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Corruption around the world: Evidence from a structural model

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The causes and consequences of corruption have attracted much attention in recent years by both academics and policy makers. Central in the discussion on the impact of corruption are perception-based indices. Recent research has shown that perceived corruption might not be a good indicator of actual corruption in a country. In this paper, we employ a structural equation model—that treats corruption as a latent variable that is directly related to its underlying causes and effects—to derive an index of corruption. The index of corruption is derived for approximately 100 countries over the period 1976–1997. *Journal of Comparative Economics* **35** (3) (2007) 443–466. ETH Zurich, KOF Swiss Economic Institute, Weinbergstrasse 35, 8092 Zurich, Switzerland; CESifo, Germany; School of Business and Economics, University of Exeter, Streatham Court, Rennes Drive, Exeter EX4 4PU, England, UK.

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1. Introduction

Corruption around the world is believed to be endemic and pervasive, a significant contributor to low economic growth, to stifle investment, to inhibit the provision of public services and to increase inequality to such an extent that international organizations like the World Bank have identified corruption as 'the single greatest obstacle to economic and social development' (World Bank, 2001).[1,2] More recently, the World Bank has estimated that more than US$ 1 trillion is paid in bribes each year and that countries that tackle corruption, improve governance and the rule of law could increase per capita incomes by a staggering 400 percent (World Bank, 2004). Commensurate with the place of corruption on the policy agenda, the economics literature has paid increased attention to the issue.[3] Recently, there have been attempts to address the causes and consequences of corruption from an empirical standpoint. Notable efforts in this area include, among others, Mauro (1995) on the impact of corruption on economic growth and investment, Treisman (2000) on the causes of corruption, and Fisman and Gatti (2002) on the links between political structure and corruption.[4]

Corruption is a variable that cannot be measured directly. However, in recent years, several organizations have developed a corruption perception-based index across a wide range of countries to qualitatively assess the pervasiveness of corruption. These indices have been used in econometric studies (including those mentioned above) either as a dependent variable when exploring the causes of corruption or as an explanatory variable when investigating its consequences. Undoubtedly, these perception-based indices have made an important contribution to the understanding of the pervasiveness of corruption across countries. They are, however, not free of problems. One such problem refers to the fact that these indices do not relate directly to the factors that are responsible for causing corruption.[5] The consequence of this may be that the correlation between perceived corruption and actual corruption is low. Indeed, recent research has pointed precisely to this. According to Mocan (2004), perceived and actual corruption are completely unrelated once other relevant factors are controlled for. Similarly, Weber Abramo (2005) shows that perceived corruption is not related to bribery. Andvig (2005) and Weber Abramo (2005) consequently conclude that perception-based indices reflect the quality of a country's institutions rather than its actual degree of corruption. Svennson (2005) also highlights problems in the construction of perception-based indices while Razafindrakoto and Rouboud (2006) compare perception-based indices with direct surveys for six sub-Saharan African countries and

[1] This argument is not supported unanimously. Routine corruption may have the desirable property of creating incentives for public employees. For an early statement of this argument, see Leff (1964), Morgan (1964) and Lui (1985). For a criticism of this view see Tanzi (1998), Kaufmann and Wei (1999) and Rose-Ackerman (1999). For recent empirical evidence, see Méon and Weill (2006) and Dreher and Gassebner (2007).

[2] The definition of corruption varies widely but the most widespread one seems to be the one provided by Klitgaard (1988) that emphasizes the deviation of public officials from formal duties. As Klitgaard notes, a corrupt official 'deviates from the formal duties of a public role because of private-regarding (personal, close family, private clique) pecuniary or status gains; or violates rules against the exercise of certain private-regarding behavior,' p. 23. See also Rose-Ackerman (1999).

[3] Bardhan (1997), Jain (2001), and Aidt (2003) provide comprehensive accounts of the latest developments on corruption. See also Rose-Ackerman (1978, 1999), Lambsdorff (1999) and Seldadyo and de Haan (2005).

[4] Kaufmann et al. (1999) provide a comprehensive account of empirical work on corruption.

[5] They might also suffer from artificial 'inertia': once a country is reported to be corrupt, perception about this country may not change, leading future survey respondents to over-estimate true corruption. Other problems exist. See, for instance, Andvig et al. (2000), Kaufmann et al. (2003), and Søreide (2005).

conclude that the perception-based measures do not tie in with reality. Furthermore, according to the results of Bjørnskov (2006), the six indices of governance (including a measure of perceived corruption) developed by Kaufmann et al. (1999) cannot be separated statistically and, therefore, all measure one underlying governance factor.

