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CORRUPTION AND OPENNESS

by

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Corruption and Openness*

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March 18, 2004

Abstract

We report an intriguing empirical observation. The relationship between corruption and output depends on the economy's degree of openness: in open economies, corruption and GNP per capita are strongly negatively correlated; but in closed economies, there is no relationship at all. This stylized fact is robust to a variety of different empirical specifications. In particular, the same basic pattern persists if we use alternative measures of openness, if we focus on different time periods, if we restrict the sample to include only highly corrupt countries, if we restrict attention to specific geographic areas or to poor countries, and if we allow for the possible endogeneity of both the corruption and openness measures. We find that the extent to which corruption affects output is determined primarily by the degree of financial openness. The difference between closed and open economies is mainly due to the different effect of corruption on capital accumulation. We present a model, consistent with these findings, in which the main channel through which corruption affects output is *capital drain*.

JEL CLASSIFICATION NUMBERS: F2, H0, O1, O4.
KEYWORDS: Corruption, Growth, Openness.

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We report an intriguing empirical observation. The relationship between corruption and output depends on the economy's degree of openness: in open economies, corruption and GNP per capita are strongly negatively correlated; but in closed economies, there is no relationship at all. This stylized fact is robust to a variety of different empirical specifications. In particular, the same basic pattern persists if we use alternative measures of openness, if we focus on different time periods, if we restrict the sample to include only highly corrupt countries, if we restrict attention to specific geographic areas or to poor countries, and if we allow for the possible endogeneity of both the corruption and openness measures. We find that the extent to which corruption affects output is determined primarily by the degree of financial openness. The difference between closed and open economies is mainly due to the different effect of corruption on capital accumulation. We present a model, consistent with these findings, in which the main channel through which corruption affects output is *capital drain*.

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1 Introduction

Economists, historians, and political scientists have long been engaged in a debate whether, and to what extent, corruption harms economic growth. The prevailing view is that corruption disrupts economic activity by imposing costs that distort the efficient allocation of resources in the economy. Perhaps surprisingly, some have argued that corruption can also sometimes be beneficial for the economy, by 'oiling the wheels' of bureaucracy.[1] In an important recent contribution to this debate, Mauro (1995) constructed a corruption index for 67 countries, and showed that corruption is indeed negatively associated with investment and growth. Mauro also argued that the evidence strongly suggests that the direction of causality is from corruption to development, rather than vice-versa.[2] A large number of theoretical studies point to several channels through which corruption may adversely affect income, but as of yet, these theoretical investigations, although suggestive, lack an empirical basis.[3]

This paper contributes to this debate by reporting on an intriguing stylized fact which seems to have escaped the attention of researchers. As shown by Figure 1, output per capita is strongly negatively correlated with corruption in open economies, but no such correlation exists in closed economies.[4] Figure 1a presents a scatter plot of log GDP per capita in the 1995-1999 period on an index of corruption among countries that were classified as open in the 1990s according to Wacziarg and Welch (2002). There is clearly a very strong negative relationship between economic development and corruption among open economies: the simple regression coefficient is -0.95, its associated t-statistic is -14.93, and corruption alone explains more than 70 percent of the variance in log income. On the other hand, there is essentially no correlation at all between corruption and GDP per capita in closed economies (Figure 1b): the regression coefficient is statistically indistinguishable from zero, and corruption explains less than one percent of the variance in log income. The graphical contrast between open and closed economies is not simply an artifact of the scales used. Had we expanded the scale of the horizontal axis among closed economies to the whole range of corruption values present in open countries, the line would have looked even flatter.

This stylized fact is robust to a variety of different empirical specifications. In particular, the same basic pattern persists if we use alternative measures of openness, if we focus on

[1] See Bardhan (1997) for a survey of this literature.

[2] Mauro's findings have been confirmed in recent work by Kaufmann et al. (1999). These findings are consistent with those of Hall and Jones (1999) and La Porta et al. (1999). See also Tanzi (1998).

[3] See, e.g., the recent surveys by Bardhan (1997), Jain (2001), and Aidt (2003), and the references therein.

[4] The corruption index is from Kaufmann et al. (1999) and the openness index from Wacziarg and Welch (2002). A detailed description of the sources and the data appears in Section 2 below.

different time periods, if we restrict the sample to include only highly corrupt countries, if we restrict attention to specific geographic areas or to poor countries, and if we allow for the possible endogeneity of both the corruption and openness measures.

In order to identify the possible causes of this empirical observation we decompose income to gauge whether the reported pattern of results is attributable to physical capital, to human capital, or to total factor productivity (TFP). We find that the results are robust with respect to the replacement of income by physical capital but not with respect to the replacement of income by TFP. That is, while corruption seems to affect the level of physical capital *only* in open economies, its effect on TFP is unrelated to the economy's degree of openness. We also find that the pattern shown in Figure 1 is weakened if openness is measured exclusively as the ratio of trade to income, but that it remains intact if openness is measured by a proxy for free capital movements.

We present a simple neoclassical growth model with endogenous corruption that is consistent with the three key stylized facts that emerge from the empirical analysis: (1) corruption is negatively correlated with output in open economies, but not in closed economies; (2) the difference between closed and open economies is mainly due to the different effect of corruption on capital accumulation in closed and open economies, respectively; and (3) the extent to which corruption affects output is determined primarily by the degree of financial, rather than trade, openness.

In the model, state officials may steal part of tax revenues which the government uses to finance the provision of a public good. An official that is caught stealing loses his job and with it his wage, which is higher in richer countries. Consequently, in richer countries where public sector wages are higher, officials are less inclined to steal and corruption is lower. Since corrupt officials have an incentive to transfer the proceeds of their illegal activities abroad, corruption depletes the country's capital stock, and slows down economic development. Hence, depending on initial conditions, an economy can either converge to a steady state equilibrium with high wealth and low corruption, or to a steady state equilibrium with low wealth and high corruption. Poor economies are trapped in a vicious circle in which high levels of corruption lead to low output, which generates yet more corruption, and so on.

Our results suggest that an important channel through which corruption impedes economic development is the transfer of illegally obtained capital abroad. It is estimated that the citizens of some African and Latin American countries hold more financial assets abroad than the entire capital stock in their country. (Pastor, 1990; Boyce and Ndikumana 2001). In economies with lower barriers to capital movement, it is easier to transfer illegal graft money abroad. In financially closed economies, illegally obtained capital is more likely to stay within the country. In other words, in open economies corruption affects income by inducing "capital drain." [5] In contrast, in closed economies the adverse effect of corruption on output is mitigated as capital drain plays a reduced role.

Finally, it is important to emphasize that our results should not be interpreted to imply that openness is detrimental to development. To the contrary: our empirical findings indicate that for the majority of countries openness is indeed beneficial for output; only in the most corrupt economies do we find that openness has a negative effect on GDP per capita. Since the most corrupt economies are also the poorest, it follows that openness may be harmful in those economies.[6] This conclusion is corroborated by the findings of Wacziarg and Welch (2002) who showed that openness had beneficial effects in the 1980s but not in the 1990s, when a large number of relatively poor countries opened up.

The rest of the paper proceeds as follows. In the next section, we describe the data we used and the robustness tests we performed. In Section 3 we explore the channels through which corruption may adversely affect output in open economies, but not in closed ones. In Section 4 we present a simple theoretical model that is consistent with our basic empirical findings. Section 5 offers concluding remarks.

2 Data and Results

2.1 Data Description

Our goal in collecting the data is to create as large a sample as possible that includes information on GDP per capita, the level of corruption, and openness. Therefore, we collect data from several sources. The variables and their sources are summarized in Table 1.

Our main measure of economic development is the 1995-1999 average of GDP per capita in current U.S. dollars evaluated at purchasing power parity, and is taken from the 2001 World Bank Development Index CD-Rom. Altogether, GDP per capita is available for 165 countries and dependencies.

[5] We use the term *capital drain* to desginate the legal transfer of (legally and ilegally obtained) capital. We distinguish between capital drain and *capital flight* which designates the illegal transfer of (possibly legally obtained) capital.

[6] This observation is consistent with the recent critique of Rodriguez and Rodrik (2000) of the empirical literature on openness and growth. Our analysis suggests that while openness may indeed be beneficial for rich countries where corruption tends to be low, it may not be the case for very poor countries where corruption is usually much higher.

As our measure of corruption we use the newly created data set of Kaufmann, Kraay and Zoido-Lobatón (1999, henceforth KKZ). KKZ use a variety of indicators collected by international organizations, political and business rating agencies, think tanks, and non-governmental organizations to construct six broad aggregates that measure governance in the 1990s. One of these aggregates, which KKZ refer to as "graft," measures perceptions of corruption. The definition of corruption is the conventional one: the exercise of public power for private gain. The various sources used by KKZ examine somewhat different aspects of corruption, ranging from "corruption of public officials," "effectiveness of anticorruption initiatives," "corruption as an obstacle to business," "frequency of 'additional payments' to 'get things done,' " "mentality regarding corruption," and the "effect of corruption on the attractiveness of a country as a place to do business." The KKZ index is standardized so as to have mean zero and standard deviation of one in the sample. High values of the index represent good governance, that is, low corruption. We multiply the index by -1 so that, consistent with our terminology throughout the paper, countries with a high value of the corruption variable are indeed more corrupt. Overall, the corruption index is available for 155 countries.

