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9 November 2009

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Abstract

Recent empirical studies find that the direct effect of corruption on growth is statistically insignificant. However, there exists a discrepancy between these results and the intuition that corruption reduces over-all productivity, because total factor productivity also depends on the quality of institutions and their efficiency. The current paper addresses this issue and offers a new perspective on growth effects of corruption and shows that direct and indirect growth effects of corruption can be statistically significant. Moreover, the empirical results confirm the existence of both negative and positive growth effect of corruption.

1 Introduction

Recent empirical studies find that the direct effect of corruption on growth is statistically insignificant. This finding is inconsistent with the notion of overall productivity deterioration due to corruption, because the total factor productivity also depends on the quality of institutions and their efficiency. This paper addresses this issue and offers a new perspective on modeling the growth effects of corruption and finds that the direct effect of corruption on growth is statistically significant.

In his seminal paper, Mauro (1995) finds some support for a negative relationship between growth and the bureaucratic efficiency index

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and the corruption index. By running various regressions of per capita GDP growth on bureaucratic efficiency or the corruption index, he shows that this relationship is robust for bureaucratic efficiency, however, not for the corruption index. Nevertheless, Levine and Renelt (1992) show empirically that the investment rate is a robust determinant of economic growth. Taking that into account, Pelegrini and Gerlagh (2004) find that after controlling for investment, the effect of corruption in à la Mauro (1995) specification becomes insignificant. Moreover, Barro and Sala-i-Martin (2004) report that estimation based on the indicator from the International Country Risk Guide (ICRG) on the extent of official corruption and the indicator for the quality of the bureaucracy, have insignificant effects on growth. Supporting these results, Dreher and Herzfeld (2005), Pelegrini and Gerlagh (2004), and Everhart *et al.* (2009), find that the direct effect of corruption appears insignificant with respect to growth in GDP per capita. On the other hand, the indirect effect of corruption working through public investment and quality of governance (*e.g.* Mo, 2001 and Everhart *et al.*, 2009), and investment and trade openness (*e.g.* Pelegrini and Gerlagh, 2004) is significant.

These empirical results, which suggest that corruption may not have a significant direct impact on growth, are likely to stem from theoretical vagueness. Notably, there are some gaps in theoretical approaches, which relates corruption to growth rates. It is well known that corruption distorts the public-private interactions, and hence, the effect of the public sector on economic growth is altered.[1] However, in growth studies, corruption has not been modeled as a factor that changes the overall effect of the public sector on economic activity. It is rather captured by its partial effects. For example, Mauro's (2002) model incorporates inefficiency of the public sector as misuse of public funds, which leads to lower productive public inputs to aggregate production. Although, the effect of corruption on public sector burden has not been accounted for. In a similar manner, in Blackburn et al. (2002), corruption is modeled as bribe-taking from tax-evaders, while in Blackburn et al (2005), corruption

[1]Shleifer and Vishny (1998) show how corruption may distort the public-private interactions.

is manifested as embezzlement of public funds.[2] There are also models that relate corruption to overall productivity. For example, Mo (2001) and Everhart *et al.*(2009) provide models that capture the direct effect of corruption on growth through the rate of productivity growth. However, in these models, the indirect effect of corruption is not formulated explicitly.

Unlike the existing studies, this paper provides a simple theoretical model that incorporates both indirect and direct effect of corruption on growth. The indirect effect is transmitted via an overall distortion of the impact of the public sector on economic activity and through reduced investment demand. The direct effect works through the change in the total factor productivity, due to corruption. This approach to modeling corruption is presented in the next section. Further, I test the implications of the model using dynamic panel data estimators. This estimation method is more suitable to panel data with a short time horizon and persistence in time series.[3]

