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David L. Ortega[1], Raymond J.G.M. Florax[1,2], and Benoît A. Delbecq[1]
[1] Department of Agricultural Economics
Purdue University
403 West State Street
West Lafayette, IN 47907-2056

[2] Department of Spatial Economics
VU University Amsterdam
De Boelelaan 1105
1081 HV Amsterdam, The Netherlands
dlortega@purdue.edu, rflorax@purdue.edu, bdelbecq@purdue.edu

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Abstract

This paper analyzes the spatial distribution of corruption and its primary economic and political determinants. Economic freedom and development are found to lower incidences of corruption. Of notable significance, this study finds empirical evidence of a non-linear relationship between a country's level of democracy and corruption. Extreme authoritarian regimes are found to have lower corruption levels than hybrid regimes, but past a certain threshold democracy inhibits corruption. More importantly the analysis in this paper finds that the economic and political actions of a country have a significant impact on corruption levels worldwide.

Keywords: Corruption, spatial econometrics, economic freedom, political democracy

JEL Codes: C21, D73, H11

"Whenever any form of government becomes destructive…. it is the right of the people to alter or abolish it, and to institute new government, laying its foundation on such principles, and organizing its powers in such form, as to them shall seem most likely to affect their safety and happiness."
— Thomas Jefferson, Declaration of Independence, 1776.

1. Introduction

All nations suffer to some degree from the debilitating effects of corruption. Corruption mitigates economic development by creating inefficiencies that significantly reduce a country's welfare. Manifestations of corruption include briberies, patronage, nepotism, cronyism, fraud and embezzlement. The consequences of corruption have social, environmental, political, and economic implications. Transparency International[1] defines corruption as the abuse of entrusted power for private gain and The World Bank[2] has labeled corruption "among the greatest obstacles to economic and social development. It undermines development by distorting the rule of law and weakening the institutional foundation on which economic growth depends."

Academics and scholars have studied corruption and its determinants for centuries. The current literature classifies the primary sources of corruption into economic, political, geographical and social determinants. While controversies regarding the source of corruption abound in the literature, empirical work focusing on the spatial dimension of corruption and its determinants is in its infant stage (see Becker et al., 2009). In this paper, we investigate the primary economic and political determinants of corruption taking into account spillover effects between countries using spatial econometric techniques.

This paper is organized as follows. In section 2 we discuss measures of corruption and provide a brief survey of previous research. Section 3 details the methodology used in this study. Section 4 presents the econometric model and discusses the results, and section 5 concludes.

[1] see http://www.transparency.org
[2] see http://go.worldbank.org/K6AEEPROC0

2. Measures of Corruption and Previous Research

Quantifying corruption is difficult given the various types of corruption and the illicit nature of the transactions that construe each. For example, corruption can be broken down into various scales, most generally: petty corruption, which is generally defined as street level, everyday corruption and grand (or political) corruption, which often involves larger sums of money. Simply aggregating between these two levels would undermine the effects of petty corruption. In addition, the lack of consensus on the meaning of corruption has direct implications on what constitutes corrupt behavior. As a result of these complexities, indices have emerged in recent decades in an attempt to gage a country's level of corruption. The most common type of corruption index is based on public or expert perception concerning the degree to which there is a lack of transparency in public transactions. The most widely cited of these indirect corruption perception measures is Transparency International's Corruption Perception Index (CPI). The CPI combines survey results from different organizations creating a "poll of polls," increasing reliability of the data by reducing the effects of any biases of individual surveys (Montinola and Jackman, 2002).

Although numerous studies have sought to empirically test various economic, political, geographic and social factors that determine corruption, there is no unanimous consensus on a theory on which to base an empirical model (Alt and Lassen, 2003). A large number of studies have found that economic development (proxied by per capita GDP) has a negative effect on corruption (Treisman, 2000; Ades and Di Tella, 1999). However, Braun and Di Tella (2004) and Frechette (2001) find that when controlling for fixed effects, income increases corruption. Additionally, income disparities within countries have been identified as an economic determinant (Paldam, 2002). Trade and integration into world markets have also been discussed in the literature as factors that reduce corruption (Ades and Di Tella, 1999). Herzfeld and Weiss (2003) and Treisman (2000) determined that higher import shares that result from low tariffs lead to lower corruption levels because it reduces the opportunities for bribes.