We classify countries based on their openness status in the 1990s using the newly created data set of Wacziarg and Welch (2002, henceforth WW). WW extend the Sachs-Warner (1995) index of openness to the 1990s, and also expand the list of countries for which the index is available to include the economies of Central and Eastern Europe and the newly independent states of the former Soviet Union. Countries are classified as open if they satisfy all the following five criteria: (1) the average of unweighted tariffs in the 1990-1999 period is lower than 40%; (2) the average of core non-tariff barriers on capital goods and intermediates is lower than 40%; (3) the average black market premium over the period is lower than 20%; (4) the country does not have an export marketing board; and (5) the country is not socialist. Note that some of the openness criteria capture the extent to which the country is open with respect to trade of physical goods, while others, such as the black market premium, have more to do with the degree of openness of financial markets. Altogether, the openness status is available for 141 countries.

We thus end up with a sample of 133 countries for which data is available on GDP per capita, corruption, and openness. The list of countries, classified by their openness status and their degree of corruption is presented in Table 2. As can be seen, all closed countries with the exception of Estonia are characterized by at least a medium degree of corruption. On the other hand, open economies exhibit a wide range of corruption levels. Most OECD countries are open and are characterized by low corruption. Interestingly, corruption and the lack thereof, do not seem to be confined to any particular geographic region. Countries with low levels of corruption can be found in Sub-Saharan Africa (Botswana), Central America (Costa Rica, Trinidad and Tobago), East Asia (Hong Kong, Malaysia, Singapore, Taiwan) and among the transition economies of Central and Eastern Europe (Slovenia, Hungary). At the same time, these regions also have worthy representatives among the list of highly corrupt countries. Summary statistics for all of our variables are presented in Table 3.

2.2 Methodology

We proceed to test whether the simple relationship that is documented in Figure 1 is robust to a variety of different specifications and estimation techniques. We have a continuous measure of corruption and a binary indicator of openness, that takes on the value of 1 for open countries, and zero for closed countries. We could run regressions of log GDP per capita on the corruption index, separately for open and closed countries, in order to test whether the coefficient on the corruption variable is significantly different from zero, and whether it is significantly more negative for open countries. However, a more efficient way of testing the robustness of our result is to pool all countries together, and estimate the following regression equation:

$$\ln GDP_i = \beta_0 + \beta_1 CORRUPTION_i + \beta_2 OPEN_i + \beta_3 CORRUPTION_i \times OPEN_i + \gamma' X_i + \varepsilon_i, \quad (1)$$

where GDP_i is GDP per capita in country i, X_i is a vector of other observed determinants of output, and ε_i is an error term that captures measurement errors and unobserved determinants of output. This regression implies that for closed countries, the relationship between output per capita and corruption is

$$\ln GDP_i = \beta_0 + \beta_1 CORRUPTION_i + \gamma' X_i + \varepsilon_i,$$

whereas for open countries the relationship is

$$\ln GDP_i = (\beta_0 + \beta_2) + (\beta_1 + \beta_3) CORRUPTION_i + \gamma' X_i + \varepsilon_i.$$

Figure 1 suggests that β_1 should be indistinguishable from zero, while $(\beta_1 + \beta_3)$ should be negative and significant.

Several points in our econometric specification deserve special comment. First, note that we focus our attention on levels of income per capita rather than growth rates. This follows the recent work of Hall and Jones (1999) and KKZ. The standard justification that is provided for this approach stems from the observation that it is levels, rather than growth rates, that capture fundamental cross-country differences in consumption, and hence also in welfare levels. In addition, the theoretical literature on growth predicts that in the long run all countries should grow at the same rate, so that cross-country differences in growth are by their nature transitory (Mankiw, Romer, and Weil, 1992; Barro and Sala-i-Martin, 1992). This prediction is confirmed by the finding in Easterly et al. (1993), who find that growth rates are weakly correlated across decades.

Second, one may wonder whether we should not include other determinants of output on the right hand side of equation (1). On the one hand, if equation (1) is viewed as a true long run relationship, then it makes little sense to control for variables (such as stocks of physical and human capital, the size of government, the rate of inflation, etc.) that are themselves the endogenous outcomes of the process of economic development. This is the approach taken by Hall and Jones (1999), who did not include any additional variables to their specification other than in their final table. On the other hand, it may be hard to believe that corruption and openness are the sole determinants of economic outcomes, and one may be interested in checking whether the relationship postulated in the theoretical section also holds true within a given subset of countries classified either by geography or by their initial stocks of capital. Therefore, we present results both with and without additional control variables: in any case, the models with control variables are extremely parsimonious, and include only continent dummies and the stock of human capital measured by the total years of schooling attained by the population aged 25 and over.

2.3 OLS Results

In Table 4 we present simple OLS estimates of equation (1). Recall that the effect of corruption on output in closed economies is given by the coefficient on corruption alone, while in open economies we must look at the sum of the coefficients on corruption and on the corruption-openness interaction. In each column of the table we report the F statistic which tests for the significance of this sum, and its corresponding p-value: high values of the F statistic indicate that we can reject the null hypothesis that corruption has no effect on output in open economies.

Column (1) of Table 4 essentially replicates the regressions presented in Figure 1, but pools all countries together and adjusts standard errors by allowing for potential heteroskedasticity. The coefficient on corruption is small and indistinguishable from zero, whereas the coefficient on the interaction is negative and highly significant. We cannot reject the null hypothesis that there is no relationship between corruption and GDP among closed countries, but the highly significant F-statistic indicates that we can strongly reject it among open countries. The size of the effect is also economically significant: if we attach to the coefficients a causal interpretation, an open economy with an average degree of corruption like Slovakia (corruption index = -0.03) could see its GDP per capita rise by 158 percent if it could achieve the same quality of government as that of Slovenia (corruption index = -1.02).

Column (2) of Table 4 controls for regional differences in income per capita by including a set of continent dummies. The results are virtually unchanged: the effect of corruption on GDP is now basically zero in closed economies, while a one standard deviation increase in corruption lowers per capita income by 80 log points if the country is open. Column (3) controls for continent dummies and education in 1990. The sample shrinks to 95 countries, as the Barro-Lee data set does not have information on the newly independent states of Eastern Europe and the former Soviet Union, but the results are virtually unchanged: a one standard deviation in corruption lowers GDP per capita by about 49 log points, even for countries that are otherwise identical in terms of their geographic location and their stock of human capital. Finally, Columns (4) and (5) report the results of separate regressions for the sample of closed and open countries with the inclusion of continent dummies and years of education. We find that in open economies, the coefficient on corruption drops to -0.45, but it is still highly statistically significant. In closed economies, the coefficient on corruption has the wrong sign, and is indistinguishable from zero.

Note that in columns (1)-(3), we find that the coefficient on openness is positive and significant. Since the effect of openness on output is $\beta_2 + \beta_3 \times CORRUPTION$, this means that for countries with a corruption index equal to zero, openness is beneficial. In fact, openness does not have a negative effect on output as long as the corruption index is below 0.74 to 1.18, depending on the specification. This implies that for at least three quarters of the countries in the sample, openness is beneficial.[7]

In Table 5 we try several alternative specifications to test the robustness of the results. One possible concern with our classification of openness is that the Wacziarg-Welch measure is based on the average of the 1990s of its component variables. The 1990s saw a large number of developing countries move towards trade liberalization. If at the beginning of the period mostly rich and non-corrupt countries were open to trade, and during the 1990s poor

[7] The 75th percentile of the corruption index is 0.769.

countries with corrupt governments also liberalized, then we would tend to find a mechanical negative relationship between GDP and corruption among open countries, that would not necessitate any particular theory about the joint determination of corruption and output. Therefore, in the first column we classify countries based on whether they were ever open based on the Sachs-Warner criteria between 1990 and 1992. As in Table 4, we find that the coefficient on corruption is essentially zero, while the coefficient on the interaction is negative and significant. In column (2) we use data on corruption and openness from the 1970s and 1980s. Specifically, the corruption variable is taken from Mauro (1995), and as our openness variable we take the average between 1975 and 1984 of the Sachs-Warner dummies. The coefficient on corruption is insignificant, while the coefficient on the interaction has a t-statistic of 1.58. However, the hypothesis that the sum of the coefficients is equal to zero is soundly rejected: even in the 1980s, there existed a significant negative relationship between corruption and output, but only among open countries.

One might wonder whether our results are not driven just by the fact that countries are either rich and non-corrupt or poor and corrupt. While rich countries are almost exclusively open, poor countries are roughly split equally between open and closed. This gives rise to three broad groups of countries: rich, non-corrupt, and open; poor, corrupt, and open; and poor, corrupt, and closed. It is possible that within each group there is no relationship between corruption and output, but, that when we pool together all the open countries, we find a strong negative relationship. Therefore, the next four columns of the Table restrict the sample along several dimensions to rule out this possibility. In column (3) we keep only countries with a corruption index greater than zero, leaving us with a sample of 51 countries. The results are essentially identical to those obtained in the full sample, both qualitatively and quantitatively. A similar pattern emerges if we exclude OECD countries (column 4). In columns (5) and (6) we estimate the equation for African and Asian countries alone, and we still find either a zero or a positive relationship between corruption and output among closed economies, and a strong and significant negative relationship among open economies.

2.4 Endogeneity

If corruption and output are jointly determined, then one cannot provide a causal interpretation to the OLS estimates of equation (1). Moreover, since corruption is only imperfectly measured, the OLS estimates suffer from attenuation bias as well as simultaneity bias. Both biases can be addressed if we have exogenous instruments that are correlated with corruption but uncorrelated with the error term in equation (1). In Table 6, we address these problems using several different sets of instruments that have been used previously in the literature.

