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EDUCATION

PhD, Economics, University of California, Riverside, 2006
MA, Economics, University of California, Riverside, 2002
BA, Geography, California State University, Dominguez Hills, 1996

DISSERTATION

"Corruption and Efficiency"
Chair: Richard Sutch

MAJOR Economic Development

MINORS Macroeconomics, Microeconomics

RESEARCH FIELDS Economic Growth, Neoinstitutional Economics

WORKING PAPERS

"Best-Practice Growth and Efficiency"
"Corruption and Efficiency"

ACADEMIC EMPLOYMENT EXPERIENCE

Assistant Professor – Central College — 2006-present
- Principles of Macroeconomics
- Principles of Microeconomics
- Macroeconomics
- International Economics
- International Finance
- Monetary Theory and Financial Systems

Lecturer/Associate In – University of California, Riverside — Summer 2002-2005
- Introduction to Microeconomics — Winter, Spring 2005
- Macroeconomic Theory — Fall 2005
- International Trade
- Industrial Organization

Lecturer – Scripps College, member of the Claremont Colleges — Spring 2004
- Principles of Macroeconomics
- Intermediate Macroeconomic Theory
- Economic Development

Lecturer – College 48, Bălți, Moldova — 1997-1998
- Introduction to Business Management (language of instruction – Russian)

Lecturer – Alecu Ruso University, Bălți, Moldova — Fall 1997
- Introduction to Business Management

Teaching Assistant – University of California, Riverside — 1999-2004
- Principles of Economics
- Introduction to Macroeconomics
- Introduction to Microeconomics
- Introduction to Environmental Economics
- Intermediate Macroeconomics (A and B)
- Intermediate Microeconomics (A)
- Intermediate Environmental Economics
- Research Methods in Business and Economics

BUSINESS AND DEVELOPMENT EXPERIENCE

Small Business Development Volunteer
– United States Peace Corps 1996-1998
Republic of Moldova

Founder/Manager – Express Metro Courier Co. 1989-1994
Covina, CA

CONFERENCES AND SEMINARS

Midwest Economics Association 71st Annual Meeting, Minneapolis, MN
March 2007
Presented "Corruption and Efficiency"
Discussant (1 paper)

Western Economic Association International, San Francisco, CA
July 5, 2005
Presented "Best-Practice Growth and Growth Efficiency"
Discussant (3 papers)

Pacific Conference for Development Economics, University of San Francisco, CA
March 4, 2005
Presented "Corruption and Growth Efficiency"

Political Economy and Development Colloquia, University of California, Riverside
Fall 2004
Presented "Corruption and Growth Efficiency"

OTHER ACTIVITIES

Guest on the radio show *In Depth* on KNIA out of Knoxville, IA
February 6, 2007
Discussed the impact of the increase of the minimum wage in Iowa.

Consultant to the Law Firm *Bradshaw, Fowler, Proctor, and Fairgrave* of Des Moines, IA
October 2007
Conducted an economic impact analysis of a base firm on the local economy.

REFERENCES

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RESEARCH

Dissertation: “Corruption and Efficiency”

Summary: In my dissertation, I reexamine such issues of economic growth as efficiency standards, convergence and the effects of corruption. The research makes contributions to the economic literature in several ways: 1) By developing a framework of dividing growth into the best-practice frontier and dynamic inefficiency, I further reconcile Neoclassical Growth Theory and Institutional Economics. The best-practice growth frontier coincides with neoclassical growth models in which perfect markets and diminishing marginal returns lead to high rates of growth for poor countries. Dynamic inefficiency, in particular growth inefficiency, corresponds to less-than-optimal growth rates as private profits diverge from social benefits. 2) By focusing on situations in which private incentives do not match social benefits, I extend the existing processes of classification and quantification of institutional failures leading to dynamic inefficiency. 3) By reexamining the relationship between corruption and growth while looking at corruption in broad terms and growth in terms of dynamic efficiency, I provide strong evidence that corruption slows growth. 4) By viewing convergence in terms of absolute changes in output levels instead of rates of change of output levels, and by relating convergence to the best-practice growth frontier, I provide compelling evidence that convergence forces exist, although convergence performance represents only a limited part of the empirical data.

“Best-Practice Growth and Efficiency”

Much of the existing literature on cross-country economic growth assumes that countries are efficient and at their steady states. This same literature has difficulty in reconciling the simultaneous existence of developed, converging and diverging countries. In this paper, I find evidence that most countries are inefficient, and therefore steady states are not appropriate concepts. Instead, I propose that one should consider the level of efficiency in relation to the economic opportunities. Developed and converging countries, with convergence measured in absolute not merely relative terms, are likely efficient with the converging countries having more opportunities due to their relative poverty. Diverging countries are inefficient. In this framework, more of the international data can be understood, and this method is contradistinctive to simple multivariable cross-country regressions, since it allows rapidly growing countries to still be inefficient.

“Corruption and Efficiency”

This paper investigates the importance of corruption in determining a country’s ability to achieve its potential growth rate, i.e. growth efficiency. Corruption is found to be an economically and statistically significant determinant of the variation of the calculated growth efficiency scores. This empirical relationship is robust to different measures of corruption and different values of the parameters used in the calculation of growth efficiency. These results are intuitively richer than those from related research, since they consider the impact of corruption on both saving and productive efficiency. These results are econometrically stronger because they are derived from a method that overcomes the multicollinearity problem found in typical, relevant cross-country regressions.

CORRUPTION AND EFFICIENCY

David Kauper*

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March 2007

Abstract

This paper investigates the empirical evidence concerning corruption's impact on a country's ability to achieve its potential growth rate, i.e. growth efficiency. Much has been written on the relationship between corruption and growth. Although the results have been described as "ambiguous," the highly cited paper, Mauro (1996), concludes that a one-standard-deviation reduction in corruption would result, on average, in a 0.8 percent point increase in the average growth rate. However, due to a lack of available data at the time, Mauro uses corruption data at the end of the growth period, thereby suggesting a causality of growth rates influencing corruption levels. When his method of analysis is used with growth data following the period of corruption instead, then the estimated effect on the rate of growth following a decrease in the level of corruption vanishes. This paper reinvestigates the relationship between corruption and growth by looking at the direct effect that corruption has on efficiency and the subsequent indirect effect on growth. Growth efficiency estimates are based on the Farrell efficiency index and efficiency standards are based on the Solow growth model. The estimated impact of corruption on growth therefore depends on the initial level of GDP per capita of the country. For Nigeria, it is estimated that a one-standard-deviation reduction in corruption would increase the growth rate by 2.6 percentage points.

Keywords: corruption, convergence, growth, efficiency
JEL Classification Numbers: H80, O11, O40

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I. Introduction

In the last ten years, the World Bank and other international organizations have since made it a priority to reduce corruption in developing countries, particularly those receiving assistance (Mukand and Rodrick 2005). "In 1996 Wolfensohn gave a groundbreaking 'cancer of corruption' speech[1] to the World Bank/IMF annual meeting, citing corruption as a major burden for the poor in developing countries. Corruption is now widely recognized as a major impediment to development that must be tackled aggressively" (World Bank 2006).

Economists at these organizations and numerous universities have conducted much research on corruption. However, the empirical evidence on corruption and *economic growth* is scant. In one of the most highly cited papers on corruption, "Corruption and Growth," Mauro (1995) finds evidence with regression analysis that corruption is associated with lower rates of investment and growth.[2] He estimates that a reduction of corruption by 2.51 on a scale of 10 will increase growth rates of per capita GDP by 0.8 percentage points. Unfortunately, limited available data on corruption meant that Mauro's measurement of corruption was dated at the end of his growth period not at the beginning. Thus, the implied causality is in the wrong direction. When measurements for corruption from the beginning of the growth period are used, this

[1] "And let's not mince words: we need to deal with the cancer of corruption."—Annual meetings address by James D. Wolfensohn, President, The World Bank, 1 October 1996.
[2] A recent search of "Corruption and Growth Mauro" on Google Scholar revealed 1,648 citations of the article.

econometric evidence vanishes (see Table 1). In fact, the coefficient is now of the wrong sign; the estimates suggest that corruption increases growth rates.

