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Corruption, governance, investment and growth in emerging markets[1]

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The article investigates the potential impact of corruption on economic growth by examining the effect that corruption may have on several significant determinants of economic growth, namely, investment in human, private and public capital, and on governance. Our theoretical approach allows for corruption to influence economic growth directly and indirectly through different investment and governance channels. All previous empirical work on this issue has been based on national income and product accounts (NIPA) data, which do not normally break down gross domestic investment into its private and public sector, and if they do, they misclassify investment by public enterprises as private investment, potentially biasing empirical findings. In this article we use a data set from the International Finance Corporation that bypasses these problems. We find that the impact of corruption on the level of public investment appears to be more ambiguous than it has been found in the previous literature. We, however, find that the impact of corruption on the accumulation of private capital is significantly more damaging than what has been previously found. We also find that the impact of corruption on governance is unambiguously negative, which further deters economic growth.

I. Introduction

Corruption, commonly defined in the literature as the abuse of public power for private benefit, is a pervasive and universal phenomenon, and affects almost every culture to differing degrees. As witnessed throughout history, corruption can affect democratic and non-democratic countries, rich and poor countries, and the public and private sectors alike. In very recent times, corruption, or the allegation of corruption, has been instrumental in the reorganization of the political system in Italy, the change of governments in Indonesia, Japan, Peru and the Philippines, the collapse of governmental authority in Zaire, and

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the bankruptcies of Arthur Andersen, Enron and MCI, among others.

From the perspective of economic growth and development, corruption poses a threat to investment for several reasons: it reduces public and private sector efficiency when it enables people to assume positions of power through patronage rather than ability; distorts the financial economic and environment; and, at the limit, introduces instability and anarchy into the political process. There is a sizable literature, reviewed in the next section that has examined the influence of corruption on investment. However, practically all this work has been based on national income and product accounts (NIPA) data, which do not normally break down gross domestic investment into its private and public sector components, especially in the case of developing and transitional countries. Even when NIPA reports contain disaggregated investment data, private investment data often includes investment by state-owned enterprises (SOE) (Pfeffermann *et al*., 1997; Everhart and Sumlinski, 2001). This classification tends to confuse the different decision making processes that stand behind private and public investment and potentially biases the empirical results. It is for these reasons that, for example, the International Finance Corporation's (IFC) definitions of public and private investment requires SOE investment be correctly identified as public, not private investment.

In this article, we re-examine the theoretical link between corruption and the accumulation of human, private and public capital and the rate of economic growth, and second, we test for the empirical validity of these links employing a new database using the IFC's definitions of public and private investment. Our theoretical model allows for corruption to influence economic growth directly and indirectly through investment and governance channels. As we note below, many of the previous examinations of the impact of corruption either explore corruption's direct impact on economic growth or a specific area of interest (investment, human capital formation, rule of law, among others) but fail to differentiate among the channels through which corruption may influence economic growth. While we find that the impact of corruption on the level of investment appears to be more ambiguous than previously suggested in the literature, we also find that the impact of corruption on the accumulation of human capital is significantly more damaging than what has been previously found. We also find that the impact of corruption on governance is unambiguously negative, which further deters economic growth.

The paper is structured as follows. In Section II, we review the previous literature on corruption, capital accumulation and their impact on growth. In Section III we develop a theoretical model that explicitly incorporates corruption's direct and indirect influences on economic growth. In Section IV, we empirically investigate the existence and significance of the hypothesized direct and indirect impacts of corruption on capital accumulation and economic growth. In the last section, we conclude.

II. Literature Review

Why do we care about the impact of corruption? A predictable economic environment is important for private investors. When investors are assured that the returns on enterprise and investment accrue to the entrepreneur and investor, investment is more likely to ensue. An environment where corruption and bribery are prevalent creates a situation where investment returns are difficult to predict. An unstable economic environment has two primary effects on private investment decisions: expected returns are lowered due to increased costs, and two, the dispersion of outcomes, and therefore risk, is larger. (Johnson *et al*.,. 2000). As noted in the seminal work of Mauro (1995, 1998), both effects serve to limit investment, which is critical to long-run, sustainable economic development. In this section we briefly review previous work on the impact of corruption on governance, capital accumulation and growth.

Investigating the impact of corruption is not a new concept, yet quantifying the impact remains elusive (Theobald, 1990; Rose-Ackerman, 1999; Jain, 2001; Tanzi, 2002). A recent transitional country survey suggests that almost 40% of new enterprise expenses are consumed by informal payments (IMF, 2000). Only 13% of central government education transfers for nonwage expenditures in Uganda reached local governments during 1991–1995, the remainder were either appropriated for noneducation purposes or corrupt activities (Reinikka and Svensson, 2004). While we must express a note of caution with respect to surveys that ask potential participants and victims of corrupt practices to report on the magnitude and frequency of such practices (Reinikka and Svensson, 2003; Svensson 2003); there appears to be sufficient consensus in the literature that less corruption might translate into more resources available for private investment. Moreover, strengthened public revenues as a result of less 'leakage' due to corruption could translate into more public services or reduced taxes.

Although one might expect a broad consensus to exist concluding that corruption is bad, some authors have argued that under the proper circumstances, corruption may facilitate faster growth by serving as an 'efficient grease' (Braguinsky, 1996; Kaufmann and Wei, 2000). Corruption can also be used to reverse errors in judgment by the government (Leff, 1989). Bribery may allow 'better' firms to bypass red tape and thus reward market performance (Lui, 1985). Excessive regulation could be muted by bribery and, in some circumstances, corruption may be efficiency enhancing (Bardhan, 1997). Corruption incorporates otherwise alienated groups, integrates them, and provides them with an alternative to violence (Huntington, 1968). Finally, corruption among politicians may serve as the glue holding a country together, suggesting that corruption may lower the probability of conflict and indirectly enhance economic growth (Graziano, 1980; Huntington, 2002).