La Porta, Lopez-De-Silanes, Shleifer, and Vishny (1999) show that the quality of government is strongly related to a country's legal origins: countries with a French or socialist legal system tend to have lower quality government, relative to countries with an English common law, and hence, more corruption, less protection of property rights, a higher regulatory burden, and less efficient provision of essential public goods. La Porta et al. argue that English common law, which developed as a reaction of Parliament and property owners to attempts by the sovereign to expropriate them, is more conducive to good governance; on the other hand, French civil law, which developed as an instrument of state building and the expansion of the sovereign's power, tends by its nature to restrict individuals' property rights; socialist law is an extreme case of the state creating institutions that protect the Communist party's hold on power, without much respect for individual's rights and freedoms. In using the legal origin dummies as instruments, we assume that the only effect of legal origins on present output is through their effect on the quality of government.

Mauro (1995) and Alesina et al. (2003) argue that societies that are more ethnically or linguistically fractionalized have more corrupt governments, as bureaucrats may have larger incentives to steal money to favor members of their own group. Since the degree of ethnic and linguistic fractionalization is to a large extent determined by the arbitrary straight-line borders traced by colonial powers in the past, it seems reasonable to assume that this variable is uncorrelated with the disturbance in today's output equation.

Hall and Jones (1999) and KKZ instrument social infrastructure using the fraction of the population who speaks English and other major European languages as a mother tongue. The underlying idea for these instruments is that countries where the extent of Western European influence was greater were more likely to adopt a social and economic infrastructure that was favorable for economic development: protection of property rights, a system of checks and balances in government, and the free-market ideas of Adam Smith. Moreover, factors that attracted Western European colonizers five centuries ago (an abundance of natural resources, sparse population) seem unlikely to be correlated with unobserved determinants of productivity today.

The first three columns Table 6 present IV estimates of equation (1) where we control for regional differences in GDP by including continent dummies. The instrument set is made up of legal origin dummies (column 1), the percentage in the population that speaks English and the percentage that speaks a major European language (column 2), and the degree of ethnic and linguistic fractionalization (column 3); in addition, the interaction of these variables with the openness dummy is also included in the instrument set, since the endogenous variable, corruption, enters equation (1) both linearly and interacted with the openness variable. There is substantial variability in the coefficients on the corruption and the corruption-openness interaction, but this is probably due to the weak power of the instruments in the closed countries sample, which leads to highly imprecise estimates. In fact, in contrast to the wide range of estimates in the individual coefficients, the implied effect of corruption on log GDP in open economies (i.e., the sum of the two coefficients) ranges from -0.806 to -1.157, a result very much in line with the OLS estimates of Table 4. In all three cases, the F test for the hypothesis that the sum of the coefficients is equal to zero is soundly rejected. The first stage F statistic is large in the first two specifications, whereas in column (3) it exceeds conventional significance values but is somewhat smaller than the "rule of thumb" value of 10, which casts some doubt on the validity of the estimates. In all cases, we do not reject the over-identification test for the validity of the instruments.

It can be argued that openness should also be treated as an endogenous variable. Countries that adopt more free-market trade policies may also adopt free-market domestic policies and stable fiscal and monetary policies, which could potentially increase their output per capita. To address this issue, we use as instrument for openness Frankel and Romer's (1999) log of the predicted trade share (imports plus exports as a fraction of GDP) obtained from a gravity model of bilateral trade. The gravity model isolates the component of trade that is due to purely geographic variables, such as distance to other trading partners, size, and whether the country is landlocked. Our variable is taken from Dollar and Kraay (2003), who use data from the 1990s to update Frankel and Romer's original instrument. In column (4) the instrument set is composed by the legal origin dummies, the Frankel-Romer instrument, and all possible interactions between the two. In this specification we find a negative relationship between corruption and output in open countries of a magnitude similar to that found in the OLS regressions (the sum of the coefficients is -0.677), and a negative relationship in closed countries, albeit imprecisely estimated. It should be noted that the first stage F-test for the openness variable is fairly weak, casting doubt on the validity of the Frankel-Romer instrument in this context. For this reason, in the remainder of the table we will treat the openness variable as exogenous.

In column (5) we return to the specification in column (1), using legal origins as our instruments, but we add log years of schooling to the list of control variables.[8] The results

[8] Using the other two instrument sets in the specification with years of schooling yields very low first stage F statistics, and the results are not reported.

are similar to those obtained using OLS: a one standard deviation in corruption lowers GDP per capita by 53 log points, holding constant the stock of human capital and geographic characteristics. Finally, columns (5) and (6) estimate separate IV regressions for open and closed countries, using the legal origin dummies as instruments. The coefficient on corruption for open countries is -0.39, which is significant at the 5.3 percent level, while the coefficient for closed countries is large, positive and marginally insignificant. However, this result is questionable given the very low value of the first stage F statistic in the closed countries sample. Altogether, the IV results confirm the findings of Tables 4 and 5. In open economies, corruption is strongly negatively correlated to output. In closed economies, no such correlation exists.

3 Interpreting the Results

Why is it then that the negative effect of corruption on output per capita is restricted to open countries alone? To shed further light on this issue, we now delve deeper into the interactions between corruption, openness, and output. In particular, we first decompose income to gauge whether our pattern of results is attributable to physical capital, to human capital, or to total factor productivity. We then investigate which particular aspects of openness appears to affect the relationship between corruption and output.

3.1 The Components of Output

The common view among economists is that corruption affects output by distorting the allocation of resources. This view contrasts with the hypothesis, which is prevalent among economic historians and political scientists, that in an economy that has a rigid bureaucracy, corruption may be beneficial as a way of 'oiling the wheels of bureaucracy.' The decomposition of output into its components, capital (physical and human) and total factor productivity (TFP) offers a glimpse into this controversy. We follow Hall and Jones (1999) in taking the view that TFP mainly reflects market efficiency.

We assume that each country has a Cobb-Douglas production function with physical and human capital as its inputs, and Hicks-neutral technological progress:

$$Y_i = A_i K_i^{\alpha} \left[e^{\psi(E_i)} L_i \right]^{1-\alpha},$$

where K and L are capital and labor, E is average years of schooling, the function $\psi(\cdot)$ describes the effects of schooling on labor productivity, and A is the productivity term.

Dividing both sides of the equation by L and taking logs yields the standard textbook decomposition of output per worker into a part due to the capital-labor ratio, a part due to human capital, and a part due to total factor productivity:

$$\ln(Y_i/L_i) = \alpha \ln(K_i/L_i) + (1-\alpha)\psi(E_i) + \ln A_i. \tag{2}$$

We set $\alpha = 1/3$, and follow Hall and Jones by letting $\psi(\cdot)$ be a piecewise linear function with coefficients derived from microeconomic evidence.[9] To measure E, we use average years of schooling of the population aged 25 and over in 1995, taken from the Barro-Lee (1996) data set. Since this variable is available in only 104 countries (and is not available in all the newly created countries of Central Europe and the former Soviet Union), we impute the missing schooling data using data on literacy rates and enrollment in school taken from the World Bank Development Index (2001). Finally, we calculate each country's capital stock in 1996 using a perpetual inventory method and data on investments dating back to as early as 1960 from the Penn World Tables, mark 6.1.[10] These components allow us to easily obtain $\ln A$ as the residual in equation (2).

In Table 7 we present regressions similar to those of Table 4, where the dependent variables are the three separate components of output per worker. Data on the individual components of output, on corruption and on openness are available for 124 countries. In the first three columns we report results for the most parsimonious specification, where we include only the corruption and openness measures and their interaction, while in columns (4)

[9] Hall and Jones (1999) base their estimates on a rich survey by Psacharopoulos (1994) on returns to schooling estimates across the world. As in Hall and Jones, we assume that the rate of return for the first four years of education is 13.4 percent. For the next four years, we assume a value of 10.1 percent. Finally, for education beyond the eighth year, we assume a value of 6.8 percent, which is the average rate of return in OECD countries as reported by Psacharopoulos.

[10] We take countries with investment data going back at least to 1980, and use all available investment data. The initial value of the capital stock is imputed to be equal to the value of investment in the first available year, divided by $(g+\delta)$, where g is calculated as the average geometric growth rate of investment in the first ten years, and δ is the depreciation rate, which we assume to be equal to 6 percent.

For the former republics of the Soviet Union, and for the Czech and Slovak republics, the capital stock was calculated as follows. We first used the Penn World Tables, mark 5.6 to calculate the capital stock of the Soviet Union and Czechoslovakia in the last available year (1989 and 1990 respectively). We then assigned to the newly created countries the capital stock so that the ratio of the initial capital stock is the same as the ratio of total GDP. So, for example, the Czech Republic's capital stock in 1990 was calculated as

$$K_{Czech\ Republic,1990} = \frac{GDP_{Czech\ Republic,1990}}{GDP_{Czechoslovakia,1990}} \times K_{Czechoslovakia,1990}$$

through (6) we report results from a specification that includes continent dummies. A striking result is that corruption is essentially unrelated to physical capital in closed countries, while the correlation is strong and negative in open countries, which is essentially the same pattern that appears in Figure 1. The joint relationship of corruption, openness, and human capital follows a similar pattern, although the magnitude and significance of the coefficients is diminished. Finally, there seems to be a small negative correlation between corruption and total factor productivity, with no significant difference between closed and open economies. Altogether, the results in Table 7 suggest that reduced capital accumulation is the main channel through which the difference in the effect of corruption on output between open and closed economies can be explained. Although our findings are not inconsistent with the view that corruption does harm the economy through the distortion of resource allocation, they do point to an additional, important, channel through which corruption adversely affects the economy.