2 A simple model with corruption in the public sector

Traditionally, the public sector is modeled as a productive externality provided to private producers by the government which comes at the cost of private disposable income decreased by taxes. Arrow and Kurz (1970) and Barro (1990) incorporated public sector services directly into the production function as follows: $y = f(k, g)$, where k is capital stock per worker, and g is the productive externality of government expenditure in per worker terms. To finance the productive public input, g, private producers have to pay taxes, and hence, their income, net of taxes, is given as $(1-\tau)y$. This is the case in general, regardless of whether corruption exists in the public sector. However, corruption makes the effective burden of taxes, τ, deviate from the statutory one. The productive externality

[2] See also Mauro,1998; Tanzi, 1998; Barreto, 2000; Keefer and Knack, 2002; Del Monte and Papagni, 2001; Lambsdorff, 2003; Meon and Weill, 2006; Delavallade, 2006; De la Croix and Delavallade, 2009.

[3] See for example, Naudé and Krugell (2007) and Romero-Avila (2009).

provided by government, g, can also be altered by corrupt behavior of the bureaucrats. The resulting distortions in the cost and benefit of the public sector caused by corruption leads to a change of the marginal product of private capital. Therefore, corruption affects investment through distortions in private capital productivity. To be more specific, I assume that production at time t is given by:[4]

$$Y_t = K^{\alpha} G_t^{\beta} (A_t L_t)^{1-\alpha-\beta} \tag{1}$$

It is assumed that the overall productivity evolves according to the function:

$$A_t = A_0 e^{\varsigma t}, \tag{2}$$

where ς is the growth rate of productivity (or technology). Denoting by i , the fraction of income invested into physical capital and expressing output and stock of capital in per unit of effective labour, the equation describing the evolution of physical capital stock is written as:

$$\dot{\hat{k}}_t = i\hat{y}_t - (n + \varsigma + \delta)\hat{k}_t \tag{3}$$

where $\hat{y} = {}^{Y}\!/_{AL} = \hat{k}^{\alpha}\hat{g}^{\beta}$ is output per unit of effective worker, $\hat{k} = {}^{K}\!/_{AL}$ is capital stock per unit of effective worker, $\hat{g} = {}^{G}\!/_{AL}$ is government expenditure per unit of effective worker, and n is a constant population growth rate, and ς is a constant technology growth rate.

A steady-state value of capital is found from (3):

$$\hat{k}^{*} = \left(\frac{i\hat{g}^{\beta}}{n + \varsigma + \delta}\right)^{\frac{1}{1-\alpha}}.$$

By inserting the expression for steady state capital above back into (1) and taking logs, steady state income per capita is derived as:

$$ln\,\hat{y}_t^{*} = \frac{\beta}{1-\alpha} ln\,\hat{g}_t + \frac{\alpha}{1-\alpha} ln\,i^{*} - \frac{\alpha}{1-\alpha} ln(n + \varsigma + \delta) \tag{4}$$

This is the well-known empirical growth equation used by Mankiw et al.

[4] It is also possible to consider the production function similar to Mankiw et al. (1992) given as $Y_t = A_t K_t^{\alpha} G_t^{\beta} H_t^{\varphi} L_t^{\vartheta}$. This will not change overall implications.

(1992). However, they employed cross-section data for estimations, hence, they were not concerned about the dynamics of the growth process.

Islam (1995) has shown how to adjust this model for the panel data framework. I follow his approach and derive a dynamic panel data model. This is done by approximating the pace of convergence around the steady state level of output, $\hat{y}^*$. This leads to the expression of the adjustment process around the steady state:

$$ln\,\hat{y}_t = (1-e^{-\lambda})(ln\,\hat{y}^* - e^{-\lambda} ln\,\hat{y}_{t-1}).$$

where $\lambda = (n+\varsigma+\delta)(1-\alpha)$. After some rearrangement and substitution for $\hat{y}^*$ from (4), we arrive at:

$$ln\,\hat{y}_t - ln\,\hat{y}_{t-1} = (1-e^{-\lambda})[\frac{\beta}{1-\alpha} ln\,\hat{g}_t + \frac{\alpha}{1-\alpha} ln\,i - \frac{\alpha}{1-\alpha} ln(n+\varsigma+\delta) - ln\hat{y}_{t-1}]. \quad (5)$$

