

Statistical Analysis of Corruption Data and Using the Internet to Reduce Corruption

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Key Words: Cp, AIC, Trimmed Correlation, Income inequality, Schooling, Red tape, Efficient judiciary.

Abstract

Corruption is a serious problem in Asia and elsewhere. Harrison and Vinod's (1992) confidence interval for the marginal excess burden (MEB) of taxation is used to estimate the economic harm arising from corruption. One dollar of corruption is estimated to impose a burden of \$1.67, which becomes very large when compounded over time. After a brief review of economic theory, this paper uses data on sixteen socio-economic and political variables. A cross-sectional study reveals the relevance of "red tape" and "efficiency of judiciary." A subset regression using Mallows' Cp and Akaike information criteria reveals relevance of schooling and income inequality. International aid and cooperation in exposing and fighting corruption and innovative uses of the Internet for information exchange are claimed to be hopeful new tools to fight corruption in the new century.

1. Introduction and Dimensions of the Corruption Problem

This section introduces the dimensions of the corruption problem by noting that corruption hurts all countries and almost everyone. The points covered here are well summarized by the titles of following sections. (2) Theoretical models of corruption: A review. (3) Measuring the burden of corruption: A new approximation. (4) Description of interdisciplinary data. (5) Cross-sectional correlations and subset regressions. (6) Conclusions.

The 1997 currency problems in Asia are widely attributed to corruption. Corruption scandals regularly appear in newspapers everywhere. When a corrupt official in a poor country chooses an economic development project because of a bribe, this wastes scarce resources. When that official imposes tariffs to favor incompetent domestic monopolists, this hurts exporting countries, causes unemployment and slower world economic growth. The terrible burden of slow economic growth in poor countries is indirectly shared by all investors. International cooperation in fighting corruption suffers from jurisdictional issues, since bribery is an internal crime against property. We need greater international technical assistance and cooperation in apprehending and punishing the corrupt.

A fight against corruption involves fighting human nature. A bribe occurs when both parties benefit and it is generally difficult to balance a large potential benefit enjoyed by both parties with appropriate punishments and disincentives. Three fundamental prob-

[†]I thank Lionel Lucero for major help with data and Rick Geddes for comments. A version has been posted on www.fordham.edu/economics/vinod since February 23, 1999 and was presented at the 9th International Anti-Corruption Conference, Durban, South Africa, 10-15 October, 1999.

lems with corruption are: (a) It is hidden, (b) Incentives for fighting it are improperly aligned, and (c) International jurisdiction is missing. I claim that all three problems can be simultaneously attacked by using Internet-based innovative techniques.

2. Theoretical Models of Corruption: A review

Corruption may be defined as (illegal) selling of a public entity's (e.g., government, public corporation, public charity) property or services for gain (bribe) to the seller (not to the public entity). In general, any criminal behavior has several facets including social, economic, racial, psychological, political, legal, moral, religious, sexual, and medical. Hence, an interdisciplinary approach is generally followed in criminology. As a property crime, economists have a large corruption literature surveyed by Bardhan (1997).

It is generally agreed that free market competition and democracy brings peace and prosperity. However, bringing true competition in traditional societies of poor countries requires good government, fair enforcement of contract laws and equality of opportunity. Besides listing such factors, this paper also measures the cumulative economic burden of corruption and provides an empirical ranking of most relevant action variables.

2.1 Microeconomic Game Theoretic Viewpoint

I start with the micro viewpoint of the individual bribe-taker. Becker (1968) considers a rational individual choosing between criminal and legal behavior in light of the probability of being detected and punished. Some refinements to Becker's model in the literature incorporate: (i) utility functions, (ii) risk neutrality associated with being caught, and (iii) the effect of the wealth of the rational individual on the decision. Game theory provides powerful tools for situations when some bargaining between economic agents is involved. For example, we can assume that there is recursive "Nash bargaining" between the bribe-taker and bribe-giver. A game-theoretic computation of an equilibrium bribe is made in Basu *et al* (1992). The viewpoint of individual bribe-taker is used in Rijckghem and Weder's (1997) cross section study, which finds a negative relation between corruption and wages, implying a need to raise wages of bureaucrats.