Similarly, economic freedom (as measured by the Heritage Foundation and the Fraser Institute) has been found to inhibit corruption (Gurgur and Shah, 2005; Park, 2003). Chafuen and Guzman (2000) link a similar result to government involvement in the economy, concluding that the fewer resources a government controls, the fewer opportunities for corruption. Montinola and Jackman (2002) further investigate the assertion made by public choice theorists that the ability to intervene in markets provides government officials the opportunity to engage in corrupt behavior. They focus on member countries of the Organization of the Petroleum Exporting Countries (OPEC) with the idea that these countries represent a group where the government has direct control over the oil sector creating opportunities for rent-seeking behavior of a distinctively large scale. Interestingly, they find that larger government (as measured by public sector size) does not generate higher levels of corruption, but they also find evidence of a distinct form of corruption in OPEC countries.

Adsera et al. (2002) find that political instability leads to higher corruption levels. This finding is explored further in Montinola and Jackman (2002) where they hypothesize that political competition inhibits corruption. In democracies, they discuss, politicians cannot always promise that particular laws and regulations will continue in the future, thus generating condition for honest government. In their study they test this hypothesis by using a 1980 political democracy measure and find that the level of democracy has a non-linear effect on corruption. This result will be examined in a subsequent section.

Although this study focuses on political and economic sources of corruption, it is worth mentioning key findings from the literature on geographic and social determinants of corruption. Natural resource endowments have been a proposed source of corruption (Leite and Weidmann, 1999). This notion is directly tied to the idea of a “resource curse” or “Dutch disease” which increases rent seeking behavior. La Porta et al. (1999) control for latitude in explaining quality of government and find that higher latitudes are correlated with lower levels of corruption in countries. Social and cultural factors have also been proposed as determinants of corruption. These include religion, colonial history, common language and ethnic heterogeneity among others (Paldam, 2001; Chang and Golden, 2007; Treisman, 2000; La Porta et al., 1999; Becker et al., 2009).

3. Method, Data and Exploratory Data Analysis

Most of the literature on the determinants of corruption makes the either implicit or explicit assumption that the level of corruption in one country is independent from the level of corruption in neighboring countries. Becker et al. (2009) pioneered away from this assumption by providing one of the first studies that explores a contagion aspect of corruption. The present study complements the work of Becker and collaborators by examining the primary economic and political determinants of corruption within a spatial econometric framework. Specifically, the main objective of this paper is to provide alternative measures and specifications of political and economic factors that determine corruption.

The analysis in this study is based on a cross-section of 150 nation-states in 2008 (see Appendix A for a country list). Data on corruption is obtained from the Transparency International's CPI. As proxies for the economic determinants of corruption, we use the Index of Economic Freedom from The Heritage Foundation/Wall Street Journal and average per capita GDP is obtained from The World Bank. As a proxy for the political determinants of corruption, we use The Economist Intelligence Unit's Index of Democracy and include OPEC membership to test for the effects of government involvement and rent-seeking behavior. The summary statistics and global distribution for each variable are presented in Table 1 and Figure 1, respectively.

Table 1. Sample descriptive statistics

Statistic	Corruption Perception Index	Index of Economic Freedom	Index of Democracy	Per Capita GDP
Mean	4.08	62.15	5.64	14093.25
Std. Dev.	2.14	10.30	2.27	20155.94
Moran's $I^{\dagger}$	0.48	0.15	0.47	0.53

† The Moran's *I* statistics are statistically significant at the 0.01-level.