Despite these interesting perspectives on corruption, the economics literature generally disapproves of such practices. Firms that spend more management time with bureaucrats pay more in bribes and also pay a higher cost of capital (Kaufmann and Wei, 2000). Corruption may strain the linkages between taxes and public sector goods and services and thus promote tax evasion and the growth of the unofficial economy (Loayza, 1996; Johnson *et al*., 1997, 1998). Higher levels of corruption and bureaucratic inefficiency appear to positively influence the unofficial economy's share of GDP (Frye and Zhuravskaya, 2000; Johnson *et al*., 2000; Schneider, 2000; Alexeev and Pyle, 2003; Hellman *et al*., 2003).

Corruption has been found to limit economic development by inhibiting growth in per capita income, child mortality and literacy (Mo, 2001; Kaufmann *et al*., 2003). Corruption also appears to adversely affect public and private investment, although questions remain on the data and methodology employed in these studies (Mauro 1995, 1998; Tanzi and Hamid, 2000; Wei, 2000; Del Monte and Papagni, 2001; Habib and Zurawicki, 2002). Corruption may also affect economic policy by distorting the judgment of policymakers (Bai and Wei, 2000, 2001). Corruption cannot be assumed to be exogenous from the distortions it creates in the allocation of resources; distortions that create incentives for increased corruption. Although specific methodologies raise doubts about issues of causation, the consensus in the literature appears to suggest that corruption is negatively related to several crucial economic variables.

If one accepts the current consensus in the literature that corruption negatively influences private and public sector outcomes, improving governance may be one way of combating corruption. Corruption thrives where states are too weak to control their own bureaucrats, to protect property and contract rights and to provide the institutions that underpin an effective rule of law (Broadman and Recanatini, 2002; Eigen, 2002; Rivera-Batiz, 2002; Brunetti and Weder, 2003; Mauro, 2004). Improving political accountability appears, as this line of reasoning goes, to improve governance and reduce corruption. Accountability allows for the punishment of politicians who adopt bad policies and the limitation of bureaucratic monopoly power, thereby more closely aligning politicians' and bureaucrats preferences with those of the populace (Rose-Ackerman, 1998, 1999; Laffont and Meleu, 2001; Djankov *et al*., 2002). Democratic elections, parliamentary systems, political stability, fiscal decentralization and freedom of the process all appear to be associated with lower levels of corruption (Andvig, 1999; Tanzi, 2000; Martinez-Vazquez and McNab, 2003). Curiously, while the topics of corruption, investment, governance and growth have garnered a significant amount of attention in the recent literature, there is a paucity of theoretical models explicitly examining the outcomes of corruption. In many cases, the study of corruption has focused on the causes and determinants of corruption rather than the outcomes of corruption (Gyimah-Brempong, 2002; Ali and Isse, 2003; Persson *et al*., 2003; Shleifer and Vishny, 1993).

More recently, empirical work by Pellegrini and Gerlagh (2004), Papyrakis and Gerlagh (2004) and Mo (2000, 2001) has analyzed the influence of corruption through various channels on economic growth. In general, these studies find that corruption retards economic growth, primarily through its detrimental impact on investment and international trade. More importantly from the perspective of our study, Pellegrini and Gerlagh (2004) note that there appears to be no statistically significant direct relationship between corruption and economic growth once other relevant factors are controlled for. While Pellegrini and Gerlagh (2004) is among the first studies attempting to examine the indirect channels through which corruption may impacts economic growth, their study relies on a cross-sectional approach and upon investment data that classifies SOE investment as private investment. Further, as pointed out by Islam (2004), unobserved fixed country effects and potential multicollinearity between explanatory variables are likely to have introduced biases in the estimation of the impact of corruption on economic growth in this previous literature. Our empirical work in this article strives to control for these estimation problems. With these findings in mind, we turn to the derivation of the theoretical model.

III. A Simple Model of Corruption, Investment and Growth

While the potential influence of corruption on output through investment is not one of the conventional arguments for anti-corruption efforts, ignoring this potential effect, we believe, may inject *a priori* bias into our analysis. In this section we propose to examine the impact of corruption within a neoclassical model of output; this allows us to explore how corruption and governance may influence investment, examine possible tradeoffs between public and private investment, and at the same time control for all other relevant variables affecting economic growth.

Following Romer (1986), Mankiw *et al.* (1992) and Islam (1995), we assume a Cobb—Douglas production function for the economy such that production at time t is given by

$$Y_t = V_t K_t^{\alpha} G_t^{\beta} H_t^{\varphi} L_t^{\theta} \tag{1}$$

where $\alpha,\ \beta,\ \varphi,\ \theta > 0$ and $\alpha+\beta+\varphi+\theta \geq 1$. In Equation 1, Y_t is the output, V_t the level of technology and other institutional factors, K_t, G_t and H_t are the stocks of private, public and human capital, and L_t is labour at time t, respectively.[2] We define V_t as the product of the level of technology and other institutional factors at time t or

$$V_t = A_t C_t Z_t \tag{2}$$

where V_t is the exogenous level of technology, C_t the level of corruption and Z_t is a row vector of exogenous variables that may influence output.[3] Note that C_t is synonymous with the direct effect of corruption on output. If corruption indirectly influences output through its impact on investment, *certius paribus*, then it will indirectly influence economic output through either K_t, H_t, or G_t.