3.2 What Type of Openness Matters?

A plausible explanation to our findings may be that corruption somehow distorts trade relationships. If that is the case then the larger the share of trade in output, the greater is the damage that corruption causes, and closed countries who trade the least are less susceptible to its effects.

We test this hypothesis in columns (1) through (4) of Table 8. We replicate the regression in column (3) of Table 4 (with continent dummies and the 1990 level of human capital included), using different measures of openness. In column (1) we classify countries as open if their trade volume (the share of imports plus exports over GDP in 1995[11]) is above the median, and closed otherwise, while in column (2) we simply use the trade share as a continuous measure of openness. The results are somewhat inconclusive: the coefficients on both corruption variables in column (1) are insignificant, while in column (2) there is some evidence of a strong negative relationship between corruption and output in the most closed countries, which becomes weaker as trade volume increases.

An alternative way to measure trade openness is by the level of tariffs. We take the average level of unweighted tariffs between 1990 and 1999 from Wacziarg and Welch (2002). In column (3) we classify countries as open if the average tariff is below 20 percent, and closed otherwise. Interestingly, we find a negative and statistically significant coefficient on corruption alone, while the coefficient on the interaction variable is positive, but small

[11] Taken from Dollar and Kraay (2003).

and statistically insignificant. This means that there exists a negative correlation between output and corruption in all countries, regardless of whether they are open to trade or not. A similar conclusion arises if we use one minus the average tariff as our measure of openness (column 4). The coefficient on the interaction variable is not statistically significant, which indicates that the relationship between corruption and output is independent of the level of tariffs.

Finally, we explore whether the difference in the effect of corruption on output between open and closed economies is due to a country's degree of financial openness. We use the black market premium as our measure of financial openness. The black market premium is in practice the effective tax that must be paid in order to circumvent restrictions on the movement of capital, and can be viewed as a measure of the ease with which one can move money in and out of the economy. Therefore, countries with a high black market premium can be considered, for all practical purposes, to be financially closed. Data on the black market premium is taken from Wacziarg and Welch (2002) and is available for 137 countries: it represents the average black market premium over the 1990-1999 period. In column (5) of Table 8 we classify countries dichotomously as open or closed based on whether the black market premium is below or above 20 percent. The results are quite similar to those found using the overall openness measure: in financially closed countries we find no relationship, and in financially open countries we find a strong negative relationship between corruption and output. In column (6) we use 1 minus the black market premium as our measure of financial openness: this variable runs from zero (countries with a black market premium above 100 percent) to one (countries where the black market premium is equal to zero). The results resemble quite closely those in column (5): the coefficient on corruption, representing the effect of corruption on output in a completely closed economy, is positive and marginally significant, while the interaction term is negative and precisely estimated: the higher the degree of financial openness, the stronger the negative correlation between corruption and output.

Overall, the evidence in Table 8 suggests that the effect of corruption is more closely related to financial openness rather than to trade openness.

3.3 Corruption, Openness, and Size

In recent work, Alesina, Spolaore, and Wacziarg (2000) have argued that the equilibrium number and size of countries and the extent of economic integration are interdependent. In particular, they claim that country borders are determined endogenously in such a way so as to optimally trade off the economic benefits of size (which are larger the higher the barriers to trade) and the costs of having a large and heterogeneous population. They also document the existence of a strong negative correlation between size and openness. This raises the question as to whether the difference in the effect of corruption on economic development between open and closed economies is not in fact due to differences in size. We examine this hypothesis in Table 9. In the first two columns of Table 9, we replicate the basic regressions from Table 4, but with additional controls that take the form of two alternative measures of size (the natural logarithms of physical area and population) and their interaction with corruption. If openness is in fact just capturing the effects of size, we expect that the coefficient on the corruption-openness interaction will be substantially reduced when we control for size. This is clearly not the case: the coefficients on corruption and openness remain essentially unchanged, while the size variables do not contribute to the regression's explanatory power. In the next columns we simply substitute size for openness in our basic specification: in columns (3) and (4) we use the continuous measures of size, while in columns (5) and (6) we classify countries as either "large" or "small" based on whether their physical area or their population is below or above the median. In all specifications, we find that the interaction between corruption and size is insignificant, which indicates that the effect of corruption on output is independent of country size. This, together with the results reported in Table 8, leads us to conclude that something specific about an economy's degree of openness, and in particular the degree of openness of financial markets, that affects the relationship between corruption and output.

4 Capital Drain

In this section we present a model for the relationship between corruption, openness, and output that is consistent with the three basic stylized facts that we have described above: (1) corruption is negatively correlated with output in open economies, but not in closed economies; (2) the difference between closed and open economies is mainly due to the different effect of corruption on capital accumulation in closed and open economies, respectively; and (3) the extent to which corruption affects output is determined primarily by the degree of financial openness.

The explanation we provide for these three observations is simple. Corrupt officials wish to hide the proceeds of their illegal activities as far as possible from the reach of law enforcement authorities in their own country. Therefore, to the extent they can do this, corrupt officials prefer to smuggle the money they steal outside of the country. The advantage of doing so is that if they are caught, then the authorities would not be able to retrieve the stolen money. Smuggling illegally obtained capital outside the country has the additional advantage of making consumption less conspicuous, which reduces the likelihood of getting caught. On the other hand, conventional wisdom suggests that investors strongly prefer to invest in their home country, where they have better information on investment opportunities (French and Poterba, 1991). The extent to which illegal money will be diverted abroad depends on the cost of transferring it. In an open economy, the cost of smuggling capital outside the economy is low, and the net return on overseas investment is high. Thus, ceteris paribus, in an open economy, more resources would be diverted abroad, depleting the economy's stock of capital, and reducing output. In contrast, in a financially closed economy, it is more expensive to divert capital abroad, and so the damage to the economy may be significantly smaller. This explanation suggests that capital drain can potentially be an important channel through which corruption affects output.[12]

4.1 Model

Our model extends the standard Solow model to include corruption and capital drain. Consider a dynamic one-sector economy with the production function

$$Y_t = A_t K_t^{\alpha} \left[e^{\psi(E_t)} L_t \right]^{1-\alpha} \qquad 0 < \alpha < 1 \tag{3}$$

where $t \geq 1$ indicates period. The government taxes output and uses the proceeds to produce the common factor of productivity, A_t. However, corrupt bureaucrats steal part of the tax revenues which implies that less can be used to pay for the production of A_t. Letting τ_t denote the tax rate, c_t the total amount of resources stolen by bureaucrats, s the saving rate and $1 - \phi$ the proportion of stolen resources that are diverted abroad, A_{t+1} and K_{t+1} are given by the following equations

$$A_{t+1} = (\tau_t Y_t - c_t)^{\beta} \qquad \beta > 0 \tag{4}$$

$$K_{t+1} = (1 - \tau_t) s Y_t + s\phi c_t \qquad 0 \leq \phi \leq 1. \tag{5}$$

Namely, in every period the government uses the collected taxes less the amount stolen, $\tau_t Y_t - c_t$, to produce the next period's common factor of productivity, A_{t+1}; and the next period's amount of productive capital, K_{t+1}, is equal to the amount of after-tax savings,

[12] Indeed, Pastor (1990) finds that exchange controls reduce the extent of capital flight.

$(1-\tau_t)sY_t$, plus the amount of stolen resources that are reinvested in the economy, $s\phi c_t$. We assume that the rest of the stolen resources are either smuggled outside of the economy, or consumed with the same proportion, s, in which legal output is consumed.

To ensure that total return to capital in both the private and public sectors is decreasing, we require that the two parameters α and β be such that

$$\alpha + \beta < 1.$$

Every period, a measure one of bureaucrats or state officials each choose an amount c_t of resources to steal that would maximize their expected utilities:

$$(1 - \pi(c_t))\, u(w_t + c_t) \tag{6}$$

subject to the constraint

$$c_t \leq \tau_t Y_t. \tag{7}$$

The function $u(\cdot)$ denotes the state officials' utility function; $\pi(c_t)$ denotes the probability of getting caught as a function of the amount of resources stolen, c_t; and w_t denotes the state officials' wage. The utility function $u(\cdot)$ is assumed to be non negative, increasing, and concave. State officials' utility when they are caught is normalized to zero. The probability of getting caught $\pi(\cdot)$ is assumed to be increasing, differentiable, and convex on the interval $[0, \overline{c}]$ for some $\overline{c} < \infty$, to be equal to one for all $c \geq \overline{c}$, to be equal to zero at zero, and to have a derivative of zero at zero. We assume that officials can only steal from the taxes they themselves have collected, which implies that $c_t \leq \tau_t Y_t$. Because all state officials are identical, they each steal the same amount c_t. The fact that there is a measure one of state officials implies that c_t is also the total amount of resources stolen in the economy, and that each state official is responsible for the collection of $\tau_t Y_t$ of tax revenues at t.

For simplicity, we assume that the officials' wage rate in every period is proportional to income, that is, $w_t = \gamma Y_t$ for some fixed $\gamma > 0$. We refer to the amount stolen in period t, c_t, as the level of corruption in the economy in period t.

In every period the government, who anticipates the amount stolen by its officials, sets the tax rate τ_t to maximize the discounted value of future output.

Finally, for simplicity, we assume that $e^{\psi(E_t)} L_t = 1$ for all $t \geq 1$.

