Advances in Management & Applied Economics, vol. 3, no.3, 2013, 155-169
ISSN: 1792-7544 (print version), 1792-7552(online)
Scienpress Ltd, 2013

The Determinants of Economic Corruption: A Probabilistic Approach

Mohamed Abdel Rahman Salih[1]

Abstract

The determinants of corruption have been debated by economists and non-economists for the past few decades. However, no consensus has been reached about the exact determinants of corruption and as well the direction of the effect of some the known key variables used in corruption studies. Most previous studies exploit some sort of index as a measure of corruption. The higher the value of the index, the less perceived corrupt a country is and vice versa. These studies use multiple regression to estimate the unknown parameters of the models specified. In this paper, we deviate from this norm and categorize the corruption index into two categories – perceived corrupt and perceived non-corrupt. This is in essence a discriminant analysis with two groups. With certain assumptions, this allows us to model the probability of corruption by appropriately selecting the factors that best separate the corrupt and non-corrupt groups. The methodology also allows computing corruption scores. With this methodology, the Kolmogorov-Smirnov (KS) statistic indicates that there is a high separation between the two groups given the variables turned out to be predictive.

JEL classification numbers: C21, C25, D73
Keywords: Corruption Index, Probability of Corruption, Kolmogorov-Smirnov Statistic, Separation, Discriminant Analysis, Corruption Scores.

1 Introduction

In the past few decades, the study of the determinants of corruption has gained attention by economists as well as non-economists. Economists, in particular, questioned the economic development performance of developing countries despite the substantial amounts of foreign aid these countries received since the 1960s. The weak performance of

[1]Taibah University, Medinah, Kingdom of Saudi Arabia.
e-mail: msalih@taibahu.edu.sa

Article Info: *Received :* February 1, 2013. *Revised :* February 23, 2013.
Published online : May 1, 2013

the economic development of these countries led some economists to question the effectiveness of foreign aid in promoting economic growth and development. Other economists, in an attempt to explain the weak performance of economic growth and development of developing countries, took the route of looking into corruption and economic growth. Even though corruption is a phenomenon that exists in all countries one way or the other, the severity of corruption is quite different between the donors and the recipients of foreign aid. As a result of corruption, donors (e.g. IMF and the World Bank) are requiring recipient governments to crack down on corruption before making aid funds available to them. Corruption is also being studied as a stand-alone phenomenon that deserves looking at and explaining what exactly causes countries through officials to be engaged in it.

Corruption has been defined by the World Bank as “the abuse of public office for private gains”. Indeed, corruption is not so easy to measure, especially when it is attempted to attach monetary value to corruption. One of the measures that is being used often, among others, is the Corruption Perceptions Index (CPI) compiled by Transparency International. As the name implies, this is not an exact measure of corruption; it is a measure of corruption perception. The higher the value of the CPI, the less perceived corrupted a country is and vice versa. In other words, countries which tend to have less corruption have higher values of the index and countries which tend to have more corruption have lower values of the index.

Numerous papers have been published on the determinants of corruption using multiple regression. The dependent variable is the CPI or any other measurement of corruption. In this paper we classify the CPI into two categories – perceived corrupt and perceived non-corrupt. We then estimate the probability of corruption by appropriately selecting the predictive variables. I will elaborate on this later in the methodology section below. This treatment allows us to measure how well the model separates the two groups using statistics such as Kolmogorov-Smirnov (KS).

The remainder of the paper is organized as follows. Section 2 reviews relevant literature on the subject. Section 3 details the methodology employed. Section 4 presents the variables and data used. Section 5 presents results and offers discussion, and section 6 wraps it up with a brief summary and conclusion.

2 Literature Review

Over the past few years several empirical papers on the determinants of corruption have been published. Nevertheless, no consensus on the exact determinants of corruption has been reached. Furthermore, the directions of the relationship between corruption and the key variables have been conflicting. In the following pages we list some of the determinants we believe that are important in explaining corruption. The list does not cover all the variables we have tried in the modeling process.

