absence of moderating incentives, rulers extract the maximum rent each period. To avoid this, societies develop political institutions that moderate their behavior. These institutions allow citizens to hold their rulers accountable and to replace the incumbent if he extracts too much rent. In a fully democratic society, elections serve this role (Ferejohn, 1986; Persson and Tabellini, 2000, chapter 3), but even in autocracies and dictatorships, rulers may be constrained by the threat of a coup or a popular revolt (Acemoglu and Robinson, 2001). Formally, at the beginning of each period, citizens announce a performance standard that the ruler has to satisfy to get "reappointed" at the end of the period. Citizens can observe perfectly what the ruler does while in office (i.e., z_t, x_t and τ_t) and so they can base the performance standard on observed policies. We denote the performance standard announced at the beginning of period t by $\widehat{s}_t = \{\widehat{\tau}_t, \widehat{x}_t\}$. The standard requires the ruler to spend a minimum amount on public services $x_t \geq \widehat{x}_t$ and to keep the fee below a certain threshold $\tau_t \leq \widehat{\tau}_t$. The two conditions combined effectively determine how much rent extraction is allowed. We assume that only citizens in the formal sector have political voice (and can set standards). This assumption is clearly appropriate in the context of developed democracies where a majority of the voting population works in the formal sector. We also believe that the assumption is appropriate for most less developed countries. Although Schneider and Enste (2000) show that the informal sector in some developing countries employs a majority of the workforce, it is important to keep in mind that political power, in particular in societies with weak institutions, has more to do with the capacity of organizing collective action, access to economic resources, personal political connections and so on rather than with bare numbers. Given that, we find it reasonable

[12] As formulated, the rent is a pure transfer from citizens to the politician and no real resources are (actually) wasted in the process of trying to obtain the rent. Nonetheless, we can think of z_t as a measure of what potential politicians would be willing to pay to gain office (see Nitzan (1994) for a survey of the literature on rent seeking and rent dissipation).

[13] See, e.g., Aidt (2003).

to focus on the case where political power rests within the formal sector.

In a well-functioning democracy, a ruler (politician) who complies with the standard is guaranteed reelection while a ruler (politician) who does not comply is certain of dismissal. These promises are, however, not equally credible in all societies, and in autocracies or dysfunctional democracies intimidation of the opposition, electoral fraud etc. can significantly reduce the level of accountability. We make a distinction between two types of governance failures:

Assumption 1 *(p-failure) Citizens can only promise to reappoint a ruler who satisfies* $\widehat{s}_t$ *in period* t *with probability* $p \in [0,1]$.

Assumption 2 *(q-failure) Citizens can only promise to dismiss a ruler who does not satisfy* $\widehat{s}_t$ *in period* t *with probability* $1-q \in [0,1]$.

A "perfect" democracy corresponds to $p = 1$ and $q = 0$.[14] A p-failure arises when citizens cannot promise for sure to reward good behavior with reappointment. This type of problem, typically, arises in situations with volatile voter turnout or general apathy among the electorate, but otherwise strong democratic institutions. A q-failure arises when citizens cannot, in all case, dismiss under-performing rulers, and a society with q close to 1 can be interpreted as a dictatorship. These failures capture exogenous variations in the quality of institutions and, as we shall see, play an important role in defining different governance regimes.[15]

The interaction between rulers and citizens (in the formal sector) can be summarized as follows. At the beginning of each period, citizens announce a performance standard. Next, the ruler collects fees and decides on public spending. This is observed by citizens. At the end of the period, citizens judge the performance of the ruler against the standard and

[14] By "perfect" we mean that citizens are able to use the only policy tool available to them – the right to dismiss rulers – as effectively as possible. Since this type of implicit incentive contract is fairly crude, it does not imply that citizens can control their rulers perfectly when $p = 1$ and $q = 0$. In reality, asymmetric information, coordination failures and other factors make it difficult for citizens to control rulers even in societies with no p- or q-failure.

[15] For a theory of why the quality of governance (as captured by the protection of property rights) differs across time and space, see Gradstein (2004).

decide if they want to reappoint the incumbent ruler or not. This together with random events, as captured by p and q, determine whether the incumbent is, in fact, replaced by another ruler. After this the sequence of events is repeated.

3 Growth and Rent Extraction

Citizens must accept some corruption and government inefficiency. How much depends on the quality of their political institutions and on economic conditions. To see this, we begin by characterizing sequences of incentive compatible performance standards. Suppose that citizens announce the standard $\widehat{s}_t = \{\widehat{\tau}_t, \widehat{x}_t\}$ at time t. Define $\widehat{z}_t = \widehat{T}_t - a_t\widehat{x}_t$ as the rent extraction allowed by the standard. A ruler who complies (C) with the standard at time t expects to get:

$$V_t(C) = \widehat{z}_t + \beta p V^*_{t+1} \tag{3}$$

where V^*_{t+1} is the continuation value of holding office at the beginning of period $t+1$. We notice that future payoffs are discounted by β, as rulers apply the same discount factor as citizens. More importantly, for $p < 1$ citizens cannot promise to reappoint a well-performing ruler with certainty, and so with probability $1-p$, he might not get reappointed and thereby foregoes the option of extracting rents in the future. This reduces his effective discount factor to βp. The p-failure reduces the discount factor of rulers below that of their constituents.

The ruler can alternatively deviate from the standard in period t and extract the maximum rent. In this case, he sets

$$\{\tau^*_t, x^*_t\} = \arg\max_{\{\tau_t, x_t\}} \tau_t a_t F(1 - \tau_t + x^\alpha_t) - a_t x_t. \tag{4}$$

We note that $\tau^*_t = \tau^*$ and $x^*_t = x^*$ for all t[16] and that the maximum rent $\mathcal{T}_t = a_t\mathcal{T}$ increases

[16] The first order conditions

$$a_t\left[F(.) - \tau_t f(.)\right] = 0.$$
$$a_t\left[\tau_t f(.)\alpha x^{\alpha-1}_t - 1\right] = 0$$

imply that the solution is stationary. The second order condition is satisfied when F is concave.

over time with

$$\mathcal{T} = (\tau^* F(1 - \tau^* - (x^*)^\alpha) - x^*)\,. \tag{5}$$

Citizens would, of course, want to replace the ruler at time $t+1$, but with probability q, they fail to achieve this. Thus, a ruler who deviates (D) from the performance standard at time t expects to get

$$V_t(D) = \mathcal{T}_t + \beta q V_{t+1}^*. \tag{6}$$

We can now write the value of being the ruler, V_t^*, as

$$V_t^* = \max\{V_t(C), V_t(D)\}. \tag{7}$$

A sequence of performance standards $\{\widehat{s}_t\}_{t=0}^{\infty}$ is incentive compatible if and only if

$$V_t(C) \geq V_t(D) \text{ for } t = 0, 1, 2, ... \tag{8}$$

By routine substitution, using equations (3) and (6), we get that $V_t(C) \geq V_t(D)$ if and only if

$$(IC_t) \qquad \widehat{z}_t + (p-q)\beta \sum_{k=0}^{\infty} (p\beta)^k \widehat{z}_{t+1+k} \geq \mathcal{T}_t \tag{9}$$

for $t = 0, 1, 2, ...$ From this equation, we note that a necessary condition for incentive compatibility is that $p > q$. If this fails, citizens would have to allow rulers to extract more rent $\widehat{z}_t$ today than the maximum rent possible, $\mathcal{T}_t$, which, of course, is impossible. This observation identifies two different *governance regimes*: regime G with incentive compatible institutions and regime B with incentive incompatible institutions.

In regime G, citizens can use the promise of future rents effectively to discipline current rulers thereby reducing rent extraction to the level that is compatible with rulers wanting to be reappointed. The next proposition characterizes the minimum rent that citizens must allow rulers to extract along incentive compatibility paths. All proofs are in Appendix A.

Proposition 1 *Assume $\beta(1+g) < 1$ and $p > q$. Along paths with constant productivity growth, incentive compatible performance standards must allow rulers to extract at least the rent*

$$z_t^* = \frac{1 - p\beta(1+g)}{1 - q\beta(1+g)} a_t \mathcal{T} < a_t \mathcal{T} \tag{10}$$

for $t = 0, 1, 2, ...$

Citizens would never allow the ruler to collect more than the minimum rent required for compliance, so $\widehat{z}_t^G = z_t^*$ for all t. Proposition 1, then, implies that a constant fraction of (potential) GNP is, with the approval of citizens, extracted each period. The minimum level of rent extraction depends on the quality of governance and on the growth rate of the economy. As expected, marginal improvements in the quality of institutions (a higher p or a lower q) reduce rent extraction and corruption.