We further assume that output is subject to decreasing returns to scale with respect to physical and human capital. This implies that the economy, over the long-run, will tend to constant private capital-labour, human capital-labour and public capital-labour ratios.[4] Once steady-state output is achieved, additional increases in per capita output can only be achieved through increases in capital productivity or decreases in the level of corruption (assuming that the overall effect of corruption on economic growth is negative).[5] It is this perspective that interests us in this article: corruption may affect output through two channels, a potential direct effect on output, and a series of potential indirect effects through the physical inputs in the production function.

To determine the influence of corruption on economic growth, we must first determine the steady-state levels of the physical inputs in the production function. We assume that the same production function applies to all forms of reproducible capital and consumption so that one unit of capital can be freely transformed into one unit of consumption and vice versa. Labour is assumed to grow exogenously at rate n, technology at rate w, capital depreciates at rate δ and corruption changes at rate c. Assuming decreasing marginal returns to all forms of reproducible capital; that no combination of capital inputs exhibits constant marginal returns; expanding V_t and taking the natural logarithm yields from (1) and (2) the steady-state level of output per effective unit of labour can be expressed by: [6]

$$\begin{aligned}\ln y_t^* = {} & \frac{\alpha}{1-\alpha-\beta-\varphi}\ln i_k + \frac{\beta}{1-\alpha-\beta-\varphi}\ln i_h \\ & + \frac{\varphi}{1-\alpha-\beta-\varphi}\ln i_g \\ & - \frac{\alpha+\beta+\varphi}{1-\alpha-\beta-\varphi}\ln(n+g+\delta+c)\end{aligned} \tag{3}$$

where i_k, i_g and i_h are the fractions of output invested in private, public and human capital, respectively. Transforming (3) into differences in per capita output, noting that $\lambda = (n+g+\delta+c)(1 - \alpha - \beta - \varphi)$, and defining y_0 as the initial level of per capita

[2] A complete derivation of the theoretical model is available upon request.
[3] At this time, for theoretical simplicity, we assume that corruption and the set of exogenous variables are uncorrelated.
[4] The growth model specified in Equation 1 can be either a Solow-augmented neoclassical growth model with constant returns to scale for all production factors ($\alpha+\beta+\varphi+\theta = 1$), or an endogenous growth model with increasing returns to scale for all production factors ($\alpha+\beta+\varphi+\theta \geq 1$). Also, if any combination of the capital inputs exhibits constant returns to scale ($\alpha+\beta = 1$, $\beta+\varphi = 1$, $\alpha+\varphi = 1$) then Equation 1 would similarly be characterized as an endogenous growth model. Senhadji (1999) noted that a large part of the empirical growth literature supports the assumption of decreasing returns to capital.
[5] While changes in resource endowments (the discovery of new resources or a cure for AIDS) may affect short-term capital-labour ratios, these changes would not necessarily affect the steady-state capital-labour ratio unless these changes influenced capital productivity. Gerson (1998) argues that since the convergence to the new steady state may take years to occur, fiscal policy can still lead to higher output growth rates for a significant period of time, even though the neoclassical model might imply that these policies would affect only the level of output and not its long-run growth rate.
[6] The effective unit of labour is the technology augmented unit of labour; see Islam (1995).

output, the evolution of per capita output over time can be expressed as:

$$\dot{y} = (1 - e^{-\lambda t})[\ln A_t + \ln C_t + \ln Z_t + \frac{\alpha}{1-\alpha-\beta-\varphi}\ln i_k + \frac{\beta}{1-\alpha-\beta-\varphi}\ln i_h + \frac{\varphi}{1-\alpha-\beta-\varphi}\ln i_g - \frac{\alpha+\beta+\varphi}{1-\alpha-\beta-\varphi}\ln(n+g+\delta+c) - \ln y_0 - e^{-\lambda t}\ln A(0) - e^{-\lambda t}\ln C(0) - e^{-\lambda t}Z(0)] \quad (4)$$

We illustrate in (4) the direct and indirect influence of corruption on the evolution of per capita output over time. Corruption may directly influence per capita output, that is, increased levels of corruption C retard per capita output growth. Corruption may also indirectly influence per capita output growth by inhibiting the accumulation of public, private and human capital. Efforts to lower corruption may have immediate direct and indirect positive influences on the evolution of per capita output over time.

An advantage of our theoretical approach over the models used in previous papers is our explicit examination of the out-of-steady-state dynamics. In addition, we also make the explicit difference between the bounded institutional factors in the production function and the physical inputs in the production function. The bounded institutional factors directly influence economic growth while the physical inputs are weighted by the ratio of their output share to labour's share of output. Finally, we explicitly capture the unobservable initial conditions in the theoretical model. Empirically, Equation 4 suggests that corruption is an explanatory variable in the evolution of private, public and human capital over time. When investigating the evolution of per capita output, corruption may enter directly as an explanatory variable or indirectly as an interaction term with other variables of interest.

Two problems may arise with our derivation of the steady-state production function and the equation for the convergence to the steady-state output level. First, if countries have permanent differences in technology, then these differences would enter as part of the error term and be positively correlated with initial per capita output. Permanent variations in technology could bias the estimated coefficient on initial per capita output toward zero. Second, while countries may not have permanent variations in technology, they may have permanent variations in their institutional factors (colonial legacy, legal system, climate, geographical region) that would also enter as part of the error term. We try to address these issues in the empirical estimation below.