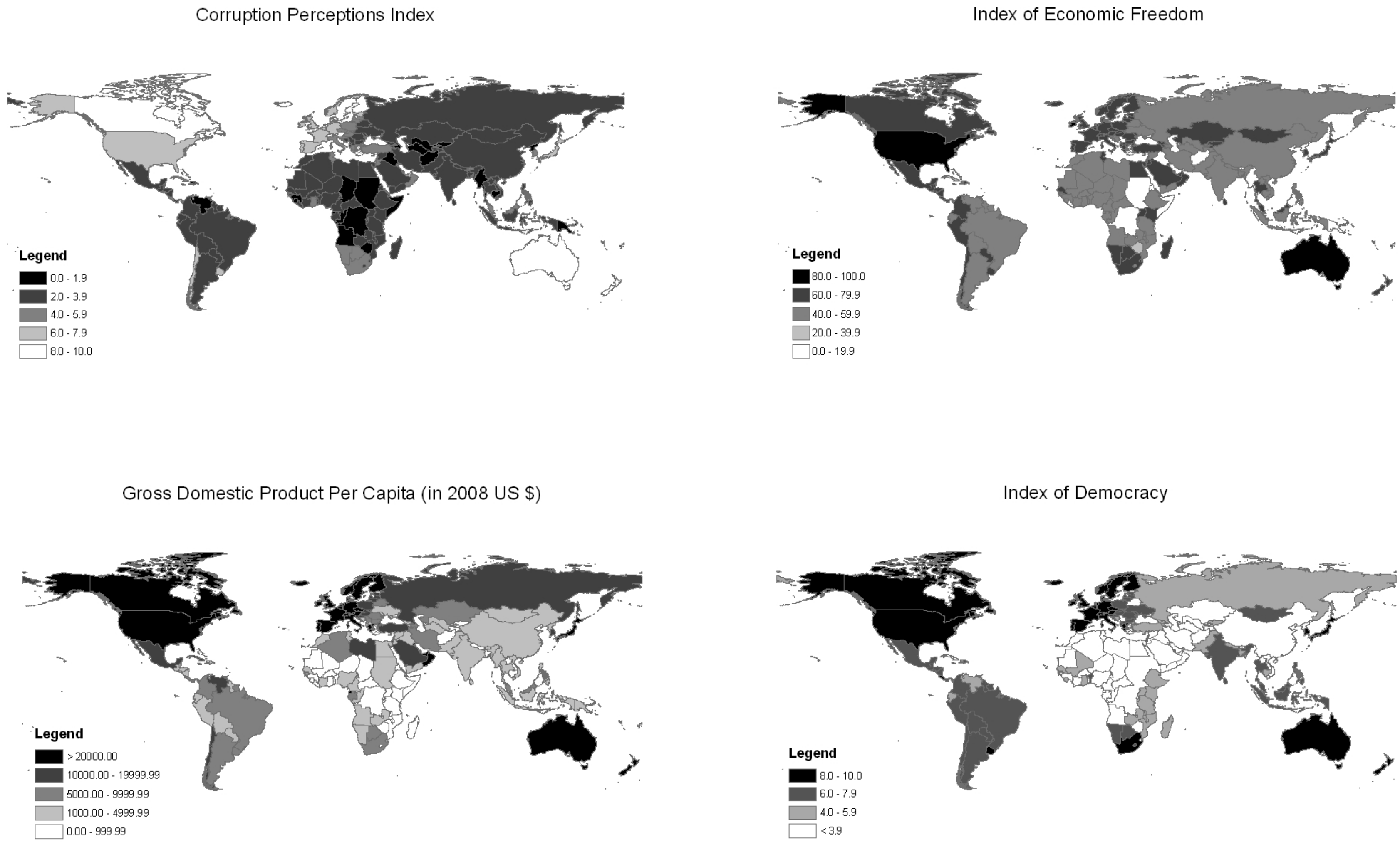

Figure 1. Global distribution of key variables

The *Corruption Perception Index* (CPI) measures the degree to which corruption is perceived to exist among public officials and politicians. The index scores range from 0 to10, where a lower score corresponds to a higher level of perceived corruption (hereafter referred to as corruption). The *Index of Economic Freedom* (IOEF) measures nine general categories: business freedom, trade freedom, monetary freedom, government size, fiscal freedom, property rights, investment freedom, and financial freedom. Index scores range from 0 to100, where higher scores correspond to a higher level of economic freedom. *Average per capita GDP* (PC_GDP) is measured in 2008 US$, and *OPEC Membership* (OPEC) is a binary or dummy variable where a value of one represents country membership and zero otherwise. The Organization of the Petroleum Exporting Countries (OPEC) is a cartel of thirteen countries made up of Algeria, Angola, Ecuador, Indonesia[3], Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela. The *Index of Democracy* (IOD) measures five general categories: electoral process and pluralism, civil liberties, functioning of government, political participation, and political culture. The index scores range from 0 to10. Based on the index scores, countries can be classified as: full democracies (8 to10), flawed democracies (6 to7.9), hybrid regimes (4 to 5.9), and authoritarian regimes (below 4).

The question of interest when looking at the spatial distribution of corruption is: do countries exhibiting a high level of corruption tend to be spatially clustered near other countries with a high level of corruption or vice versa? Advances in spatial statistics make it possible to answer such a question. Furthermore, spatial econometric methods allow for the incorporation of spatial dependence and spatial heterogeneity in regression analysis, avoiding statistical problems that invalidate statistical inferences made from standard econometric models.

In order to measure the degree of spatial clustering in this system, it is necessary to define a spatial weights matrix that exogenously determines geographical proximity among the 150 observations. Using standard GIS software, a distance based $N \times N$ weights matrix, W, is constructed. Bilateral distance between two countries, d_{ij}, is measured as the distance between the centroid of each polygon (country), given a minimum distance so that all observations are interconnected in one spatial system. More specifically, the inverse of the squared value of