The impact of economic growth on the level of rent extraction along incentive compatible paths can be calculated from equation (10):

$$\frac{\partial\left(\frac{z_t^*}{a_t}\right)}{\partial g} = \frac{\beta\mathcal{T}(q-p)}{(1-q\beta(1+g))^2}. \tag{11}$$

We see that this is negative for $p > q$ and we have:

Proposition 2 *(Growth and Rent Extraction) Assume that $p > q$. Economic growth (g) reduces rent extraction ($\frac{z_t^*}{a_t}$).*

Proposition 2 shows that economic growth, at the margin, performs a very similar role to improvements in the quality of political institutions: it reduces rent extraction. In a society in which GNP and potential rents ($\mathcal{T}_t$) are growing, rulers have an incentive to postpone rent extraction because larger rents can be collected in the future. This makes it easier for citizens to get rulers to comply in the present and rent extraction along incentive compatible paths can be reduced. It is important to notice, however, that two opposite effects are at work. An increase in the growth rate increases the continuation value of retaining office. This, on the one hand, makes rulers who decide to comply more amenable to reduce rent extraction today as long as they can be fairly sure that this is rewarded with reappointment (p high). On the other hand, the incentive to deviate from the performance standard and seek all available rents is enhanced in societies with higher growth rates as long as there is a chance that rulers are reappointed despite their misbehavior ($q > 0$). Along incentive compatible paths $p > q$, and the former effect dominates. Economic growth can, therefore, serve as a substitute for improvements in the quality of institutions.

Proposition 1 characterizes the minimum level of rent extraction (z_t^*) in incentive compatible economies for any path of fees and spending levels. Given that $z_t = z_t^*$ at each t,

the constrained efficient paths of τ_t and x_t solve the following problem:

$$\max_{\{\tau_t, x_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left[a_t(1-\tau_t) + a_t x_t^a\right] \tag{12}$$

subject to

$$z_t = z_t^* \quad t = 0, 1, 2, 3... \tag{13}$$

$$T_t = z_t + a_t x_t \quad t = 0, 1, 2, 3... \tag{14}$$

where $T_t = a_t \tau F(1-\tau_t+x_t^{\alpha})$. The solution to this problem is characterized in the following proposition.

Proposition 3 *(Tax Rates and Public Services) Assume that $p > q$ and that F is uniform on $[0, \theta]$. Along a path with constant productivity growth, the constrained efficient performance standard is unique and stationary, i.e., $\widehat{s}_t^G = \left\{\widehat{\tau}^G, \widehat{x}^G\right\}$ for all t. Provision of public services is growing over time in line with productivity*

$$y_t^G = a_t \left(\widehat{x}^G\right)^{\alpha}.$$

Moreover, $\widehat{\tau}^G$ and $\widehat{x}^G$ are continuously differentiable functions of $\{g, p, q\}$ with $\widehat{\tau}^G < \tau^*$ and $\widehat{x}^G > x^*$.

Proposition 3 shows that the constrained efficient performance standard is stationary and that provision of public services grows over time in line with productivity.[17] The ruler reduces the fee below the rent maximizing level and increases the labour input to the production of public services above that level. More importantly, the size of the formal sector $F\left(1-\widehat{\tau}^G + \left(\widehat{x}^G\right)^{\alpha}\right)$ is a function of the growth rate g (and p and q):

Proposition 4 *(Growth and the Size of the Formal Sector) Assume that $p > q$ and that F is uniform on $[0, \theta]$. Along a path with constant productivity growth, the size of the formal sector is non-decreasing in the growth rate.*

[17] The assumption that F is uniform is sufficient to insure that the constrained efficient path of τ_t and x_t is unique.

Proposition 4 compares the size of the formal sector along two different growth paths of an economy and shows that the formal sector, ceteris paribus, will be larger along the path with faster growth. Intuitively, a high growth rate reduces the rent required for incentive compatibility (Proposition 2) because the ruler is more eager not to be replaced. Consequently, the fee is reduced and more public services are provided. This induces some individuals who previously sheltered themselves in the informal sector to move into the formal sector.

In regime B, no ruler ever complies with any performance standard, and the only protection that citizens have against rent extraction is to move into the informal sector. Rulers cannot be disciplined by the threat of replacement because the threat is not credible. Rulers who disregard the performance standard are rarely replaced (q is large), while rulers who comply are rarely rewarded for the effort (p is small). In this environment, the optimal strategy for any ruler is to extract as much as possible today and accept being replaced in the future. We, therefore, have:

Proposition 5 *Assume that $p \leq q$. All rulers extract the maximum rent*

$$\frac{z_t^B}{a_t} = \mathcal{T}$$

by setting $\tau_t^B = \tau^*$ and $x_t^B = x^*$ for $t = 0, 1, 2, ...$

The fact that all rulers extract the maximum rent means that rent extraction as a fraction of potential GNP does not depend on the growth rate of the economy and that marginal improvements in the quality of institutions do not lead to a reduction in corruption. An implication, then, is that the size of the informal sector is independent of the growth rate and of the quality of institutions.

4 Rent Extraction and Growth

In the analysis above, we took economic growth to be exogenous and independent of corruption. Numerous studies have, however, pointed to the possibility that corruption is detrimental to economic growth. Krusell and Rios-Rull (1996), for example, argue that

vested interests associated with knowledge of how to operate older vintages of technology sometimes block the adoption of the most recent technology. Misallocation of talent between entrepreneurship and rent seeking is another important reason why corruption hinders growth (Acemoglu and Verdier 1998, Murphy et al. 1991). Yet another reason is corruption-induced under-investment in public capital (Del Monte and Papagni, 2001).

To allow for the possibility that corruption or rent extraction has a negative effect on growth, we endogenize the growth rate. There are, of course, many different ways of doing so.[18] Here, we argue that the formal sector is likely to play an important role. First, industrial production generates learning-by-doing externalities with the potential to increase the growth rate of the economy (Arrow, 1962). Activities in the formal sector are most likely to generate such externalities at a scale that has macroeconomic implications.[19] Second, firms in the formal sector have access to the legal system. This helps to protect property rights and to enforce contracts which, in turn, spurs the incentive to produce growth enhancing innovations. Consider, for example, a R&D-based endogenous growth model a la Romer (1986) or Jones (1998, chapter 5). In this type of model, the growth rate is proportional to the fraction of the workforce employed in R&D activities. Insofar as a portion of formal sector employment is devoted to R&D, an increase in the size of the formal sector leads to a higher growth rate. Thirdly, Murphy et al. (1991) argue that the growth rate of the economy is determined by the most able self-employed person, again providing a direct link between the growth rate and the allocation of resources between the formal and informal sector.

We do not want to model the precise mechanism that generates endogenous growth here, but believe that the discussion above is sufficient to allow us to postulate a reduced form relationship between the growth rate and the size of the formal sector:

$$g = H[F(1 - \tau + x^{\alpha})], \tag{15}$$

[18] See, e.g., Jones (1998) or Aghion and Howitt (1998).

[19] The informal sector does often provide training to school leavers with low eduction that allows them to move to formal sector jobs after some years (Maloney, 2004). Thus, some learning-by-doing takes place in that sector. What we argue is that learning effects of the type used in endogenous growth models are more likely to be generated in the formal sector.

where H is a strictly increasing (differentiable) function with either congestion ($H'' < 0$) or agglomeration ($H'' > 0$) effects. Since corruption encourages individuals to seek employment in the informal sector, this formulation implies a simple negative feedback from corruption to growth.

5 Equilibria

In order to make optimal choices, the citizens and the ruler must form expectations about the growth rate. We follow Katz and Shapiro (1985) and many others and assume that the agents have identical expectations about the growth rate and that, in equilibrium, these expectations are fulfilled. More precisely, we define an equilibrium as a constant growth rate such that i) agents' expectations are fulfilled and ii) the choices of citizens and of the ruler are optimal each period. The equilibrium characterization depends on which of the two governance regimes the economy belongs to.