By noting that

$$ln\,\hat{y}_t = ln\,y_t - ln\,A_0 - \varsigma t,$$

where $y_t = {}^{Y_t}/_{L_t}$, (5) is transformed into the following form:

$$\begin{aligned} ln\,y_t = (1-e^{-\lambda})[\frac{\beta}{1-\alpha} ln\,g_t + \frac{\alpha}{1-\alpha} ln\,i - \frac{\alpha}{1-\alpha} ln(n+\varsigma+\delta) + \\ + \frac{1-\alpha+\beta}{1-\alpha} lnA_0] + e^{-\lambda} ln\,y_{t-1} + \varsigma\left[\frac{t(1-\alpha-\beta)(1-e^{-\lambda})}{1-\alpha} + e^{-\lambda}\right] \end{aligned} \quad (6)$$

How should corruption be incorporated into this result? As it was discussed above, corruption affects the public input, g, and the investment level, i. By affecting the technology coefficient, A, corruption can also impact growth directly. I employ this rationale to incorporate corruption into this growth model.

Let us first consider how corruption influences the technology coefficient, A_t. Since the productivity gains from any technology are likely to be lower for countries with higher corruption, it is reasonable to assume that corruption affects the level of technology, A_t. Based on the idea that corruption not only directly lowers productivity but also dampens it through miriads of negative externalities it creates, I assume that the impact of corruption on productivity grows at an increasing rate. Thus, the evolution of technology, given by (2), is modified to:

$$A_t = \frac{A_0 e^{\varsigma t},}{e^{\chi}} \tag{7}$$

where $0 < \chi < \bar{\chi}$ stands for the coefficient that measures corruption, so when $\chi = 0$, there is no corruption, whereas $\bar{\chi}$ stands for the maximum value for the corruption measure.

Next, let us consider how corruption distorts the economic effect of the public sector. Intuitively it is clear that corruption makes the public sector inefficient. This generally means that for a given tax revenue, the government generates less amount of productive inputs. Therefore, the public productive input, in a very simple case, can be expressed as: $g = \frac{\tau y}{f(\chi)}$, with τy being the total tax revenue in per capita terms, and $f(\chi)$ is an increasing function of the level of corruption. However, corruption distorts the collection of taxes, and ultimately the output level is also endogenous and influenced by corruption. To capture this complex relationship, one can express the public inputs as a function of the average tax rate, τ , output, y_t, and the level of corruption: $g_t = g(\tau, y_t, \chi)$.

Finally, corruption affects investment through increased uncertainty and reduced productivity.[5] Uncertainty requires an additional premium on investment returns, hence, it raises real interest rates, and leads to lower investment demand. Public inputs into production are reduced by corruption, which, in turn, decreases private capital productivity. To capture this idea, one can write the amount of investment as the following function:

$$i_t = i[r_t(\chi)] \tag{8}$$

where r_t is the real interest rate, which itself is an increasing function of corruption. In our context $r_t^{\prime}(\chi) > 0$ and $i_t^{\prime}(\chi) < 0$.

Now, based on the discussion above, the growth equation given by (6) can be modified to incorporate the effects of corruption. The modification

[5]See Lambsdorff, 2003; Campos, 2001; Shleifer and Vishny, 1993; Aizenman and Marion, 1993. See Angeletos, 2007 for the impact of idiosyncratic production risk on investment.

yields:

$$ln\, y_t = (1-e^{-\lambda})[\frac{\beta}{1-\alpha} ln\, g_t(\tau, y_t, \chi) + \frac{\alpha}{1-\alpha} ln\, i(\chi) - \frac{\alpha}{1-\alpha} ln(n+\varsigma+\delta) +$$
$$+\frac{1-\alpha+\beta}{1-\alpha} lnA_0 - \frac{1-\alpha+\beta}{1-\alpha}\chi] + e^{-\lambda} ln\, y_{t-1} + \varsigma \left[\frac{(1-\alpha-\beta)(1-e^{-\lambda})}{1-\alpha} + e^{-\lambda}\right] \quad (9)$$