It is clear, then, that the provision of a meaningful and comparable estimate of corruption across countries requires an alternative approach to the one usually taken. This paper deals with this issue. Recognizing that corruption is inherently a latent variable, and relying on the existing theory that identifies measurable variables that indicate and cause corruption, we employ a structural equation methodology to estimate the relationship between the manifest variables (causes and indicators) and the latent (corruption).[6] In particular, we estimate an index of corruption employing a special case of a structural equation model, the Multiple Indicators Multiple Causes (MIMIC) model, introduced to economics by Weck (1983), and Frey and Weck-Hannemann (1984) and latterly explored by Loayza (1996), Giles (1999), and Schneider (2005), among others, to measure the size of the hidden economy,[7] Raiser et al. (2000) to investigate the institutional change in Eastern Europe, and Kuklys (2004) to measure welfare.

Based on a sample of around 100 countries, we derive an index of corruption based on estimated parameters that relate directly to its causes and indicators. There are two key advantages to this approach of measuring corruption. First, the ranking of countries in our index is firmly based on a structural relationship between causes and the variables that are known to be good proxies (indicators) of corruption. The selection of the variables are drawn from the existing literature on corruption. In this sense, the methodology is confirmatory in nature in that the structural model confirms (or otherwise) the role of the causal factors as determinants of corruption. Second, since we have, albeit limited, data on the causes and indicators of corruption dating back to the 1970s, we can re-estimate the model for different time periods allowing us to address the question of whether corruption has increased or decreased since the late 1970s. In addition, the index also has implications for empirical studies of corruption. As discussed later, the index provides not only an ordinal ranking of corruption across countries but it also, reflecting the nature of the data, provides a meaningful measure of ‘distance’ between countries in the corruption index.

The key results are as follows. The estimated model produces cross-countries indices (and so a ranking) of corruption based on the structural relationship between the variables that cause and indicate corruption from the mid-1970s to the late 1990s. The resulting ranking of countries is not surprising with the developed countries reported as having lower corruption than the developing ones. The estimates show that in 1997 Switzerland was the least corrupt country followed by Japan, Norway, Denmark, Germany and the Netherlands. The US is in 9th position followed by France and Belgium. The most corrupt countries are (in reverse order) Zambia, Ghana, the Central Africa Republic, Syria, Nigeria and Guinea-Bissau, the most corrupt country.

The paper is organized as follows. In Section 2, the MIMIC methodology to measure corruption as a latent variable is presented. In Section 3, data on the causes and indicators of corruption are discussed. In Section 4, the results from the estimated MIMIC model and the index of corruption across countries are presented, while in Section 5 we provide some further discussion on

[6] As will be seen later on, the estimated model does rely on one perception-based variable but this is unavoidable due to lack of appropriate data. Nevertheless, the structural dimension of the estimated model is preserved since this perception-based index is not the only determinant that is being used. We turn to this below.

[7] Schneider and Enste (2000, 2002) offer a comprehensive account of studies on the hidden economy that have employed this approach. Pickhardt and Sardà Pons (2006) provide a recent application to Germany’s shadow economy.

(and the use of) the derived index. Finally, in Section 6, we conclude with some observations on the relevance of the results for further empirical research on corruption.

2. A structural equation model for corruption

We focus on the MIMIC model that is characterized by a latent endogenous variable with no measurement error in the independent variables. The unknown coefficients of the model are estimated separately through a set of structural equations with the indicator variables being used to capture the effect of the unobserved variables indirectly. Using causal and indicator variables of corruption across countries, the structural model can be estimated and, in turn, a cardinal index of corruption across countries retrieved.