[3] Indonesia left OPEC at the end of 2008 and is thus included in the dummy variable with unity.

distance is used to represent distance decay interdependence. In order to measure the average effect of neighbors irrespective of the total number of neighbors, the weights matrix is row-standardized, which means that all rows sum to one. More formally for country pairs *i* and *j*:

$$w_{ij} = \frac{d_{ij}^{-2}}{\sum_{j=1}^{N} d_{ij}^{-2}}. \tag{1}$$

With this specification of *W* we can derive a measure of spatial autocorrelation commonly known in the literature as Moran's *I*. Positive values of Moran's *I* indicate the presence of positive spatial autocorrelation or clustering in the variables of interest.

To better illustrate this notion a Moran scatterplot for the CPI is presented in Figure 2. The Moran scatterplot can be decomposed into quadrants. Observations in the upper right quadrant represent countries with high (i.e., above average) CPI values whose neighbors also have high CPI values. Similarly, observations in the bottom left quadrant represent countries with low (i.e., below average) CPI values whose neighbors also have low CPI values. Countries marked with a star are considered outliers relative to their neighbors.

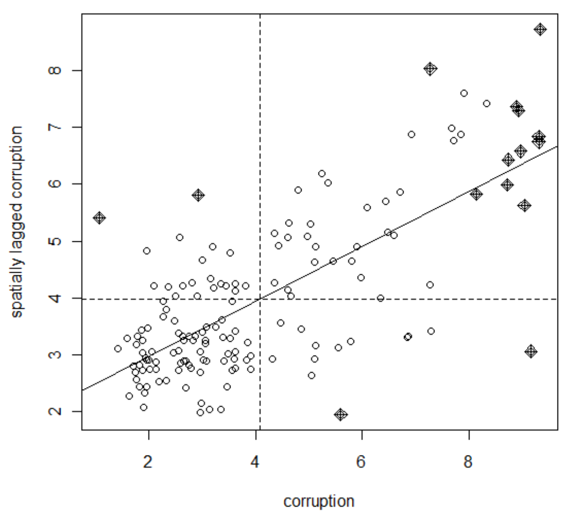

Figure 2. Moran scatterplot for Corruption Perception Index

4. Spatial Econometric Model

Spatial econometrics, a branch of econometrics, focuses on the treatment of spatial interaction (spatial autocorrelation) and spatial structure (spatial heterogeneity) in regression models (Paelinck and Klaassen, 1979; Anselin, 1988). The presence of a spatial process, as found in the previous section, destabilizes parameter estimates from regular OLS regressions, and as such, standard econometric techniques are no longer appropriate. In the present context, omission of a relevant spatial lag process will lead to biased estimates of the proposed primary determinants of corruption. Furthermore, omitting spatial dependence in the error term will lead to inefficient parameter estimates. To correct for these problems, a spatial autoregressive lag model with spatially autoregressive errors (SARAR) is proposed. In matrix notation, the model takes the form:

$$c = \rho Wc + X\beta + \mu, \quad \mu = \lambda W\mu + \varepsilon, \quad \text{with } \varepsilon \sim N(0,\sigma_i^2), \tag{2}$$

where c is a $N \times 1$ vector of corruption scores, W a $N \times N$ weights matrix with w_{ij} elements, and X a $N \times K$ matrix of covariates. The vector β is a $K \times 1$ parameter vector for the covariates in X, ρ is a spatial lag parameter and λ is a parameter capturing spatial correlation in the error term. Since spatial dependence in the error term does not have a substantive economic or political meaning, the discussion will focus primarily on the observed spatial dependence captured through the spatially lagged dependent variable.

The matrix of explanatory variables X includes an intercept, the index of economic freedom, the natural log of average per capita GDP,[4] the OPEC dummy variable, the index of democracy and its square. The non-linear specification of the proxy for the IOD bears some further discussion. As suggested by Montinola and Jackman we hypothesize that the effect of political competitiveness associated with democracy is non-linear. In their study, Montinola and Jackman (2002) highlight the existence of a threshold in the relationship between political democracy and corruption. Specifically, they claim that "corruption is usually lower in dictatorships than in

[4] A logarithmic transformation is applied because observed per capita GDP in our sample is highly positively skewed, and because of the assumption that the positive effect of economic development on corruption exhibits marginally declining returns with increasing development (Montinola and Jackman, 2002).

countries that have partially democratized. But once past a threshold, democratic practices inhibit corruption." This hypothesis has merit and the implications of such a finding as discussed in their study are sound. However, a close inspection of the econometric results presented in their study shows that their claim is not supported by their empirical model. In their a-spatial regression, the coefficients on democracy and democracy squared are both positive, which would not mathematically provide an extremum or threshold, over the non-negative range of the democracy variable. This can easily be seen by examining the classical first order optimization conditions over the defined range of the variable of interest. We therefore reexamine their hypothesis within a spatial econometric framework.

The model proposed in equation (2) is estimated using a General Method of Moments (GMM) estimator for a Cliff-Ord type model with heteroskedastic innovations (Arraiz et al., 2010; Keljian and Prucha, 2007, 2010). The procedure consists of two steps alternating GMM and Instrumental Variable (IV) estimation. In step one $\delta = (\beta', \rho)'$ is estimated by a two stage least squares (2SLS) procedure. The 2SLS residuals are first employed to obtain an initial consistent but inefficient GM estimator of λ. In step two, the spatial Cochrane-Orcutt transformed model is estimated by 2SLS. The residuals are then used to obtain a consistent and efficient GMM estimator for λ. Model results are presented in Table 2.[5]

Table 2. Regression results OLS and SARAR model

	OLS		SARAR	
Variable	Coef.	S.E.	Coef.	S.E.
intercept	–1.893**	0.771	– 2.286***	0.883
IOEF	0.064	0.010	0.661***	0.016
OPEC	– 0.169	0.305	– 0.178	0.324
ln(pc_GDP)	0.405***	0.072	0.321***	0.114
IOD	– 1.097***	0.186	– 0.959***	0.186
IOD^2	0.129***	0.017	0.112***	0.018
λ			0.206**	0.078
ρ			0.143	0.155

Note: *, **, ***, denote statistical significance at the 0.10, 0.05, and 0.01-level, respectively.

[5] For comparison, results of a standard (a-spatial) ordinary least squares (OLS) regression are provided as well.