Equation (9) expresses the direct and indirect influence of corruption on the evolution of per capita output over time. Corruption directly affects per capita output, decreasing the technology growth rate. Corruption also indirectly influences per capita output growth by reducing the growth of private capital and diminishing the productive externality provided by the public sector. Using the conventional notation of the panel data literature, (9) is rewritten as follows:

$$z_{it} = \gamma z_{i,t-1} + \sum_{j=1}^{4} \beta_j x_{it}^j + \eta_t + \mu_i + \upsilon_{it}, \quad (10)$$

where $z_{it} = ln\, y_t$, $z_{i,t-1} = ln\, y_{t-1}$, $\gamma = e^{-\lambda}$, $\beta_1 = (1-e^{-\lambda})\frac{\beta}{1-\alpha}$, $\beta_2 = (1-e^{-\lambda})\frac{\alpha}{1-\alpha}$, $\beta_3 = -(1-e^{-\lambda})\frac{\alpha}{1-\alpha}$, $\beta_4 = -(1-e^{-\lambda})\frac{1-\alpha+\beta}{1-\alpha}$, $x_{it}^1 = ln\, g_t(\tau, y_t, \chi)$, $x_{it}^2 = ln\, i(\chi)$, $x_{it}^3 = ln(n+\varsigma+\delta)$, $x_{it}^4 = \chi$, $\eta_t = \frac{(1-\alpha-\beta)(1-e^{-\lambda})}{1-\alpha}$, and $\mu_i = (1-e^{-\lambda})\frac{1-\alpha+\beta}{1-\alpha} lnA_0 + \varsigma e$.

This modeling approach has several advantages over the models used in the literature: i) importantly, it builds on the well known neoclassical growth model; ii) the model allows the use of the dynamic panel data methods in estimations; iii) in addition, incorporation of the effects of corruption into the model is done in a general way that captures main direct and indirect effect of corruption. The assumptions in modeling are based on the stylized facts, suggested by the empirical and theoretical research mentioned above. Now, in the next section, we turn to the discussions of an empirical model based on equation (10).

2.1 The estimation method

To obtain the empirical specification used for estimations, I have made some adjustments to the model given by (10). To capture the effect of corruption on investment and public services, I have included the interaction terms between the level of corruption and log of the public sector

input, $log(g_{it})$ and between the level of corruption, $corruption_{it})$, and log of investment, $log(i_{it})$. In addition, I include other conditioning variables given by a vector:
$Z = \{log(g_{it}), log(sch2_{it}), log(I_{it}/N_{it}), development_{it}\}$, where $sch2$ is a measure of secondary school enrollment, I/N is the amount of private investment per capita, $development$ is a measure of economic development as GDP per capita or the quality of public institutions.[6] After incorporating all adjustments mentioned above, the resulting empirical model to be estimated is written as:

$$
\begin{aligned}
log(y_{it}) = \alpha_t + \gamma_i + \beta_0 log(y_{it-1}) + \beta_1(corruption_{it}\, log(g)_{it}) + \\
+\beta_2(corruption_{it}\, log(i)_{it}) + \beta_3 corruption_{it} + \beta_4 Z_{it} + \varepsilon_{it}
\end{aligned}
\tag{11}
$$

It should be noted that one might encounter several difficulties related to estimation of equation (11):

- corruption is endogenous as economic growth and corruption may cause each other, thus, $corruption_{it}$ may be correlated with the error term;
- the explanatory variables may be correlated with country-specific fixed effects, thus causing the error term to be correlated with the explanatory variables;
- the lagged dependent variable $log(y_{it-1})$ on the right-hand side may lead to auto-correlation of the error term;
- the panel dataset has a short time dimension that contributes to estimation bias.