IV. Data

Being aware of the various limitations of measures of corruption discussed in the literature, we utilize the corruption index from Political Risk Service's International Country Risk Guide (ICRG) which has been previously employed in the economics literature (Knack and Keefer, 1995; Knack, 2001; Rajkumar and Swaroop, 2002; Tanzi and Davoodi, 2002). The ICRG attempts to measure corruption by investigating whether high-ranking government officials are likely to demand special payments and if illegal payments are generally expected in lower levels of government.[7] For convenience, we rescale the ICRG index originally in a scale from 0 (most corruption) to 6 (least corruption) into a new index ranging from 0 (absence of corruption) to 1 (complete corruption). The ICRG database has monthly ratings for over 100 countries from 1984 to present.[8] We follow a similar approach to re-scale the ICRG index for bureaucratic quality, which we use as a proxy for institutional quality and the strength of the public service.[9]

Turning to the measurement of public and private investment, we define private investment as the difference between total gross domestic investment and consolidated public investment.[10] This approach is necessary, we argue, to remove the potential bias introduced by the fact that SOEs' capital spending and other types of public investment are normally reported as private investment in the national income

[7] For additional information on the International Country Risk Guide, see http://www.icrgonline.com

[8] We choose not to employ Transparency International's Corruption Perceptions Index due to the short length of the time series and the variability in the measurement methodologies over time. We also choose not to employ the World Bank's 2000 World Business Environment Survey (http://info.worldbank.org/governance/wbes) as we wished to investigate the evolution of corruption, investment and growth across time. We do note, however, that the ICRG index correlates highly with the Transparency International's Corruption Perceptions Index for the 1996–2002 periods.

[9] The precise ICRG definition of their measure is as follows: the institutional strength and quality of the bureaucracy is another shock absorber that tends to minimize revisions of policy when governments change. Therefore, high points are given to countries where the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services. In these low-risk countries, the bureaucracy tends to be somewhat autonomous from political pressure and to have an established mechanism for recruitment and training.

[10] For a detailed discussion of the investment data employed in this research, see Everhart and Sumlinski (2001).

accounts data. Consolidated public investment data for each country were compiled primarily from the World Bank Country Economic Memoranda, Public Investment Reviews, Public Expenditure Reviews and other World Bank and IMF country reports. Where World Bank data were not available, country data obtained from government officials and websites were used. Sixty-three countries are represented in the investment data.[11]

When we merge the investment data with the corruption and governance measures, our sample falls to 50 developing and transitional countries.[12] We do, however, believe that this is still the largest panel of public and private investment data to date for developing and transitional economies. Our final sample covers 50 countries for the period 1984–1999 with a total of 684 observations.[13]

V. Econometric Model and Empirical Estimation Issues

We must first note that, unlike our study which employs panel data, the majority of the research on the impact of corruption has been done with cross-sectional data. In addition, much of the work on investment in emerging markets has also relied on cross-sectional data. Those time-series analyses that do exist are largely country-specific.

Our empirical strategy is straightforward. We first examine whether serial correlation is present using a Durbin—Waston test for OLS regressions and a Bhargava *et al.* (BFN) (1982) test based upon the residuals of the Within estimator for the panel data regressions. If serial correlation is present, we first difference the data and test whether serial correlation is present in residuals from the estimations employing first differenced data. We then test for heteroskedasticity using Breusch—Pagan (1980) for the OLS estimations as, for example, suggested by Koenker and Bassett (1982). For panel data estimators, we employ the Koenker and Bassett (1982) test using the Within or GLS residuals, as appropriate. To correct for heteroskedasticity, if present, we use the White (1980) heteroskedastic consistent covariance estimator. Baltagi (1995) points out that even if we have homoskedastic errors, there is no penalty associated with the incorrect use of the White heteroskedastic consistent covariance estimator for the OLS or Within models. Thus, even if there are models we have incorrectly diagnosed as being heteroskedastic when they are not, the parameter estimates are not adversely affected.

For questions of endogeneity, we follow Hausman (1978), Hausman and Taylor (1981) and Baltagi (1995). To calculate Hausman test statistics, we must have a sufficient number of independent regressors. One difficulty is the number of available instruments that are independent. Anderson and Hsiao (1981) present a ready solution when using panel data in differences. In the case of first-differenced panel data, an appropriate instrument is the second-period lagged *level* of the regressor in question. The choice of instruments should be correlated with the endogenous variable but not with the contemporaneous value of the dependent variable; the second-period lagged level of the regressor in question typically meets these requirements. It is this lack of available instruments that precludes us from estimating the equations below as a system.

What is the impact of corruption on private investment? To investigate the influence of corruption, we employ the pooled OLS estimator, one-way country-specific error components estimator, the one-way time-effects errors component estimator and the two-way error components estimator.[14] We hypothesize that private investment is a function of public investment, the quality of governance, and, among other explanatory variables, corruption, or

$$I_{it}^{P} = \beta_1 C_{it} + \beta_2\left(C_{it}I_{it}^{G}\right) + \beta_3 I_{it}^{G} + \beta_4 Q_{it} + \beta_5 Z_{it} + \mu_i + \lambda_t + \nu_{it} \quad (5)$$

where $I^{P}{}_{it}$ is private investment, C_{it} is corruption, $I^{G}{}_{it}$ is public investment, Q_{it} is the quality of governance, $C_{it} * I^{G}{}_{it}$ is the interaction between corruption and public investment and Z represents an array of conditioning variables. The error term is composed of μ_I, the unobservable country-specific effect, λ_t, the unobservable time specific effect and the white-noise stochastic disturbance term, ν_{it}. The subscripts i and t refer to country i during year t, respectively. We note the presence of serial correlation in the error terms

[11] See Appendix A for the countries included in the sample used for this study.
[12] Comparable data for developed countries are not available at this time. Future research could focus on developing similar measures for developed countries.
[13] See Appendix B for the variables included in the sample.
[14] The full set of estimation results is available upon request.

when the base estimation equation is estimated in levels and thus specify the equation in first differences (Table 1).[15]

Testing for the presence of endogeneity of public investment in (5)[16], we fail to reject the null hypothesis of exogeneity for private investment with respect to the public investment.[17] We also note the presence of heteroskedasticity (Table 2). We then examine whether the random effects GLS estimator or fixed effects Within estimator is more appropriate for the estimation of (5). While we would prefer to use the random effects estimator to avoid the loss of degrees of freedom associated with the use of the Within estimator, we reject the null hypothesis that the regressors and effects are uncorrelated. As this result suggests that the random effects estimator would be inconsistent, we use the fixed effects estimator for the estimation of the relationship between private investment, public investment and corruption. Finally, we examine whether the fixed effects are jointly significant, that is, whether the time and country-specific effects are significant. Curiously, the time and country-specific effects are insignificant, regardless of the set of conditioning variables, suggesting the pooled OLS estimator is the most efficient estimator.