Table 1
Growth on Corruption

GROWTH ON CORRUPTION					
Dependent variable:	Average Per Capita GDP Growth				
	(1960-1985)		(1980-2000)		
Independent variables:	(1 M)	(2 K)	(3 K)	(4 K)	(5 K)
Constant	0.019	0.0245	0.0414	0.0448	0.0394
	(1.86)	(2.34)	(3.60)	(4.16)	(3.61)
BI Corruption Index 1980	0.003	0.0021	-0.0018	-0.0010	-0.0009
	(1.91)	(1.12)	(-1.00)	(-0.61)	(-0.58)
GDP per capita in 1960 (1,000's)	-0.007 (-3.88)	-0.0034 (-2.93)	—	—	—
GDP per capita in 1980 (1,000's)	—	—	-0.0006 (-0.74)	-0.0011 (-1.31)	-0.0011 (-1.21)
Population growth rate from 1960-1985	-0.395 (-1.88)	-0.3400 (-1.46)	-0.7500 (-2.47)	—	—
Population growth rate from 1980-2000	—	—	—	-1.1503 (-2.99)	-1.0899 (-3.58)
Enrollment rate in secondary education in 1960	0.031 (2.40)	0.0310 (1.69)	0.0202 (1.41)	0.0163 (1.08)	—
Enrollment rate in secondary education in 1980	—	—	—	—	0.0148 (0.96)
N	58	58	55	55	55
R^2	0.27	0.22	0.19	0.27	0.27

A high value on the corruption index means good institutions. Reported in parentheses are White-corrected t-statistics.
Data on corruption come from Mauro (1995). Data on GDP per capita and population come from Heston, Summers, and Aten (2002). Data on education enrollment rates come from Barro and Lee (1993).
Column 1M reprints the data reported by Mauro (1995). Column 2K shows Kauper's regression estimates using the same model as Mauro. Columns 3K through 5K show estimates based on growth occurring after the period of measured corruption. In column 5K data on population growth rates and enrollment rates in secondary education reflect the time period of the economic growth.

Mauro's estimates of the negative impact of corruption might be unreliable for more reasons than the discrepancy regarding the date of the measurement of corruption in relation to the period of growth. Columns 1M and 2K do not match, particularly the estimated coefficient of the initial level of per capita GDP. Mauro takes his data set from

Barro (1991), who had taken the data set from Barro and Wolf (1989), who in turn had based their data set on the Penn World Tables version 5.5. This data set is available from Barro's homepage. Mauro does not specify which of the six available measures of per capita GDP he utilizes. However, for the fifty-eight observations for which Mauro estimates coefficients, Mauro's summary statistics coincide with none of those from Barro's data set. I use the "Real GDP per capita (Constant price: Chain series)" from the more recent Penn-World Tables version 6.1. Similar problems arise matching the summary statistics of the other variables of interest—corruption, bureaucratic efficiency, average population growth rate from 1960 to 1985, and enrollments rates in secondary education—despite the fact that Mauro provides the values for all fifty-eight (plus an additional ten) observations for "Corruption" and "Bureaucratic Efficiency."

Given the re-estimated evidence, are the World Bank's and others' efforts warranted? Theoretically, corruption could be helpful or harmful. In one scenario corruption is a Coasean solution to market-distorting institutions and policies (Bardhan 1997). Efficiency results from policies being awarded to those who will gain the most and therefore are willing to pay the highest bribe/price (Leff 1964). In another scenario corruption is a form of rent seeking that generates high opportunity costs (Murphy, Shleifer and Vishy 1993; Bardhan 1997). Corruption by producers signals that resources are being diverted away from productive investments, and corruption by government officials suggests that social-welfare-maximizing policies are neglected in favor of personal-profit-maximizing ones (Knack 2003).

The existing empirical evidence seems to support the view that corruption has little impact on rates of economic growth. Is the World Bank's current focus on corruption well directed towards development, or is it just another misguided policy of the Washington consensus? Past policy prescriptions by the World Bank have not always been effective for development (Sachs 1996; Easterly 2002).

How can one reconcile the common anti-corruption beliefs with the weak empirical evidence? Is it possible that economists' frames of reference have hampered their abilities to model the problem of corruption such that empirical evidence has eluded them?

Many economists might not have suspected that corruption could be a very important determinant of growth, because they underestimated the levels of inefficiency in the world. The economists that focus on the neoclassical models could easily forget that efficiency is a built-in assumption. When they look for sources of variations in growth rates, they test for variations in factors of production such as physical and human capital, without considering institutional variables (Barro 1991; Mankiw, Romer, and Weil 1992). When they consider saving rates, they treat them as preference variables, ignoring the possibility that inefficient institutions could also lead to inefficient capital markets. If economists were to start with a view that economies might generally be inefficient, then it might be easier to find the evidence that corruption is a major source of inefficiency, particularly since it has been difficult to show that lack of corruption is a source of growth.

Ironically, heterodox economists might be equally predisposed to dismissing the potential significance of corruption. Those that feel that poverty results from exploitation by the powerful might be inclined to view corruption as a populist solution to economic injustices. In this regard corruption would be efficiency enhancing. Those that dismiss the notion of market equilibria might dismiss the standard of efficiency that the theoretical market equilibrium provides. Those that place more emphasis on the dynamics of economies might overlook the usefulness of neoclassical techniques of static analysis. Under these assumptions, it might be hard to find empirical evidence of the harm of corruption beyond anecdotal examples.

In this paper I provide what I believe is compelling evidence that corruption is primarily a predatory behavior that lowers efficiency and slows economic growth. I do this by dismissing the market-efficiency hypothesis, setting the standard of efficiency as the neoclassical growth model complete with its predictions of convergence, and then using standard econometric regressions to see if variations in levels of corruption can explain the variations in efficiency in cross-country data. The results presented here suggest that corruption retards growth far more than previously estimated. For example a reduction in corruption levels by one standard deviation, 2.51 units, should result in a reversal in Nigeria's recent negative growth rate of –3.55 percent to a positive 1.50 percent.[3] For a poor country with a strong potential for convergence, the effects of corruption on growth appear to be large.

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[3] I use the same corruption data as did Mauro (1995), and yet combine it with data on the subsequent period of economic growth. See Table 5.

The ultimate reason for the difference in estimates is a difference in the methods used to overcome the multicollinearity problem arising between the initial values of GDP per capita and the levels of corruption. Mauro (1995) controls "for endogeneity by using ethnolinguistic fractionalization as an instrument." I independently determine the relationship between initial levels of income and optimal rates of growth, and then regress levels of corruption on the differences between optimal rates of growth and actual.

This change in methodology is not merely an econometric device; it is a restructuring of the problem. Instead of viewing countries as either developed or less developed and trying to explain measured poverty, countries are viewed as developed, converging or diverging, and the analysis tries to explain the divergence. Markets are no longer implicitly efficient, with analysis aimed at finding the variables associated with growth. Under the proposed framework most countries are seen as having inefficient institutions, with economic analysis aimed at finding the variables associated with institutional efficiency.

The organization of the paper is as follows. Section II looks at the empirical problem. The dynamic efficiency scores are described in section III, followed by the empirical results in section IV. Section V concludes

II. The Empirical Problem

There are several ways to interpret this ambiguous evidence. In one interpretation evidence that corruption slows growth is faint because the association is not based on direct causality. Corruption might be associated with some as of yet undetermined variable that is responsible for the observed slower rates of growth. Corruption by itself is neutral, according to this view. In another interpretation the evidence on corruption is ambiguous because the data on levels of corruption are of poor quality, and therefore incapable of generating credible empirical results. In this view, corruption is harmful to growth, although evidence has yet to support this. In a third view, strong empirical evidence is not found because of a misspecification of the functional form used in past studies. In a fourth view, there are different types of corruption. "Bad" corruption slows growth and "good" corruption facilitates growth. The empirical measures introduced do not distinguish between the forms of the corruption. A fifth alternative, which I will argue to be the most probable, presumes that corruption does not slow growth per se, but it reduces efficiency. Since different countries face different circumstances, they face different opportunities for growth. Those opportunities might only be partially realized or not at all depending on the efficiency of the institutions—depending on the extent of corruption.

In the rest of this section, I will consider each of these alternative views in sequence. The possibility that the relationship between corruption and growth is a spurious one can, in my opinion, be dismissed. Societies are economically more efficient the more they can channel entrepreneurial energy into rent creation instead of rent appropriation. While corruption might play a role in both, theoretically it plays a larger role in rent appropriation. The presence of corruption indicates that at least one of the three actors—lawmaker, official or citizen—is a predator. The theoretical evidence that predation slows growth is substantial.

The easy way out is to blame the data. Since corruption is usually illegal, there tends to very little direct data on it. Most of the data are collected through surveys, and of course people can have biased judgment or even lie (Hungarian Gallup Poll Institute 1999). My own view, however, is that the corruption indices are reliable. Casual observation suggests that there is likely more corruption in the United States than in New Zealand, and more in Moldova than in the United States, as indicated by the indices of corruption used in this study.