These estimation issues can be overcome by using Arrelano-Bond (1991) Difference GMM estimators and Blundell-Bond (1998) System GMM esti-

[6]In the estimations, I used as a measure of the quality of institutions, the Economic Freedom Index (EFI) from the Fraser Institute. I also experimented with the Legal Structure and Security of Property Rights Index and the Business Freedom Index from the Fraser Institute. I found that the effects of the different measures of the quality of the institutions on growth are similar. The level of development is peroxide by GDP per capita and with a dummy for the OECD member countries. The OECD dummy is found to be insignificant. The description of the data is given in the appendix.

mators. Arrelano-Bond estimator (Difference GMM) uses the lagged level endogenous variables as instruments. In case, the dependent variable is close to a random walk, the Difference GMM estimator may not be efficient because past levels convey little information about future changes, that makes lagged levels of the regressors poor instruments for the differenced regressors.[7] Therefore, equation (11) is estimated using the Blundell-Bond (1998) System GMM estimator. It is also known that the system estimators have a downward bias due to smaller SEs of the estimates, when cross-section dimension is small. This may lead to false significance of the regressors.[8] Windmeijer's (2005) procedure that allows to compute heteroskedasticity-consistent SEs is used to correct this bias.[9] Consistency of the System GMM estimator depends on the validity of the instruments. To see if the the instruments are valid, the Hansen test for over-identifying restriction is utilized. In addition, the first and second order autocorrelation test for the error term is performed. The AR(1) and AR(2) statistics are used to test the null of no autocorrelation. The test results are reported in Table 1 and 2, in section 2.3.

2.2 Data description

The dataset used in estimations covers the time period from 2000 to 2007 across 141 countries.

Corruption measures: As measures of corruption, after some transformation, I use the Corruption Perception Index (*CPI*) complied by the Transparency International, and the Control of Corruption Index (*CC*) from Governance Indicators Dataset complied by the World Bank (Kaufmann et al., 2004; Kaufmann, 2004). The CPI values are determined in the range of (0,10); the higher the value, the less there is corruption in the economy. The Control of Corruption Index, *CC*, ranges within (-1.5, 2.8), and again higher values indicate lower corruption. Since, these measures are counterintuitive, I convert them into intuitive measure of corruption by using the following procedure: first, normalize the original lack of cor-

[7] See Temple et al. (2001), Roodman (2006).

[8] See Judson and Owen (2000).

[9] Estimations are done using a Stata package xtabond2 developed by Roodman (2006). This package incorporates the Windmeijer (2005) small-size correction procedure.

ruption measures as, $\overline{CPI} = \frac{CPI}{max(CPI)}$ and $\overline{CC} = \frac{CC}{max(CC)}$, then I use, as a measure of corruption, $(1 - \overline{CPI})$ and $(1 - \overline{CC})$.

Control variables: As a proxy for the quality of public institutions, I use the Index of Business Regulations ($busreg$).The data on this index come from the Fraser Institute. This index captures the burden on the private agents due to price controls, administrative procedures and other obstacles that hinder starting a new business, time cost of senior management in dealing with government bureaucracy, payments or bribes such as irregular, additional payments connected with permits, licenses, exchange controls, tax assessments, and police protection. The higher values of this index signify public institutions which are of a higher quality.

As control variables, I also use GDP per capita in constant $US, (*Y/N*), secondary gross enrollment rates, (*SCH2*), government size, (*G/Y*), and physical capital investment, (*I/Y*). The data on GDP per capita, *G/Y, SCH2*, and *I/Y* are obtained from the World Bank database: the World Development Indicators.

2.3 Results and discussion

It is notable, that without the interaction terms in the specification, the direct effect of corruption is not significant for both measures of corruption. It is likely that the existing empirical results, which find the direct growth effect of corruption statistically insignificant, are driven by the bias caused by omission of the indirect effects of corruptions in estimations. However, in specifications when at least one of the indirect channels is accounted for, the direct effect of corruption proves to be statistically significant and of the right sign. Therefore, we can conclude that corruption is a significant negative factor for economic growth.