More formally, but briefly,[8] the specification of the MIMIC model is as follows. Let y_i, $i = 1, \ldots, n$, be one of the indicators of the latent random variable corruption, denoted by η, such that:

$$y_1 = \gamma_1 \eta + u_1, \ldots, y_n = \gamma_n \eta + u_n, \tag{1}$$

where γ_i is the factor loading[9] and u_i, $i = 1, \ldots, n$, are the error terms with mean zero and covariance matrix $\boldsymbol{\Theta}_u$. The disturbances are mutually independent such that any correlation across the indicators are driven by the common factor η. Equation (1) is, then, a confirmatory factor analysis model for the observable indicators $\mathbf{y} = (y_1, \ldots, y_n)'$ with common factor η and unique factor u_i, $i = 1, \ldots, n$. The latent variable η is linearly determined by a set of exogenous variables (causes) given by $\mathbf{x} = (x_1, \ldots, x_k)'$ and a stochastic disturbance ϵ, that is:

$$\eta = \boldsymbol{\beta}'\mathbf{x} + \epsilon, \tag{2}$$

where $\boldsymbol{\beta} = (\beta_1, \ldots, \beta_k)'$. The model, therefore, comprises of two parts: the measurement model in Eq. (1) which specifies how the observed endogenous variables are determined by the latent variable and the structural equation model, Eq. (2), which specifies the relationship between the latent variable and its causes.[10] Since the latent variable η is unobserved, it is impossible to recover direct estimates of the structural parameters $\boldsymbol{\beta}$. Substituting (2) into (1), the MIMIC model can be interpreted as a multivariate regression model that takes the reduced form, connecting the observable variables, given by:

$$\mathbf{y} = \boldsymbol{\Pi}'\mathbf{x} + \mathbf{z}, \tag{3}$$

where the reduced-form coefficient matrix is $\boldsymbol{\Pi} = \boldsymbol{\gamma}\boldsymbol{\beta}'$, where $\boldsymbol{\gamma} = (\gamma_1, \ldots, \gamma_n)'$, and the reduced-form disturbance vector is $\mathbf{z} = \boldsymbol{\gamma}\epsilon + \boldsymbol{u}$, with covariance matrix:

$$\boldsymbol{\Theta}_\epsilon = E\big[(\boldsymbol{\gamma}\epsilon + \boldsymbol{u})(\boldsymbol{\gamma}\epsilon + \boldsymbol{u})'\big] = \boldsymbol{\gamma}\boldsymbol{\gamma}'\sigma_\epsilon^2 + \boldsymbol{\Theta}_u, \tag{4}$$

where σ_ϵ^2 is the variance of the disturbance ϵ. Clearly, the rank of the reduced form regression matrix $\boldsymbol{\Pi}$, in (3), is equal to 1. The error covariance matrix $\boldsymbol{\Theta}_\epsilon$, being the sum of a rank-one

[8] See Jöreskog and Goldberger (1975) for the original contribution to estimating the MIMIC model with a single latent variable and Bollen (1989) for a more accessible, but thorough, treatment.

[9] A factor loading represents the expected change in the respective indicators following a one unit change in the latent variable.

[10] Figure 1, presented in Section 4, provides a graphical representation of the system of simultaneous equations (path diagram) estimated in this paper.

matrix and a diagonal matrix, is also similarly constrained. This property calls for a normalization of one of the elements of the vector $\boldsymbol{\gamma}$ to a prespecified value prior to the estimation of the reduced form of the model. The fundamental hypothesis for a structural equation model is that the covariance matrix of the observed variables, denoted by $\boldsymbol{S}$, may be parameterized based upon a given model specification with parameter vector $\boldsymbol{\delta}$. The model parameters are estimated based upon minimizing the function[11]:

$$F = \ln\left|\boldsymbol{\Sigma}(\boldsymbol{\delta})\right| + \operatorname{tr}\left\{\boldsymbol{S}\boldsymbol{\Sigma}^{-1}(\boldsymbol{\delta})\right\} - \ln|\mathbf{S}| - \rho, \tag{5}$$

where $\boldsymbol{\Sigma}^{-1}$ is the estimated population covariance matrix and $\rho = k + n$ is the number of measured variables.

Once the hypothesized relationship between the variables has been identified and estimated, the latent variable scores η_j for each country $j = 1, \ldots, J$ can be obtained following the procedure suggested by Jöreskog (2000). Intuitively, what the procedure behind the derivation of latent variable scores (and so of the ranking and indices of corruption) does is to calculate a score using the estimated coefficients for both the causal and indicator variables placing particular weights to the individual variables. In principle, the weight that each individual variable has is determined by minimizing an underlying objective function relating to the statistical properties of the sample data (specifically, the mean vector of the coefficients of the indicator variables and the covariance matrices across the random errors relating to both the indicator and causal variables), normally putting more weight on the indicator variables, as compared to the causal variables.[12] This process is not too dissimilar to standard uses of econometric models when used to derive a value for the dependent variable, the difference being that, in this case, the structural equation model uses the full information on causes and indicators and the 'dependent' variable is an unobserved latent, which relates directly to the causes and indicators used to specify and estimate the model. The derived latent variable scores are, then, used to rank countries in terms of least to most corrupt and also provide a measure of 'distance' between countries and, therefore, provide evidence of the extent of corruption across countries.