More convincingly, comparisons with journalists' articles appearing in the media on corruption that were collected by the Corruption Information Exchange (Vinod 2001) do roughly correspond to Transparency International's index (See Table 2), despite the problem that media accounts are also biased by the degree of free press and on the relative news-worthiness of the topic according to each market. Countries with very high Corruption Perception Index (CPI) scores, meaning very clean governments, tend to have very few reports of only minor corruption involving bribes less that $60,000. Countries with somewhat lower CPI scores show more articles on corruption and more severe instances of corruption including a murder and voter fraud. The countries with the lowest scores, meaning the highest level of corruption, tend to show corruption at all levels of

Table 2
Selected Articles from the Corruption Information Exchange

SELECTED ARTICLES FROM

THE CORRUPTION INFORMATION EXCHANGE (Vinod 2001)

- New Zealand – CPI 9.4 – one procurement bribe for $57K.
- USA – CPI 7.6 – several cases of procurement bribes ($5K – 35K); transfer bribes ($34K); false testimony by a government official ($125K); departmental corruption in some police departments (LA Rampart); murder of sheriff-elect.
- Moldova, Romania, Russia – CPI 3.1, 2.8, 2.3 – several procurement bribes and embezzlement ($38M – 880M); capital flight and money laundering at $20B – 100B per year; mafia intimidation and control over some sectors; systematic police extortion; murder of several journalists; media output for sale; undervalue of privatized assets (Gazprom $250B vs. $298M); bribes extorted for university entrance and grades; safety violations for sale; trade in children (buy $1K, sell $20K); trade in sex slaves (50 thousand women and girls from former USSR each year).
- Bangladesh – CPI 0.4 – Transparency International estimates corruption costs 2.6% of GDP; kickbacks $35M; food imported on non-existent ships; $17M in 3-day projects; each government blaming the other for corruption.

CPI Scores from Transparency International (2001)

government, affecting all levels of society and involving the largest bribes. For these countries there were reports of murder related to corruption, individual government officials collecting bribes in the millions of dollars, money laundering estimated to be in the billions of dollars, and corruption facilitating human trafficking. While this evidence is not conclusive, it is suggestive.

I believe it to be unlikely that a strong association between corruption and growth has not been found due to misspecification of the functional form of the models. In each of the studies cited here, the authors have tried several combinations of controlling independent variables, including institutional variables. Some have used the actual levels of GDP per capita in their regressions (Mauro 1995) and others have used the natural logs of per capita GDP (Knack and Keefer 2003) with similar results.

There likely exists "good" and "bad" corruption; corruption might help organize entrepreneurs in overcoming coordination failures. However, I suspect that much of the found "good" corruption has been misidentified. The real difference probably lies in the extent of ambition of the entrepreneurs and other individuals. The socially ideal entrepreneur would only pursue rent creation. The antithetical variant would only pursue rent appropriation. The more ambitious the entrepreneur, the more forms of rent seeking she would pursue. An ambitious, rational entrepreneur would be amoral and pursue rent creation in tandem with rent appropriation. Finding subsets of data where corruption is positively associated with growth might be an indicator of entrepreneurial strength, not social efficiency.

In the final view, if corruption reduces efficiency and opportunities for growth, then it is possible to find corrupt countries that are growing faster than less corrupt countries. South Korea or Taiwan might be relatively corrupt and yet have growth rates higher than those in less corrupt countries like New Zealand and Sweden, because there are more opportunities for growth in the less developed countries. While certainly the institutions in South Korea are more efficient than those in Brazil, for example, South Korea might still be inefficient relevant to its opportunities. Possibly South Korea or China could have growth rates of GDP per capita exceeding 15 percent per year, if they were able to reduce the levels of corruption, although this might be a low priority for them in their current situations. This is an extension of the argument by Olson in "Big Bills Left on the Sidewalk" (1996) that poor nations are not realizing their economic opportunities because of institutional failures. The empirical problem is that cross-country research on corruption has tended to look for a direct and monotonic association with growth without separately assessing the potential for growth.

Neither initial GDP per worker nor level of clean government is statistically related to average growth rate of per worker GDP in the same way that would be predicted by institutional and growth theories. The correlation coefficient between

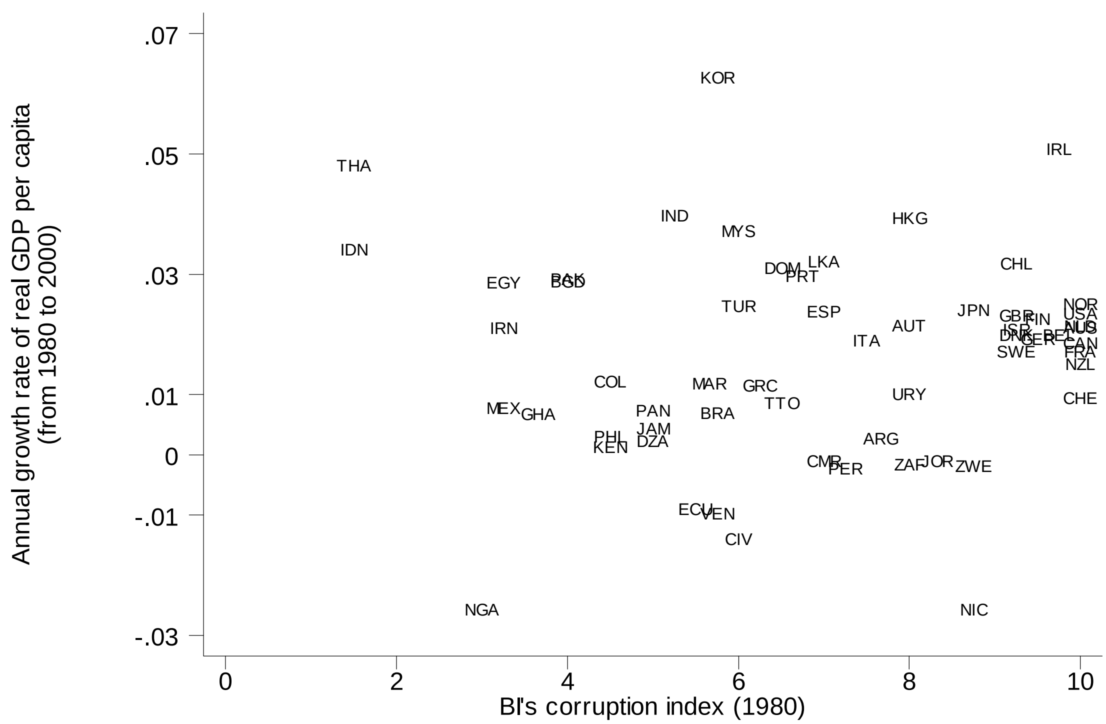

Figure 1
Correlation between Corruption and Growth

Simple correlation = 0.04. A high value on the corruption index indicates clean government. Data are from Mauro (1995) and Heston, Summers, and Aten (2002).

Business International's estimate of clean government (absence of corruption) in 1980 (BI) and average annual growth rate of GDP per capita from 1980 to 2000 is 0.04 (see Figure 1). The arguments outlined earlier in this section suggested that the correlation should be much stronger. The correlation coefficient between GDP per capita in 1980 and average growth rate over the subsequent twenty years is 0.29 (see Figure 2). Standard neoclassical growth models predict that there should be a negative relationship. In the same samples for 1980, the correlation coefficient between level of clean government and level of GDP per worker is 0.75 (see Figure 3). There are at least two reasons why one should expect such a strong correlation: 1) Clean government is a