In regime G, our specification of the growth process implies that economic growth and corruption become endogenous *and* self-reinforcing. High growth reduces rent extraction. This makes working in the formal sector more attractive. This expansion of the formal sector increases the growth rate of the economy. This implies that corruption has an amplifying negative effect on growth and opens up the possibility of multiple equilibria. Formally, an equilibrium growth rate is a solution to

$$g_G^* = H\left[F(1-\widehat{\tau}^G(g_G^*) + \left(\widehat{x}^G\left(g_G^*\right)\right)^\alpha)\right] \tag{16}$$

for $g \in [0, \frac{1-\beta}{\beta})$. Equation (16) has no, one or more solutions depending on circumstances.[20]

To illustrate the range of possible equilibrium configurations of regime G, we discuss three examples. For the majority of parameter values, the economy has a unique and stable equilibrium. An application of the implicit function theorem to equation (16) shows that an

[20] A sufficient condition for existence of at least one equilibrium is that

$$1 > \beta\left[1 + H\left[F(1-\widehat{\tau}^*(\frac{1-\beta}{\beta}) + \left(\widehat{x}^*\left(\frac{1-\beta}{\beta}\right)\right)^\alpha)\right]\right]$$

This is sufficient because $H\left[F(1-\widehat{\tau}^*(0) + (\widehat{x}^*(0))^\alpha)\right]$ is positive and $F(1-\widehat{\tau}^*(g) + (\widehat{x}^*(g))^\alpha)$ is a non-decreasing function of g.

improvement in the quality of institutions increases growth and reduces rent extraction.[21] Better institutions lead to less rent extraction. This induces more people to work in the formal sector. This, in turn, increases the growth rate because of the resulting growth promoting externalities and innovations. We note that within regime G institutions affect growth *indirectly* through their impact on rent extraction.

In specific circumstances, however, there exist multiple equilibria. One interesting possibility is an economy with deficient, yet incentive compatible, institutions. In such an economy, a typical equilibrium configuration is shown in Figure 1.[22] We see that this economy has two stable equilibria: one at point A with relatively low growth and relatively high levels of rent extraction and one at point C with high growth and low rent extraction.[23] A third unstable equilibrium is located in the middle at point B. An improvement in the quality of institutions can eliminate the two low growth equilibria and induce the economy to move to equilibrium C where all individuals work in the formal sector.[24] Another possibility that gives rise to a similar configuration is an economy with high quality institutions (q is close to 0 and p is close to 1) in which there are substantial agglomeration effects associated with the learning-by-doing or innovation process ($G'' >> 0$).[25]

In regime B, there is no feedback from economic growth to rent extraction. This implies that (exogenous) variations in corruption has a smaller negative impact on growth than in regime G. Formally, the equilibrium growth rate is uniquely given by

$$g_B^* = H\left(F\left(1-\tau^B+\left(x^B\right)^\alpha\right)\right).$$

Since the fee is larger ($\tau^B > \widehat{\tau}^G(g)$) and less public services are provided ($x^B < \widehat{x}^G(g)$) in this regime than in regime G, the growth rate g_B^* is lower than the growth rate associated with the worse equilibrium in regime G. Thus, regime B is characterized by low growth and

[21] See Appendix A for a proof.

[22] The picture can be generated with the following parameter values: $\beta = 0.9$, $p = 1$, $q = 0.99$, F is uniform on $[0, 1.2]$ and $H = l + \gamma F(.)^k$ with $l = -0.24$, $\gamma = 0.5$ and $k = 2$.

[23] The kink in the equilibrium locus happens at the point where all individuals are employed in the formal sector.

[24] Note that after an improvement in the quality of institutions, unstable equilibria become associated with lower growth and more corruption.

[25] An example of this is an economy with the following parameter values: $\beta = 0.9$, $p = 0.9$, $q = 0.1$, F is uniform on $[0, 1.22]$ and $H = l + \gamma F(.)^k$ with $l = -0.34$, $\gamma = 0.6$ and $k = 20$.

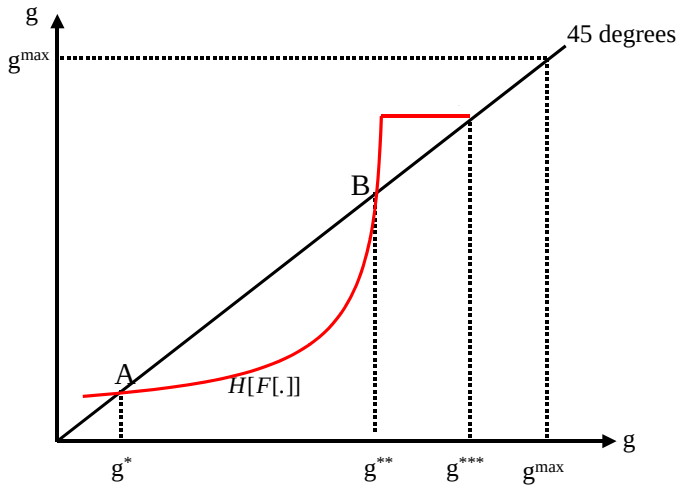

Figure 1: Economies with multiple equilibria in regime G.

high levels of rent extraction. While marginal improvements in institutional quality do not affect the growth performance in regime B, sustained improvements may trigger a regime shift, thereby leading to better economic performance and a reduction in corruption.

6 The Empirical Specification

The theoretical analysis highlights two points that motivate the empirical investigation. First, the model gives one reason why the distinction between different governance regimes is important and shows that institutional quality does not affect the growth performance of a country directly, but indirectly, through the regime choice and through the impact on corruption levels.[26] Second, within a particular governance regime economic growth and corruption are jointly determined and the corruption/growth relationship is regime specific. In particular, the model highlights a self-reinforcing relationship between corruption and growth that amplifies the negative impact of corruption on growth in societies where institutional quality exceeds a certain threshold (regime G). In contrast, in societies where the quality of institutions falls short of this threshold this amplifying effect is absent. This

[26] This is in contrast to Barro (1996), Knack and Keefer (1995) and others who argue that institutions have a direct impact on growth.

weakens the negative impact of (exogenous) variations in corruption on growth.

Before we discuss the details of our econometric procedure, it is useful to lay out the overall identification strategy. Since corruption and growth are jointly determined, we need instruments to get unbiased estimates of the impact of corruption on growth. Our model suggests that the level of corruption is the outcome of "purposeful collective choices made under different institutional arrangements" (Persson, 2004). We can, therefore, think of corruption as part of what Hall and Jones (1999) call social infrastructure[27] and what Persson (2004) call structural policies. In this way, two broad classes of instruments for corruption seem appropriate. First, Hall and Jones (1999) and many others since them have noted that "good" institutions originated in Western Europe and were transplanted to the rest of the world from there. A potential determinant of social infrastructure (and thus of corruption) is, therefore, the extent to which a country has been influenced by European values and institutions, and so variables that capture exposure to "European influence" can be used as instruments. Second, Persson (2004, 2005) and Eicher and Leukert (2006) have recently argued that the type of constitutional arrangements is an important determinant of structural policies (and thus of corruption) and that these arrangements only affect economic outcomes through their impact on structural policies. This "hierarchy of institutions" hypothesis implies that we can use measures of political institutions as instruments for corruption. This scheme of identification is sketched in Figure 2. We note that while the measures of "European influence" only affect growth through the impact on corruption, measures of the quality of political institutions (constitutional arrangements) affect growth partly through the impact on corruption and partly through the impact on the regime choice. Various economic and demographic factors are assumed to affect growth directly and indirectly through corruption.

Formally, we assume that the relationship between corruption, economic growth and political institutions in a cross section of countries can be summarized by the following equation:

[27] Social infrastructure is measured as a the average of an index of government anti-diversion policy and openness to trade. Anti-diversion policy can be interpreted as an inverse measure of corruption.

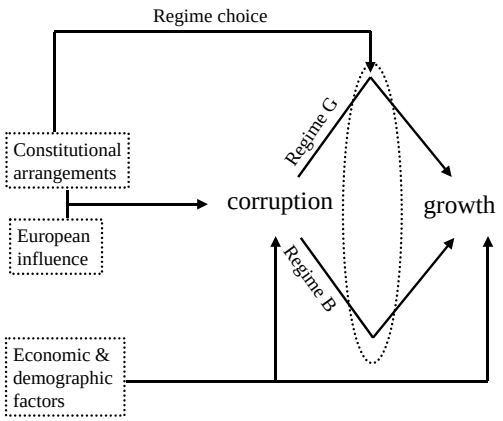

Figure 2: Sketch of Identification Scheme.

$$g_i = \beta_1 c_i 1(q_i \leq \gamma) + \beta_2 c_i 1(q_i > \gamma) \tag{17}$$
$$+1(q_i \leq \gamma) x_i \beta_3 + 1(q_i > \gamma) x_i \beta_4 + e_i,$$

where g_i measures growth of real GDP per capita, c_i is an (endogenous) measure of corruption, q_i is an (exogenous) measure of the quality of institutions, x_i is a vector of (other) exogenous economic and demographic variables known to affect economic growth directly and a constant term, $1(.)$ is an indicator function and γ is a threshold to be estimated. We assume that the error term follows a martingale difference sequence.[28]

The key feature of this growth model is that it allows for two distinct governance regimes. Once the threshold γ has been estimated from the data, the quality of political institutions (q_i) determines which of the two possible regimes a particular country belongs to. Moreover, the marginal impact of corruption and other (exogenous) determinants of growth is regime specific. Econometrically speaking, estimation of equation (17) is complicated by the fact that corruption is an endogenous variable and the error term (e_i) is correlated with the corruption variable, c_i. Therefore, threshold models developed for the estimation of models with exogenous regressors, such as that proposed by Hansen (2000), cannot be used. Instead, we use the procedure developed by Caner and Hansen

[28]This strong assumption is required because simple orthogonality assumptions are insufficient to identify non-linear models.