Clearly, then, the challenge in implementing this framework is to identify the relationship amongst the variables. This, together with data issues, is discussed in the following section.

3. Causes and indicators of corruption

3.1. Causes of corruption

To identify the hypothesized variables that relate to the causes and indicators of corruption, we draw extensively on the theoretical and empirical literature on this topic. We start with a discussion of the causal variables and then turn to the variables that have been used as indicators. To ease the exposition, the causal variables have been categorized into four main factor-groups namely: political and judicial factors; historical factors; social and cultural factors, and economic factors.[13]

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[11] This, of course, presumes that the observed variables have a distribution that is multivariate normal. See also footnote 22.

[12] The computations of the latent scores are carried out in the LISREL® software.

[13] The specific data employed in our modeling effort is discussed in Section 4. Description of all the variables that have been tried and their sources can be found in Appendix A.

3.1.1. Political factors

The political factors capture the democratic environment of a country, the effectiveness of its judicial system and the origin of its legal system. The role of an established democracy has been highlighted in several studies of corruption (see, among others, Treisman, 2000, and Paldam, 2003). It is widely believed that corruption is related to the deficiencies of the political system and that an established democracy, by promoting political competition and hence increasing transparency and accountability, can provide a check, albeit an imperfect one, on corruption. Other characteristics of the political environment, including electoral rules (Persson et al., 2003) and the degree of decentralization (Treisman, 2000, and Fisman and Gatti, 2002) may also be important in explaining corruption.[14]

The judicial system is also expected to play a role in controlling corruption (Becker, 1968). The role of the legal system and the rule of law have featured prominently in many recent studies on the quality of governance and its consequences for development (see, for example, North, 1990, and Easterly and Levine, 1997). Strong legal foundations and efficient legal systems with well-specified deterrents protect property rights and so provide a stable framework for economic activity. Failure of the legal system to provide for the enforcement of contracts undermines the operation of the free market and, in turn, reduces the incentives for agents to participate in productive activities. But legal systems may differ in the degree to which property rights are protected and in the quality of government they provide. Empirical work suggests that the common law system, mostly found in the former colonies of Britain, appear to have better protection of property rights compared with the civil law system typically associated with the former colonies of continental Europe (see, for example, La Porta et al., 1999). Political instability may also matter for corruption, the expectation being that more unstable countries will have higher levels of perceived corruption.[15]

3.1.2. Historical factors

To a large extent, it is difficult to separate the historical factors from the political and judicial factors since the effectiveness of the judicial system is dependent on the colonial heritage of the country in question. La Porta et al. (1999) show that those countries that were former colonies of Britain and who adopted the common law system appear to have more effective judicial systems than those who adopted civil law systems associated with former colonies of continental European countries. Treisman (2000) also explores the direct influence of historical tradition on perceived corruption showing that former British colonies or dominions appear to reduce perceived corruption in excess of the role played by the common law system.

3.1.3. Social and cultural factors

This group of factors captures the social and cultural characteristics of a country that may impact upon the pervasiveness of corruption in a given country. For example, religion may shape social attitudes towards social hierarchy and family values and thus determine the acceptability, or otherwise, of corrupt practices. In more hierarchical systems (for example, Catholicism, Eastern Orthodoxy and Islam), challenges to the status quo are less frequent than in more equalitarian or individualistic religions. The role of the religious tradition and corruption has been explored explicitly by Treisman (2000) who found that a Protestant tradition appears to have a negative

[14] To be more precise, since the measure of corruption is based on the perception-based indices discussed above, these studies investigate whether the structure of the political system leads to higher levels of perceived corruption.

[15] Treisman (2000), however, finds little support for this.

(though small) effect on perceived corruption. Religion may also impact on the quality of the legal system, as explored by La Porta et al. (1999). They found that countries with a high proportion of Catholics or Muslims reduces the quality of government and, by extension, may reduce the deterrence of corruption. Religious fractionalization may also have an impact on corruption and other characteristics associated with the quality of government (Alesina et al., 2003).