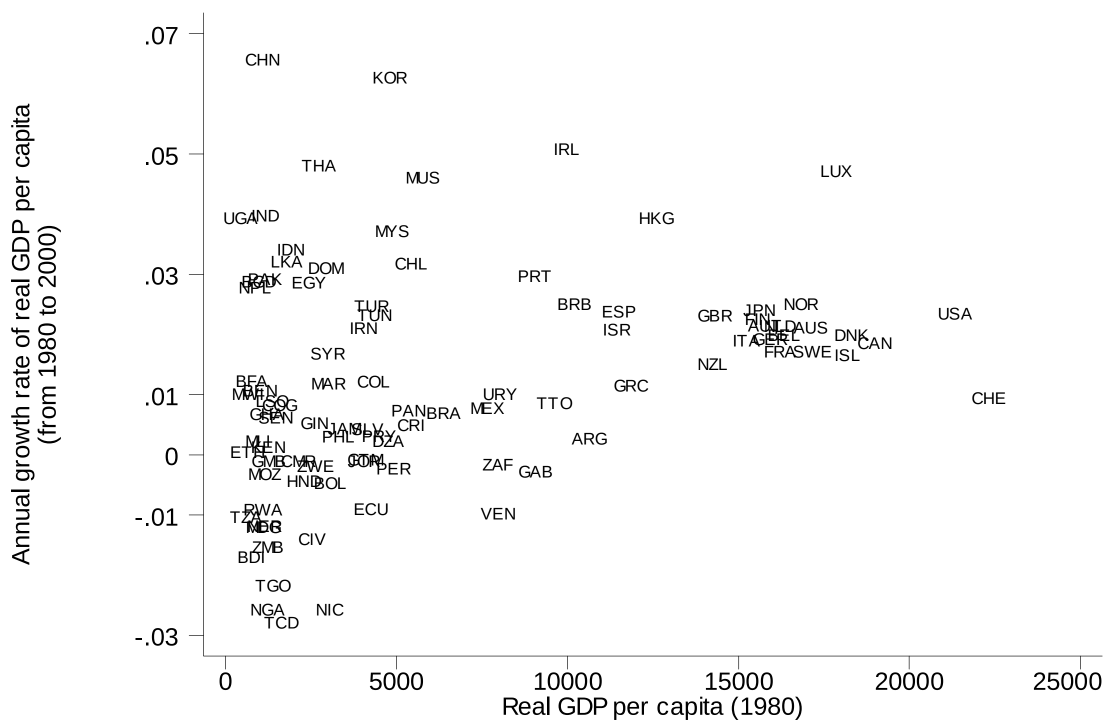

Figure 2
Correlation between GDP and Growth

Simple correlation = 0.29. Data are from Mauro (1995) and Heston, Summers, and Aten (2002).

normal good—in other words, when societies are poor, the citizens will put less time and effort into fighting for clean government since subsistence and survival are greater concerns; and 2) a long history of relatively clean government has likely led to a relatively high level of GDP per worker. This second reason perpetuates the first in a virtuous circle. In contrast, if there is more corruption, then there will be lower growth rates, and hence lower levels of GDP per worker with the continued poverty of the country leading to a low priority for governmental reform—thereby generating a vicious circle.

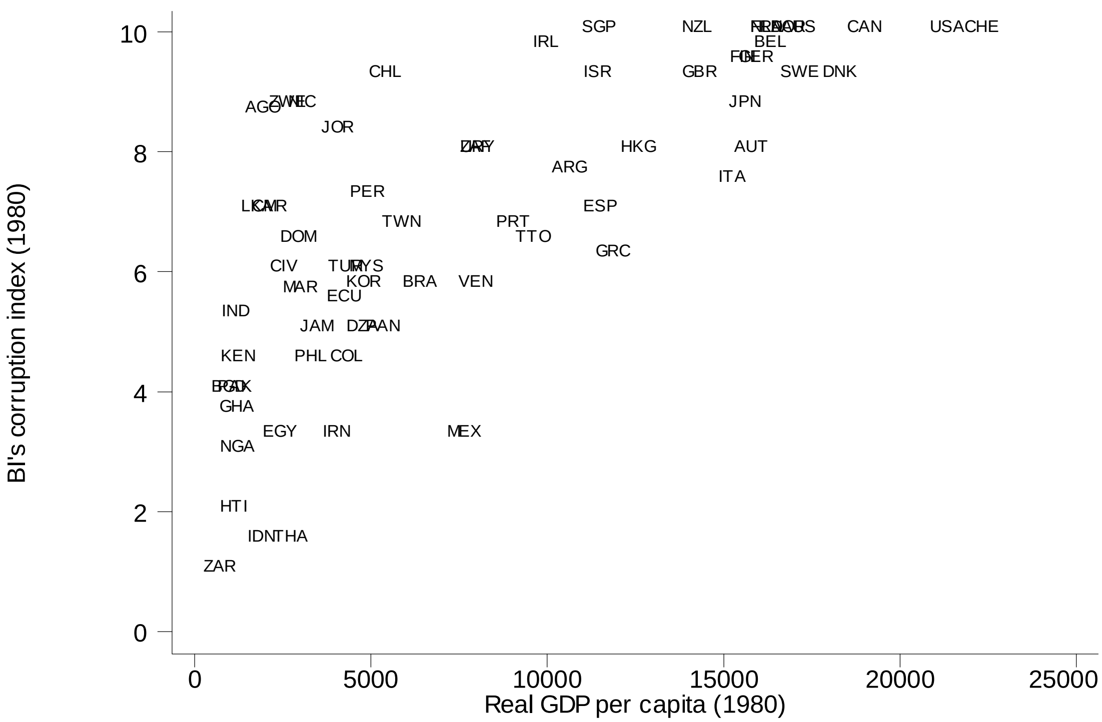

Figure 3
Correlation between GDP and Corruption

Simple correlation = 0.75. A high value on the corruption index indicates clean government. Data are from Mauro (1995) and Heston, Summers, and Aten (2002).

These twin mechanisms have two important statistical implications. First, multicollinearity between the two regressors of the Mauro model will inflate the standard errors of the estimated coefficients and lower their t-statistics. In this situation there is little precision in the estimated coefficients, and the null hypothesis that the slope coefficients are zero is rarely rejected.

Where the subscript, *i*, denotes the i^{th} observation, β_1, β_2, *and* β_3 represent the three estimated slope coefficients, and υ represents a normally distributed error term, the standard regression of the level of clean government or absence of corruption in government, *C*, and the initial level of GDP per worker, (y_o), on the average growth rate of GDP per worker, γ_y, can be written

$$\gamma_{y\,i} = \beta_1 + \beta_2 y_{oi} + \beta_3 C_{i} + \upsilon_i \qquad (1)$$ [4]

If the explanatory variables can be written, where λ denotes the proportional relationship between the two explanatory variables and ν a normally distributed error term,

$$C_i = \lambda y_{0i} + \nu_i \qquad (2)$$

then, the simple correlation reported above and illustrated in Figure 3 suggests that the regression in Equation (1) can be rewritten

[4] This is the basic form of the Mauro model.

$$\gamma_{y\,i} = \beta_1 + (\beta_2 + \beta_3\lambda)y_{0i} + \upsilon_i + \beta_3\nu_i \quad (3)$$

If β_2 and $\beta_3\lambda$ are of the same sign, then although the separate coefficients cannot be estimated well, at least the combined estimated slope coefficient will be the best linear unbiased estimator (Gujarati 1995). However, if β_2 and $\beta_3\lambda$ are not of the same sign, then the combined estimator will be 'biased' towards zero. In the case of convergence of GDP per worker and clean government, we expect

$$\beta_2 < 0 \quad (4)$$

and

$$\beta_3 > 0 \quad (5)$$

and

$$\lambda > 0 \quad (6)$$

therefore,

$$|\beta_2 + \beta_3\lambda| < |\beta_2| + |\beta_3\lambda|. \quad (7)$$

If

$$|\beta_2| = |\beta_3\lambda| \tag{8}$$

then

$$|\beta_2 + \beta_3\lambda| = 0. \tag{9}$$

Strictly speaking, this would be the true economic value; combined, the direct and indirect effects cancel each other out, such that the net effect is zero. However, this might be revealing a vicious circle of a poverty trap or it might be resulting from $\beta_2 = \beta_3\lambda = 0$.

The second statistical implication of the twin mechanisms takes its significance from the fact that the sample used in this paper contains a large proportion of all of the countries in the world. From a statistical point of view, it would be ideal if the sample contained observations in all four combinations of high and low levels of corruption and high and low levels of initial GDP per capita. If there were some observations of initially poor countries that were randomly relatively less corrupt than most poor countries and some observations of initially rich countries that were randomly more corrupt than most rich countries, then we could track these observations to test the hypothesis that corruption slows growth. The poor country with a clean government would grow and maintain its clean governance. The corrupt rich country would cease to grow and the corruption would persist. However, instances of poor but uncorrupt countries are rare since the countries that escape the trap of poverty and corruption can grow rapidly such that soon they are no longer so poor. Since wealthy countries generally demand clean governments, there are few cases of countries that are wealthy but corrupt. We can interpret the strong correlation between clean government and GDP per worker as evidence that the twin mechanisms of clean government being a normal good and corruption slowing economic growth are both prevalent.

As mentioned earlier, Mauro (1995) uses two-stage least squares regressions to reduce the problem of multicollinearity between regressors.[5] Alternatively, one might find an earlier period when small institutional differences had yet to generate large differences in per worker GDP.[6] I try a different approach by determining the levels of efficiency independently from the levels of corruption and then regressing the levels of efficiency on the levels of corruption. In this way, the multicollinearity problem can be avoided.

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[5] The process of two-sage least squares regression *reduces* the statistical significance of corruption in Mauro's results.