(2004). This procedure allows right-hand side variables, in this case corruption, to be endogenous. The reduced form equation for corruption is the conditional expectation of c_i given x_i':

$$c_i = h(x_i', \pi) + u_i \tag{18}$$

where π is an unknown parameter vector, h is a (linear) function and u_i is a random error. The vector x_i' contains some variables (instruments) not included in the growth regression along with the other exogenous variables of the model and $E(u_i|x_i') = 0$. We discuss these instruments in more detail below. This equation can be substituted into equation (17) to get:

$$\begin{aligned} g_i = \beta_1 h(x_i', \pi) 1(q_i \leq \gamma) + \beta_2 h(x_i', \pi) 1(q_i > \gamma) \\ +1(q_i \leq \gamma) x_i \beta_3 + 1(q_i > \gamma) x_i \beta_4 + v_i \end{aligned} \tag{19}$$

where

$$v_i = \beta_1 u_i 1(q_i \leq \gamma) + \beta_2 u_i 1(q_i > \gamma) + e_i \tag{20}$$

The parameters of this equation can be estimated sequentially. First, Least Squares are used to estimate the parameter vector π from the reduced form. Second, the threshold γ is chosen to minimize the sum of squared residuals from a sequence of regressions of growth on the predicted value of corruption from the first stage. Third, the regime specific slope parameters, β_1 to β_4, are estimated by Generalized Method of Moments (GMM) on the split sample implied by the estimate of γ.

In estimating growth models on cross country data, robustness is a real concern. To deal with this, we estimate the model using two alternative measures of economic growth, two alternative measures of corruption, two different sets of instrumental variables and a number of different control variables. The sample contains 67 to 86 countries drawn from all five continents. Appendix B lists the countries and provides information on the main variables used in the analysis.

We consider both short-run (1995-2000) and long-run (1970-2000) growth in real GDP per capita. The specification with short-run growth rates has the advantage that both the economic data and the measures of corruption and institutional quality (see below) refer to the same time period, but is problematic because temporary shocks may mask longer-term growth effects. The specification with long-run growth rates avoids this problem, but suffers from the problem that growth performance over a 30 years period is explained by the level of corruption at the end of the period. For this to be valid, corruption must be stable over time (see the discussion in Méon and Sekkat (2005)). We believe that both approaches have merits and report results for both specifications.

Several business risk analysts and polling organizations routinely construct indexes of "perceived" corruption, based on survey responses of business people, experts and local residents. These indices, typically, measure corruption as the likelihood that government officials would demand bribes in exchange for special licenses, policy protection, biased judicial sentences, avoidance of taxes and regulations or simply to expedite government procedures, but occasionally also use information about "grand corruption" and government capture. We use two alternative measures of corruption. The first measure is the average from 1996 to 2002 of the corruption perception index constructed by Transparency International. The corruption perception index uses information from a number of individual surveys and ratings and varies between 10 (the least corrupt country) and 0 (the most corrupt country). Compared to other indices of corruption, the corruption perception index has the advantage that it is based on averages from different sources, and one might hope that measurement errors wash out.[29] The second measure of corruption is taken from the World Bank's "Governance Matters" database, constructed by Kaufmann et al.

[29]It is also worth noting that the sub-indices of the corruption perception index are highly correlated both with each other and across time. Furthermore, indices of perceived corruption constructed from surveys of business people match well with indices constructed from cross-sectional polls of the inhabitants of the countries (Treisman, 2000). These observations give some confidence that these measures do capture important aspects of corruption in a consistent way. Yet, since views on corruption can be influenced by the economic circumstances of a particular country, it cannot be ruled out entirely that the indices partly capture economic outcomes rather than corruption per se, nor can it be ruled out that they capture other aspects of the governance environment than corruption. This should be kept in mind when interpreting the results of the analysis.

(1999) and updated by Kaufmann et al. (2005), and is called "control of corruption". It measures the exercise of public power for private gain, including both petty ("additional payments to get things done") and grand corruption and state capture. The indicators in the "Governance Matters" database are constructed from a large number of separate data sources covering several hundred individual perception based measures of governance using an unobserved components model. Thus, the control of corruption indicator is based on broader aspects of corruption than the corruption perception index. In that sense, it captures more precisely our theoretical notion of rent extraction. We use the average value of the control of corruption indicator for the period 1996-2004. The index varies from -1.07 (the most corrupt country) to 2.45 (the least corrupt country).

The quality of political institutions is hard to measure empirically, but some attractive measures are available in the "Governance Matters" database discussed above. To keep as closely as possible to the theoretical model, we have chosen to use the so-called voice and accountability index as the threshold variable (q_i in equation (17)). This index aggregates indicators of various aspects of the political process, civil liberties, and political rights with the purpose of measuring the extent to which citizens of a country are able to participate in the selection of their government and able to hold the government accountable for its policy choices. It also includes indicators of the independence of the media, which serve an important role in holding those in authority accountable. The index has been time averaged for the available years and re-scaled to lay in the interval 0 (weak institutions) to 1 (strong institutions). We believe that the measure is the best available proxy for the factors that we attempt to capture with p and q in the model.

As discussed above, we use two broad classes of instruments for corruption, either related to "European influence" or to constitutional arrangements. Within each of these classes, the literature has considered a wide range of specific instruments, including distance from equator (latitude)[30], the population share with English as their mother tongue[31], settlers mortality[32] and legal tradition[33] as measures of "European influence", and age of

[30]See Hall and Jones (1999).
[31]See Hall and Jones (1999).
[32]See Acemoglu et al. (2001).
[33]See La Porta et al. (1999).

democracy, election rules and regime types[34] or the indicators in the "Governance Matters" database[35] as measures of constitutional arrangements. We have settled on two sets of instruments that work well across most specifications. Instrument set I contains latitude, size of a country (its area) and the voice and accountability index while instrument set II contains age of democracy and the voice and accountability index.[36] Latitude was proposed as an instrument for social infrastructure by Hall and Jones (1999). They noted that countries located farther from equator were less densely populated in the past and had a geography more similar to Europe. These features made them more attractive for European migration and more likely to have benefited from the transplantation of "good" European institutions.[37] The size of a country is a likely determinant of the cost of building effective political institutions. This is so for at least two reasons. Firstly, a country covering a larger geographical area is likely to need more layers of government. This increases the scope for corruption and other divergent policies. Secondly, smaller countries are likely to be more homogenous. This makes it easier to accumulate social capital and to develop norms of honesty. The size of a country is, on the other hand, unlikely to have a direct impact on the growth rate. Consequently, we argue, on a prior grounds, that the size of a country affects economic growth exclusively through social infrastructure (and corruption). Age of democracy is measured as the number of years of uninterrupted democratic rule going back from year 2000. Persson and Tabellini (2003, chapter 5) argue that countries with a longer democratic tradition have developed better and more effective means of controlling corruption (and other diversion policies pursued by governments).

[34] See Persson (2004, 2005).

[35] See Eicher and Leukert (2006).

[36] Generally, the results are similar but less consistent across specifications when other instruments for corruption, such as the index of ethnolinguistic fractionalisation (Mauro, 1995) or measures of legal tradition (La Porta et al. 1999), are used. However, two of the instruments used by Persson (2004) – electoral system and regime type – do not generate enough variation to allow separate identification of the two governance regimes.

[37] Acemoglu et al. (2001) and Acemoglu (2005) have questioned this approach and argued that the impact of Europeans on institutional development depended on the most attractive colonization strategy and that it was only where the environment was suitable for long-term settlement that the settlers had the incentives to build "good institutions". They, therefore, argue that settlers mortality is a better instrument. However, measures of settlers mortality are not available for a broad enough sample to be of use in our study.

Older democracies are, therefore, likely to pursue systematically different policies from newer ones whilst age of democracy is not in itself a determinant of growth. A similar argument can be made for the voice and accountability index.[38] In conclusion, we believe that there are a priori reasons why these variables are reasonable, although not perfect, candidates for instruments for corruption.