Ethnic and linguistic fractionalization of a society may also contribute to the pervasiveness of corruption in a given country. The evidence is, however, mixed. Treisman (2000) found no evidence that linguistic fractionalization had a direct impact on perceived corruption, while La Porta et al. (1999) found evidence that, in societies that were more ethno-linguistically diverse, governments exhibited inferior performance. More recently, Alesina et al. (2003) have presented evidence that ethnic and linguistic fractionalization has a statistically significant impact on corruption, i.e., countries that are ethno-linguistically diverse are associated with higher perceived levels of corruption.

3.1.4. Economic factors

The economic determinants of corruption across countries have focussed typically on three factors: the degree of openness, a country's endowments of natural resources and the size of the public sector. Less open countries restrict trade and impose controls on capital flows. This creates rents and hence enhances the incentives to engage in corrupt activities. There are a number of papers that have investigated this issue: for example, Ades and Di Tella (1999) have shown that increased competition reduces corruption and that more open economies are less corrupt. Treisman (2000) has shown that higher imports lowers corruption. Wei and Wu (2001) have presented evidence that countries with capital controls have higher corruption and, in turn, receive less foreign investment and are more prone to financial crisis. More recently, Neeman et al. (2003) have shown that the effect of corruption on economic growth depends on the openness of the economy.[16]

Natural resource endowments have also featured in cross-country studies of corruption; the justification here being that the concentration of exports on natural resources is a proxy for rent-seeking opportunities. Ades and Di Tella (1999) suggest that corruption may offer greater gain to officials who exercise control over the distribution of the rights to exploit these natural resources. Treisman (2000) finds that a higher concentration of natural resource exports has a positive effect on perceived corruption.

Several studies on the causes of corruption have emphasized the size of the public sector. Tanzi (1998), for instance, notes that the significant role of the public sector in the economy affords public officials some degree of discretion in the allocation of goods and services provided and hence increases the likelihood of corruption. This mechanism is reinforced if the wages public officials receive are relatively low. This issue is explored by Van Rijckeghem and Weder (2001) who find that low wages for civil servants have a statistically significant effect on (perceived) corruption. Treisman (2000), however, finds rather inconclusive evidence of the size of the public sector in influencing corruption across countries.

We now turn to a discussion of the possible indicators of the structural model.

[16] Neeman et al. (2003) suggest that higher levels of openness are more likely to increase the impact of corruption as openness will allow for the dissipation of stolen money abroad. However, while they use an overall index of openness, the mechanism for whether corruption will have this effect is primarily limited to restrictions on the capital account.

3.2. Indicators of corruption

As has been the case regarding the causal variables to be used as determinants of corruption, the existing literature offers sufficient guidance with respect to appropriate indicators. The challenge is to select variables that appear to be correlated with the pervasiveness of corruption across the countries on our sample. This, as emphasized above, will enable us to estimate the MIMIC model and retrieve a measure of the latent variable. While there are a large number of candidate variables, we report only those that were successful in our modeling effort.[17]

Naturally, the most obvious indicator variable that should be incorporated into the structural model is GDP per capita. Almost all available evidence would appear to suggest that corruption varies inversely with development (see, among others, Mauro, 1995 and Paldam, 2003). Capital control restrictions are also included as an indicator variable. As noted in the discussion above, countries less open to foreign trade appear to be correlated with high levels of corruption.[18] More specifically, recent studies have noted that countries appearing to exhibit relatively high levels of corruption are more likely to impose capital account restrictions (Wei and Wu, 2001, and Dreher and Siemers, 2005). Recent empirical studies on the consequences of corruption have also focused on the allocation of resources, emphasizing not only the negative impact of corruption on investment but also its negative impact on the composition of investment. Mauro (1997) argues that the allocation of public procurement contracts through a corrupt system will lead to lower quality public services and quality of infrastructure.[19] A natural variable that captures the distortion of corruption on the allocation of resources is a measure of financial development. One would expect, in the absence of a well-developed financial sector, that corruption would be particularly distorting relative to those countries where a highly developed financial sector is present. Along these lines, Hillman and Krausz (2004) argue that corruption provides the source of the ineffectiveness of the financial system by reducing the volume of financial intermediation. Following Claessens and Laeven (2003), financial development is proxied by private credit as a share of GDP.