From this article's perspective, the two most important results are that the estimated coefficients for public investment and the corruption interaction term are relatively large and statistically significant with the expected negative sign (Table 3). These results hold when we re-estimate (5) without the statistically insignificant quality of bureaucracy variable and under various alternative specifications. The results appear to suggest that crowding-out is present among the sample countries during the observed periods. Curiously, corruption by itself is statistically insignificant, thus suggesting that corruption does not directly influence private investment, but that it does indirectly through its impact on public investment. This result complements the cross-sectional results of Dreher and Herzfeld (2005) who also fail to detect a statistically significant direct effect for corruption, although for aggregate investment only.

What is the impact of corruption on public investment? Turning to the question of the impact of corruption on public investment, we employ the same approach above for private investment. Following our theoretical model, we allow corruption to directly influence the accumulation of public capital and indirectly through its influence on the quality of the bureaucracy and the accumulation of private investment. Using the same variable notation as in (5), the base estimation equation for the change in public investment is

$$I^G_{it} = \beta_1 C_{it} + \beta_2 \left(C_{it} I^P_{it}\right) + \beta_3 I^P_{it} + \beta_4 Q_{it} + \beta_5 Z_{it} + \mu_i + \lambda_t + \nu_{it} \qquad (6)$$

Again, we note the presence of serial correlation in the error terms when the base estimation equation is estimated in levels and thus specify the equation in first differences.[18]

Testing for the presence of endogeneity of private investment in (6)[19], again we fail to reject the null hypothesis of exogeneity for private investment with respect to the public investment.[20] When investigating whether the random effects GLS estimator is more appropriate than the fixed effects Within estimator, we again reject the null hypothesis that the regressors and effects are uncorrelated and thus employ the fixed effects estimator. Lastly, when we examine whether the fixed effects are jointly significant, we find the time-specific effects to be statistically significant and thus employ the one-way time-specific fixed effects error components estimator.

An important result is that corruption is not statistically significant, whether through its direct effect or its indirect effect through private investment (Table 4). This result is striking and contrary to the results of the majority of the previous literature, with the previously noted exception of Dreher and Herzfeld (2005). This result holds when we re-estimate (6) without the statistically insignificant

[15] We reject the null hypothesis of no serial correlation at the 1% significance level using a Durbin–Watson test for serial correlation. Re-specifying the model in first differences, we fail to reject the null hypothesis.

[16] We fail to reject the null hypothesis of exogeneity with a Hausman test statistic of 0.08 with 565 degrees of freedom.

[17] We employ different alternatives of conditioning variables to examine whether this result is robust and conclude that we fail to reject the null hypothesis with the given set of countries, time periods and explanatory variables. We also fail to reject the null hypothesis of exogeneity for corruption, the interactive term, and the conditioning variables, to include Current Account Balance as a percentage of GDP, Broad Moneyas a percentage of GDP and External Trade as a percentage of GDP.

[18] We reject the null hypothesis of no serial correlation at the 1% significance level using a Durbin–Watson test for serial correlation. Re-specifying the model in first differences, we fail to reject the null hypothesis of no serial correlation.

[19] We fail to reject with a Hausman test statistic of 2.07 with 678 degrees of freedom.

[20] We employ different alternatives of conditioning variables to examine whether this result is robust and conclude that we fail to reject the null hypothesis with the given set of countries, time periods and explanatory variables. We also fail to reject the null hypothesis of exogeneity for corruption, the interactive term and the conditioning variables, to include Current Account Balance as a percentage of GDP, Broad Money as a percentage of GDP and External Trade as a percentage of GDP.

Table 1. Testing for serial correlation (data in levels)

Dependent variable N = number of observations	Durbin-Watson OLS	BFN One-way fixed effects - Country	BFN One-way fixed effects - Time	BFN Two-way fixed effects
Private investment/GDP $N = 684$	0.4319	0.0468	0.2108	0.2326
Public investment/GDP $N = 684$	0.3131	0.0632	0.0549	0.1519
Quality of bureaucracy $N = 684$	0.4875	0.0206	0.0187	0.3199
GDP growth $N = 680$	1.541	0.7945	1.063	1.508
Human capital-infant mortality $N = 652$	0.2127	0.0023	0.0031	0.0048

Table 2. Testing for heteroscedasticity

Dependent variable N= number of observations	B-P OLS	K-B One-way fixed effects-Country	K-B One- way fixed effects-Time	K-B Two-way fixed effects
Private investment/GDP $N = 684$	18.36	23.36	3.04	10.73
Public investment/GDP $N = 684$	16.85	427.73	397.56	230.99
Quality of bureaucracy $N = 684$	28.27	2.13	.26	7.23
GDP growth $N = 680$	35.36	647.77	647.91	647.88
Human capital-infant mortality $N = 652$	27.78	602.04	606.66	607.55
Human capital-life expectancy $N = 381$	20.15	597.95	597.60	597.61