Result 1 (Absentee Owner Hazard): A failure of incentives occurs because the cooperative Nash equilibrium between the bribe-taker and the bribe-giver ignores the public interest. The public is the absent third party, which owns the asset, not represented by anyone in the Nash bargain.

This is similar to the "moral hazard," arising from asymmetric information (See Sandmo, 1999), and agency costs arising from the "principal-agent problem." Mookherjee and Png's (1995) theory of "delegated enforcement" is also similar. To avoid confusion, I call this the "absentee owner hazard," where the public gets the worst deal. The bribe-taker is "selling" something that belongs to the absent third party. Unless detected, a seller's cost is near zero. The bribe-giver gets a resource at a fraction of the real price. Hence, there is a great incentive among both to keep the deal secret at the cost of the absent third-party owner. The hazard summarizes all such reasons, which make a fight against corruption difficult.

2.2 Can Corruption Be Beneficial?

It seems plausible that bribe-taking bureaucrats work harder. Leff (1964) suggested that corruption may help economic growth, since it may be the "speed money," which

reduces bureaucratic delays and induces hard work by bribe-taking government workers. However, Santhanam (1964) notes that, in practice, the opposite is true. The bureaucrats deliberately cause delays to extract the largest bribes that the “market” can bear. See Bardhan (1997) and Susan Rose-Ackerman (1999) for a recent overview of this literature. For examples of regressive impact, see Susan Rose-Ackerman and Andrew Stone (1996).

Mookherjee and Png (1995) start with the assumption of no social cost of bribery, ignore all transfer payments and still are able to prove the following proposition. “For every outcome when bribery is profitable, there exists another in which bribery is not profitable, that yields higher welfare.” Thus, corruption can be proved to reduce social welfare, and cannot be beneficial in the long run.

2.3 Arguments for Compounding the Burden of Corruption

The aggregative dynamic macroeconomic view of corruption in this subsection hopes to show that compounding of burden is appropriate. It is well known that capital accumulation is the main engine of growth. Consider an aggregative closed economy producing output $Y(t)$ at time t using two homogeneous inputs: capital $K(t)$ and labor $L(t)$. Let these inputs include the input of government services and public capital. The income identity states that the income can be either consumed or invested: $Y(t)=C(t)+I(t)$, where $C(t)$ denotes consumption, and $I(t)$ denotes investment. $I(t)=(d/dt)K(t)+\delta K(t)$ is called the investment identity which states that economic investment $I(t)$ equals change in capital stock measured by the time derivative (d/dt) of $K(t)$ plus a depreciation term $\delta K(t)$ proportional to the capital stock. Besides the two identities above, production function is the third pillar of neoclassical growth theory. It is customary to define $y(t)=Y(t)/L(t)$, $k(t)=K(t)/L(t)$ and $c(t)=C(t)/L(t)$, which leads to a univariate production function $y=f(k)$, by measuring output and capital, per unit of labor and omitting the postscript (t) . The fundamental differential equation of neoclassical economic growth, Intriligator (1971, p.402) or Barro and Sala-i-Martin (1995, p.18), is:

$$(dk/dt)=s f(k) - (n+\delta) k, \quad (1)$$

where n denotes the growth rate of population (labor force) and s is the savings rate. Dividing both sides by k gives $(d \log k / dt)$ on the left side. The solution of the differential equation is

$$k=\exp[s t f(k)/k - n t - \delta t]. \quad (2)$$

To verify (2) take the log of both sides and differentiate with respect to t . Since the solution (2) involves the power of e (exp operator), the *compounding* over time is obvious.

Result 2: Corruption reduces savings rate, efficiency of capital in producing output per employee and increases depreciation of inputs. This exponentially reduces the rate of capital accumulation over time. Hence, the burden of corruption should be compounded.