[6] The assumption made in this study is of convergence. Jared Diamond (1997) writes the history of a time when the institutional differences were small, and the correlation between initial per capita GDP and growth rates was positive—when those countries with initially higher levels of GDP per capita due to geographic circumstances were able to subsequently grow more quickly. Both relationships are not necessarily mutually exclusive. It is possible that when the incentives for rent creation are strong, then technological improvements exhibit increasing returns to scale, and thus show divergence. However, countries with inadequate institutions might still be able to catch up with developed countries by improving their institutions, investing in physical capital, and incorporating best-practice technologies. In this case, convergence would result from decreasing returns to scale to physical capital and lower costs of adapting existing technologies.

III. Dynamic Efficiency Scores

The dynamic efficiency scores are closely based on how quickly a country has been growing relative to its potential given its initial level of output per capita or capital per capita.[7] The theoretical best-practice frontier shows the potential growth rates as a function of initial levels, and is based on the Solow growth model, which assumes perfect institutions and market efficiency, and exogenous saving rates. Actual country performance is then assumed to be the result of inefficiencies in markets, institutions or policies, as well as other factors such as differences in population growth rates and levels of human capital per capita, which are in part a function of institutions and policies.

The procedure takes several steps. First beginning with the Cobb-Douglas production function used in the Solow growth model[8],

$$Y = AK^{\alpha}L^{(1-\alpha)}, \tag{10}$$

the predicted growth rate is calculated as a function of initial levels of capital per worker,

$$\gamma_{yi} = (sA)_i \alpha k_i^{(\alpha - 1)} - \alpha(n + \delta). \tag{11}$$

[7] For a comparison with other dynamic efficiency scores based more explicitly on growth rates and data-driven results, see Kauper (2006).

[8] The standard notation is used such that Y = output, A = the level of technology, K = stock of physical capital, L = stock of labor, α = income share of physical capital, γ_y is the growth rate of GDP per capita, s is the saving rate, n is the population growth rate, δ is the depreciation rate, and k is the initial level of capital per worker.

From Equation (11) the saving rate, s, times the Solow residual, A, is calculated. In the Solow growth model, these variables are the two primary sources of inefficiency when we consider s to be endogenous, and A to be a residual that not only includes the level of technology, but also the level of institutions and market efficiency.[9]

$$(sA)_i = [(\gamma_{yi}/\alpha) + (n + \delta)]\ k_i^{(1-\alpha)} \tag{12}$$

Equation (12) shows the sA as a function of initial capital per worker. After substituting the production function, Equation (13) shows sA as a function of initial output per worker.

$$(sA^{1/\alpha})_i = [(\gamma_{yi}/\alpha) + (n + \delta)]\ y_i^{((1-\alpha)/\alpha)} \tag{13}$$

is calculated for all of the countries in the data set. The highest value is sA_{max}. The dynamic, or growth, efficiency score for each country, de_i , is given in equation (14).

$$de_i = (sA)_i / (sA)_{max} \tag{14}$$

The Penn World Tables are used for values of output per worker (version 6.1) and capital per worker (version 5.6). It is assumed here that the sum of the population growth

[9] Weil explicitly decomposes the Solow residual, A, into these two components, technology, T, and efficiency, E, such that A = T x E. (Weil 2005) As written, E represents productive or technical inefficiency.

rate and the depreciation rate equals 0.09.[10]

Dynamic efficiency scores are calculated with various values of α. $\alpha = 0$ is equivalent to setting sA equal to the initial value of y or k. $\alpha = 1$ is equivalent to setting sA equal to γ_y. Dynamic efficiency scores are reported for values of $\alpha = 1/3$, 2/3, and the value which generated two countries on the frontier. $\alpha = 1/3$ corresponds to common specifications of the Solow growth model. $\alpha = 2/3$ corresponds to the augmented Solow growth model where investment can be made in human capital as well as in physical capital, or to models where the income share of capital is 1/3, but there are some externalities to capital present (Mankiw, Romer, and Weil 1992).

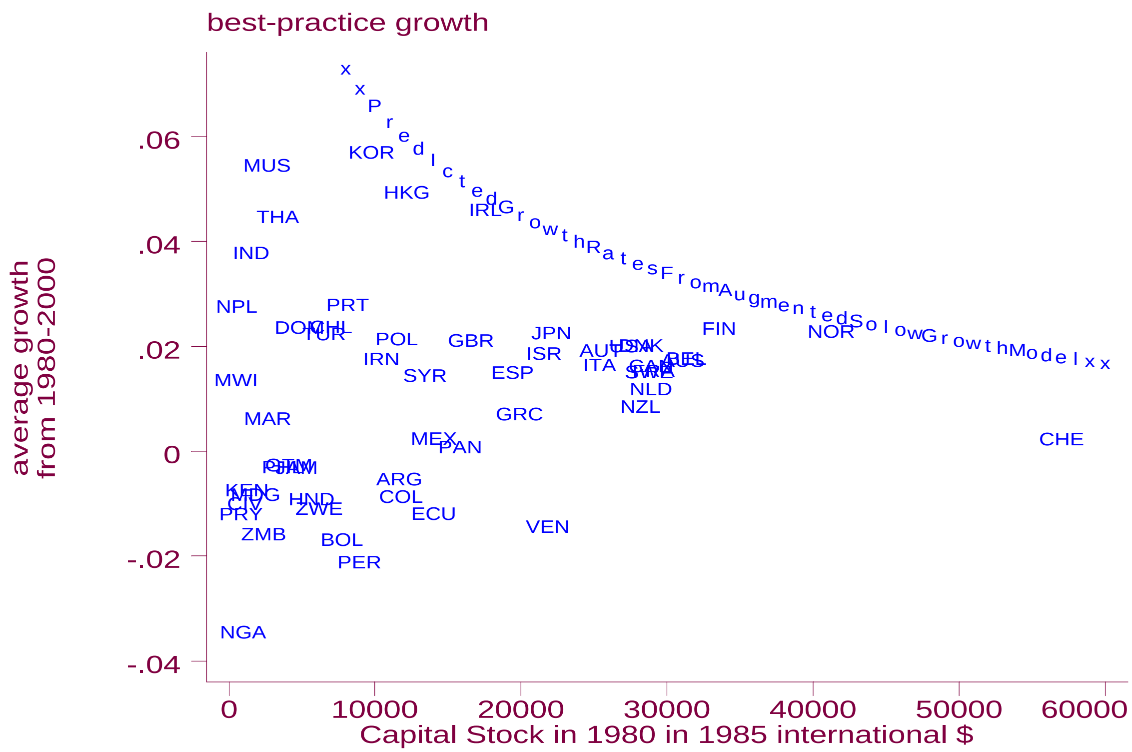
When looking at initial levels of capital per capita, $\alpha = 0.723504$ generated two countries on the frontier and the highest sum of the scores of the ten most efficient countries. When looking at initial levels of output per capita, $\alpha = 0.626101$ generated two countries on the frontier and the highest sum of the scores of the ten most efficient countries. Most of the statistics reported in this paper are based on a value of $\alpha = 2/3$.[11]

Figure 4 shows the best-practice growth frontier using the Cobb-Douglas production function and $\alpha = 2/3$ in relation to the data. Each country's dynamic efficiency score depends on its vertical, relative position to the frontier. This can be seen in Figure 5.

Countries with populations less than one million in 1960 are removed in order to

[10] Mankiw, Romer and Weil (1992) assume a value of 0.05. Higher values decrease the potential of rich countries and thereby increase their efficiency.

[11] While the Solow model can be used to predict growth in one period, I am using it to predict growth over periods of twenty years. Because of convergence leading to slowing growth rates, my predictions of potential growth rates will be too high. However, this is equivalent to specifying a value of α that is too large.



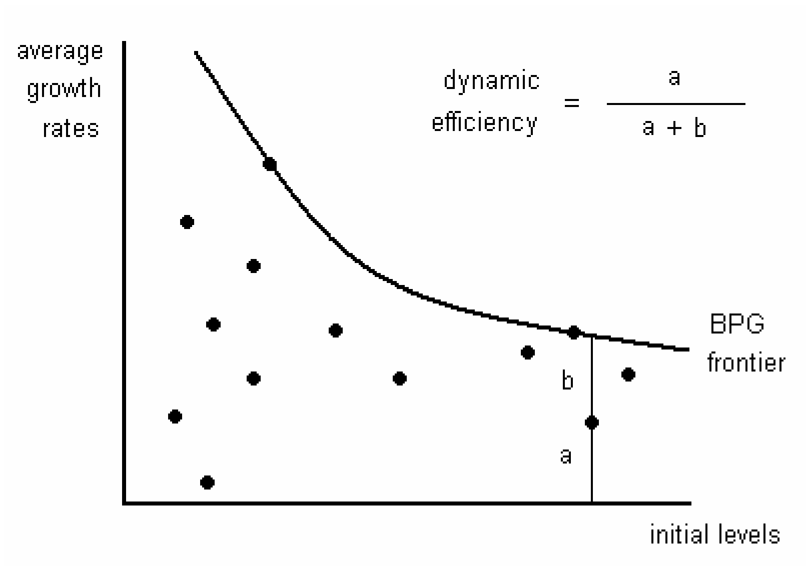
The curve labeled 'xxPredictedGrowthRatesFromAugmentedSolowGrowthModelxx' shows a possible best-practice frontier. Values are per worker. Average growth rates are from the PWT 6.1, and capital stock values are from the PWT 5.6.