The model also includes a number of economic and demographic control variables (investment share, population growth, primary education) and all specifications control for the initial level of GDP (either in 1995 or in 1970) and include a set of regional dummies (retained only if they are significant).

7 The Results

We report the empirical results in Tables 1 to 6. To preserve space, we only report the coefficients on the corruption indicators.[39] Each table contains the results for 4 different model specifications. Since we are splitting the sample into two and, therefore, typically estimate on subsamples of 30 observations or less, we start with a parsimonious specification and then add one by one the other control variables. In model specification 1, we only control for initial GDP per capita only. In model specification 2 to 4, we add the investment share, population growth and a measure of primary education, respectively.[40]

As a benchmark, we have estimated the econometric model on the whole sample of countries without taking the possibility of thresholds into account. The results for short-run growth are reported in Table 1. We note that corruption is insignificant in all specifications. Table 2 reports the results for long-run growth. Here, we note that the broader measure of corruption – *control of corruption* – is significant with both sets of instruments, suggesting that corruption reduces growth in the full sample of countries. In the specification with the corruption perception index the impact is, however, not statistically

[38] See Persson et al. (2003), Lederman et al. (2005) and Chang and Golden (2006) for careful studies of the institutional determinants of corruption.

[39] The full set of results, including the first stage regressions, is available upon request.

[40] These control variables always refer to the beginning of the (relevant) sample period. All specifications initially include regional dummies, but these are only retained if statistically significant.

significant. These results are broadly in line with those of Mauro (1995).

[Table 1 to appear here].

[Table 2 to appear here].

Tables 3 to 6 report the estimates using the threshold estimation technique. Each table is divided into two panels. Panel A reports the regime specific estimate of the impact of corruption on economic growth for instrument set I, while Panel B reports the corresponding results for instrument set II. In all specifications, we find a significant threshold effect that identifies two separate corruption/growth regimes: one regime with high quality institutions and one with low quality institutions. The cut-off value of the voice and accountability index differs somewhat from specification to specification, but is in the range from 0.65 to 0.76. The countries in the regime with high quality institutions have, on average, less corruption and higher long-run growth than the countries in the regime with low quality institutions. With regard to short-run growth, the regime differences are, however, small.

[Table 3 to appear here]

[Table 4 to appear here]

Table 3 and 4 show the results for the short-run growth rates for the corruption perception index and the control of corruption indicator, respectively. For both sets of instruments, the estimated impact of corruption on growth depends on the regime. In the regime with high quality institutions (regime G), corruption reduces growth in all specifications and the effect is statistically significant. To get a sense of its magnitude, we can consider the point estimates from Table 3. Based on the estimates reported in panel A, a one unit increase in the corruption perception index reduces short-run growth by 0.28 percentage points. Alternatively, if the Czech Republic could increase its score on the (2001) corruption perception index from 3.9 to the level of Denmark (which has a score of 9.5), the growth rate of the Czech Republic would, ceteris paribus, increase by

1.57 percentage points. The estimated effect is even larger when age of democracy and the voice and accountability index are used as instruments for corruption (panel B). In the regime with low quality institutions (regime B), the impact of corruption on growth is insignificant in all specifications. It is, however, interesting to note from Table 3 (panel A) that the point estimate is negative, suggesting that corruption might have a positive impact on short-run growth. The corresponding results for long-run growth, reported in Tables 5 and 6, show a similar pattern: corruption reduces growth in regime G and has no statistically significant impact in regime B.[41] It is interesting to note that estimated impact of corruption tends to be larger in the long-run than in the short-run.

[Table 5 to appear here]

[Table 6 to appear here]

We report for each set of instruments two tests from the first stage regressions: Hansen's J-test for validity and the F-test for relevance of the instruments.[42] We see that instrument set II, containing age of democracy and the voice and accountability index, passes both tests in all specifications. Instrument set I, containing latitude, the size of a country and the voice and accountability index, works well in most specifications, but fails both tests in the regressions with long-run growth rates and *control of corruption* (Table 5, panel A).

In conclusion, these results strongly support the view that the relationship between growth and corruption is regime specific. Moreover, we find robust evidence that (exogenous) variations in corruption reduce growth conditional on having governance institutions of a high quality. In contrast, our results suggest that corruption has little impact on growth in societies with deficient institutions.

[41] There is one exception to this. In the specification where we control of the percentage of the population in primary education, *control of corruption* is significant at the 10 per cent level (Table 6, panel A).

[42] Strictly speaking, the F-test is suitable only in the case of linear IV models. As we use non-linear estimation techniques (GMM), the F-test is not a proper test for weak instruments (Stock et al. 2002) and should be interpreted with care.

8 Discussion and Conclusion

The paper offers a theoretical and an empirical investigation of the links between corruption, economic growth and political institutions that takes the possibility of multiple governance regimes into account. The theoretical model highlights a particular mechanism through which this can happen and stresses a) the role of political institutions as a determinant of the governance regime and b) the complementarity between economic growth and corruption within some, but not all, governance regimes.

Empirically, we demonstrate the importance of allowing for non-linear effects in the mapping from corruption (and other divergent government policies) to economic growth, as also stressed by Méon and Sekkat (2005) and Méndez and Sepúlveda (2006). We show that regime specific differences are important. The result that corruption has a weaker impact on growth in regime B than in regime G is consistent with our model, but may also be related to the "greasing the wheels" hypothesis of corruption. This hypothesis suggests that corruption may improve efficiency by allowing individuals to circumvent the worst institutional deficiencies. This, of course, leaves out the broader question of why the institutions are deficient in the first place, the answer to which might well be related directly to corruption (Aidt, 2003) and we are careful not to interpret our findings as evidence in favour of the proposition that corruption can have beneficial economic consequences in a broader sense.[43] The results show that corruption has a regime specific impact on growth and that it is most harmful where institutions are "good", possibly because of the self-reinforcing mechanism discussed in our model. Our model makes additional predictions about the size of the informal sector and the level of corruption that it would be of interest to explore in future work. It is encouraging to note that recent empirical work by Dreher and Schneider (2005) shows that the link between corruption and the size of the informal sector is regime specific and that there exist systematic differences between rich and poor countries.

We conclude by raising three further caveats related to the interpretation of our em-

[43] The narrower claim that corruption, conditional on weak institutions, may improve productivity levels has found support in Méon and Weill (2006).

pirical results. First, we interpret the two sub-samples identified by Caner and Hansen (2004)'s procedure as evidence of two distinct governance regimes, rather than as evidence of the existence of multiple equilibria. This is in line with the warning issued by Durlauf and Johnson (1995), although we cannot rule out alternative interpretations based on multiple equilibria.[44] Second, one may worry that there exist variables omitted from the reported growth regressions that are correlated with the instruments and that the instrumental variables estimates therefore remain biased. We have tried to address this issues by using a range of different instruments. We take some comfort in the fact that all the results point in the same direction: negative impact of corruption on growth conditional on high quality institutions and no impact conditional on deficient institutions. Third, we emphasize that the evidence is based on a cross section of countries. Caner and Hansen (2004)'s procedure does not allow for panel analysis, so this must await further advances in the methodology.

9 Appendix A: Proofs

Proof of Proposition 1. Note that

$$max\{\beta p(1+g), \beta q(1+g)\} \leq \beta(1+g) < 1 \tag{21}$$

Incentive compatibility requires that

$$IC_t \quad \widehat{z}_t + (p-q)\beta \sum_{k=0}^{\infty} (p\beta)^k \widehat{z}_{t+1+k} \geq \mathcal{T}_t \tag{22}$$

for $t = 0, 1, 2, ...$ The electorate wants to minimize rent extraction $\sum_k \beta^k z_{t+k}$ subject to incentive compatibility constraints $\{IC_{t+k}\}_{k=0}^{\infty}$ for all t, yielding

$$\widehat{z}_t - q\beta\widehat{z}_{t+1} = \mathcal{T}_t(1 - \beta p(1+g)) \quad \text{for } t = 0, 1, 2, ... \tag{23}$$

Substitution, using the fact that $\mathcal{T}_t = a_0(1+g)^t\mathcal{T}$, yields

$$\widehat{z}_t = \mathcal{T}(1 - \beta p(1+g))a_0(1+g)^t \sum_{k=0}^{\infty} (q\beta(1+g))^k \tag{24}$$

[44] Durlauf and Johnson (1995) point out that it is not possible to distinguish empirically between a situation with multiple equilibria (societies with similar characteristics are located at different growth/corruption equilibria) and a situation where the equilibrium locus has a discontinuity and some countries are below and other above the discontinuity point.

which can be simplified to get z_t^* defined in equation (10). Any sequence $\widehat{z}_t \geq z_t^*$ is incentive compatible