Economic growth refers to growth of output $f(k)$, which depends on capital accumulation k , the capital per employee. Equation (2) shows that accumulation of capital k is exponentially related to savings rate s , $f(k)/k$, and δ . One can verify our Result 2 by considering these three terms as follows. The bribe money needs to be hidden or quickly spent on conspicuous consumption. Only a small fraction is saved. It diverts productive resource from the entrepreneur to the corrupt official. Hence, bribes reduce the savings

rates. Misappropriation of property reduces the efficiency of both labor and capital and increases the depreciation term δ .

The above growth theory arguments use several simplifying assumptions. However, the assumptions are not critical for the main point and can be relaxed. We need to modify standard methods in Barro and Sala-i-Martin (1995) to incorporate the effects of corruption in obvious ways. I can permit optimization by economic agents, open economies, multiple sectors, endogenous growth, etc. Input augmentation, (See Barro and Sala-i-Martin, 1995, p.34) will have to be replaced by input contraction due to corruption. There is empirical evidence that corruption increases market volatility, bank failures and discourages foreign direct investment in poor countries. This too can cause misallocation of trading patterns and inefficient prices paid for internationally traded goods and services.

A bribe can saddle a poor country with a white elephant project, where economic costs far exceed the corrupt payment. A corrupt policy environment makes a value-subtracting investment appear nominally profitable, but ultimately reduce capital accumulation. Mauro's (1995) international cross sectional study also finds that corruption lowers investment and hence economic growth.

2.4 Corruption as Illegal Taxation

I have already listed several sources of the burden of corruption. This subsection continues that discussion and develops the theory needed for the numerical estimation of the burden developed in the following section. Shleifer and Vishny (1993, hereafter SV93) take an interdisciplinary view of corruption with a focus on resource misallocations. SV93 consider a simplified model of a government produced good, such as an import license or a passport. Next, they assume that a corrupt official can restrict the supply of the good without being detected. SV93 also use familiar diagrams from microeconomic theory of monopoly pricing to establish the analogy between commodity taxes and bribes. Wei (1997) considers bribery as a tax from the viewpoint of international investors.

The graphics from economics textbooks describing Chamberlin's theory of monopolistic competition may be used to extend SV93 results. My extension shows that corruption imposes layers of monopolies or quasi monopolies creating contrived scarcities, higher average costs, misallocation of resources and inefficiencies. Chamley (1986) proved that any 'tax on capital income' is highly distortionary. Thus we have:

Result 3: Since corruption must be kept secret to avoid punishment, and since some corruption is akin to a tax on capital income, it is more distortionary than taxes.

SV93 give specific examples of distortions, where the corrupt official favors items, which yield larger and/or less easily detected bribes. Bribe-takers can sometimes favor domestic monopolists by imposing tariffs and taxes on imports, follow rent-seeking activities to waste resources and capital. Money laundering activities, use of more extravagant equipment than needed, etc. are caused by corruption.

3. Measuring the Burden of Corruption: A New Approximation

This section exploits SV93 model, establishing the analogy between commodity taxes and bribes, to estimate the burden of corruption. Any tax system imposes some distortions and burdens on a productive economy. Welfare loss to households occurs when taxes force the consumer to a lower utility level. Browning (1987) and Stuart (1984) de-

fine marginal excess burden (MEB) of legal taxes as the “per dollar surcharge that must be borne due to reduction in social welfare when tax revenue increases by one dollar.”

Let T_m denote household's total labor time of which L_n is devoted to taxed uses in normal employment and let H_m refer to home production or leisure. Thus, by definition, $T_m = L_n + H_m$. Let w denote the average wage rate and let τ denote average tax rate on labor income wL_n . The government budget is assumed to balance with revenue equal to expenditures. That is, $\tau wL_n = G + R$, where G denotes government consumption and R denotes government transfer payments. Further assume that we have a linear relation: $G = a + b(\tau wL_n)$, whose slope b is used later in the formula (3) for MEB.