Table 3. Estimation results

	Dependent variable			
Explanatory variables	Private investment/GDP	Private investment/GDP	Public investment/GDP	Public investment/GDP
Interaction: C* (Pub Inv/GDP)	−0.466 (0.242)*	−0.455 (0.241)*		
Quality of bureaucracy	0.767 (1.36)		−0.488 (1.94)	1.96 (1.62)
Public investment/GDP	−0.342 (0.066)***	−0.343 (0.065)***		
Current Account Balance/GDP	−0.265 (0.035)***	−0.266 (0.035)***		−0.154 (0.042)***
Trade/GDP	0.099 (0.011)***	0.993 (0.012)***	0.045 (0.010)***	0.055 (0.015)***
Broad money/GDP	0.085 0.019)***	0.084 (0.019)***		
Private iInv/GDP			−0.099 (0.059)*	−0.256 (0.075)***
Corruption			0.822 (1.88)	2.53 (1.71)
Constant	0.031 (0.097)	0.024 (0.095)		
R^2	0.031	0.358	0.107	0.258
df	565	566	678	601
Estimator	Pooled OLS	Pooled OLS	Within one-way time effects	Within one-way time effects

Note: ***, ** and * denote significance at the 1, 5, and 10% level, respectively. White corrected SEs are reported.

quality of bureaucracy variable and under various alternative specifications. The estimated coefficient for the quality of the bureaucracy is quite fragile with respect to the inclusion of the time-specific effects, suggesting that previous results may merely be capturing a proxy effect. The crowding out effect noted in the estimation of (5) appears again, suggesting that crowding out does occur in the sample countries and time periods.

We must caution, however, that other explanations exist for the lack of significance of corruption and the quality of bureaucracy variables. We are estimating with panel data in first differences, not in levels or cross-section as with previous analyses in

Table 4. Estimation results

Explanatory variables	Dependent variable: Human capital: infant mortality		Human capital: infant mortality		Quality of bureaucracy (Governance proxy)		Growth		Growth	
Quality of bureaucracy	12.50	(13.45)					3.60	(1.72)**	3.86	(1.60)**
Public investment/GDP							0.141	(0.151)	0.066	(0.174)
Private iInvestment/GDP							0.269	(0.093)***	0.400	(0.115)***
Budget deficit as% GDP									0.242	(0.094)**
Interaction: corruption*aid as% government expenditures			1.40	(0.574)**						
Interaction: corruption*public investment/GDP			12.83	(5.73)**	−0.019	(0.015)*				
Corruption	22.73	(11.15)**	7.79	(4.77)*	−0.124	(0.057)**	−2.41	(2.38)	−2.79	(2.43)
Aid as% of imports									−0.083	(0.094)***
Per Capita GDP	−0.008	(0.001)***	−0.0088	(0.003)***						
Human capital proxy: infant mortality							0.031	(0.023)		
Constant							0.016	(0.224)	−0.124	(0.234)
R^2	0.457		0.46		0.653		0.04		0.075	
df	572		364		568		582		431	
Estimator	Within one-way time effects		Within 1-way country effects		Within one-way time effects		Pooled OLS		Pooled OLS	

Note: ***, **and * denote significance at the 1, 5 and 10% level, respectively. White corrected SEs are reported.

the literature. Another explanation of the lack of significance is also related to our estimating panel data in differences. When estimating in differences we are attempting to determine if the changes in bureaucratic quality and corruption induce changes in the level of investment. We are not smoothing the data as is often the case with cross-section analysis; we are attempting to capture unobserved time and country-specific effects. Finally, corruption may in fact have confounding effects on public investment. On the one hand, we would expect lower corruption to lead to more responsive public sector, with higher tax morale by taxpayers and easier time for government for financing necessary and desirable infrastructure. On the other hand, it has been well established in the corruption literature that corrupt officials are more likely to favour public spending in infrastructure as the best vehicle to get kickbacks and bribes. So therefore, both lower and higher levels of corruption would seem could lead to higher levels of public investment. From this perspective, it may not be surprising that econometric results for corruption on public investment are not statistically different from zero. This is clearly an area in need of future research.

What is the impact of corruption on human capital? Measuring the potential impact of corruption on the accumulation of human capital is, understandably, a difficult task. As with measuring corruption, we must employ imperfect proxies for human capital. Given our desire to investigate the influence of corruption across countries and time, school-based measures of human capital are unavailable to us.[21] However, we can employ an outcome based measures of human capital accumulation, namely infant mortality per 1000 live births. Our estimating equation for the change in human capital, H, is:

$$H_{it} = \beta_1 C_{it} + \beta_2 y_{it} + \beta_3 Q_{it} + \beta_4 Z_{it} + \mu_i + \lambda_t + \nu_{it} \tag{7}$$

where y is the change in per capita GDP. We add public health expenditures as a percentage of GDP as a conditioning variable for these regressions. Again, we note the presence of serial correlation in the error terms when the base estimation equation is estimated in levels and thus specify the equation in first differences.[22] Testing for the presence of endogeneity of corruption in (7),[23] we fail to reject the null hypothesis of exogeneity.[24] When investigating whether the random effects GLS estimator is more appropriate than the fixed effects estimator, we again reject the null hypothesis that the regressors and effects are uncorrelated and thus employ the fixed effects estimator.

From this article's perspective, the most important result is the fragility of the corruption variable to different specifications. In the most parsimonious specification, without public health expenditures as a percentage of GDP, corruption is positive and statistically significant. Including public expenditures as a percentage of GDP does reduce the number of observations significantly and the estimated coefficient for corruption becomes insignificant. Finally, re-specifying the equation to investigate whether corruption directly and indirectly influences the accumulation of human capital, we find that the direct effect of corruption is one-third of the one obtained in the parsimonious specification and that the indirect effect through public investment is positive and significant. The message is clear, however, corruption does have a cost in terms of human capital. These results echo those of Mo (2001) who notes that corruption lowers average schooling (a viable proxy in cross-sectional samples) by 0.25 years. Dreher and Herzfeld (2005) also note that an increase in the corruption index by one point appears to lower school enrollment and life expectancy by five percentage points and 2.5 years, respectively.