The final indicator variable uses apparent consumption of cement and endeavors to capture projects where the scope for corruption is high. As noted by Mauro (1997), lucrative opportunities for corruption typically arise with large projects the exact value of which are difficult to monitor. It is also easier to collect bribes on large infrastructure projects or on military expenditure.[20] In addition, data from the Bribe Payers Index shows that sectors where corrupt practices are likely to be higher include public works contracts and construction. Rose-Ackerman (1999, pp. 30–31) provides direct justification for the use of cement consumption as an indicator variable noting that: “In Nigeria in 1975, the military government ordered cement that totaled two-thirds of the estimated needs of all of Africa and which exceeded the productive capacity of Western

[17] Indicator variables that were tried, but without success, include, among others, growth of GDP, growth of GDP per capita, public investment as a share of GDP and trade as a percentage of GDP. Naturally, the size of the shadow economy may also be a good candidate as an indicator of corruption. Since such data are not available for a sufficient number of countries and periods, it is not used in the paper. This is also true for military spending as a percentage of GDP. Clearly, there are other variables that are potentially affected by corruption. While it is always possible to employ more variables, we restricted our attention to those most prominently discussed in the previous literature.

[18] As noted in the previous footnote, the level of trade (imports and exports) as a share of GDP was tried as an indicator variable but without much success.

[19] See also Rose-Ackerman (1999) and Tanzi (1998).

[20] As noted in footnote 17, military expenditure—being unavailable for the whole period—has not be included in the set of estimated variables.

Europe and the Soviet Union." Supportive of this is also della Porta and Vannucci (1997) who note that per capita cement consumption in Italy (a country that is perceived to be high on corruption indices) has been double that of the US and triple that of the UK and Germany. It seems, therefore, that cement is a natural proxy for large-scale projects. Given this evidence and the results from the Bribe Payers Index, we collected data on total consumption of cement for all the countries in our sample. To account for the role of development, this consumption data was expressed as a percentage of GDP. In addition, to account for the distribution of the population, this data was also adjusted for the density of the population.

4. Results

4.1. Corruption 1991–1997

We initially estimated the model for the 1991–1997 period covering between 98 and 103 countries.[21] The time period was restricted to the cut-off year 1997 because of unavailability of more recent data for the causal and indicator variables. We took the mean values of the available data over this period. In estimating the model, we used data that relate directly to the causes of corruption outlined in the previous section.[22] Since we estimate the model over different sub-periods, we include only those variables where data was available from the 1970s to the 1990s.[23] For the political factors, we used the following: whether the country was a democracy; the period of uninterrupted democratic government; number of years in office of the incumbent government; the rule of law; whether the political system was presidential; fractionalization of elected parties; whether the political system was federal; extent of decentralization; degree of political stability; freedom of the press and the school enrollment rate. The latter variable is used by Treisman (2000) who argues that corruption will be lower where populations are more educated and literate and where the normative separation between 'public' and 'private' is clearer. In a similar vein, Knack et al. (2003) suggest that education and literacy act as a vertical check on government. For social and cultural factors, we used data on: the dominant religion in each country; the extent of religious fractionalization; whether English was the dominant language; the degree of linguistic fractionalization and ethnic fractionalization. Historical causes included the following: legal origin; whether the country is a former colony of Britain; whether a common or civil law system applies; settler mortality and latitude. Variables used to capture the economic causes of corruption included: trade as a percentage of GDP; natural resource exports as a percentage of merchandise exports and the size of the public sector.

Making use of these variables, a number of specifications have been tested. The approach followed is the general to specific. Where variables were insignificant at the 10 percent level or above, they have been excluded from the model. Since the structural equation modeling is confirmatory in nature, this is an acceptable practice. In what follows, discussion is confined to those variables which are statistically significant at conventional levels.

[21] All estimations have been performed with LISREL® V. 8.5.4.

[22] We tested each specification for multivariate normality. In those cases where transformations have been necessary, in order for the data to satisfy the multivariate normality assumption, the transformed data produced similar results.

[23] Since the objective is to provide a model that would be comparable across sub-periods, variables with data available only for recent years, or a subset of countries, have been excluded.