A static general equilibrium is defined by Stuart (1984) from a numerical solution of ten equations of his complete model involving production and utility functions and first order conditions for static utility maximization. Let ΔC denote the numeraire value of the reduction in household utility because taxes transfer money from the household sector to the government, leaving less for the household to consume. The ΔC is measured as the amount of taxed-sector output that would just restore the household to the original utility level. Let $\Delta(\tau wL_n)$ denote a change in tax revenue. Stuart then defines a static general equilibrium measure of the burden from (legal) taxation as

$$\text{MEB} = \{ \Delta C / \Delta(\tau wL_n) \} - b. \quad (3)$$

Browning (1987) uses extensions of his own earlier static models to suggest that the benefits from taxation should be in the range of \$1.15 to \$1.50 to justify a one dollar of distortion caused by every additional (legal) tax dollar. Stuart's general equilibrium calculations are essentially similar and consistent with Browning's estimates.

Applied general equilibrium (AGE) analysis models, surveyed by Shoven and Whalley (1984), can obviously refine the MEB calculation with much greater detail, richer choice of functional forms and superior dynamic optimization algorithms. Accordingly, Ballard *et al* (1985) developed a more sophisticated AGE model to estimate the MEB of the US tax system. A typical AGE model considers the effects of a 1% increase in all tax rates; determines the resulting increase in government revenues and reduction in household welfare. These are measured relative to a common numeraire. Ideally, we need a separate AGE study of each country's corruption burden. However, such studies are too expensive, if at all possible, since they require data about secret activities where no records are kept. Ballard *et al's* (1984) estimate of the tax burden is 0.332 compared to Harrison and Vinod's (1992) 0.45. Recall our Result 3 that corruption is “more distortionary than taxes.” Hence, Harrison and Vinod's ‘point estimate’ for US data suggests that a dollar increase in corruption will create a burden in excess of \$1.45 for the US and other developed countries. In developing countries, the larger burden of corruption can be estimated from the upper limit of Harrison-Vinod's 95% confidence interval: (0.33, 0.67). Thus, a dollar reduction in corruption will benefit developing countries at least \$1.67. Compounding raises \$1.67 even higher in few years. The estimation of the burden with reference to AGE models for MEB and its compounding are new concepts in this paper.

4. Description of Interdisciplinary Data

This section describes interdisciplinary international data for an empirical study of corruption. Records of corrupt activities are destroyed or never kept, and bribe-takers try

to punish any informant, his family and his business interest. Hence Transparency International has devised a corruption *perception* index (CPI) based on opinion surveys of business people, professional risk analysts and the public. It ranges from 0 (highly corrupt) to 10 (highly clean). At least three surveys are used and larger countries receive up to twelve surveys. I call this a corruption ‘purity index,’ (PI) rather than CPI to avoid confusion with the consumer price index. The term “PI” is consistent with the intuition that a higher number (10) is associated with greater purity or less perceived corruption.

I report descriptive statistics by the following convention. Six numbers are in parentheses separated by commas, (Q1, Median, Mean, Q3, N and Standard deviation), where Q_i denotes i th quartile and N is the number of data points. For example, descriptive statistics for “PI” are (2.925, 4.05, 4.778, 6.4, N=78, 2.403), where the convention is to explicitly identify N only. The first number is always Q_1 (=2.925) and the fourth is Q_3 (=6.4). Now I list fifteen variables, which are potentially related to corruption and for which data are available. I use UNDP (1998) data for my first ten variables.