(1) Income. One of the key variables that have been used in most papers is income. If we think of corruption as an inferior good, then one would expect a negative relationship between income and corruption. Authors who establish a negative relationship between income and corruption include but not limited to Chang and Golden (2007), Kunicova and Rose-Ackerman (2005), Lederman, et al (2005), Braun and Di Tella (2004), Alt and Lassen (2003), Herzfeld and Weiss (2003), Persson, et al (2003), Tavares (2003), Fisman and Gatti (2002), Swamy, et al (2001), Treisman (2000), Wei (2000), Ades and Di Tella

(1999), and Goldsmith (1999). On the other hand, authors such as Ali and Isse (2003) and Frechette (2001), among others, find a positive relationship between income and corruption.

(2) Government Size. Ali and Isse argue that corruption comes with large government size. Their study also establishes this positive relationship empirically. However, we argue that countries with larger government sizes are known to have little corruption. In contrast, countries with little government sizes are known to have high corruption levels. It thus makes more sense to argue for a negative relationship between the size of government and corruption. Indeed, Fisman and Gatti and Bonagalia, et al (2001) establish this negative relationship empirically.

(3) Foreign Direct Investment. Countries that enjoy high foreign direct investment indicate that they are stable, safe, and have trusted regulations. As such, it is expected that these countries are perceived non-corrupt. On the other hand, countries that have little foreign direct investment indicate that these countries are not to be trusted as far as corruption is concerned. Therefore, we would expect a negative relationship between foreign direct investment and corruption.

(4) Economic Freedom. The findings on the relationship between corruption and economic freedom are conflicting. The majority of authors find a negative relationship between economic freedom and corruption e.g. Kunicova and Rose-Ackerman, Gurgur and Shah (2005), Ali and Isse, Graeff and Mehlkop (2003), Park (2003), Treisman, and Goldsmith. In contrast, Paldam (2001) finds a positive relationship between economic freedom and corruption. Intuitively, we would expect a negative relationship between economic freedom and corruption. As Shabbir and Anwar (2007) put it, "economic freedom reduces the involvement of public offices/officials with the masses. This limited connection minimizes the chances of indulging into corruption by politicians and public office bearers to grab a part of profit attached to the concessions allowed there-under".

(5) Judiciary System. Perhaps this is one of the rare determinants where all the authors we have come across, find a negative relationship between the judiciary system (a proxy used is the rule of law published by Kaufman) and corruption. Among these authors are: Damania et al (2004), Ali and Isse, Park, and Ades and Di Tella (1997).

(4) Import Share. The higher the import share to GDP, the less corrupt a country one would expect. Herzfeld and Weiss, Fisman and Gatti, Frevette (2001), Treisman, and Ades and Di Tella, find a negative relationship between import share and corruption. There seems to be a consensus among authors on the negative relationship between this variable and corruption.

(6) Trade Openness. The more trade open a country is, the less corruption activities one would expect. This theoretical relationship is also established empirically by numerous studies such as Gurgur and Shah, Knack and Azfar (2003), Fisman and Gatti, Frechette, Wei, Ades and Di Tella, and Leite and Weidmann (1997). Again, none of the studies we have come across finds a positive relationship between this variable and corruption.

(7) Foreign Aid. Findings on the relationship between foreign aid and corruption have been conflicting. While Ali and Isse find a positive relationship, Tavares finds a negative relationship between foreign aid and corruption. We personally argue that the relationship is positive. It is observed that countries that are aid recipients are characterized by higher corruption levels and donor countries are characterized by lower corruption levels.

(8) Inflation. Few authors have used inflation as a determinant of corruption. A priori, one would expect countries with higher inflation rates to have higher corruption. Indeed,

Braun and Di Tella, and Paldam (2002) establish a positive relationship between inflation and corruption empirically.