The results show that economic freedom and per capita GDP have a statistically significant positive effect on the corruption index, meaning that these factors reduce the prevalence of corruption in a country. OPEC membership was not found to be a statistically significant determinant of corruption. Of particular importance are the results associated with our specification of political democracy, which suggest that corruption is typically lower in authoritarian regimes than in countries that have a hybrid regime, but once past a threshold democracy inhibits corruption. The presence of this threshold is statistically significant. More specifically, this threshold level occurs at an IOD score of 4.27.

Unlike the traditional a-spatial OLS regression, the parameters from the spatial model do not directly represent marginal effects of variations in exogenous determinants. To obtain marginal effects, these parameters must be interacted with the spatial multiplier. By deriving the spatial multiplier:

$$(I - \rho W)^{-1}, \tag{3}$$

and multiplying it by the estimated coefficient for an explanatory variable, the marginal effect on each country of a variation in an exogenous determinant can be obtained (Anselin, 2003).

The spatial multiplier allows the model to capture the direct, indirect, and induced effects of any incremental change in one of the exogenous determinants (LeSage and Pace, 2009). To illustrate, if country *i* experiences a shock to one of its determinants, the shock will directly affect country *i*'s level of corruption. Subsequently, this effect will propagate to neighboring countries, altering their level of corruption and generating a feedback effect on country *i*'s corruption level. The total effect of the shock can be decomposed into a direct and indirect effect, where the direct effect captures the immediate effect on country *i*'s corruption level and all of the spatial feedback, and the indirect effect captures spillovers from the shock.

Given the structure of the spatial model, we can simulate the effects of changes in any of the determinants of corruption. Of particular interest is to compare exogenous changes to democracy for countries on either side of the threshold. Nigeria has an index of democracy score of 3.53 indicating it has not yet reached the threshold level of 4.27. The left side of Table 3 shows the results of a simulated change to Nigeria's democracy score by one unit. The direct effect on

Nigeria’s corruption score is –0.167, an increase in its own level of corruption. In contrast, the same magnitude shock applied to France, which has an index of democracy score of 8.07 and has cleared the threshold, generates a direct effect of only 0.855. Consequently, spillover effects are drastically different for these two countries (Table 3). Indirect effects are stronger for countries that are geographically closer to the source of the shock. For example, the one-unit shock to Nigeria’s democracy score has a much stronger impact on Cameroon, an immediate neighbor, than on its more distant neighbors such as Morocco or China. The same is true for the simulated shock to France. The United Kingdom benefits significantly more than China in terms of a decrease to its level of corruption. It is important to note the simultaneous nature of the indirect effects felt by other countries. A shock to Nigeria’s democracy increases its own level of corruption (i.e., decrease in its CPI score). As a result, this increase in Nigeria’s level of corruption propagates through the system via the spatial multiplier affecting other countries’ levels of corruption. This propagation effect across countries is referred to as regional corruption contagion (Becker et al., 2009).

Table 3. Simulated effects of separate one-unit shock to Democracy

	Nigeria (IOD score: 3.53)		France (IOD score: 8.07)	
Country	Direct effect	Indirect effect (× 1000)	Direct effect	Indirect effect (× 1000)
Nigeria	– 0.167		0.855	
France		– 0.099		0.708
Cameroon		– 4.202		0.099
South Africa		– 0.032		0.001
United Kingdom		– 0.017		14.715
China		< 0.0005		< 0.0005
Venezuela		< 0.0005		< 0.0005
Morocco		– 0.467		5.524

Similarly we can observe the effects that a shock to the Index of Economic Freedom for a group of countries generates. Table 4 shows the result of a 10-point increase in the IOEF for a subgroup of Latin American countries composed of Argentina, Brazil, Paraguay, Uruguay, Ecuador, Bolivia and Venezuela. The largest direct effect is felt by Argentina and the lowest by Brazil.

Indirect effects from this regional shock are felt much stronger by the U.S. than by a more distant country such as Spain.

Finally a proportional shock to log per capita GDP of a one-standard-deviation magnitude (1.16) is simulated for Sub-Saharan Africa. Results from this simulation are presented in Table 5.