Figure 2.

minimize the chance that super efficient countries determine the frontier. It is presumed that small countries might encounter unique situations that are not replicable in other countries. Were this the case, they would be super efficient.

This method of calculating the frontier and efficiency scores has the drawback that a production function is imposed on the data. It would be better if the data could be used to determine the functional form. Two other methods that could have been used are data envelopment analysis (DEA) and stochastic frontier analysis (SFA) (Kauper 2006).

While both DEA and SFA have the advantage that they do not require the imposition of a functional form, they each have traditionally been used for calculating



This graph shows the general principle of the dynamic efficiency scores.

Figure 3.

production frontiers and consequently have drawbacks when being used for growth frontiers. DEA requires that the data set be convex. Since the data set appears to be non-convex, then it would have to be transformed which might change the underlying relationships between a country's position relative to the frontier.[12] SFA requires the specification of a two-sided and a one-sided distribution of error terms. The one-sided error terms represents inefficiency. However, since the distribution of inefficiency is likely to vary with the initial level of output, any single specification could dramatically change the results, and misrepresent inefficiency.

The results are somewhat dependent on the initial variable chosen. When per worker output instead of per worker capital is chosen as the initial variables, there are

[12] I am deeply indebted to Prasanta Pattanaik for pointing out to me that any transformation would not only likely change the scores, but also the ranking. I am also deeply indebted to Xu Cheng for pointing out to me that in trying to measure distance from a growth frontier, I was essentially trying to measure sA.

only modest changes in ranking. Notable changes are in the ranking of the United States and the Republic of Korea. The United States ranks 2nd when the dynamic efficiency scores are based on initial levels of output per capita, but only ranks 9th when the scores are based on initial capital per capita. This could possibly be because much of US output is due to land resources such as agriculture. The Republic of Korea ranks 20th out of the scores based on output, and moves up to 5th out of the scores based on capital. Possibly, capital-intensive industries are more important in the Korean economy.

The scores are also somewhat sensitive to the value used for α. The higher the value of α, the higher the efficiency scores for high growth countries. The lower the value of α, the higher the efficiency scores for wealthy countries. Since corruption scores tend to be highly correlated with income levels, low values of α will tend to increase the correlation between dynamic efficiency and corruption. Generally, I report statistics based on high values of α, and therefore, should understate the actual correlation.

IV. EMPIRICAL RESULTS

Tables 3 and 4 show the results of regressions of dynamic efficiency on various measures of corruption.[13] Table 3 shows the results with one independent variable, CPI, Corr, or Bureaucratic Efficiency, and several variants of dynamic efficiency scores.

[13] It is assumed that the error term is normally and independently distributed, even though the maximum value of the dynamic efficiency score is one. For coefficient estimate results of tobit analysis, see Appendices C and D.

Table 3
Dynamic Efficiency on Corruption, Bureaucratic Efficiency

Dynamic Efficiency on Corruption, Bureaucratic Efficiency						
Independent Variables: / Dependent Variable:	Constant	TI CPI 1998	BI Corruption Index 1980	Bureaucratic Efficiency 1980	N	R^2
Dynamic Efficiency:	0.197	0.078	—	—	47	0.66
Period from	(4.00)	(9.42)				
1980-2000,	0.188	—	0.064	—	43	0.45
initial value of capital	(2.20)		(5.76)			
per worker,	0.149	—	—	0.070	43	0.42
α = .723504	(1.54)			(5.44)		
Dynamic Efficiency:	0.131	0.082	—	—	47	0.68
Period from	(2.63)	(9.86)				
1980-2000,	0.110	—	0.070	—	43	0.48
initial value of capital	(1.26)		(6.12)			
per worker,	0.066	—	—	0.077	43	0.45
α = 2/3	(0.67)			(5.81)		
Dynamic Efficiency:	-0.116	0.095	—	—	47	0.73
Period from	(-2.25)	(11.03)				
1980-2000,	-0.184	—	0.086	—	43	0.54
initial value of capital	(-1.96)		(6.96)			
per worker,	-0.251	—	—	0.096	43	0.53
α = 1/3	(-2.39)			(6.83)		
Dynamic Efficiency:	0.223	0.081	—	—	64	0.68
Period from	(5.86)	(11.56)				
1980-2000,	0.225	—	0.062	—	57	0.44
initial value of output	(3.27)		(6.64)			
per worker,	0.154	—	—	0.074	57	0.47
α = .626101	(2.07)			(7.03)		
Dynamic Efficiency:	0.256	0.075	—	—	64	0.67
Period from	(6.99)	(11.26)				
1980-2000,	0.268	—	0.057	—	57	0.42
initial value of output	(4.06)		(6.30)			
per worker,	0.202	—	—	0.068	57	0.45
α = 2/3	(2.81)			(6.72)		
Dynamic Efficiency:	0.004	0.097	—	—	64	0.69
Period from	(0.10)	(11.69)				
1980-2000,	-0.046	—	0.082	—	57	0.48
initial value of output	(-0.55)		(7.17)			
per worker,	-0.139	—	—	0.097	57	0.51
α = 1/3	(-1.54)			(7.64)		

A high value on all of the independent variables means good institutions. Reported in parentheses are t-statistics.

Table 4
Dynamic Efficiency on Corruption and Net Royalty Payments[14]

DYNAMIC EFFICIENCY ON CORRUPTION AND NET ROYALTY PAYMENTS					
Dependent variable: Dynamic Efficiency Scores— period from 1980 to 2000; initial value of capital per worker; $\alpha = 2/3$					
Independent variable	(1)	(2)	(3)	(4)	(5)
Constant	0.110	0.537	0.334	0.336	0.338
	(1.26)	(5.15)	(2.62)	(2.77)	(3.33)
BI Corruption Index 1980	0.070	0.039	0.024	0.028	__
	(6.12)	(3.60)	(2.05)	(1.96)	
Population growth rate from 1980-2000	__	-14.603	-8.338	-8.426	-7.977
		(-5.41)	(-2.34)	(-2.48)	(-2.68)
Enrollment rate in secondary education in 1980	__	__	0.353	0.350	0.311
			(2.49)	(2.60)	(2.73)
Net royalty payments as a fraction of GDP from 1980-1999	__	__	__	6.742	7.952
				(1.21)	(1.74)
TI Corruption Perception Index 1998	__	__	__	__	0.029
					(2.81)
N	43	42	42	41	45
R^2	0.48	0.71	0.75	0.78	0.85

A high value on the corruption indices means good institutions. Reported in parentheses are t-statistics. Data on corruption come from Mauro (1995). Data on GDP per capita and population come from Heston, Summers, and Aten (2002). Data on education enrollment rates come from Barro and Lee (1993).

Table 4 shows the results of multivariable regressions of one variant of dynamic efficiency scores. Summary statistics of the regressors and regressands are shown in Appendices A and B.

In every case, variations in levels of corruption are strongly associated with variations in levels of efficiency. In the single-variable regressions, R^2's range from a low of 0.42 to a high of 0.73. In the multivariable regressions, a regression with three independent variables in addition to one for corruption, generate an R^2 of 0.85. The sign on the coefficient is as expected—better institutions lead to higher efficiency. The

[14] For a comparison of the coefficient estimates with growth rates as the dependent variable instead of dynamic efficiency, see Appendix E.