3 Methodology

Generally speaking, the methodology employed by the researchers of the determinants of corruption has been multiple regression. In this regression, the dependent variable is some measure of corruption – usually an index. The independent variables differ from one study to another even though there are usually some common key variables. In this paper, we deviate from this methodology and think of the dependent variable as being a binary variable as opposed to a continuous variable, which is the case in previous studies. In particular, we think of this in terms of being a question of discriminant analysis with two groups – namely perceived corrupt and perceived non-corrupt. Thus, we choose the determinants in such a way that there is a best separation between the two groups in question. This treatment has some advantages. First, we will be able to estimate the probability of corruption for each country included. Also, for any country that is outside the sample and which has values of the predictors, one can compute the probability of corruption. Second, we will be able to measure how well the predictive variables chosen separate perceived corrupt and perceived non-corrupt countries using statistical measures such as KS statistic and/or divergence. Third, we will be able to construct, what we call, corruption scores and rank countries based on these scores. To the best of our knowledge, this is the first time that a study of the determinants of corruption uses this type of methodology i.e. a probabilistic approach. There are others (see e.g. Ali and Isse) who have used a binary dependent variable in the context of multiple regression. However, the ordinary least squares (OLS) estimation technique used, when the dependent variable is binary, is not appropriate as the probabilities obtained may lie outside the unit circle. Also, when the dependent variable is binary, the error term suffers from the problem of heteroscedasticity and therefore OLS estimates of the unknown parameters will not be efficient i.e. the variance of error term is not minimized.

We use the same index (CPI) that is used in most corruption studies and convert it into a binary variable. Countries with higher values of the index are classified as one group and countries with lower values of the index are classified into the second group. Even though the line we draw between the perceived non-corrupt and the perceived corrupt groups is somewhat arbitrary, this will still serve the purpose at hand. Indeed, we realize that there is a cost associated with misspecification of the groups – See Maddala (1983) page 80.

Following Maddala's terminologies on discriminant analysis, the problem is to classify an individual object into one of two populations π_1 and π_2 based on a vector of characteristics $x = (x_1, x_2, \dots, x_k)$. Let $f_1(x)$ and $f_2(x)$ be the probability density functions of the distributions of characteristic x in the two populations. Also, let the means of x in the two groups be μ_1 and μ_2, respectively, and the covariance matrices of x for the two groups be Σ_1 and Σ_2, respectively. Assume that p_1 and p_2 are the proportions of the groups μ_1 and μ_2 in the total population, respectively. The linear discriminant function and the assignment rule depend on the following assumptions – Maddala (1983):

1. Both $f_1(x)$ and $f_2(x)$ are multivariate normal.
2. The covariance matrices Σ_1 and Σ_2 are equal (i.e. Σ).
3. The prior probabilities p_1 and p_2 are known.

4. The means μ_1 and μ_2 and the covariance matrices Σ_1 and Σ_2 (i.e. Σ) are known.

The probability of being a member of π_i, using Bayes theorem of conditional probability is given as follows (where Pr stands for probability):

$$\Pr(\pi_i|x) = \Pr(x|\pi_i)p_i / \sum_{i=1}^{2} \Pr(x|\pi_i)p_i \qquad (i = 1, 2) \tag{1}$$

Given that $\Pr(\pi_i|x)$ is multivariate normal, with mean μ_i and covariance matrix Σ, then:

$$\Pr(\pi_1|x)/\Pr(\pi_2|x) = \Pr(x|\pi_1)p_1/\Pr(x|\pi_2)p_2 = \exp(\alpha+\beta' x) \tag{2}$$

where, $\alpha = \ln(p_1/p_2) - \frac{1}{2}(\mu_1 - \mu_2)'\Sigma^{-1}(\mu_1 + \mu_2)$ and $\beta = \Sigma^{-1}(\mu_1 - \mu_2)$ using the normality assumption noted above. It follows from equation (2) that:

$$\Pr(\pi_1|x) = \exp(\alpha+\beta' x)/[1 + \exp(\alpha+\beta' x)] \tag{3}$$

$$\Pr(\pi_2|x) = 1/[1 + \exp(\alpha+\beta' x)] \tag{4}$$

The model in (3) and (4) is referred to as the logistic model. Note that the probability in (4) is the compliment of the probability in (3). “Even though the model is derived from the normality assumption, Cox (1966) and Day and Kerridge (1967) noted that this model holds for a variety of situations, including (a) multivariate normal with equal covariance matrices, (b) multivariate independent dichotomous, (c) multivariate dichotomous following the log-linear model with equal second and higher-order effects, and (d) a combination of (a) and (c)” – see Maddala (1993). According to Cox (1966), the unknown parameters α and β of the model in (3) and (4) can be estimated using the Maximum Likelihood method. Let:

$$y_i = 1 \qquad \text{if } x_i \in \pi_1 \tag{5}$$

$$y_i = 0 \qquad \text{if } x_i \in \pi_2 \tag{6}$$

Then the likelihood function is given as follows:

$$L = \prod_{y_i = 1} \exp(\alpha + \beta' x_i)/[1 + \exp(\alpha + \beta' x_i)] \prod_{y_i = 0} 1/[1 + \exp(\alpha + \beta' x_i)] \tag{7}$$

Maximizing the natural logarithm of the above likelihood function with respect to α and β results in non-linear equations in α and β. Iteration methods such as Newton-Raphson or the Quadratic Hill Climbing can be used to estimate these unknown parameters. Once these unknown parameters are estimated, we can then obtain the probabilities specified in (3) and (4). These probabilities are in essence the probabilities of being corrupt and being non-corrupt.

Operationally, we create a dummy variable for the dependent variable. If an object (country in this case) is classified as corrupt, the dummy variable assumes the value 1. On the other hand, if an object is classified as non-corrupt, the dummy variable assumes the value 0. The details of how the classification is made are explained in the next section. Assuming the probability of a country being perceived corrupt is denoted by *p*, the model we estimate takes the following form:

$$y_i^* = \alpha + \beta' x_i \tag{8}$$

where, $y^* = ln(p/(1-p))$ is the natural logarithm of the odds of being perceived corrupt, x is a vector of independent variables, α and β’s are the unknown parameters to be estimated, and ε is the disturbance term. Obviously, y^* is unobservable and hence we use its realization y as defined in (5) and (6) to estimate the model in (8). The estimation results are presented in section 5 below. We now proceed to the mechanics of the computation of scores. Assuming, without loss of generality, that the score is linear in the log of odds, then:

$$\text{Score} = \alpha + \beta y^{*} \tag{9}$$

Further assuming that every 20 score points doubles the odds of being perceived corrupt and that the odds of 1:50 occur at the score of 500, then it follows that β = 20/ln(2) = 28.8539, and α = 500 – 28.8539*ln(50) = 387.1229. Therefore, we calculate the score as follows:

$$\text{Score} = 387.1229 + 28.8539\, y^{*} \tag{10}$$

Notice that, the lower the score, the less perceived corrupt a country is, since we are modeling the odds of being perceived corrupt. If p (the probability of being perceived corruption) is less than (1-p), which is the probability of being perceived non-corrupt, then y^{*} is negative and hence the score is lower than 387.1229. If $p = 0.5$, the score is equal to α = 387.1229. When p is greater than (1-p) then score is greater than 387.1229. Since we have set 20 points to double the odds of being perceived corrupt, a country with a score of, say, 420 is twice as likely to be corrupt than a country with a score of 400.

4 Data and Variables

The data to estimate the model was obtained from different sources. Consistent data on 136 countries was obtained. The data was sorted by the CPI and was then divided into two equal groups. The first group with higher CPI values was considered as the perceived non-corrupt group. The second group with lower CPI values was considered as the perceived corrupt group. We intentionally chose to have equal numbers of the response groups for three reasons. First, to get meaningful probability estimates. Second, if one of the groups is dominant in terms of the number of cases, this may bias the selection of significant predictors. Third, to avoid adjusting the value of the intercept that is necessary when the number of cases in each group is not the same.

Whenever possible, the variables are taken as the averages of 1995-2010 figures. In the first few years the Kaufman's governance indicators are available bi-annually. The Health expenditure per capita is available through 2009. The variables considered in the paper are the following:

1. The Corruption Perception Index. This variable was obtained from Transparency International.

2. GDP Per Capita. This variable was calculated based on data obtained from the World Bank statistics.

2. Health Expenditure Per Capita. This variable was calculated based on data obtained from the World Bank statistics.

3. Inflation. This is obtained from the World Bank statistics.

4. Economic Openness. This is measured by sum of imports and exports divided by GDP. Imports, Exports, and GDP were obtained from the World Bank statistics.