Proof of Proposition 3. To simplify notation define $k(g) \equiv \frac{1-p\beta(1+g)}{1-q\beta(1+g)}\mathcal{T}$. Constraints (13) and (14) in problem (12) are binding at each t. We can, therefore, combine the two constraints at each t and consider the following sequence of one-period Lagrangians

$$L_t = \beta^t \left[a_t(1-\tau_t) + a_t x_t^a + \lambda_t \left[a_t \tau F(1-\tau_t+x^\alpha) - a_t x_t - a_t k(g)\right]\right]. \tag{25}$$

where λ_t is the multiplier on the (joint) constraint at time t. It is clear that the solution must have τ_t and x_t strictly positive, and that $\lambda_t > 0$ for all t. The Kuhn-Tucker conditions at time t imply

$$-1 + \lambda_t \left[F(1-\tau_t+x_t^\alpha) - \tau_t f(1-\tau_t+x_t^\alpha)\right] = 0, \tag{26}$$

$$\alpha x_t^{\alpha-1} - \lambda_t \left[\tau_t f(1-\tau_t+x_t^\alpha)\alpha x_t^{\alpha-1} - 1\right] = 0, \tag{27}$$

$$\tau F(1-\tau_t+x_t^\alpha) - x_t - k(g) = 0. \tag{28}$$

We note that any solution must be stationary. Let $\{\tau^{**}, x^{**}\}$ be a candidate solution to the problem. Observe that

$$\left[F(1-\tau+x^\alpha) - \tau f(1-\tau+x^\alpha)\right] = 0 \tag{29}$$

and

$$\left[\tau f(1-\tau+x^\alpha)\alpha x^{\alpha-1} - 1\right] = 0 \tag{30}$$

at $\tau = \tau^*$ and $x = x^*$. Equation (26) and (27) then imply that $\tau^{**} < \tau^*$ and $x^{**} > x^*$ for all t. Rearrange equation (26) to get

$$\lambda = \frac{1}{\left[F(1-\tau+x^\alpha) - \tau f(1-\tau+x^\alpha)\right]} \tag{31}$$

and rewrite equation (27) as

$$\alpha x^{\alpha-1} F(1-\tau+x^\alpha) - 1 = 0. \tag{32}$$

Equations (28) and (32) determine the constrained efficient τ and x uniquely. To prove this, we write

$$h_1(\tau, x) = \tau F(1-\tau+x^\alpha) - x - k(g) = 0, \tag{33}$$

$$h_2(\tau, x) = \alpha x^{\alpha-1} F(1-\tau+x^\alpha) - 1 = 0. \tag{34}$$

For $\tau < \tau^*$ and $x > x^*$, we get

$$\frac{\partial h_1(\tau,x)}{\partial x} = \tau f(.)\,\alpha x^{\alpha-1} - 1 < 0 \tag{35}$$

$$\frac{\partial h_1(\tau,x)}{\partial \tau} = F(.) - \tau f(.) > 0 \tag{36}$$

$$\frac{\partial h_2(\tau,x)}{\partial x} = \alpha x^{\alpha-2}\left[\alpha x^\alpha f(.) - (1-\alpha) F(.)\right] < 0 \tag{37}$$

$$\frac{\partial h_2(\tau,x)}{\partial \tau} = -\alpha x^{\alpha-1} f(.) < 0 \tag{38}$$

where a sufficient condition for $\frac{\partial h_2(\tau,x)}{\partial x} < 0$ is that F is uniform on $[0,\theta]$. Thus, for $\tau < \tau^*$ and $x > x^*$, we see that

$$\left.\frac{d\tau}{dx}\right|_{h_1} = -\frac{\frac{\partial h_1(\tau,x)}{\partial x}}{\frac{\partial h_1(\tau,x)}{\partial \tau}} > 0 \tag{39}$$

and

$$\left.\frac{d\tau}{dx}\right|_{h_2} = -\frac{\frac{\partial h_2(\tau,x)}{\partial x}}{\frac{\partial h_2(\tau,x)}{\partial \tau}} < 0 \tag{40}$$

Notice that $h_1(\tau^*,x^*) > 0$ so $h_1(\tau',x^*) = 0$ implies that $\tau' < \tau^*$ because $\tau F(1-\tau+x^\alpha)-x = \mathcal{T}$ at $\{\tau^*,x^*\}$ and $\frac{1-p\beta(1+g)}{1-q\beta(1+g)} < 1$. Notice that $h_2(\tau^*,x^*) = 0$ because $F(1-\tau+x^\alpha) = \tau f(1-\tau+x^\alpha)$ and $\alpha x^{\alpha-1}\tau f(1-\tau+x^\alpha) = 1$ at $\{\tau^*,x^*\}$. Thus, there exists one and only one solution to equations (28) and (32). The proposition follows by setting $\left\{\widehat{\tau}^G,\widehat{x}^G\right\} = \{\tau^{**},x^{**}\}$.

Proof of Proposition 4. Let $\widehat{\upsilon}^G = 1-\widehat{\tau}^G+\left(\widehat{x}^G\right)^\alpha$ and let

$$\begin{aligned}\Delta &= \frac{\partial h_1(\tau,x)}{\partial \tau}\frac{\partial h_2(\tau,x)}{\partial x} - \frac{\partial h_1(\tau,x)}{\partial x}\frac{\partial h_2(\tau,x)}{\partial \tau} \\ &= \left(F(.)-\tau f(.)\right)\alpha x^{\alpha-2}(\alpha-1)F(.) + \alpha f(.)x^{\alpha-1}\left(\alpha F x^{\alpha-1}-1\right)\end{aligned} \tag{41}$$

where $\Delta < 0$ at $\left\{\widehat{\tau}^G,\widehat{x}^G\right\}$ and the functions h_1 and h_2 are defined in the proof to proposition 3. Using Cramer's rule, we find that

$$\frac{\partial \widehat{\tau}^G}{\partial g} = \frac{\frac{\partial h_2(\widehat{\tau}^G,\widehat{x}^G)}{\partial x}\frac{\partial k}{\partial g}}{\Delta} < 0 \tag{42}$$

$$\frac{\partial \widehat{x}^G}{\partial g} = \frac{\frac{\partial h_1(\widehat{\tau}^G,\widehat{x}^G)}{\partial \tau}\frac{\partial k}{\partial g}}{\Delta} > 0 \tag{43}$$

and so $\frac{\partial \widehat{\upsilon}^G}{\partial g} > 0$. The proposition follows from the fact that the size of the formal sector $F(\upsilon)$ is decreasing in υ until the point where all workers are in the formal sector.

Proof of comparative statics. Assume that some individuals are employed in the informal sector both before and after the change and that the institutional reform does not trigger a regime shift. Applying the implicit function theorem to equation (16), we find

$$\frac{dg_G^*}{dp} = \frac{-G'(.)f(.)\frac{\partial \widehat{\upsilon}^G}{\partial p}}{1+G'(.)f(.)\frac{\partial \widehat{\upsilon}^G}{\partial g}} \tag{44}$$

and

$$\frac{dg_G^*}{dq} = \frac{-G'(.)f(.)\frac{\partial \widehat{\upsilon}^G}{\partial q}}{1+G'(.)f(.)\frac{\partial \widehat{\upsilon}^G}{\partial g}}, \tag{45}$$

where $\widehat{\upsilon}^G = 1-\widehat{\tau}^G+\left(\widehat{x}^G\right)^\alpha$. We note that $1+G'(.)f(.)\frac{\partial \widehat{\upsilon}^G}{\partial g}$ is positive if and only if the initial equilibrium is locally stable in the sense that a small deviation from g_G^* would, through the choices of citizens and their ruler, lead to a self-correcting adjustment back to that growth rate. Unstable equilibria become associated with lower growth and more rent extraction.

10 Appendix B: Data

The following variables are used in the analysis:

1. GDP per capita, PPP adjusted, is taken from Penn World Data Tables, version 6.1 (Heston et al., 2002). The short-run growth is annual GDP growth per capita over the period 1996-2000 in percentage. The long-run growth rates is calculated in a similar way for the period 1970-2000.

2. The corruption perception index is measured as an average of up to 12 different corruption perception indices of corruption and is constructed by Transparency International (http://www.transparency.org).

3. The control of corruption indicator (from the "Governance Matters" database) is constructed from a large number of underlying data on various aspects of corruption using an unobserved components model (Kaufmann et al., 1999 and Kaufmann et al., 2005). It measures the exercise of public power for private gain.

4. The voice and accountability index (from the "Governance Matters" database) measures aspects of the political process, civil liberties and political rights related to the extent to which citizens can participate in the election of their governments and are able to hold them accountable for their policy choices (Kaufmann et al., 1999 and Kaufmann et al., 2005).