Table 5

Predicted Average Growth Rates

PREDICTED AVERAGE GROWTH RATES with Reduction in Levels of Corruption by 2.54 (based on Table 4)						
		model specification in Table 4	col. 1	col. 2	col. 3	col. 4
		predicted increase in efficiency	0.18	0.10	0.06	0.07
Country	estimated efficiency	average growth rate	predicted growth rate			
Argentina	0.43	-0.63%	1.59%	0.61%	0.13%	0.26%
Australia	0.85	1.63%	3.23%	2.53%	2.18%	2.27%
Austria	0.81	1.83%	3.54%	2.78%	2.41%	2.51%
Belgium	0.85	1.67%	3.26%	2.56%	2.22%	2.31%
Canada	0.82	1.53%	3.17%	2.45%	2.09%	2.19%
Chile	0.56	2.28%	4.91%	—	—	—
Colombia	0.41	-0.96%	1.25%	0.28%	-0.20%	-0.07%
Cote d'Ivoire	0.18	-1.09%	3.81%	1.64%	0.59%	0.87%
Denmark	0.85	1.93%	3.58%	2.85%	2.50%	2.59%
Dominican Republic	0.49	2.27%	5.24%	3.93%	3.29%	3.46%
Ecuador	0.40	-1.28%	0.81%	-0.12%	-0.57%	-0.45%
Finland	0.94	2.25%	3.81%	3.12%	2.79%	2.88%
France	0.81	1.43%	3.07%	2.34%	1.99%	2.09%
Greece	0.63	0.62%	2.48%	1.65%	1.25%	1.36%
Hong Kong	0.88	4.85%	7.04%	6.07%	5.60%	—
India	0.39	3.69%	8.07%	6.13%	5.19%	5.44%
Iran	0.59	1.66%	3.97%	2.95%	2.45%	2.59%
Ireland	0.97	4.51%	6.45%	5.59%	5.17%	5.28%
Israel	0.76	1.77%	3.58%	2.77%	2.39%	2.49%
Italy	0.78	1.55%	3.27%	2.51%	2.14%	2.24%

Table 5
(Continued)

model specification in Table 4			col. 1	col. 2	col. 3	col. 4
predicted increase in efficiency			0.18	0.10	0.06	0.07
Country	estimated efficiency	average growth rate	predicted growth rate			
Jamaica	0.33	-0.40%	2.62%	1.28%	0.63%	0.80%
Japan	0.81	2.16%	3.96%	3.16%	2.78%	2.88%
Kenya	0.19	-0.84%	3.86%	1.78%	0.77%	1.04%
Korea, Republic of	0.88	5.60%	7.95%	6.91%	6.41%	6.54%
Mexico	0.52	0.15%	2.23%	1.31%	0.86%	0.98%
Morocco	0.32	0.53%	4.16%	2.55%	1.78%	1.98%
Netherlands	0.77	1.09%	2.73%	2.01%	1.66%	1.75%
New Zealand	0.73	0.76%	2.42%	1.68%	1.33%	1.42%
Nigeria	0.09	-3.55%	1.50%	-0.74%	-1.82%	-1.53%
Norway	1.00	2.20%	3.65%	3.01%	2.69%	2.78%
Panama	0.53	-0.01%	2.00%	1.11%	0.68%	0.79%
Peru	0.28	-2.21%	0.21%	-0.86%	-1.38%	-1.24%
Philippines	0.31	-0.39%	2.86%	1.42%	0.72%	0.91%
Portugal	0.62	2.70%	5.20%	4.10%	3.56%	3.70%
Spain	0.70	1.40%	3.28%	2.45%	2.05%	2.15%
Sweden	0.80	1.42%	3.07%	2.34%	1.99%	2.08%
Switzerland	0.83	0.14%	1.45%	0.87%	0.59%	0.66%
Thailand	0.55	4.38%	7.74%	6.26%	5.54%	5.73%
Turkey	0.54	2.14%	4.84%	3.65%	3.07%	3.22%
United Kingdom	0.72	2.02%	4.00%	3.12%	2.70%	2.81%
United States	0.84	1.91%	3.58%	2.84%	2.48%	2.58%
Venezuela	0.44	-1.53%	0.27%	-0.53%	-0.91%	-0.81%
Zimbabwe	0.31	-1.19%	1.55%	0.34%	-0.25%	-0.09%

Data on GDP per capita come from Heston, Summers, and Aten (2002).

magnitudes on the coefficients are economically significant. An increase by one standard deviation in the CPI score (2.54) would lead to an increase in the dynamic efficiency score of 0.208. For a country like Mexico, this would predict that their growth rate would increase to 2.23% from its current 0.15% (see Table 5).

The 1998 CPI is the institutional variable most strongly related to dynamic efficiency scores. It part this could because the CPI is a better measure of corruption. It is also likely that economic growth leads to less corruption, and therefore the CPI scores of 1998 are in part the result of the intervening growth of an efficient country. This is one problem faced by Mauro (1995), as mentioned earlier.

The results appear to be relatively insensitive to the variable of initial levels or to the value of α. When using the BI corruption Index as the independent variable, the R^2's range from 0.42 to 0.54. The results are slightly stronger with $\alpha = 1/3$, the appropriate value for the standard Solow growth model with the Cobb-Douglas production function, and initial values of capital per capita.[15]

In the multivariable regressions, additional explanatory variables of population growth, enrollment in secondary schools and net royalty payments as a fraction of GDP are included. Population growth rates are added since they are likely important to efficiency as measured here, and they are actually part of the model but were heretofore assumed to be the same for all countries. Population growth rates are a statistically and economically significant determinant of dynamic efficiency scores. This is consistent with the Solow growth model where higher population growth dilutes physical capital per

[15] The results presented in this section are based on $de_i = (sA^{(1/\alpha)})_i/(sA^{(1/\alpha)})_{max}$.

worker.

Human capital should also be strongly correlated with efficiency scores. Many economists have argued that educated workers are a prerequisite for convergence. The Augmented Solow growth model achieves its good fit in part because of its inclusion of human capital. In these regressions enrollment in secondary schools, a proxy for human capital, is a statistically and economically significant determinant of dynamic efficiency scores.

Net royalty payments are used as a proxy for overcoming coordination failures. If a country were to catch up, it would likely borrow technology from others. In a world of intellectual property rights, this would be manifested as royalty payments. Since a corrupt country may still encourage investment in new production, net royalty payments in the presence of corruption could indicate that governments want to take a share of a growing pie instead of a static one. The estimated coefficient for this proxy is not statistically significant, but it is of the right sign—more efficient countries seem to be buying rather than selling technology.[16]

The results presented in this chapter differ somewhat from Mauro's (1995) investigation into corruption and investment rates. Investigating investment in this paper would be the equivalent to investigating the saving rates. However, I try to explain variations in sA not just s. Since the Solow residual is likely to vary between countries, differences in levels of corruption might help explain that as well.

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[16] It is interesting to note that this sign is in contradistinction to another theoretical possibility that more efficient countries are net sellers of technology.

The results presented in Tables 4 and 5 suggest that corruption plays a far stronger role in slowing the growth rates of poor countries than has previously been suggested by the empirical literature. As suggested earlier in this chapter, this might be because it is more difficult to explain growth rather than dynamic efficiency. The results of this study support the hypothesis that poor countries have higher potential growth rates than rich countries, but that poor countries are also less efficient. In other words, poor countries have a tendency to grow quickly due to their low initial levels, but simultaneously have a tendency to grow slowly due to their inefficiency. On average, the poor countries grow at the same rate as the rich, thereby making it difficult to explain econometrically.

V. Concluding Remarks

The analysis in this paper suggests that corruption explains a large proportion of the inefficiency in the world's economies. The data presented implies that the diverging countries could converge to the developed countries if they reduced their governmental corruption—if their institutions encouraged rent creation more, and rent appropriation less. I suspect that the governments in diverging countries would not have to eliminate corruption, just reduce it. If corruption is reduced enough, sustained growth is possible, and then as the citizens' standard of living improved, they would demand a more honest, less corrupt, and more efficient government. The improvements would be self-sustaining.

This study made this argument by applying a standard econometric technique in a novel way. By using frontier analysis to calculate the opportunities for growth, and then explaining the inefficiencies relative to the opportunities through ordinary least squares regressions, better estimates of the negative influence of corruption were made.

The results can be expressed qualitatively. First, corruption appears to be far more harmful to growth than previously estimated. Second, there seems to be far more inefficiency in the world than many have assumed. Third, the potential for growth in developing nations has been heretofore underestimated. Finally, institutions matter more than is often postulated. Getting prices right does not merely generate a one-time gain in GDP of a couple of percentage points. Getting prices right can generate a sustained increase in the average growth rate of GDP per capita of a couple of percentage points—affecting billions of people.

I hope that my study has made an incremental step towards the universal goal of reducing corruption and rent appropriation, and increasing efficiency, the rate of economic growth, standards of living, and justice. There are scores of economists, policymakers and volunteers that are working towards these goals. I hope that this study encourages them by demonstrating that their efforts are even more important than previously acknowledged. I hope others join them.