5. Economic Freedom. This variable is measured by indexes of Heritage Foundation.

6. Rule of Law. This variable is a proxy for judiciary system and was obtained Kaufman.

5 Estimation Results and Discussion

In this section we display the results obtained and offer discussion of these results. The estimation was conducted using the estimation technique of the logistic regression. Since the equations involving the unknown parameters are nonlinear, we have used the Newton Raphson method of iteration to get the final estimates of the parameters. The Eviews Software was used for this purpose. The calculation of the KS table was conducted using the excel software.

5.1 Estimation Results

We use the logistic regression estimation technique to estimate the parameters of model the equation (8). Several variables have been tried. We report here three versions of the model with different specifications. Table 1 below shows the results of these specifications – Model A, Model B, and Model C. In model A, we include all the 13 variables. In this model, only the economic freedom and the foreign direct investment turn out to be statistically significant with the correct signs. All the other remaining variables are insignificant. Notice inflation and official development assistance have the correct positive signs but they are insignificant. Also, we note that the trade share has the wrong positive sign. This is due to the fact that it is highly correlated with the import share. In model B, we drop the trade share variable and few other highly insignificant variables. In this model, GDP per capita, government size, economic freedom, judiciary system, and foreign direct investment are significant. The other remaining two variables, trade share, and female labor force participation rate are statistically insignificant. In Model C, we drop the variables that are insignificant in Model B and re-estimate the model. In this last model the McFadden R-Squared drops slightly.

Table 1: Estimates of the Models.

Variable	Model (A)	Model (B)	Model (C)
C	13.99718	14.96521	13.39561
Log of GDP Per Capita	-0.625481	-0.459012*	-0.397125*
Government Size	-9.925240	-15.13203***	-16.16510***
Economic Freedom	-0.110690**	-0.135859***	-0.135895***
Judiciary System	-0.641625	-0.873251*	-0.836685**
Foreign Direct Investment	-0.046036**	-0.034527**	-0.034978**
Inflation	0.000367	-	-
Health Expenditure Per Capita	-0.000540	-	-
Official Development Assistance	0.002971	-	-
Import Share	-9.973991	-	-
Trade Share	4.824915	-0.112927	-
Schooling	-1.260268	-	-
Gini Coefficient	-0.001267	-	-
Female LF Participation	-0.010215	-0.029015	-
McFadden R-Squared	*0.4776*	*0.5232*	*0.5192*

*, **, and *** indicate the variable is significant at the 10%, 5%, and 1% or lower, respectively.

It is clear from the above table that the determinants of corruption include: Income as measured by GDP per capita, government size, economic freedom, foreign direct investment, and judiciary system as measured by the rule of law. We use Model B in the calculation of the scores and the separation tests, since it has the highest R-Squared, even though some of the variables are insignificant.

We compute the scores using equation 10. In order to compute the KS statistic, we have arranged the data by the score (low to high) and created 14 classes. The first 13 classes contain 10 observations each and the last class contains 6 observations. By definition, the KS statistic is the highest difference between the cumulative percent of non-corrupt and the cumulative percent of corrupt in these classes. This maximum difference occurs at class 7. Thus, the value of the KS statistics is 73.53. Indeed, this is a high value and it indicates there is a good separation between the corrupt and non-corrupt groups given the determinants included in the final logistic regression equation (Model B).

Table 2: KS Table

Classes	Score Range	# Non-Corrupt	# Corrupt	Cum % Non-Corrupt	Cum % Corrupt
1	052-204	10	0	14.71%	0.00%
2	206-258	10	0	29.41%	0.00%
3	268-298	9	1	42.65%	1.47%
4	300-353	10	0	57.35%	1.47%
5	330-353	9	1	70.59%	2.94%
6	356-377	7	3	80.88%	7.35%
7	*378-394*	*6*	*4*	*89.71%*	*13.24%*
8	395-417	2	8	92.65%	25.00%
9	418-425	2	8	95.59%	36.76%
10	427-443	0	10	95.59%	51.47%
11	444-459	0	10	95.59%	66.18%
12	462-485	2	8	98.53%	77.94%
13	486-499	1	9	100.00%	91.18%
14	502-553	0	6	100.00%	100.00%
Total		68	68		

The following chart shows the KS chart. The horizontal axis shows the score intervals 1 to 14, where 1 is the lowest score range and 14 is the highest score range; keeping in mind lower scores are associated with lower probability of corruption. Interval 0 is being added for convenience. The vertical axis shows the cumulative percentages of corrupt and non-corrupt.