What is the impact of corruption on governance? While recent empirical evidence suggests that governance positively and significantly influences economic growth, the evidence is far from conclusive. As with our previous estimations, we hypothesize that corruption may impact the quality of governance directly and also indirectly through the impact of corruption

[21] A number of authors have used education as a proxy for human capital in growth regressions, and we investigated this route for our research as well. However, education data for such a broad *panel* of emerging market economies is not available. However, we merged the education dataset from Lee and Barro (2001) with our panel for the overlapping years and countries to investigate whether infant mortality and education were related. Using data for 35 of our countries for the years 1985, 1990 and 1995, we find a correlation of 0.71 between the two series, leading us to conclude that much of the informational content in an education proxy is also contained in our primary proxy for human capital, infant mortality.

[22] We reject the null hypothesis of no serial correlation at the 1% significance level using a Durbin–Watson test for serial correlation. Re-specifying the model in first differences, we fail to reject the null hypothesis of no serial correlation.

[23] We fail to reject with a test statistic of 0.2127 with 652 degrees of freedom.

[24] We employ different alternatives of conditioning variables to examine whether this result is robust and conclude that we fail to reject the null hypothesis with the given set of countries, time periods and explanatory variables. We also fail to reject the null hypothesis of exogeneity for public health expenditures as percentage of GDP.

on public investment. We estimate the following equation:

$$Q_{it} = \beta_1 C_{it} + \beta_2 C_{it} * I_{it}^G + \beta_3 y_{it} + \beta_4 Z_{it} + \mu_i + \lambda_t + \nu_{it} \quad (8)$$

Again, we note the presence of serial correlation in the error terms when the base estimation equation is estimated in levels and thus specify the equation in first differences.[25] Testing for the presence of endogeneity of corruption in (8),[26] we fail to reject the null hypothesis of exogeneity.[27] When investigating whether the random effects GLS estimator is more appropriate than the fixed effects Within estimator, we again reject the null hypothesis that the regressors and effects are uncorrelated and thus employ the fixed effects estimator.

Both corruption's direct effect and the interaction term between corruption and public investment are statistically significant and have the expected negative sign. The explanatory power of this equation is among the highest of any we report in this article. Further, this relationship is robust to the inclusion of various conditioning variables in the Z matrix. Hence we conclude that increases in corruption are associated with declines in the quality of the bureaucracy.

What is the impact of corruption on economic growth? We turn now to the question of whether corruption significantly influences economic growth. As suggested by Equation 4 of the theoretical model, GDP growth is a function of human and physical capital, and macroeconomic conditions, as the literature suggests, but also corruption and governance. Thus, we specify the estimation equation for GDP growth as

$$\begin{aligned} y_{it} = \beta_1 C_{it} + \beta_2 I_{it}^G + \beta_3 I_{it}^P + \beta_4 Q_{it} + \beta_5 H_{it} \\ + \beta_5 Z_{it} + \mu_i + \lambda_t + \nu_{it} \end{aligned} \quad (9)$$

Again, we note the presence of serial correlation in the error terms when the base estimation equation is estimated in levels and thus specify the equation in first differences.[28] Testing for the presence of endogeneity of corruption in (8),[29] we fail to reject the null hypothesis of exogeneity.[30] When investigating whether the random effects GLS estimator is more appropriate than the fixed effects Within estimator, we again reject the null hypothesis that the regressors and effects are uncorrelated and thus employ the fixed effects estimator.

Curiously, corruption appears to be insignificant with respect to growth in GDP per capita, regardless of the specification used. This result, which complements the cross-sectional findings of Dreher and Herzfeld (2005) and Pellegrini and Gerlaugh (2004) who also fail to detect a statistically significant direct effect of corruption on economic growth, goes against the general finding in the corruption literature. But here again, we must caution that we are examining whether the change in corruption influences the rate of growth in GDP; a much more difficult association to detect than that previously examined in the literature, that is, whether levels of GDP per capita are associated with levels of corruption. Nevertheless, our *a priori* hypothesis that corruption appears to directly influence economic growth is not supported by the empirical evidence at this point in time.

In contrast, the expected positive impact of quality of the bureaucracy is statistically significant. The coefficient is quite large, implying that a 1% change in governance (as proxied by quality of the bureaucracy), elicits a 3.6% change in the GDP growth rate. This finding is consistent with those in the previous literature and suggests that corruption may indirectly influence economic growth through its negative influence on governance. Also consistent with the previous literature is the positive and statistically significant coefficient for private investment. Curiously, public investment and human capital (as proxied by infant mortality) fail to test significant in any of the models we report. The finding on human capital is somewhat surprising and contrasts with a number of works found in the literature. Our finding on public capital is consistent with the country-specific literature that breaks down public investment by type. We must again caution that our findings are limited to our sample countries and time periods but suggest that these findings warrant further investigation.

[25] We reject the null hypothesis of no serial correlation at the 1% significance level using a Durbin–Watson test for serial correlation. Re-specifying the model in first differences, we fail to reject the null hypothesis of no serial correlation.
[26] We fail to reject with a test statistic of 04875 with 684 degrees of freedom.
[27] We employ different alternatives of conditioning variables to examine whether this result is robust and conclude that we fail to reject the null hypothesis with the given set of countries, time periods and explanatory variables.
[28] We reject the null hypothesis of no serial correlation at the 1% significance level using a Durbin–Watson test for serial correlation. Re-specifying the model in first differences, we fail to reject the null hypothesis of no serial correlation.
[29] We fail to reject with a test statistic of 1.541 with 680 degrees of freedom for the OLS model.
[30] We employ different alternatives of conditioning variables to examine whether this result is robust and conclude that we fail to reject the null hypothesis with the given set of countries, time periods and explanatory variables.