4.2 Equilibrium

Definition. A sequence $\{(Y_t, A_t, \tau_t, c_t)\}_{t\geq 1}$ is a competitive equilibrium of the economy if it satisfies equations (3)-(5), and is such that for every $t \geq 1$, c_t is chosen optimally by state officials given Y_t and τ_t, and τ_t is chosen optimally by the government given Y_t and c_t.

Fix some period t. For every level of Y_t and τ_t, denote the state officials' optimal choice of corruption by $c(Y_t, \tau_t)$. As shown by Lemma 1 below, the amount of resources stolen in every period, decreases as the economy becomes richer.[13]

Lemma 1. *There exists a level of resources $\underline{Y} > 0$ such that in every period $t \geq 1$, for every $Y_t \leq \underline{Y}$, the state officials' optimal choice of corruption is given by $c(Y_t, \tau_t) = \tau_t Y_t$ for every $\tau_t \in [0, 1]$. For $Y_t > \underline{Y}$, $c(Y_t, \tau_t)$ declines continuously in Y_t and is independent of the tax rate τ_t except in case where the tax rate is so low that state officials would want to set $c_t > \tau_t Y_t$ if they could. In this case, because c_t is constrained to be smaller than or equal to $\tau_t Y_t$, $c(Y_t, \tau_t) = \tau_t Y_t$.*

The reason that corruption declines with output is simple. Higher wages reduce the marginal utility from corruption, and therefore, weaken the incentive of government bureaucrats to steal. Hence, our assumption that state officials' wages are proportional to output implies that bureaucratic corruption is lower in richer countries. In very poor economies, that is when $Y \leq \underline{Y}$, the marginal utility from corruption is so high and tax revenues are so low that all tax revenues are stolen.

As mentioned above, in every period, the government, who anticipates the level of corruption, determines the tax rate τ_t so as to maximize the discounted present value of output.

Lemma 2. *In equilibrium, if $Y_t > \underline{Y}$ and the government expects the level of corruption to be equal to $c_t = c(Y_t, \tau_t)$, then it sets the tax rate equal to*

$$\tau(Y_t, c_t) = \frac{\beta}{\alpha + \beta} + \frac{(1+\phi)\alpha}{\alpha + \beta} \cdot \frac{c_t}{Y_t}; \tag{8}$$

if $Y_t \leq \underline{Y}$, then the government is indifferent among all tax rates $\tau_t \in [0, 1]$.

Lemma 2 implies that greater corruption leads to higher tax rates. This is because the government anticipates the loss of revenues caused by corruption and reacts to it by raising the tax rate. However, if the economy is so poor that all the tax revenues will anyway be stolen, then the tax rate becomes immaterial.

Three remarks are in order. First, if $Y_t > \underline{Y}$, then the government sets the tax rate τ_t in such a way that $c_t < \tau_t Y_t$.

[13] This is consistent with the empirical findings of Van Rijckeghem and Weder (2001) who show that corruption is decreasing in the wage paid to state employees (which, in our model, is assumed to be increasing in Y_t).

Second, by construction, taxes in our model are not distortionary. If they were, as they usually are in practice, then corruption would have caused an additional harm by inducing higher tax rates.

Third, whenever, $Y_t > \underline{Y}$, corruption affects output only through its effect on the level of capital drain. In the extreme case in which the economy is completely closed and $\phi = 1$, the level of corruption has no effect on equilibrium at all. To see this, suppose that if there was no corruption ($c = 0$), then by Lemma 2 the government would have set the tax rate optimally at $\tau^* = \frac{\beta}{\alpha+\beta}$, with the resulting levels of $A^* = (\tau^* Y)^\beta$ and $K^* = (1 - \tau^*)Y$. If $\phi = 1$, then given any corruption level c, setting $\tau = \tau^* + c/Y$ generates the same values of A^* and K^*, as in the economy without corruption.

In equilibrium, the state of the economy at date t is completely determined by the value of Y_t. In order to study the dynamics of the economy, it is convenient to express Y_{t+1} in terms of Y_t. Equations (3)-(5), imply that $Y_{t+1} = f_\phi(Y_t)$ where $f_\phi(\cdot)$ is given by:

$$f_\phi(Y_t) = (\tau_t Y_t - c_t)^\beta ((1 - \tau_t) sY_t + \phi s c_t)^\alpha \tag{9}$$

where $c_t = c(Y_t, \tau_t)$ and τ_t is given by (8). The following lemma describes the properties of $f_\phi(Y_t)$.

Lemma 3. *The function $f_\phi(\cdot)$ has the following properties:*

1. *$f_\phi(\cdot)$ is continuous;*
2. *For $Y \in [0, \underline{Y}]$, $f_\phi(Y) = 0$; $f_\phi(\cdot)$ is strictly increasing on $[\underline{Y}, \infty)$;*
3. *$f_\phi(Y)$ tends to infinity with Y;*
4. *The derivative of $f_\phi(Y)$ tends to zero as Y tends to infinity.*

The properties of $f_\phi(\cdot)$ imply that, generically, there are two possibilities. Either the entire graph of f_ϕ lies below the 45^0 line, in which case there is a unique steady-state equilibrium at $Y = 0$; or f_ϕ crosses the 45^0 line at least twice in which case there are at least two stable steady-states, one at zero and the other at some $Y^* > 0$ as illustrated in Figure 2.

In this case, the equilibrium to which the economy converges depends on the initial level of output. If $Y > \underline{Y}$, then the economy converges to a steady state with high output and low corruption, and if $Y < \underline{Y}$, then the economy converges to a steady state with zero output and high corruption.

Note that $f_\phi(\cdot)$ increases and $\underline{Y}$ declines as the probability of getting caught, π, increases. In the extreme case where $\pi(0) = 1$, there is no corruption and the model becomes very similar to a standard growth model. Note also that $f_\phi(\cdot)$ is increasing and therefore $\underline{Y}$ declines in ϕ. This is due to the fact that capital drain declines with ϕ (again, for simplicity, we focus our attention only on the negative effects of openness in facilitating capital drain while ignoring its benefits). Consequently, in a more open economy, the threshold level of wealth above which there is convergence to the good steady state is higher, which implies that it is more likely that the economy would be trapped in a vicious cycle with high corruption and low wealth.

5 Conclusions

Many agree that corruption and poverty feed on each other to create a vicious cycle: high corruption leads to poverty, which generates yet more corruption, and so on. Bardhan (1997) for example writes "it is probably correct to say that the process of economic growth ultimately generates enough forces to reduce corruption" (p. 1329). But, as Williams (2000) cautions, because "the 'take off' phase of economic growth seen as necessary for [...] development had not materialized. [...] It is no longer legitimate to assume that development would resolve the multiple problems besetting the South" (p. ix). This pessimistic observation is at odds with the fact that many of today's developed economies experienced widespread corruption during their history, and yet have managed to break out of the vicious circle to become rich and non corrupt. Theobald (1990), for example, describes the widespread corruption of state legislatures and city governments during the "gilded age" of 1860s and 1870s in the U.S. (see also Josephson, 1934, and Callow, 1966). In England, corruption was so severe at times that Wraith and Simkins (1963) write "The settlements of 1660 and 1688 inaugurated the Age of Reason, and substituted a system of patronage, bribery, and corruption for the previous method of bloodletting" (p. 60). Indeed, Bardhan (1997, p. 1328) notes that "Historians [...] point to many cases when a great deal of corruption in dispensing licenses, or loans, or mine and land concessions has been associated with (and may have even helped in) the emergence of an entrepreneurial class."

What is it that makes present corruption so much more harmful to development than past corruption? Why is corruption said to stall development in many of today's developing economies, but not in the developing economies of one or more centuries ago?

Our answer to this puzzle is that one or two centuries ago, illegally obtained capital remained and was invested in one's home country: a late 19th century public official implicated with corruption in New York could safely enjoy the proceeds of his graft in Minneapolis or in San Francisco. Thus, there was no need to smuggle illegally obtained resources outside the economy and the gains from corruption became part of the economy's productive capital. In contrast, today it is harder for public officials, even in third world countries, to hide the proceeds of their illegal activities within their own country, and therefore, a larger proportion of stolen money is smuggled abroad.

This insight may also help explain the otherwise puzzling flow of capital from poor to rich countries (Lucas, 1990), which conflicts with the predictions of conventional neoclassical growth theories according to which capital should flow from rich economies where the return to capital is relatively low to poor economies where the return to capital is relatively high.

Appendix

Proof of Lemma 1. Inspection of the necessary and sufficient first-order condition of state officials' optimization problem reveals that $c(Y_t, \tau_t)$ is implicitly given by the unique solution, c_t, of the following equation,

$$(1 - \pi(c_t))\, u'(\gamma Y_t + c_t) = u(\gamma Y_t + c_t)\pi'(c_t), \tag{10}$$

provided it exists, or by $\tau_t Y_t$, whichever is smaller. The properties of $u(\cdot)$ and $\pi(\cdot)$ imply that $c(Y_t, \tau_t)$ is continuous and nonincreasing in Y_t, and nondecreasing in τ_t. The value $\underline{Y}$ is given by the solution to the equation $c_t(Y, 1) = Y$. As Y_t tends to infinity, $c(Y_t, \tau_t)$ tends to zero; and $c(Y_t, \tau_t) = \tau_t Y_t$ for all sufficiently small values of Y_t and τ_t. By (10), $c(Y_t, \tau_t)$ is independent of τ_t except in case where τ_t is so small that state officials would want to set $c_t > \tau_t Y_t$ if they could. In this case, because c_t is constrained to be smaller than or equal to $\tau_t Y_t$, $c(Y_t, \tau_t) = \tau_t Y_t$. ■

Proof of Lemma 2. The size of the tax rate τ_t has a direct effect on future output only through its effect on Y_{t+1}. As will become clear below when we specify the dynamics of the model, Y_{t+2} is positively related to Y_{t+1}. Similarly, Y_{t+3}, in turn, is positively related to Y_{t+2} and so on. Therefore, choosing the tax rate τ_t to maximize Y_t would also maximize the discounted present value of output, regardless of which discount rate is chosen.