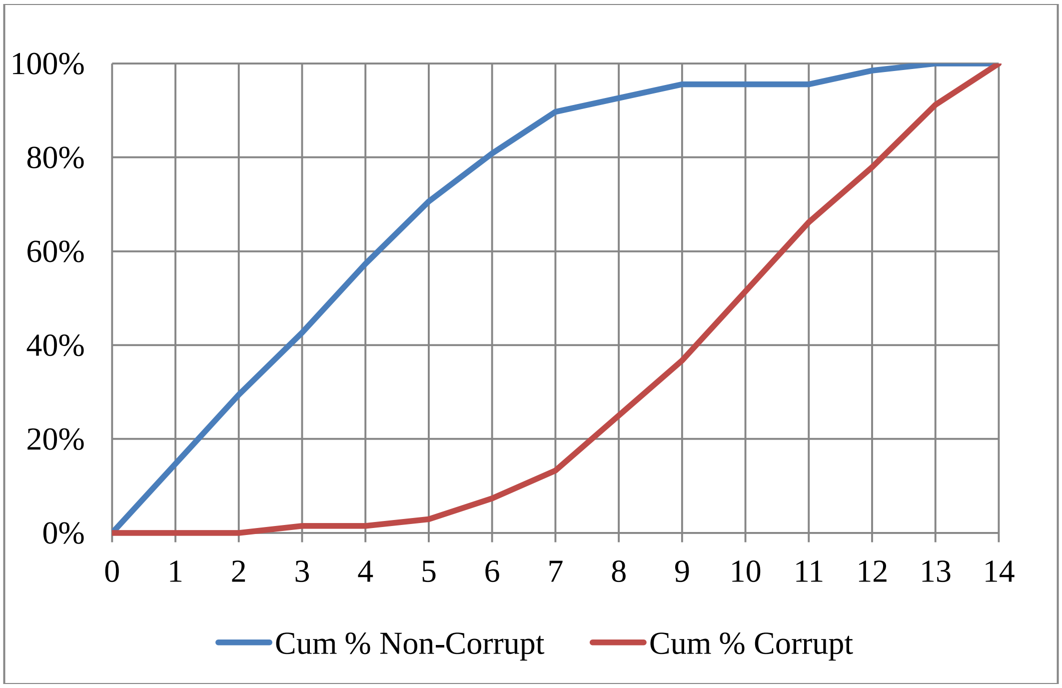

Figure 1: KS Chart

5.2 Discussion

All the determinants identified in the final regression have the correct expected signs. The results indicate that countries with higher GDP per capita, higher government size, higher foreign direct investment, higher economic freedom, and better judiciary system have lower probability of perceived corruption. In terms of the direction of the relationship, the negative relationship between income and corruption confirms the findings of Chang and Golden, Kunicova and Rose-Ackerman, Lederman, et al, Braun and Di Tella, Alt and Lassen, Herzfeld and Weiss, Persson, et al, Tavares, Fisman and Gatti, Swamy, et al, Treisman, Wei, Ades and Di Tella, and Goldsmith. The negative relationship between the government size and corruption confirms the findings of Fisman and Gatti and Bonagalia, et al. The negative relationship between foreign direct investment confirms our intuition, as this variable has not been used in previous studies. The negative relationship between economic freedom and corruption confirms the findings of Kunicova and Rose-Ackerman, Gurgur and Shah, Ali and Isse, Graeff and Mehlkop, Park, Treisman, and Goldsmith. Finally, the negative relationship between the judiciary system and corruption confirms the findings of Damania et al, Ali and Isse, Park, and Ades and Di Tella.