- 1) Lpcgnp=log of per capita GNP in 1997. (1118, 2965, 9108, 16310, N=78, 11490)
- 2) Grwth=average annual growth rate between 1996 and 1997. (0.975, 2.8, 2.944, 4.825, N=68, 3.459)
- 3) Lgnp2=log of per capita GNP in 1997 measured in purchasing power parity (PPP) exchange rates and units of 100. (33.55, 64.2, 98.34, 168, N=76, 83.19)
- 4) Govt=general government consumption as a percent of GDP. (10, 14, 14.71, 18, N=77, 5.304)
- 5) Trade=trade as a percent of GDP. (46, 62, 75.49, 92.5, N=78, 52.85). Note that for Hong Kong this percentage is 356, much larger than 100.
- 6) Exports=exports as a percent of GDP. (22, 30, 36.56, 43.5, N=78, 26.42)
- 7) Litrcy=adult literacy rate. (81.58, 92.95, 85.66, 99, N=78, 17.15)
- 8) School=mean years of schooling. (4, 6.45, 6.553, 9.2, N=78, 3.393)
- 9) Urban=urban population as a % of total. (45, 63.5, 61.56, 77, N=78, 21.25)
- 10) Ineq=percent of income (or consumption) enjoyed by the richest 20% earners. (39.3, 44.7, 45.83, 51.8, N=69, 8.894)
- 11) EcFree=index of economic freedom defined over the range 0 to 10, where 10 means most free based on 1996 rankings of countries in the *Wall Street Journal*, Dec. 3, 1998. The index developed jointly with the Heritage Foundation goes from 1 for Hong Kong to 152 for the least free Vietnam. Descriptive statistics for the original data are (25.5, 54, 57.41, 88.75, N=78, 38.14). I make them comparable to my dependent variable purity index “PI” as follows. I construct a new index, $y=ax+b$, where x denotes the original index. Now y should range from 0 to 10. I simply solve two equations in two unknowns a and b such that, for example, $y=0$ for Vietnam and $y=10$ for Hong Kong. The solution is: $a=(-10/151)$ and $b=10+(10/151)$. In short, the data are such that $EcFree=10$ for the country having the greatest economic freedom from Government controls and $EcFree=0$, for the controlled economy. The new descriptive statistics are (4.189, 6.49, 6.264, 8.377, N=78, 2.526).

The following data are from Mauro (1995), and detailed descriptions are omitted for brevity. The descriptive statistics are reported as before.

12) Redtp= red tape or the degree to which regulatory environment forces approvals and permits and create an obstacle to business. (4.5, 6.33, 6.434, 8.5, N=53, 2.275)

13) Effjud= efficiency of the judiciary, as it affects business. (6, 7.25, 7.548, 10, N=53, 2.031)

14) PolStb= political stability and the degree to which the process becomes violent or tends to disintegrate. (6, 7.25, 7.548, 10, N=53, 2.031)

15) EthLF= ethno-linguistic fractionalization index, which equals

$$\text{EthLF} = 1 - \sum_{i=1}^I (\eta_i / N)^2, \quad (4)$$

where $i=1, \dots, I$; η_i is the number of people in the i -th ethno-linguistic group, and I is the number of such groups. One of the novelties in Mauro (1995) is the use of eq. (4). This index equals 89 for a diverse country like India, 75 for Canada, 50 for United States, 32 for UK, 7 for Brazil and only 1 for a homogeneous society like Japan. The descriptive statistics are: (4.5, 6.33, 6.434, 8.5, N=53, 2.275).

I abbreviate all variable names as indicated above. The trade and export variables are included partly because economic literature suggests that “open” economies promote competition and improved allocation of resources across national boundaries. The empirical results in Rodrik (1998) suggest that open economies with greater participation in international trade tend to have bigger governments. Rodrik argues that greater reliance on international markets involves greater risks to the national economy and bigger governments are needed to reduce this risk. The presence of foreign competition encourages efficiencies, the need for risk reduction requires a larger bureaucracy, and greater dealings with foreigners offers greater opportunities for easily concealed bribes in a foreign currency paid abroad. Thus, it is an empirical question whether open economies have greater or less corruption. Chiu and Madden (1998) have several theoretical arguments showing that increases in income inequality lead to increases in burglary. To test whether income inequality is positively correlated with corruption, I include the “Ineq.” The World Bank (1997) report supports the relevance of “EffJud” variable. The “PolStb” variable is a proxy for political legitimacy of the current government.