The government's objective in every period t may thus be limited to choosing the tax rate $\tau_t \leq 1$ that maximizes the level of output Y_t in period t, which, by (3)-(5) is given by

$$Y_{t+1} = (\tau_t Y_t - c(Y_t, \tau_t))^{\beta} ((1 - \tau_t)sY_t + s\phi c(Y_t, \tau_t))^{\alpha}. \tag{11}$$

Obviously, if it is at all possible, or whenever Y_t is sufficiently large, the government would set $\tau_t > \frac{c_t}{Y_t}$. In this case, $\frac{\partial c(Y_t, \tau_t)}{\partial \tau_t} = 0$, and so differentiation of (11) with respect to τ_t and equating the derivative with zero yields (8). The second order condition for optimization is satisfied in this solution. When Y_t is not sufficiently large, $c(Y_t, \tau_t) = \tau_t Y_t$ for every $\tau_t \leq 1$ and so every $\tau_t \in [0, 1]$ is optimal. ■

$$f_{\phi}(Y_t) = (\tau_t Y_t - c_t)^{\beta} ((1 - \tau_t)\, sY_t + \phi s c_t)^{\alpha} \tag{12}$$

Proof of Lemma 3. (1) Continuity is a consequence of the continuity of $c(Y_t, \tau_t)$ and $\tau(Y_t, c_t)$.

(2) By Lemma 1, for $Y \leq \underline{Y}$, $c(Y, \tau) = \tau Y$ for every tax rate $\tau \leq 1$, from which it follows that $f_\phi(Y) = 0$. To see that f_ϕ is increasing for $Y > \underline{Y}$, note that if c declines from c_1 to c_2, then the government can increase output from Y_1 to Y_2 by choosing $\tau_2 = \tau_1 + \frac{c_1 - c_2}{Y}$,

$$\begin{aligned} Y_2 &= (\tau_2 Y_t - c_2)^\beta ((1-\tau_2) s Y_t + \phi s c_2)^\alpha \\ &= (\tau_1 Y_t - c_1)^\beta ((1-\tau_1) s Y_t + \phi s c_1 + (1-\phi)(c_1 - c_2))^\alpha \\ &> Y_1. \end{aligned}$$

For $Y > \underline{Y}$, by Lemma 1, c declines with Y and is unaffected by τ. Hence, an increase by Y reduces c in which case there exist τ for which output increases.

(3) Follows from the fact that $c(Y, \tau)$ is nonincreasing in Y and independent of the value of τ when Y is large, and the fact that $\tau(Y_t, c(Y_t))$ is decreasing in Y_t. Finally,

(4) $f_0(Y_t)$ is bounded from above by $sY_t^\beta (Y_t + \phi c_t)^\alpha$ which has a derivative that tends to zero as Y_t tends to infinity. ■

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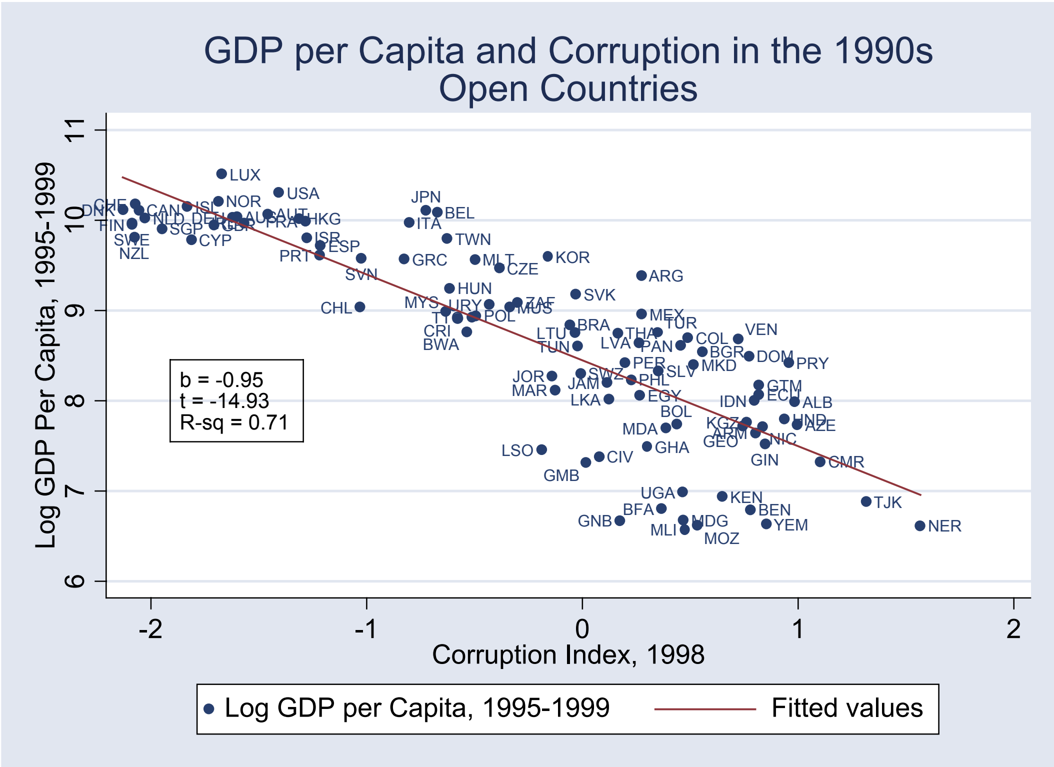