Two ways in which we implement our proposal merit attention. First, we are able to compute the probability of corruption for each individual country. Second, we are able to compute a corruption score for each country. These scores are linked directly to the odds of a country being perceived corrupt. Indeed, cross-country comparisons make much more sense using these scores than comparisons based on CPI. The CPI ranking of countries along with the corruption score ranking is shown in the Appendix. Countries are first ranked by CPI and the corresponding score rankings are then shown. For instance, New Zealand is ranked number 1 based on the CPI and ranked number 9 based on the corruption score.

6 Summary and Conclusion

This paper deviates from the existing empirical literature on corruption in a significant way. To the best of our knowledge, for the first time, corruption is modeled in the context of discriminant analysis with two groups. Since the dependent variable is binary, the logistic regression estimation technique is used to model the probability of corruption. We believe this a very promising methodology specially that we are able to construct scores that are directly linked to the odds of being perceived corrupt. We also believe that, with carefully chosen explanatory variable, these scores can be used as substitutes for corruption indexes. Even though the constructed scores are in line with the CPI, there is no perfect correlation between the two. For example, according to the CPI, New Zealand is the least perceived corrupt. According to the scores we constructed, the United States is the least perceived corrupt. This makes sense given the variables turned out to be predictive in the final logistic regression equation.

In terms of the determinants of corruption, the GDP per capita, the government size, the foreign direct investment, the economic freedom, and the rule of law turn out to be the significant predictors of corruption. We retained the variables that are significant up to the level of 10% significance. In term of signs, all variables have the expected negative signs. These signs confirm the results obtained by the majority of the studies conducted earlier. Some of the variables that we have tried but turned out to be statistically insignificant include the Gini coefficient, schooling, inflation, official development assistance, import share, and trade openness. It is important to point out that trade openness, trade share, and official development assistance when used as single explanatory variables; they turn out to statistically significant. However, when used with the rest of the explanatory variables, they become statistically insignificant. We also constructed a score that features 20 score points to double the odds of being corrupt. Comparison across countries can be done using this score, which makes much more sense than just mere rankings based on CPI.

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Appendix

Table 3: Correlation Matrix

	Dep. Var.	Income	Gov. Size	Import Share	Trade Share	Foreign Dir. Inv.	Judiciary System	Econ. Freedom
Dep. Var.	1.00							
Income	-0.61	1.00						
Gov. Size	-0.47	0.45	1.00					
Import Share	-0.14	-0.03	0.37	1.00				
Trade Share	-0.20	0.18	0.35	0.93	1.00			
Foreign Dir. Inv.	-0.30	0.41	0.16	-0.23	-0.16	1.00		
Judiciary System	-0.58	0.74	0.46	-0.03	0.10	0.40	1.00	
Econ. Freedom	-0.56	0.69	0.23	0.00	0.12	0.36	0.70	1.00

Table 4: Countries Ranked by CPI and by Corruption Score.

Country	CPI	Score	CPI Rank	Score Rank	Country	CPI	Score	CPI Rank	Score Rank
New Zealand	9.5	201	1	9	Albania	3.1	436	69	97
Denmark	9.4	181	2	4	India	3.1	444	70	101
Finland	9.4	212	3	12	Swaziland	3.1	376	71	59
Sweden	9.3	191	4	7	Argentina	3.0	375	72	57
Norway	9.0	223	5	15	Benin	3.0	446	73	103
Australia	8.8	206	6	11	Burkina Faso	3.0	418	74	83
Switzerland	8.8	217	7	13	Djibouti	3.0	381	75	63
Canada	8.7	189	8	6	Gabon	3.0	409	76	76
Hong Kong	8.4	175	9	3	Indonesia	3.0	450	77	106
Iceland	8.3	195	10	8	Madagascar	3.0	445	78	102
Germany	8.0	204	11	10	Malawi	3.0	427	79	91
Japan	8.0	252	12	18	Mexico	3.0	371	80	54
Austria	7.8	230	13	16	Suriname	3.0	416	81	79
Barbados	7.8	258	14	20	Tanzania	3.0	411	82	78
United Kingdom	7.8	125	15	2	Algeria	2.9	429	83	93
Belgium	7.5	182	16	5	Egypt	2.9	433	84	95
Chile	7.2	283	17	24	Moldova	2.9	396	85	72
Qatar	7.2	300	18	31	Senegal	2.9	447	86	104
United States	7.1	52	19	1	Vietnam	2.9	488	87	123
France	7.0	218	20	14	Bolivia	2.8	401	88	73