5. Cross-sectional Correlations and Subset Regressions

Having chosen the fifteen variables, I first study the simple correlation coefficients between all pairs of variables. I focus on correlations with the corruption purity index “PI”. If N denotes the number of observations, define the sample correlation coefficient with the denominator $(N-1)$. In the available international data sets, we acknowledge the common problem of missing data for different countries and for different variables. For computation of correlation coefficients, it is possible not to waste any information by using information from all available pairs of data. Of course, this means that different country pair correlations are based on different $(N-1)$ values in the denominator.

Countries have a unique history, geography and various special circumstances. Hence, international data are often subject to a serious problem of “outliers.” These outliers can hide or distort important general relationships among the majority of countries. However,

generally accepted characterization of individual observations as outliers is not available. The object of “trimming” is to eliminate the influence of a certain pre-specified percent of extreme observations from the computations, without explicitly calling them as outliers. Such trimming does focus attention on the main relationships. I trim respectively 5, 10 or 20 percent of extreme observations.

The S-Plus software (Version 4.5) used here does the trimming only after removing missing data, to ensure that the sample size N for different variables is the same. Table 1 reports ranked correlation coefficients between PI (corruption purity index) and 15 listed variables. There are separate columns for correlations after 5%, 10% and 20% trimming. Now these simple correlations reveal important bivariate relations. From the largest to the smallest absolute values of correlation coefficients the listing of the variables from the most important to the least important is: Redtp, Effjud, Lpcgnp, Lgnp2, EcFree, School, PolStb, Urban, Litrcy, Govt, EthLF, Ineq, Export, Trade and Grwth. Each column of Table 1 has the superscript (1) for the variable with the highest correlation with PI. Superscripts (2), (3) and (15) are respectively for the second highest and third highest and the lowest absolute correlations. The correlations and their rankings differ across columns. For example, economic freedom (EcFree) has a correlation of 0.72 with the corruption purity index (PI), which increases to 0.88 upon trimming of 20% of extreme data values.

Policy implications from Table 1 rankings are that countries could reduce corruption by reducing red tape, making their judiciary more efficient and increasing economic freedom and schooling. It is also tempting to conclude that increasing per capita GNP will reduce corruption, except that previous studies, including Mauro (1995), have shown that income may be an endogenous variable. There is a vicious cycle, where corruption decreases by increasing the income, and the income increases by reducing corruption. Detailed tables of all correlations (available on my web page) are omitted for brevity.

Note that “School, PolStb, Urban and Litrcy” have a higher correlation with “PI” than “Govt, Ineq, Export, Trade and Grwth.” Thus, socio-political variables seem to deserve greater attention than some economic variables. A big government *per se* may not necessarily encourage corruption, if it is well run, with an efficient judiciary and reduced red tape. At first glance, these low correlations cast doubt on Chiu and Madden's (1998) theory. However, “Ineq” contributes important independent information in the subset regressions of section 5.1. The correlations between “PI” and “School” (0.7101 for all data and 0.9371 for the 20% trimmed data) reveal the importance of schooling in reducing corruption, and that this relation is subject to outliers.

5.1 A Subset Regression Model

Now I propose a subset regression model for these data. Since these are interdisciplinary data, the theory from any particular discipline is not likely to be appropriate. Hence, a regression model is chosen by Mallows' (1973) C_p statistic and Akaike Information Criterion (AIC): $AIC = s^2(C_p + N)$, where s^2 is the usual unbiased estimate of residual variance σ^2 in the regression model. The C_p criterion seeks a subset regression, which is closest to the true regression in terms of mean squared error (MSE). MSE equals expected squared Euclidean distance between estimated and the true parameter vector β . The intuition behind AIC is to maximize the ‘information content’ of the final subset. AIC imposes a penalty for including too many regressors.