Figure 1a: Corruption and Economic Development – Open Countries

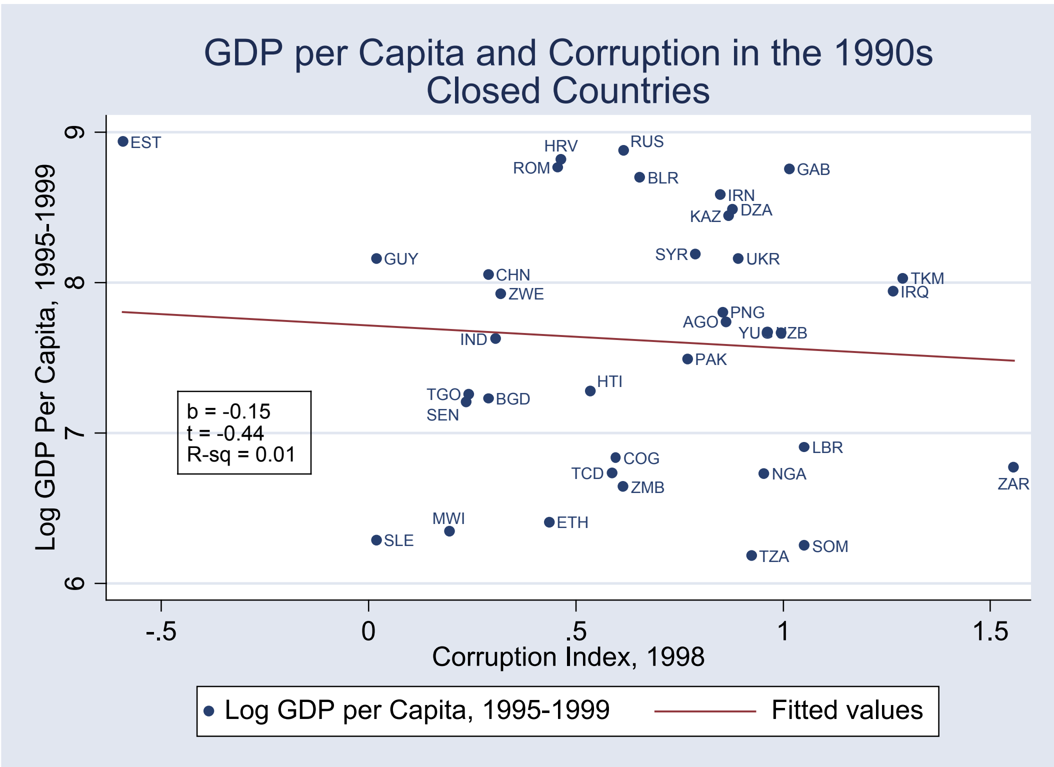

Figure 1b: Corruption and Economic Development – Closed Countries

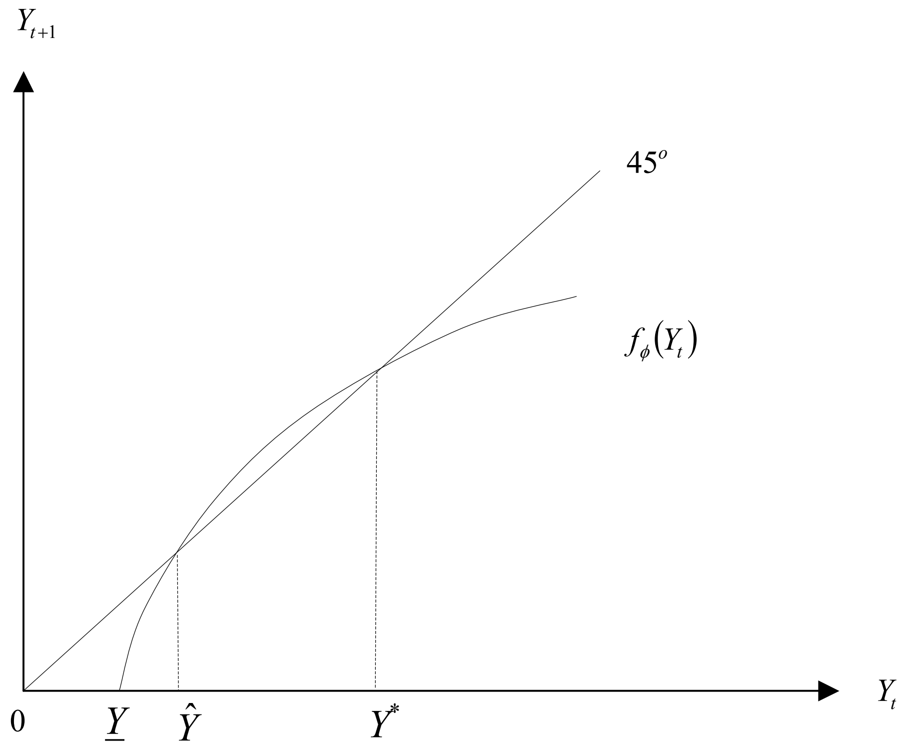

Figure 2: Y_{t+1} as a Function of Y_t

Table 1: Variable Description and Sources			
Variable	**Description**	**Source**	**Availability**
Log GDP per capita, 1995-1999	GDP per capita in current US $, at purchasing power parity	World Bank Development Index CD Rom, 2001	165 countries
Corruption, 1998	An aggregate of several indicators, collected by international organizations, political and business risk rating agencies, think tanks and non-governmental organizations, measuring "the exercise of public power for private gain." The index is standardized to have mean 0 and standard deviation 1.	Kaufmann, Kraay and Zoido-Lobatón (1999).	155 countries
Corruption, 1982	An index for "the degree to which business transactions involve corruption or questionable payments," collected by Business International, a private firm, during the period 1980-1983. The raw index is standardized to have mean 0 and standard deviation 1.	Mauro (1995)	68 countries
Wacziarg-Welch openness dummy, 1990-1999	A country is defined as open if all the following criteria are met: 1) the average of unweighted tariffs in the 1990-1999 period is lower than 40%; 2) the average of core non-tariff barriers on capital goods and intermediates is lower than 40%; 3) the average black market premium over the period is lower than 20%; 4) the country does not have an export marketing board; 5) the country is not socialist.	Wacziarg and Welch (2003)	141 countries

Table 1: Variable Description and Sources (continued)			
Variable	**Description**	**Source**	**Availability**
Sachs-Warner openness dummies 1975-1992	A country is defined as open in any given year if it meets all the following criteria: 1) the average of unweighted tariffs is lower than 40%; 2) the average of core non-tariff barriers on capital goods and intermediates is lower than 40%; 3) the black market premium is lower than 20%; 4) it does not have an export marketing board; 5) it is not socialist.	Sachs and Warner (1995)	110 countries
Years of schooling	Log(1+total years of schooling of population aged 25 and over).	Barro and Lee (2000)	107 countries
Legal origins	Dummies for whether the origin of the country's legal system is British (common law), French (civil law), German/Scandinavian (civil law) or socialist.	La Porta, Lopez-de-Silanes, Shleifer and Vishny (1998)	207 countries
Percentage English speakers	Percentage of the population who speaks English as their "mother tongue".	Alesina et al. (2002)	217 countries
Percentage European language speakers	Percentage of the population who speaks a major European language (English, French, German, Spanish, Portuguese) as their "mother tongue".	Alesina et al. (2002)	217 countries
Ethnic fractionalization	A variable measuring the probability that two randomly selected individuals in the population belong to different ethnic groups. Calculated as one minus the Herfindahl index of ethnic group shares.	Alesina et al. (2002)	190 countries

Table 1: Variable Description and Sources (continued)

Variable	Description	Source	Availability
Linguistic fractionalization	A variable measuring the probability that two randomly selected individuals in the population speak the same "mother tongue". Calculated as one minus the Herfindahl index of language shares.	Alesina et al. (2002)	202 countries
Capital per worker: ln (K/L)	Capital stock per worker in 1996, in 1996 US $, imputed using a perpetual inventory method using all available investment data	Penn World Tables, mark 6.1	141 countries
Human capital: $\phi(E)$	Human capital index based on a piecewise linear function of total years of schooling of population aged 25 and over in 1995.	Barro and Lee (2000)	175 countries
Productivity: ln A	Total factor productivity in 1996, calculated from the decomposition of output: $\ln(Y/L) = \alpha \ln(K/L) + (1-\alpha)\phi(E) + \ln A$	Penn World Tables, mark 6.1 and Barro and Lee (2000)	139 countries
Trade volume	(Exports + Imports)/(GDP at PPP) in 1995, at constant 1985 $.	Dollar and Kraay (2002)	144 countries
Tariffs	Average of unweighted tariffs in 1990-1999 period.	Wacziarg and Welch (2002)	121 countries
Black market premium	Average black market premium in 1990-1999 period.	Wacziarg and Welch (2002)	137 countries
Surface area (in square kilometers)	Surface area (in square kilometers)	World Bank Development Index, 2001	196 countries
Population	Population in 1998	World Bank Development Index, 2001	194 countries

Table 2: List of Countries by Openness Status and Degree of Corruption

	Low Corruption	Medium Corruption	High Corruption
Closed	Estonia *Total: 1 country*	Bangladesh, China, Croatia, Ethiopia, Guyana, India, Malawi, Romania, Senegal, Sierra Leone, Togo, Zimbabwe. *Total: 12 countries*	Algeria, Angola, Belarus, Chad, Congo, Congo Democratic Republic (Zaire), Gabon, Haiti, Iran, Iraq, Kazakhstan, Liberia, Nigeria, Pakistan, Papua New Guinea, Russia, Serbia/Montenegro, Somalia, Syria, Tanzania, Ukraine, Uzbekistan, Zambia. *Total: 24 countries*
Open	Australia, Austria, Belgium, Botswana, Canada, Chile, Costa Rica, Cyprus, Denmark, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Malaysia, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovenia, Spain, Sweden, Switzerland, Taiwan, Trinidad and Tobago, United Kingdom, United States. *Total: 35 countries*	Argentina, Bolivia, Brazil, Burkina Faso, Colombia, Cote d'Ivoire, Czech Republic, Egypt, El Salvador, The Gambia, Ghana, Guinea-Bissau, Jamaica, Jordan, South Korea, Latvia, Lesotho, Lithuania, Madagascar, Mali, Malta, Mauritius, Mexico, Moldova, Morocco, Panama, Peru, Philippines, Poland, Slovak Republic, South Africa, Sri Lanka, Swaziland, Thailand, Tunisia, Turkey, Uganda, Uruguay. *Total: 38 countries*	Albania, Armenia, Azerbaijan, Benin, Bulgaria, Cameroon, Dominican Republic, Ecuador, Georgia, Guatemala, Guinea, Honduras, Indonesia, Kenya, Kyrgyzstan, FYR Macedonia, Mozambique, Nicaragua, Niger, Paraguay, Tajikistan, Venezuela, Yemen. *Total: 23 countries*

Notes: Countries are defined to have low, medium, or high corruption based on the Kaufmann et al. (1999) graft index. Countries with an index smaller than –0.5 are defined as low corruption, countries with an index between –0.5 and 0.5 are defined as medium corruption, and countries with an index above 0.5 are defined as high corruption. The openness dummy is taken from Wacziarg and Welch (2003).

Table 3: Summary Statistics

	N	Mean	Standard Deviation	Minimum	Maximum
Log GDP per capita, 1995-1999	133	8.393	1.147	6.183	10.515
Corruption, 1998	133	-0.003	0.949	-2.129	1.567
Corruption, 1982	65	0.010	1.009	-1.254	2.264
Wacziarg-Welch Openness Dummy, 1990-1999	133	0.722	0.450	0	1
Sachs-Warner Openness Dummy, 1992	132	0.591	0.494	0	1
Sachs-Warner Openness Dummy, 1984	101	0.317	0.468	0	1
Log years of schooling, 1990	95	1.767	0.485	0.436	2.565
Legal Origin – English	133	0.271	0.446	0	1
Legal Origin – French	133	0.444	0.499	0	1
Legal Origin – Socialist	133	0.203	0.404	0	1
Legal Origin – Other	133	0.083	0.276	0	1
Percentage English Speakers	133	0.064	0.226	0	0.984
Percentage European Language Speakers	133	0.250	0.402	0	1
Ethnic Fractionalization	132	0.444	0.262	0.002	0.930
Linguistic Fractionalization	131	0.393	0.296	0.002	0.923
Log (K/L)	124	9.880	1.508	6.085	12.102
$\phi(E)$	131	0.712	0.301	0.092	1.224
Log(A)	124	5.533	0.557	3.972	6.626
Trade Volume [(IM+EX)/GDP]	122	0.445	0.431	0.037	2.876
Average unweighted tariff	113	14.728	9.21	0.32	54.73
1 if tariff $\leq$ 20 %	113	0.805	0.398	0	1
Black market premium	129	1518.068 (Median = 5.25)	12993.95	-0.35	138,935.9
Log area (square miles)	129	12.287	1.825	5.768	16.655
Log population	132	16.217	1.491	12.521	20.938

Note: The full sample of 133 countries includes all countries with non-missing data on GDP per capita, corruption and openness in the 1990s based on the Wacziarg-Welch indicator.