5. Age of democracy is measured as the number of years with uninterrupted democratic rule, going backwards from year 2000 (democracy defined as the first year in which the POLITY IV (Marshall and Jaggers, 2000) index is positive. The variable is constructed by Persson and Tabellini (2003).

6. Investment share of GDP is taken from Penn World Data Tables, version 6.1 (Heston et al., 2002).

7. Human capital is measured as the percentage of population in primary education (Barro and Lee, 2001) for the regressions with short-run growth rates. Human capital is measured as the gross enrollment ratio (%) in the regressions with long-run growth rates. This is defined as the ratio of the total enrollment (regardless of age) to the population of the age group that officially corresponds to the level of education shown (World Bank Global Development Network Growth Database, 2001).

8. Population growth is from Penn World Data Tables, version 6.1 (Heston et al., 2002).

9. Distance from equator is the distance from equator (in degrees), ranging between -90 to 90 (Hall and Jones, 1999).

10. The size of a country is measured as country area in square kilometers. (World Bank Global Development Network Growth Database, 2001).

Table A1 shows that descriptive statistics of the variables used in the econometric analysis. Table A2 lists for each country the key variables.

[Table A1 to appear here].

[Table A2 to appear here].

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Table 1: Short-run growth rates (1995-2000): IV (GMM) estimates without thresholds.

Model specification	1	2	3	4
Instrument set I				
Corruption perception index	-4.13E-04	-0.001	0.007	-0.003
	(-0.01)	(-0.021)	(0.14)	(-0.05)
Control of corruption	3.51E-04	7.19E-04	-0.005	0.018
	(0.0001)	(0.01)	(-0.05)	(0.18)
Instrument set II				
Corruption perception index	-0.00567	-0.0033	-0.0046	-0.0018
	(-0.11)	(-0.07)	(-0.09)	(-0.04)
Control of corruption	-0.0097	-0.0058	-0.0075	-5.01E-04
	(-0.1)	(-0.06)	(-0.07)	(-0.01)

Notes: Robust t-statistics in brackets; *= significant at 10%; **=significant at 5%; ***=significant at 1%. Instrument set I: size of country, latitude and the voice and accountability index; Instrument set II: age of democracy and the voice and accountability index. Model specification: 1 includes no additional controls; 2 includes initial investment share; 3 includes population growth; 4 includes the percentage of the population at the beginning of the period in primary education. The corruption perception index is measured on a scale from 0 (most corruption) to 10 (least corruption). Control of corruption is measured on a scale from –1.07 (most corruption) to 2.45 (least corruption). Models estimated with GMM.

Table 2: Long-run growth rates (1970-2000): IV (GMM) estimates without thresholds.

Model specification	1	2	3	4
Instrument set I				
Corruption perception index	-0.185	-0.044	-0.239	-0.337
	(-0.56)	(-0.12)	(-0.75)	(-1.08)
Control of corruption	1.43**	1.57**	1.45**	1.22*
	(2.53)	(2.51)	(2.51)	(1.96)
Instrument set II				
Corruption perception index	0.03	0.035	-0.04	-0.19
	(0.11)	(0.11)	(-0.19)	(-0.73)
Control of corruption	1.12*	1.36*	1.11*	1.037
	(1.75)	(1.92)	(1.71)	(1.44)

Notes: See Table 1.

Table 3: Short-run growth rates (1995-2000): IV (GMM) estimates with thresholds and the corruption perception index.

Model specification	1	2	3	4
	Panel A: Instrument set I			
Regime G: VA[c]>0.76 (19 countries)				
Corruption perception index	0.28***	0.28**	0.28**	0.28**
	(4.03)	(2.04)	(2.44)	(2.08)
Regime B: VA[c]<0.76 (48 countries)				
Corruption perception index	-0.14	-0.15	-0.07	-0.14
	(-1.11)	(-1.48)	(-0.75)	(-1.11)
χ^2 (2) test for validity[a]	0.660	0.661	0.860	0.566
F-test for relevance[b]	F(3,63)=22.6***	F(3.63)=23.3***	F(3,62)=22.1***	F(3,62)=21.8***
	Panel B: Instrument set II			
Regime G: VA[c]>0.76 (19 countries)				
Corruption perception index	0.40**	0.48**	0.37**	0.40**
	(2.31)	(2.22)	(2.17)	(2.15)
Regime B: VA[c]<0.76 (48 countries)				
Corruption perception index	0.14	0.15	0.14	0.14
	(0.85)	(0.86)	(0.87)	(0.80)
First stage tests				
χ^2 (1) test for validity[a]	0.066	0.016	0.066	0.284
F-test for relevance[b]	F(2,64)=36.4***	F(2,63)=40.2***	F(2,63)=35.7***	F(2,63)=36.1***

Notes: Robust t-statistics in brackets; *= significant at 10%; **=significant at 5%; ***=significant at 1%. Instrument set I: size of country, latitude and the voice and accountability index; Instrument set II: age of democracy and the voice and accountability index. Regime specific models estimated with GMM. a=Hansen's J-test for joint null that the extra instruments are valid. The critical value with two over-identifying restrictions is 5.99 and with one the critical value is 3.84. b=the null is that the coefficients on all instruments are zero. c=VA means voice and accountability index. Model specification: 1 includes no additional controls; 2 includes initial investment share; 3 includes population growth; 4 includes the percentage of the population at the beginning of the period in primary education. The corruption perception index is measured on a scale from 0 (most corruption) to 10 (least corruption).

Table 4: Short-run growth rates (1995-2000): IV (GMM) estimates with thresholds and the control of corruption index.

Model specification	1	2	3	4
	Panel A: Instrument set I			
Regime G: VA[c]>0.76 (36 countries)				
Control of corruption	0.82**	0.88**	0.81**	0.81*
	(2.16)	(2.14)	(2.05)	(1.76)
Regime B: VA[c]<0.76 (48 countries)				
Control of corruption	0.17	0.18	0.17	0.17
	(0.72)	(0.74)	(0.75)	(0.67)
First stage tests				
χ^2 (2) test for validity[a]	0.693	0.661	0.861	0.575
F-test for relevance[b]	F(3,80)=36.1***	F(3,79)=36.3***	F(3,79)=35.6***	F(3,78)=35.2***
	Panel B: Instrument set II			
Regime G: VA[c]>0.75 (37 countries)				
Control of corruption	1.16**	1.30**	1.15**	1.20**
	(2.43)	(2.36)	(2.23)	(2.22)
Regime B: VA[c]<0.75 (47 countries)				
Control of corruption	0.21	0.23	0.19	0.21
	(0.85)	(0.90)	(0.82)	(0.83)
First stage tests				
χ^2 (1) test for validity[a]	0.069	0.017	0.069	0.285
F-test for relevance[b]	F(2,81)=56.4***	F(2,80)=58.8***	F(2,80)=57.1***	F(2,80)=55.2***

Notes: Robust t-statistics in brackets; *= significant at 10%; **=significant at 5%; ***=significant at 1%. Instrument set I: size of country, latitude and the voice and accountability index; Instrument set II: age of democracy and the voice and accountability index. Regime specific models estimated with GMM. a=Hansen's J-test for joint null that the extra instruments are valid. The critical value with two over-identifying restrictions is 5.99 and with one the critical value is 3.84. b=the null is that the coefficients on all instruments are zero. c=VA means voice and accountability index. Model specification: 1 includes no additional controls; 2 includes initial investment share; 3 includes population growth; 4 includes the percentage of the population at the beginning of the period in primary education. The control of corruption index is measured on a scale from –1.07 (most corruption) to 2.45 (least corruption).

Table 5: Long-run growth rates (1970-2000): IV (GMM) estimates with thresholds and the corruption perception index.

Model specification	1	2	3	4
	Panel A : Instrument set I			
Regime G: VA^c>0.65 (27 countries)				
Corruption perception index	0.54**	0.54**	0.34**	0.47**
	(2.16)	(2.15)	(2.05)	(2.12)
Regime B: VA^c<0.65 (32 countries)				
Corruption perception index	-0.22	-0.03	-0.64	-0.46
	(-0.19)	(-0.04)	(-0.59)	(-0.33)
χ^2 (2) test for validity[a]	12.66	12.46	12.74	6.04
F-test for relevance[b]	F(3,52)=1.97	F(3.51)=1.66	F(3,51)=1.95	F(3,51)=2.06
	Panel B: Instrument set II			
Regime G: VA^c>0.75 (25 countries)				
Corruption perception index	0.50**	0.33*	0.33**	0.32**
	(2.83)	(1.99)	(2.40)	(2.27)
Regime B: VA^c<0.75 (34 countries)				
Corruption perception index	0.31	0.32	0.63	0.33
	(0.55)	(0.61)	(0.74)	(0.54)
First stage tests				
χ^2 (1) test for validity[a]	0.889	1.852	0.678	0.714
F-test for relevance[b]	F(2,53)=4.78**	F(2,51)=3.56**	F(2,51)=4.47**	F(2,52)=4.83**

Notes: See notes to Table 3.