The most general (encompassing) model for the algorithm is:

$$PI = f \{ \text{Lpcgnp, Grwth, Trade, Export, Litrcy, School, Urban, Govt, Lgnp2, EcFree, Effjud, Redtp, PolStb, EthLF, Ineq} \}.$$

Given the encompassing set of *relevant* variables, the subset selection algorithm helps choose the “best” subset by the Cp and AIC criteria. The regressors in the best model should not have too low t-values. The initial AIC is 38.5924. The algorithm first evaluates Cp for one regressor at a time and drops the one with the lowest Cp. “Urban” had unit degrees of freedom (df), Residual sum of squares = 16.93833 and Cp= 37.25011, which is the lowest. Single term deletions and additions are attempted. Extreme versions where only one or two variables are present (besides the intercept) are also considered. The “Trade and Urban” variables are deleted early. It deletes and adds regressors until it finds a model, which parsimoniously explains most of the variation in “PI”, the dependent variable. The first four columns of Table 2 report the “best” model having AIC= 30.5316, the lowest achieved by any subset of the complete set of fifteen regressors.

This subset includes the “Lpcgnp” (income level) regressor, which is not exogenous. Hence, our second encompassing set excludes “Lpcgnp and Lpgnp2” variables:

$$PI = f \{ \text{Grwth, Trade, Export, Litrcy, School, Urban, Govt, EcFree, Effjud, Redtp, PolStb, EthLF, Ineq} \}.$$

The “best” model for this 13-variable set is similar to the earlier one, except that the “PolStb” is now excluded. This set worsens the ultimate AIC by 0.818 to 31.3496. The resulting coefficients, standard errors and t values are reported in the last three columns of Table 2. If we interpret the absolute size of t values as indicating the importance of the variable, the top three are “EcFree, Redtp, and Govt” from the last column.

It is interesting that after including the top two socio-political variables (Effjud and Redtp), others such as “School, Urban, EthLF” do not contribute independent additional explanatory power. Similarly, international trade variables “Trade and Export” are left out. Although I omit details, it is clear that the subset regression model supplements the results of simple and trimmed correlation analysis in Table 1.

5.2 Implications for a Fight against Corruption

After combining the results of both correlation and regression analyses the top five actions recommended for reducing corruption in order of importance are: (1) reduce red tape, (2) increase efficiency of the judiciary, (3) increase per capita GNP, (4) increase economic freedom and schooling, and (5) reduce income inequality. To reduce red tape one requires elimination of all unnecessary regulations, government licenses, and permits. Poor countries suffer from chronic shortages of almost everything, and it is tempting to impose rationing, so that most vulnerable people do not unduly suffer from shortage of vital supplies. Unfortunately, higher prices are needed to match supply with demand, to create incentives for greater production and for reduced waste. Rationing becomes politically expedient and creates several regulations that last far too long, and actually end up hurting the most vulnerable, as well as, the honest. World Bank (1997) report mentions how well intentioned policies can produce unintended corruption. Wherever possible, competition among bureaucrats should be injected to reduce red tape.

The second action item above is improving the efficiency of the judiciary. India has only about 11 judges per million people, whereas UK has 113 per million. Countries like India need a better judicial infrastructure, efficient court management and better enforcement of existing laws. The bribery must be made more risky. The third action item in fighting corruption is raising the per capita GNP. I have noted above a vicious cycle when low per capita income itself causes corruption and makes the burden of corruption even greater. A well-designed foreign aid should help break the vicious cycle of poverty and help in improving the judicial infrastructure. Many proposals for using the Internet to fight corruption are included on my web page (cited in the author's footnote). It includes governance with respect, ethics, accountability and transparency (GREAT) agenda. I provide several web references. For example, to Seoul, South Korea's program to use the Internet to reduce corruption. Internet's potential is promising and obviously vast.