The results show that the effects of public sector inputs, *log(G/Y),* are insignificant in all estimations. Although, the coefficient on the interaction term between lack of corruption and public spending is positive and statistically significant in most cases. This confirms our theoretical conjecture that corruption creates significant inefficiencies in the working of

Table 1: Estimation results. Corruption measure: the Control of Corruption Index

	1	2	3	4	5
$log(Y/N)(-1)$	0.95	0.95	0.94	0.95	0.93
	(63.9*)	(53.3*)	(49.6*)	(57.8*)	(39.0*)
$log(I/Y)$	0.04	0.049	0.063	0.058	0.06
	(2.41**)	(2.87*)	(3.12*)	(3.3*)	(2.93*)
$log(G/Y)$	0.005	0.013	0.015		
	(0.39)	(1.61)	(1.6)		
$log(n+\delta+\varsigma)$	-0.087	-0.092	-0.04	-0.049	-0.01
	(-2.7*)	(-1.0)	(-1.39)	(-1.39)	(-0.26)
$log(sch2)$	0.007	-0.001	-0.01	0.015	0.04
	(0.28)	(-0.11)	(-0.55)	(0.60)	(2.0**)
$(1-\overline{CC})$	0.007	-0.07	-0.091	-0.088	-0.085
	(0.6)	(-2.7*)	(-4.2*)	(-3.13*)	(-2.7*)
$log(I/Y)\cdot\overline{CC}$		-0.02	-0.01	-0.031	-0.036
		(-2.27**)	(-4.7*)	(-3.3**)	(-2.49**)
$log(G/Y)\cdot\overline{CC}$		0.011		0.022	0.027
		(1.0)		(2.1**)	(1.85***)
$busreg$		0.007	0.007	0.008	
		(2.2**)	(1.98**)	(2.7*)	
Y/N					2.76e-03
					(2.41**)
Specification test statistics					
Wald test	0	0	0	0	0
AR(1)	0.003	0.005	0.005	0.005	0.002
AR(2)	0.16	0.15	0.15	0.14	0.14
Hansen test	0.16	0.33	0.19	0.40	0.26
No. Instrum	59	86	77	77	77
No. Groups	98	92	92	92	98
No. Observ	429	385	385	385	429

Note: Models 1-4 are estimated using System GMM. The higher the value for CC, the higher is corruption. In parenthesis, heteroskedasticity-consistent with finite-sample Windmeijer (2005) correction, t-statistics are reported. (*), (**), and (***) denote statistical significance at 1%, 5%, and 10% level, correspondingly. The Wald test tests for the joint-significance of all coefficients included in the regression and is distributed as χ^2 with degrees of freedom equal to the number of restrictions. The Hansen test is used to test the null hypothesis that the instruments are valid. This statistics is distributed as χ^2 with degrees of freedom determined by the number of instruments and the number of regressors. AR(1) and AR(2) statistics are used to test the presence of autocorrelation in differences and levels respectively.