In summary, private investment appears to be important for growth, as does governance. Public and human capital flows do not appear to influence growth, though we must caution that our measure of human capital leaves much to be desired. Corruption's impact on public and private investment is not as unambiguous as previous cross-section and country-specific time series studies suggest. We find that, for our sample countries, corruption does not appear to directly influence economic growth but does so indirectly via its interaction with public investment and governance quality. We recognize that much work needs to be done in this area, however, and merely suggest a proper accounting of corruption's influence may need a more careful examination of the indirect as opposed to the direct linkages between corruption and economic growth.

V. Conclusion

In this article we investigate the potential impact of corruption on economic growth by examining the effect that corruption may have on several significant determinants of economic growth, namely, investment in human, private and public capital, and on governance. Our theoretical model allows for corruption to influence economic growth directly and indirectly through investment and governance channels. The predictions of the model are tested with a data set, which following IFC's definitions correctly classify investment by public enterprises as public investment. Together with a better accounting for private and public investment components, our panel data set of 50 developing and transitional countries covering the period 1984–1999 represents the most complete data set that has been used to date to test the impact of corruption on investment and economic growth.

The most important empirical finding in the article is that for the sample of countries in our data set the interaction between corruption and public investment considerably dampens private investment, adding to the crowding out effect of public investment on public investment. This is significant since the role of private investment on economic growth is well established in the literature and also because of the fact that numerous previous studies have found private investment to be more important than public investment as a determinant of economic growth.

In contrast, we find that corruption is not a significant determinant of public investment, whether through its direct effect or its indirect effect through private investment. This result, which differs from that obtained in the majority of the previous literature, is robust to various alternative specifications. The difference may be explained by the fact that our approach uses panel data in first differences, not in levels or cross-section as with previous analyses; in addition, and depending on the perspective taken both lower and higher levels of corruption would seem could lead to higher levels of public investment. This is clearly an area in need of future research.

Besides working indirectly through private investment and the quality of governance, there appears to be no direct significant impact of corruption on economic growth. This result complements some of the cross-sectional findings in the previous literature, but contradicts findings in other previous studies. Part of the explanation for the different results is again that our approach uses panel data in first differences and not in levels as most of the previous literature.

The overall policy message in this article is very straightforward: reducing the level of corruption in a country will facilitate private investment and ultimately help to increase the rate of economic growth. Still much work needs to be done in this area of the interaction of corruption with the accumulation of private, human and public capital and the impact on economic growth. One of the main contributions of this article is to highlight the importance of providing more careful attention to the indirect as opposed to the direct linkages between corruption and economic growth.

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Appendix A:

Investment Sample

Country	Period	Country	Period
Argentina	1984-1999	Azerbaijan	1998-1999
Bangladesh	1984-1999	Bolivia	1987-1999
Brazil	1984-1998	Bulgaria	1990-1999
Chile	1984-1999	China	1984-1999
Colombia	1984-1999	Costa Rica	1984-1998
Cote d'Ivoire	1986-1999	Dominican Rep.	1984-1999
Ecuador	1984-1999	Egypt	1984-1999
El Salvador	1984-1999	Estonia	1998-1999
Guatemala	1984-1999	Guinea-Bissau	1987-1999
Guyana	1987-1999	Haiti	1984-1999
India	1984-1999	Indonesia	1984-1999
Iran	1984-1999	Kazakhstan	1998-1999
Kenya	1985-1999	Korea Republic	1984-1999
Lithuania	1998-1999	Madagascar	1984-1999
Malawi	1984-1999	Malaysia	1984-1999
Mexico	1984-1999	Morocco	1984-1999
Namibia	1990-1999	Nicaragua	1990-1999
Pakistan	1984-1999	Panama	1985-1999
Papua New Guinea	1984-1998	Paraguay	1984-1999
Peru	1984-1999	Philippines	1984-1999
Poland	1989-1999	Romania	1991-1999
South Africa	1984-1999	Thailand	1984-1999
Trinidad & Tobago	1984-1999	Tunisia	1984-1999
Turkey	1984-1999	Uruguay	1984-1999
Venezuela	1984-1999	Yugoslavia	1998-1999

Appendix B:

Variable Appendix

	Description and source
Bureaucratic Quality	Quality of the bureaucracy: re-scaled from 0 = Inept to 6 = Totally competent to 0 = Inept to 1 = Totally competent *Source*: International Country Risk Guide
Corruption	Corruption index: re-scaled from 0 = Inept to 6 = Totally competent to 0 = Inept to 1 = Totally competent *Source*: International Country Risk Guide
Private investment	Public investment to Gross Domestic Product *Source*: Author created
Public Investment	Private investment to Gross Domestic Product *Source*: Author created
GDP Per Capita	Gross Domestic Product per Capita *Source*: World Development Indicators 2002
Current account	Current Account Balance as a percentage of GDP *Source*: World Development Indicators 2002
Aid	International aid as a percentage of central government expenditures *Source*: World Development Indicators 2002
External debt	External debt as a percentage of GDP *Source*: Global Development Finance 2002
Trade	Exports + Imports as a percentage of GDP *Source*: World Development Indicators 2002
Infant mortality	Deaths per 1000 live births *Source*: International Database, U.S. Census 2002
Population	Total population *Source*: World Development Indicators 2002