6. Conclusions

Viewing corruption as an illegal tax, we estimate that in developing countries a dollar's worth of corruption causes a \$1.67 worth of a burden on the economy. Neoclassical economic growth theory is used in Sections 2 and 3 to show that this burden *compounds* over time to become rather large. A small reduction in corruption will have a significant payoff for economic development in Asia and elsewhere. International cross-section data on corruption and fifteen related variables for seventy-eight countries (including Asian) are now available. Simple, as well as, 5% to 20% trimmed correlation coefficients reveal variables related to corruption. The AIC and Cp criteria suggest optimal subset of regressors. After combining the results of correlation and regression analysis, the top five actions recommended for reducing corruption in order of importance are: (1) reduce red tape, (2) increase efficiency of the judiciary, (3) increase per capita GNP, (4) increase economic freedom and schooling, and (5) reduce income inequality.

Mere dissemination of information about human rights abuses such as torture of political dissidents or child labor has helped reduce the abuses in recent years. The taxpayers in developed countries who help give the foreign aid and shareowners of multinational corporations need to be made more aware of the rampant corrupt practices in many countries. We refer to innovative proposals to use the Worldwide Web to expose corruption. The long-term benefits of competitive politics, active media, informed civil society and better economic allocations are large and compounded over time.

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TABLE 1 CORRELATION COEFFICIENTS BETWEEN PI AND OTHER VARIABLES

Variable	All data	5% trim	10% trim	20% trim
EthLF	-0.4125	-0.5250	-0.5680	-0.7240
Ineq	-0.3843	-0.5230	-0.5748	-0.6905
Grwth	0.0469 ⁽¹⁵⁾	0.2442	0.2272	0.2167
Trade	0.2609	0.0969 ⁽¹⁵⁾	0.0856 ⁽¹⁵⁾	0.1422 ⁽¹⁵⁾
Export	0.3090	0.1962	0.1578	0.1817
Govt	0.4756	0.5705	0.6415	0.7090
Litrey	0.4827	0.6686	0.7321	0.8274
Urban	0.5422	0.7625	0.7917	0.7548
PolStb	0.6319	0.7015	0.7092	0.7324
School	0.7101	0.8861 ⁽³⁾	0.9087 ⁽²⁾	0.9371 ⁽¹⁾
EcFree	0.7168	0.8428	0.8626	0.8761
Lgnp2	0.7895	0.8616	0.8795	0.9066
Lpcgnp	0.8268 ⁽³⁾	0.8925 ⁽²⁾	0.9083 ⁽³⁾	0.9269 ⁽³⁾
Effjud	0.8541 ⁽²⁾	0.8655	0.8953	0.9224
Redtp	0.8947 ⁽¹⁾	0.9123 ⁽¹⁾	0.9229 ⁽¹⁾	0.9330 ⁽²⁾

Superscripts (1), (2), (3) and (15) indicate *within column* ranks of the variables.

TABLE 2: REGRESSION OF PURITY INDEX ON OTHER VARIABLES

Variable	Coeff.	Std.Error	t value	Coeff.	Std.Error	t value
Intercept	-1.4820	1.6081	-0.9216	-11.1173	1.2796	-0.8732
Lpcgnp	0.3954	0.1785	2.2152	-	-	-
Grwth	0.1014	0.0504	2.0127	0.1258	0.0517	2.4324
Ineq	-0.0390	0.0177	-2.2020	-0.0422	0.0178	-2.3783
Govt	0.0922	0.0296	3.1159	0.1125	0.0296	3.8012
EcFree	0.2203	0.0959	2.2979	0.3529	0.0769	4.5894
Effjud	0.2685	0.1280	2.0969	0.1838	0.1155	1.5911
Redtp	0.3913	0.1034	3.7828	0.4347	0.1054	4.1229
PolStb	-0.2885	0.1759	-1.6402	-	-	-

Left Panel (first four columns): Residual standard error = 0.7571, R-Squared = 0.9357, $F(8,32) = 58.25$, with the p-value = 0.0. The right Panel (last three columns): Residual standard error = 0.7952, R-Squared = 0.9247, $F(6,34) = 69.57$, p-value = 0.0