Table 4: Corruption, Openness, and Economic Development: Basic OLS Results

	(1)	(2)	(3)	(4)	(5)
Sample	Full Sample	Full Sample	Full Sample *	Open Countries	Closed Countries
Openness Measure	Wacziarg-Welch dummy	Wacziarg-Welch dummy	Wacziarg-Welch dummy	-	-
Corruption	-0.151 (-0.42)	-0.013 (-0.05)	0.183 (0.76)	-0.450 (-6.02)	0.301 (0.95)
Corruption × Openness	-0.801 (-2.19)	-0.789 (-3.05)	-0.678 (-2.76)	-	-
Openness	0.732 (2.44)	0.585 (3.00)	0.805 (4.79)	-	-
Log Years of Schooling	-	-	0.836 (5.05)	0.957 (5.42)	0.887 (1.98)
Continent Dummies	No	Yes	Yes	Yes	Yes
F test for $\beta_{corruption} + \beta_{corr \times open} = 0$	342.71 (0.00)	261.53 (0.00)	43.51 (0.00)	-	-
N	133	133	95	74	21
R^2	0.6506	0.7989	0.8768	0.8789	0.5124

Notes: The dependent variable is the log of average GDP per capita between 1995 and 1999. Robust t-statistics in parentheses.
* : The sample in column (3) is restricted to countries with non-missing education data.

Table 5: Robustness Checks

	(1) Sachs-Warner Openness Dummy	(2) 1980s	(3) Only Countries with Corruption Index > 0	(4) Only Non-OECD countries	(5) Africa only	(6) Asia only
Corruption	0.032 (0.16)	-0.094 (-0.90)	0.290 (1.05)	0.231 (0.92)	0.149 (0.43)	0.635 (2.15)
Corruption × Openness	-0.516 (-2.57)	-0.198 (-1.58)	-0.703 (-2.12)	-0.804 (-2.95)	-0.816 (-1.86)	-1.285 (-4.00)
Openness Dummy	0.618 (3.51)	0.119 (0.60)	0.642 (2.85)	0.796 (4.55)	0.874 (2.92)	0.632 (2.51)
Log Years of Schooling	0.937 (5.53)	1.067 (4.71)	0.507 (2.37)	0.838 (4.67)	0.977 (4.14)	1.356 (4.42)
Continent Dummies	Yes	Yes	Yes	Yes	No	No
F test for $\beta_{corruption} + \beta_{corr \times open} = 0$	34.82 (0.00)	9.22 (0.00)	5.55 (0.02)	46.95 (0.00)	5.79 (0.03)	26.36 (0.00)
N	94	54	51	66	26	19
R^2	0.8715	0.7752	0.6691	0.7973	0.6311	0.8820

Notes: The dependent variable is the log of average GDP per capita between 1995 and 1999. Robust t-statistics in parentheses.
[*]: In all columns, the sample is restricted to countries with non-missing education data.

Table 6: Instrumental Variables Estimates

	(1) Full Sample	(2) Full Sample	(3) Full Sample	(4) Full Sample	(5) Full Sample*	(6) Open *	(7) Closed *
Corruption	2.690 (1.22)	0.318 (0.89)	-3.026 (-1.27)	-0.543 (-0.65)	1.152 (1.35)	-0.391 (-1.93)	1.170 (1.60)
Corruption × Openness	-3.557 (-1.59)	-1.124 (-2.95)	1.869 (0.79)	-0.134 (-0.16)	-1.678 (-1.87)	-	-
Openness Dummy	2.280 (1.59)	0.793 (3.92)	-1.404 (-0.92)	0.595 (0.90)	1.384 (2.73)	-	-
Log Years of Schooling	-	-	-	-	0.825 (3.23)	1.040 (3.19)	0.912 (2.10)
F test for $\beta_{corruption} + \beta_{corr \times open} = 0$	94.86 (0.00)	90.10 (0.00)	31.93 (0.00)	44.22 (0.00)	9.08 (0.00)	-	-
N	133	133	130	133	95	74	21
Instrumented Variables	Corruption, Corruption × Openness	Corruption, Corruption × Openness	Corruption, Corruption × Openness	Corruption, Corruption × Openness, Openness	Corruption, Corruption × Openness	Corruption	Corruption
Instrument type	Legal origin	Languages	Fractionalization	Legal origin, Frankel-Romer Index	Legal origin	Legal origin	Legal origin
First Stage F- test: Corruption	25.36 (0.000)	8.32 (0.000)	4.43 (0.002)	16.39 (0.000)	6.44 (0.000)	6.46 (0.001)	1.74 (0.214)
First Stage F- test: Corruption × Openness	27.58 (0.000)	8.69 (0.000)	5.25 (0.001)	15.87 (0.000)	6.81 (0.000)	-	-
First Stage F- test: Openness	-	-	-	2.07 (0.052)	-	-	-
Overid. Test	1.348 (0.717)	2.529 (0.282)	0.277 (0.871)	7.850 (0.097)	6.494 (0.090)	4.580 (0.101)	0.000

Notes: The dependent variable is the log of average GDP per capita between 1995 and 1999. Robust t-statistics in parentheses. All regressions include continent dummies. The instrument set includes the set of exogenous variables, and these variables interacted with the openness dummy. In Column 4, the instrument set includes the legal origin dummies, the Frankel-Romer index, and their interactions.
* : The sample in columns (5), (6), and (7) is restricted to countries with non-missing education data.

Table 7: Corruption and the Decomposition of Output into its Components

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample
Dependent variable	Capital per worker: ln(K/L)	Human capital: ϕ(E)	Productivity: ln A	Capital per worker: ln(K/L)	Human capital: ϕ(E)	Productivity: ln A
Corruption	0.174 (0.22)	0.016 (0.11)	-0.189 (-0.83)	0.395 (0.75)	0.067 (0.76)	-0.180 (-0.81)
Corruption × Openness	-1.260 (-1.61)	-0.202 (-1.36)	-0.164 (-0.71)	-1.131 (-2.10)	-0.170 (-1.88)	-0.195 (-0.84)
Openness	0.931 (1.83)	0.137 (1.26)	0.267 (2.21)	0.752 (2.25)	0.100 (1.49)	0.207 (1.78)
Continent Dummies	No	No	No	Yes	Yes	Yes
N	124	124	124	124	124	124
R^2	0.4799	0.3367	0.4359	0.7524	0.6737	0.5143

Notes: The dependent variable is specified at the top of each column. Robust t-statistics in parentheses. For explanations on the construction of the dependent variables, see text.

Table 8: Corruption, Financial Openness and Trade Openness

Sample Openness Measure	(1) Full Sample Open if trade volume ≥ median	(2) Full Sample Trade volume, continuous	(3) Full Sample Open if average tariff ≤ 20%	(4) Full Sample Average tariff, continuous	(5) Full Sample Open if BMP<=20%	(6) Full Sample BMP, continuous
Corruption	-0.211 (-1.28)	-0.471 (-3.86)	-0.587 (-2.05)	-0.002 (-0.00)	0.234 (0.92)	0.855 (1.70)
Corruption × Openness	-0.196 (-1.11)	0.255 (1.65)	0.174 (0.63)	-0.410 (-0.45)	-0.741 (-2.82)	-1.409 (-2.71)
Openness	0.269 (1.74)	0.523 (2.55)	-0.092 (-0.45)	1.462 (2.04)	0.792 (4.11)	1.206 (2.34)
Log Years of Schooling	1.047 (5.61)	0.977 (4.81)	1.065 (5.26)	1.028 (5.53)	0.881 (5.24)	0.889 (4.90)
Continent Dummies	Yes	Yes	Yes	Yes	Yes	Yes
F test for $\beta_{corruption} + \beta_{corr \times open} = 0$	14.92 (0.00)	3.97 (0.05)	22.82 (0.00)	20.35 (0.00)	41.29 (0.00)	41.53 (0.00)
N	89	89	90	90	95	95
R^2	0.8578	0.8572	0.8555	0.8617	0.8697	0.8609

Notes: The dependent variable is the log of average GDP per capita between 1995 and 1999. Robust t-statistics in parentheses.

Table 9: Corruption, Openness and Size

	(1)	(2)	(3)	(4)	(5)	(6)
Measure of size	Ln Area (in sq miles)	Ln Population	Ln Area (in sq miles)	Ln Population	Dummy for area greater than median	Dummy for population greater than median
Corruption	-0.209 (-0.49)	0.414 (0.59)	-1.113 (-4.20)	-0.361 (-0.59)	-0.788 (-16.23)	-0.773 (-13.76)
Corruption × Openness	-0.754 (-2.76)	-0.795 (-2.95)	-	-	-	-
Openness	0.577 (2.99)	0.576 (2.88)	-	-	-	-
Corruption × Size	0.015 (0.65)	-0.026 (-0.72)	0.029 (1.33)	-0.025 (-0.68)	0.083 (1.06)	-0.008 (-0.09)
Size	0.037 (1.05)	0.018 (0.51)	0.050 (1.44)	0.019 (0.48)	0.192 (1.79)	0.189 (1.94)
N	129	132	129	132	129	132
R^2	0.7972	0.8017	0.7755	0.7790	0.7774	0.7837

Notes: The dependent variable is the log of average GDP per capita between 1995 and 1999. Robust t-statistics in parentheses.