Table 2: Estimation results. Corruption measure: the Control Perception Index

	6	7	8	9	10
$log(Y/N)(-1)$	0.96	0.94	0.94	0.94	0.93
	(41.3*)	(43.8*)	(43.8*)	(41.7*)	(51.0*)
$log(I/Y)$	0.036	0.09	0.072	0.098	0.08
	(1.49)	(3.6*)	(3.16*)	(4.31*)	(4.1*)
$log(G/Y)$	0.006	-0.006	0.021		
	(0.7)	(-0.25)	(1.95***)		
$log(n+\delta+\varsigma)$	-0.06	-0.03	-0.028	-0.032	-0.011
	(-1.89***)	(-1.25)	(-0.87)	(-1.15)	(-0.51)
$log(sch2)$	-0.006	-0.002	-0.006	-0.011	0.04
	(-0.22)	(-0.11)	(-0.31)	(0.65)	(1.73***)
$(1-\overline{CPI})$	0.004	-0.044	-0.045	-0.043	-0.041
	(0.67)	(-3.2*)	(-3.87*)	(-4.0*)	(-3.4*)
$log(I/Y)\cdot\overline{CPI}$		-0.02	-0.005	-0.009	-0.008
		(-2.55**)	(-4.84*)	(-4.19*)	(-4.4*)
$log(G/Y)\cdot\overline{CPI}$		0.006		0.005	0.004
		(1.44)		(2.63*)	(2.7*)
$busreg$		0.007	0.007	0.007	
		(2.4**)	(2.0**)	(2.7*)	
Y/N					2.5e-03
					(2.89*)
Specification test statistics					
Wald test	0	0	0	0	0
AR(1)	0.01	0.005	0.005	0.005	0.006
AR(2)	0.18	0.15	0.15	0.14	0.18
Hansen test	0.29	0.72	0.59	0.59	0.55
No. Instrum	65	86	77	77	83
No. Groups	89	87	87	87	89
No. Observ	391	370	370	370	391

Note: Models 6-10 are estimated using System GMM. The higher the value for CPI, the higher is corruption. In parenthesis, heteroskedasticity-consistent with finite-sample Windmeijer (2005) correction, t-statistics are reported. (*), (**), and (***) denote statistical significance at 1%, 5%, and 10% level, correspondingly. The Wald test tests for the joint-significance of all coefficients included in the regression and is distributed as χ^2 with degrees of freedom equal to the number of restrictions. The Hansen test is used to test the null hypothesis that the instruments are valid. This statistics is distributed as χ^2 with degrees of freedom determined by the number of instruments and the number of regressors. AR(1) and AR(2) statistics are used to test the presence of autocorrelation in differences and levels respectively.

the public sector, and hence, negatively affects overall economic performance.

The estimations confirm the positive growth effects of physical capital investment. Curiously, the interaction term between the lack of corruption measure (*CC* or *CPI*) and investment has a negative coefficient. This result is capturing the positive effect of corruption on investment through a decrease in red tape and regulatory burden.

The estimation results also suggest that human capital accumulation, *log(sch2)* is not significant, unless the per capita income level is controlled for. The results also confirm that the quality of institutions (expressed by the Index of Business Regulations, *busreg*) plays a significant positive role in economic growth. It is likely that the stock of human capital is instrumental to growth only when the environment is less corrupt and the quality of the institutions is high.

Another difference of these estimation results from the existing ones is that the term, $log(n+\delta+\varsigma)$, is insignificant overall, although the sign of the coefficient is correct. Only when the interaction terms with lack of corruption are omitted, the effect of this term becomes significant. The possible explanation is that when the interaction between investment and corruption (or lack of it) is included in the specification, the assumption that the rate of technology growth, ς, and the rate of depreciation, δ, is the same across the countries, is not valid anymore. Hence, the impact of these three parameters becomes blurred and insignificant.

The overall effect of corruption is negative, as the negative effects transmitted directly and through the public sector inefficiencies dominate the positive effect through increased investment, which is possibly caused by collusive corruption that allows the firms to overcome excessive red tape and the burden of regulations.

3 Conclusion

By using a model that treats corruption as distortions created in the public-private sector nexus and a factor that affects overall productivity, it has been shown how corruption affects growth directly and indirectly. Empirical estimations confirm that corruption can affect growth in both ways. This result differs from the previous findings in that even after controlling for the effect of corruption through investments and public sector inputs, there is evidence of an overall direct negative effect. From this result one can infer that corruption inhibits growth by distorting the publicly provided productive externality and by deteriorating the overall business climate and perpetuating bad expectations about economic opportunities. However, the results also indicate that investment levels are higher with an increase in corruption levels, other things being equal. Therefore, the model presented in the paper is able to capture both negative and positive effects of corruption on growth simultaneously. Nevertheless, the overall effect of corruption is negative, as the negative effects transmitted directly and through the public sector inefficiencies are greater than the positive effect through investment.

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