I hope also that this study will inspire an incremental change to the paradigm of "mainstream economics." Mainstream economics emphasizes the benefits of free markets and downplays the importance of institutions. By assuming that institutions are both exogenous and invariant, they are givens in the model. Intermediate macroeconomics textbooks typically devote two chapters to neoclassical growth theory, and a couple of paragraphs or merely a sentence or two to institutional problems. They ignore rent appropriation despite its uneven prevalence in the world.[17] An improvement would be to specifically acknowledge three types of countries when discussing economic growth: 1) developed countries whose major source of growth is technological improvement; 2) converging countries whose major source of growth is the accumulation of physical and human capital; and 3) diverging countries whose major promise for growth would be the creation of institutions that encourage production and discourage predation.

This study is by no means definitive. Many questions remain regarding the techniques. The frontier analysis is largely non-stochastic, leaving much doubt regarding its statistical power. The variable that measures "corruption" might simply proxy for other more serious economic problems. Possibly the endogenous determinants of corruption are so strong that increasing economic growth is the best way to reduce corruption, not the other way around. Perhaps predatory governments have to get a taste for the potentially unlimited wealth generated by rent creation before they are willing to relinquish their access to the limited wealth generated by appropriation.

[17] These generalizations are based on a review of DeLong (2002), Dornbusch, Fisher, and Startz (2004), Farmer (2002), and Mankiw (2003).

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Appendix A

Descriptive Statistics of Regressors and Regressand

Variable	N	Mean	Std. Dev.	Min	Max
CPI 1998	70	5.13	2.54	1.4	10
BI Corruption 1980	68	6.79	2.56	1	10
Bureaucratic efficiency	68	6.63	2.19	1.89	10
Net royalty payments	107	0.0006	0.0025	-0.0087	0.0220
Growth in output per worker 1980-2000	91	0.0083	0.193	-0.3550	0.0560
Growth in population 1980-2000	93	0.0189	0.0010	0.0011	0.0412
Secondary school enrollment	108	0.446	0.299	0.03	1.05
GDP per worker in 1980	88	15301	12966	942	46121

A high value on the corruption indices means good institutions. Data on corruption come from Mauro (1995). Data on GDP per capita and population come from Heston, Summers, and Aten (2002). Data on education enrollment rates come from Barro and Lee (1993).

APPENDIX B

DESCRIPTIVE STATISTICS OF EFFICIENCY SCORES USED AS REGRESSANDS

Variable	N	Mean	Std. Dev.	Min	Max
Dynamic efficiency 1980 capital, alpha = 0.723504	53	0.602	0.245	0.121	1
Dynamic efficiency 1980 capital, alpha = 2/3	53	0.560	0.256	0.086	1
Dynamic efficiency 1980 capital, alpha = 1/3	53	0.376	0.284	-0.009	1
Dynamic efficiency 1980 output, alpha = 0.626101	88	0.551	0.246	0.164	1
Dynamic efficiency 1980 output, alpha = 2/3	88	0.563	0.233	0.183	1
Dynamic efficiency 1980 output, alpha = 1/3	88	0.407	0.287	-0.103	1

Data on GDP per capita come from Heston, Summers, and Aten (2002).

Appendix C
Dynamic Efficiency on Corruption, Bureaucratic Efficiency—Tobit Model

Independent Variables: / Dependent Variable:	Constant	TI CPI 1998	BI Corruption Index 1980	Bureaucratic Efficiency 1980	N	LR Chi^2
Dynamic Efficiency:	0.195	0.078	—	—	47	50.4
Period from	(3.98)	(9.52)				
1980-2000,	0.183	—	0.065	—	43	25.3
initial value of capital	(2.15)		(5.86)			
per worker,	0.146	—	—	0.071	43	22.9
α = .723504	(1.52)			(5.51)		
Dynamic Efficiency:	0.128	0.083	—	—	47	53.7
Period from	(2.58)	(9.98)				
1980-2000,	0.104	—	0.071	—	43	27.7
initial value of capital	(1.20)		(6.23)			
per worker,	0.059	—	—	0.078	43	25.7
α = 2/3	(0.60)			(5.91)		
Dynamic Efficiency:	-0.118	0.096	—	—	47	60.5
Period from	(-2.30)	(11.12)				
1980-2000,	-0.189	—	0.086	—	43	33.0
initial value of capital	(-2.02)		(7.05)			
per worker,	-0.257	—	—	0.097	43	32.2
α = 1/3	(-2.45)			(6.91)		
Dynamic Efficiency:	0.222	0.081	—	—	64	72.7
Period from	(5.85)	(11.64)				
1980-2000,	0.220	—	0.063	—	57	33.6
initial value of output	(3.21)		(6.74)			
per worker,	0.148	—	—	0.075	57	36.6
α = .626101	(1.99)			(7.14)		
Dynamic Efficiency:	0.254	0.076	—	—	64	70.8
Period from	(6.96)	(11.36)				
1980-2000,	0.265	—	0.058	—	57	30.9
initial value of output	(4.02)		(6.39)			
per worker,	0.199	—	—	0.068	57	33.8
α = 2/3	(2.79)			(6.79)		
Dynamic Efficiency:	0.003	0.098	—	—	64	73.5
Period from	(0.07)	(11.76)				
1980-2000,	-0.051	—	0.083	—	57	37.5
initial value of output	(-0.61)		(7.26)			
per worker,	-0.146	—	—	0.098	57	41.2
α = 1/3	(-1.62)			(7.75)		

A high value on all of the independent variables means good institutions. Reported in parentheses are t-statistics.

APPENDIX D

DYNAMIC EFFICIENCY ON CORRUPTION AND NET ROYALTY PAYMENTS —TOBIT MODEL

DYNAMIC EFFICIENCY ON CORRUPTION AND NET ROYALTY PAYMENTS					
Dependent variable: Dynamic Efficiency Scores					
Period from 1980-2000; Initial value of capital per worker; $\alpha = 2/3$					
Independent variable	(1)	(2)	(3)	(4)	(5)
Constant	0.104	0.535	0.330	0.333	0.336
	(1.20)	(5.22)	(2.67)	(2.87)	(3.44)
BI Corruption Index 1980	0.071	0.039	0.024	0.022	—
	(6.23)	(3.73)	(2.16)	(2.09)	
Population growth rate from 1980-2000	—	-14.670	-8.355	-8.444	-7.960
		(-5.54)	(-2.41)	(-2.60)	(-2.79)
Enrollment rate in secondary education in 1980	—	—	0.355	0.352	0.312
			(2.59)	(2.74)	(2.85)
Net royalty payments as a fraction of GDP from 1980-1999	—	—	—	6.591	7.829
				(1.24)	(1.78)
TI Corruption Perception Index 1998	—	—	—	—	0.030
					(2.98)
N	43	42	42	41	45
Likelihood ration of Chi^2	27.73	51.28	57.48	61.06	84.14

A high value on the corruption indices means good institutions. Reported in parentheses are t-statistics. Data on corruption come from Mauro (1995). Data on GDP per capita and population come from Heston, Summers, and Aten (2002). Data on education enrollment rates come from Barro and Lee (1993).

APPENDIX E

GROWTH ON CORRUPTION AND NET ROYALTY PAYMENTS

GROWTH ON CORRUPTION AND NET ROYALTY PAYMENTS					
Dependent variable: Per Worker GDP Growth (1980-2000 average)					
Independent variable	(1)	(2)	(3)	(4)	(5)
Constant	0.001 (1.17)	0.043 (3.91)	0.037 (2.75)	0.036 (2.84)	0.032 (2.74)
GDP per worker in 1980 (1,000's)	0.00022 (0.71)	-0.00062 (-1.78)	-0.00074 (-1.94)	-0.00056 (-1.49)	-0.00092 (-2.67)
BI Corruption Index 1980	-0.000 (-0.27)	0.000 (0.15)	-0.000 (-0.08)	-0.001 (-0.48)	—
Population growth rate from 1980-2000	—	-1.341 (-4.02)	-1.179 (-3.09)	-1.101 (-2.99)	-1.247 (-3.68)
Enrollment rate in secondary education in 1980	—	—	0.016 (0.87)	0.012 (0.67)	-0.003 (-0.17)
Net royalty payments as a fraction of GDP from 1980-1999	—	—	—	1.091 (1.37)	0.777 (1.08)
TI Corruption Perception Index 1998	—	—	—	—	0.003 (2.12)
N	57	55	54	53	60
R^2	0.01	0.25	0.25	0.29	0.38

A high value on the corruption indices means good institutions. Reported in parentheses are t-statistics. Data on corruption come from Mauro (1995). Data on GDP per capita and population come from Heston, Summers, and Aten (2002). Data on education enrollment rates come from Barro and Lee (1993).