Uruguay	7.0	333	21	43	Mali	2.8	458	89	109
Estonia	6.4	257	22	19	Bangladesh	2.7	512	90	134
Botswana	6.1	294	23	29	Ecuador	2.7	435	91	96
Portugal	6.1	279	24	23	Ethiopia	2.7	485	92	120
Slovenia	5.9	330	25	42	Guatemala	2.7	433	93	94
Israel	5.8	250	26	17	Iran	2.7	499	94	129
Bhutan	5.7	380	27	62	Kazakhstan	2.7	425	95	88
Malta	5.6	294	28	28	Mongolia	2.7	402	96	74
Poland	5.5	325	29	39	Mozambique	2.7	462	97	111
Dominica	5.2	330	30	41	Armenia	2.6	393	98	69
Bahrain	5.1	293	31	26	Dominican Rep.	2.6	437	99	99
Mauritius	5.1	319	32	37	Syria	2.6	491	100	124
Rwanda	5.0	473	33	113	Cameroon	2.5	486	101	121
Lithuania	4.8	298	34	30	Guyana	2.5	417	102	80
Oman	4.8	315	35	35	Lebanon	2.5	393	103	68
Hungary	4.6	284	36	25	Maldives	2.5	421	104	85
Kuwait	4.6	301	37	32	Nicaragua	2.5	443	105	100
Jordan	4.5	328	38	40	Niger	2.5	499	106	128
Cyprus	4.4	268	39	21	Pakistan	2.5	477	107	115
Namibia	4.4	316	40	36	Sierra Leone	2.5	437	108	98
Saudi Arabia	4.4	308	41	34	Azerbaijan	2.4	452	109	107
Malaysia	4.3	346	42	49	Belarus	2.4	449	110	105
Croatia	4.2	359	43	52	Comoros	2.4	485	111	119
Latvia	4.2	307	44	33	Mauritania	2.4	424	112	87
Turkey	4.2	390	45	67	Russia	2.4	388	113	66
Georgia	4.1	394	46	70	Togo	2.4	499	114	130
Cote D'ivoire	4.0	482	47	117	Uganda	2.4	411	115	77
Slovakia	4.0	383	48	64	Tajikistan	2.3	459	116	110
Ghana	3.9	418	49	82	Ukraine	2.3	423	117	86
Italy	3.9	293	50	27	Cent. Afr. Rep.	2.2	487	118	122
Brazil	3.8	339	51	47	Costa Rica	2.2	339	119	46
Tunisia	3.8	378	52	61	Guinea-Bissau	2.2	553	120	136
China	3.6	341	53	48	Kenya	2.2	419	121	84
Romania	3.6	403	54	75	Laos	2.2	506	122	132
Lesotho	3.5	321	55	38	Nepal	2.2	476	123	114
Colombia	3.4	373	56	55	Papua N. Guinea	2.2	428	124	92
El Salvador	3.4	374	57	56	Paraguay	2.2	425	125	90

Morocco	3.4	384	58	65	Zimbabwe	2.2	516	126	135
Peru	3.4	395	59	71	Cambodia	2.1	467	127	112
Thailand	3.4	353	60	50	Guinea	2.1	481	128	116
Bulgaria	3.3	377	61	60	Kyrgyzstan	2.1	418	129	81
Jamaica	3.3	360	62	53	Yemen	2.1	509	130	133
Panama	3.3	356	63	51	Chad	2.0	497	131	127
Serbia	3.3	336	64	44	Czech Rep.	2.0	269	132	22
Bosnia & Herz.	3.2	375	65	58	Burundi	1.9	483	133	118
Liberia	3.2	496	66	126	Equ. Guinea	1.9	494	134	125
Trinidad & Tobago	3.2	337	67	45	Venezuela	1.9	453	135	108
Zambia	3.2	425	68	89	Sudan	1.6	502	136	131