Table 4. Simulated effects of a 10-point shock to Economic Freedom

Country	Direct effect	Indirect effect	Total effect
Argentina	0.673	0.071	0.744
Brazil	0.662	0.076	0.739
Paraguay	0.666	0.118	0.784
Uruguay	0.666	0.123	0.788
Ecuador	0.663	0.022	0.686
Bolivia	0.664	0.086	0.751
Venezuela	0.664	0.014	0.678
United States		0.001	0.001
Spain		< 0.0005	< 0.0005
Iran		< 0.0005	< 0.0005
Australia		< 0.0001	< 0.0005

Table 5. Simulated effects of a one-standard-deviation shock in log per capita GDP to Sub-Saharan Africa

Country	Direct effect	Indirect effect	Total effect
Nigeria	0.373	0.081	0.455
Congo	0.374	0.089	0.464
Ethiopia	0.374	0.063	0.438
South Africa	0.378	0.091	0.469
Rwanda	0.382	0.084	0.466
France		0.004	0.004
Venezuela		< 0.0005	< 0.0005
United States		< 0.0005	< 0.0005
Saudi Arabia		0.011	0.011
New Zealand		< 0.0005	< 0.0005

5. Conclusion

There is a growing literature that suggests corruption is a common characteristic of countries in particular regions most notably Latin America and Sub-Saharan Africa (see for example Weyland, 1998; Easterly, 2001). Becker et al. (2009) is one of the first studies to explore the spatial aspects of corruption across countries. This paper builds upon their work and provides alternative measures of the primary economic and political determinants of corruption within a spatial framework. The results of our research suggest that economic freedom and development inhibit the incidence of corruption. Our work also provides significant empirical evidence that suggests the relationship between a country's level of democracy and corruption is non-linear. As first suggested by Montinola and Jackman (2002), we also find that extreme authoritarian regimes have lower corruption levels than hybrid regimes, but past a certain threshold, democracy hampers corruption. More importantly our analysis shows that the economic and political actions of one country can have a significant impact on corruption levels worldwide.

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Appendix A

Countries included in sample are presented in Table A1.

Table A1. Sample countries

Algeria	Cuba	Israel	Netherlands
Albania	Cyprus	Italy	New Zealand
Angola	Czech Republic	Ivory Coast	Nicaragua
Argentina	Denmark	Jamaica	Niger
Armenia	Djibouti	Japan	Nigeria
Australia	Dominican Republic	Jordan	North Korea
Austria	Ecuador	Kazakhstan	Norway
Azerbaijan	Egypt	Kenya	Oman
Bahrain	El Salvador	Kuwait	Pakistan
Bangladesh	Equatorial Guinea	Kyrgyzstan	Panama
Belgium	Estonia	Laos	Paraguay
Benin	Ethiopia	Latvia	Peru
Bolivia	Finland	Lebanon	Philippines
Bosnia and Herzegovina	France	Lesotho	Poland
Botswana	Gabon	Libya	Portugal
Brazil	The Gambia	Lithuania	Qatar
Bulgaria	Georgia	Luxembourg	Romania
Burkina Faso	Germany	Macedonia	Russia
Burundi	Ghana	Madagascar	Rwanda
Belarus	Greece	Malawi	Saudi Arabia
Cambodia	Guatemala	Malaysia	Senegal
Cameroon	Guinea	Mali	Sierra Leone
Canada	Guinea-Bissau	Malta	Singapore
Cape Verde	Guyana	Mauritania	Slovakia
Central African Republic	Haiti	Mauritius	Slovenia
Chad	Honduras	Mexico	South Africa
Chile	Hungary	Moldova	South Korea
China	Iceland	Mongolia	Spain
Colombia	India	Morocco	Sri Lanka
Congo	Indonesia	Mozambique	Suriname
Costa Rica	Iran	Namibia	Swaziland
Croatia	Ireland	Nepal	Sweden
Switzerland	Trinidad and Tobago	United Arab Emirates	Vietnam
Syria	Tunisia	United Kingdom	Yemen
Tajikistan	Turkey	United States	Zambia
United Republic of Tanzania	Turkmenistan	Uruguay	Zimbabwe
Thailand	Uganda	Uzbekistan	
Togo	Ukraine	Venezuela	