Table 6: Long-run growth rates (1970-2000): IV (GMM) estimates with thresholds and the control of corruption index.

Model specification	1	2	3	4
	Panel A: Instrument set I			
Regime G: VA^c>0.76 (29 countries)				
Control of corruption	1.73**	1.64**	1.51*	1.63***
	(2.33)	(2.40)	(2.00)	(3.20)
Regime B: VA^c<0.76 (59 countries)				
Control of corruption	1.74	1.84	1.01	3.07*
	(1.32)	(1.34)	(0.86)	(1.92)
First stage tests				
χ^2 (2) test for validity[a]	3.057	2.810	2.269	1.034
F-test for relevance[b]	F(3,80)=6.82***	F(3,79)=6.35***	F(3,79)=6.68***	F(3,78)=5.75***
	Panel B: Instrument set II			
Regime G: VA^c>0.75 (31 countries)				
Control of corruption	1.92**	1.94**	1.71	1.73**
	(2.17)	(2.13)	(1.66)	(2.23)
Regime B: VA^c<0.75 (55 countries)				
Control of corruption	2.47	3.21	2.36	2.08
	(0.97)	(1.01)	(1.06)	(0.81)
First stage tests				
χ^2 (1) test for validity[a]	0.005	0.294	0.006	0.003
F-test for relevance[b]	F(2,81)=8.82***	F(2,80)=7.97***	F(2,80)=8.77***	F(2,80)=8.35***

Notes: See notes to Table 4.

Table A1: Descriptive statistics

Series	Mean	Minimum	Maximum
Institutional Variables			
Corruption perception index[a]	5.06	1.71	9.93
Control of corruption	0.22	-1.07	2.45
Voice and accountability index	0.62	0.3	0.8
Macroeconomic Series			
Per capita GDP growth (1995-2000)[b]	0.74	-1.3	3.4
Investment/GDP (1995)	18.45	5.4	43.9
Per capita initial GDP (1995)	11042	466	34372
Primary Education (1995)	34.6	8.2	62.0
Population Growth (1995-2000)	0.05	-0.07	0.25
Per capita GDP growth (1970-2000)[b]	1.96	-1.92	7.28
Investment/GDP (1970)	17.20	2.07	41.2
Per capita initial GDP (1970)	2801.45	341	12963
Primary Education (1970)	96.22	47.05	122.4
Population Growth (1970-2000)	1.178	-0.08	4.52

Notes: a = The perception corruption index is computed as the simple average of the corruption indexes for the period 1995-2000. b = the growth rate is the average annual rate.

Table A2: List of countries and key variables.

Countries	Long-run growth rates[a]	Short Run Growth Rates[b]	Control of Corruption	Corruption Perception Index	Voice and accountability index
Argentina	0.95	0.26	-0.27	3.00	0.58
Australia	1.85	0.97	1.60	8.70	0.98
Austria	2.65	0.88	1.46	7.60	0.92
Belgium	2.40	-0.16	0.67	5.30	0.91
Bolivia	0.30	3.43	-0.44	2.50	0.55
Brazil	2.68	0.26	0.06	4.10	0.60
Cameroon	1.13	1.33	2.06	9.20	0.88
Canada	1.88	0.67	2.07	3.40	1.00
Chile	2.79	0.87	1.03	6.90	0.63
Colombia	1.99	0.65	-0.49	2.90	0.37
Costa Rica	1.67	-0.24	0.58	5.10	0.88
Denmark	2.08	0.87	2.13	10.00	0.98
Egypt, Arab Rep.	3.31	1.07	-0.27	3.30	0.17
Finland	2.78	2.12	2.08	9.80	0.97
France	2.15	1.74	1.28	6.60	0.81
Germany	1.05	0.87	1.88	NA	0.32
Greece	2.60	0.87	-0.30	3.30	0.26
Honduras	0.49	0.69	-0.82	3.20	0.21
Hungary	2.23	1.19	0.67	NA	0.03
Iceland	2.96	-0.26	-0.94	1.80	0.39
India	2.72	1.20	-0.80	1.70	0.00
Indonesia	4.92	1.58	-0.31	2.90	0.58
Ireland	4.22	-0.59	1.57	7.70	0.93
Israel	2.66	1.37	1.83	9.20	0.92
Italy	2.36	3.08	1.28	6.80	0.79
Jamaica	0.08	1.25	0.80	4.70	0.86
Japan	3.34	0.25	-0.12	3.80	0.67
Latvia	1.58	0.54	-0.13	NA	0.47
Luxembourg	3.27	0.22	2.05	NA	0.97
Malaysia	4.25	0.94	-0.65	2.00	0.16
Mauritius	4.29	1.95	-0.28	3.40	0.37
Mexico	1.59	1.83	-0.53	3.50	0.35
Morocco	1.82	1.54	0.11	NA	0.95
Netherlands	2.07	1.43	0.63	5.10	0.36
Nicaragua	-1.92	0.70	2.03	9.20	0.97
Norway	3.03	0.44	1.69	8.90	0.99
Pakistan	2.53	-0.03	2.07	9.40	0.92
Panama	1.45	1.10	-0.34	NA	0.22
Paraguay	1.98	0.70	-0.77	2.20	0.26
Peru	0.47	0.24	-0.20	4.50	0.17
Poland	1.65	0.59	0.45	NA	0.08
Portugal	3.40	0.29	1.22	6.70	0.93
Romania	0.70	1.56	-0.33	NA	0.90
Senegal	-0.26	-1.15	-0.96	2.00	0.26

Singapore	6.60	-1.31	-0.24	3.40	0.31
South Africa	0.28	1.04	1.95	9.10	0.42
Spain	2.59	0.81	-0.35	3.90	0.37
Sweden	1.64	1.66	2.09	9.40	0.98
Tanzania	0.43	-0.29	-0.98	NA	0.80
Thailand	5.14	1.41	-0.29	NA	0.71
Trinidad and Tobago	2.05	1.31	0.20	NA	0.75
Tunisia	3.09	0.54	0.02	5.00	0.20
Turkey	2.32	0.19	-0.35	3.60	0.11
United Kingdom	1.94	0.30	0.43	4.40	0.68
United States	1.72	1.15	1.41	4.40	0.93
Uruguay	1.64	-0.65	0.30	5.00	0.76
Venezuela	-0.70	0.13	-0.76	NA	0.59
Zambia	-1.58	0.54	-0.61	3.50	0.39
Zimbabwe	1.44	-1.22	-0.32	4.10	0.17
Angola	-1.46		-1.16	NA	0.20
Bangladesh	1.32		-0.61	NA	0.43
Botswana	7.28		0.69	NA	0.75
Burundi	0.15		-1.01	NA	0.18
Central African Republic	-0.74		-0.91	NA	0.41
China	6.87		-1.10	1.50	0.16
Ecuador	1.91		-0.82	2.40	0.50
El Salvador	0.25		1.21	6.60	0.88
Georgia	-0.89		-0.86	NA	0.14
Ghana	-0.07		1.71	8.60	0.93
Guatemala	1.00		0.82	4.90	0.78
Haiti	-0.77		-1.13	NA	0.28
Hong Kong, China	5.46		1.31	7.70	0.38
Iran	-0.53		-0.60	NA	0.35
Iraq	-4.85		-1.33	NA	0.37
Jordan	2.13		0.14	4.40	0.46
Kenya	1.34		0.72	6.00	0.81
Korea, South	6.84		-0.74	NA	0.33
Lesotho	3.29		0.05	NA	0.28
Malta	6.34		0.51	NA	0.83
Mozambique	0.89		0.34	4.90	0.76
Myanmar	1.96		-1.26	NA	0.00
New Zealand	1.28		-0.84	3.10	0.43
Nigeria	1.46		-1.15	NA	0.18
Philippines	1.14		-0.23	3.60	0.62
Saudi Arabia	0.60		0.16	NA	0.26
Swaziland	2.26		-0.21	NA	0.53
Syria	3.09		-0.57	NA	0.93
Uganda	2.40		-0.47	2.20	0.23

Notes: a. 1970-2000; b. 1995-2000. The dataset for the short-run growth rates is substantially shorter than that for the long-run growth rates because of missing information on the control variables for the mid 1990s.