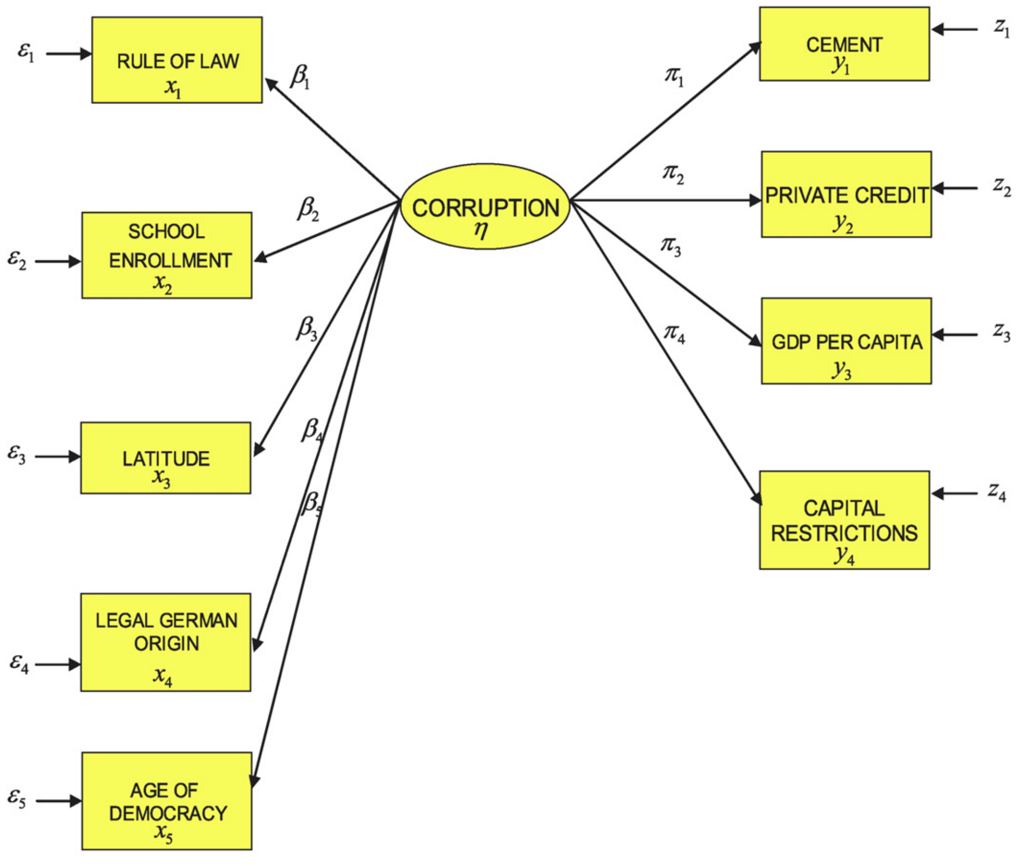

Fig. 1. The path diagram of the structural model.

Figure 1 presents the hypothesized set of relationships that link the variable of interest, corruption, to the indicators and causes.[24] These constructs predict the measured variable (corruption). The implication is that corruption is 'indicated' by the country's cement consumption, private credit, GDP per capita and capital restrictions. The latent variable of corruption is also predicated by a series of causal variables namely, the rule of law, school enrollment, latitude, legal German origin and the age of democracy. The model is then estimated to derive the values of the estimated parameters that link both the causes and indicators to the latent variable.

Before reporting the results, one should draw attention to the issue of separating causes from indicators. All models presented below employ the causal and indicator variables with their contemporaneous values. Clearly, this might give rise to endogeneity or reverse causality issues. Some of the causal variables can equally plausibly be used as indicators, and vice versa. As the MIMIC method is confirmatory in nature, it is inevitable we decide upon a model that can be accepted or rejected *a priori*. In those cases where the literature is indecisive about whether a

[24] It is common practice to represent the measured variables (indicators) by squares and the latent variables (factors) by circles. The hypothesized relationship between the variables are indicated by lines. Straight single-headed arrows represent one-way influences from the variable at the arrow base to the variable to which the arrow points.

Table 1
Estimates of corruption for 1991–1997

	(1)	(2)	(3)	(4)
Causes				
Rule of law	−0.09	−0.08	−0.06	−0.06
	(2.41**)	(2.33**)	(2.04**)	(2.10**)
School enrollment	−0.14	−0.15	−0.12	−0.09
	(2.61***)	(2.66***)	(2.43**)	(2.36**)
Latitude	−0.04			−0.03
	(1.78*)			(1.72*)
Legal German origin		−0.09		−0.09
		(2.56**)		(2.59**)
Age of democracy			−0.09	−0.09
			(2.35**)	(2.47**)
Indicators				
Cement	1.00	1.00	1.00	1.00
Private credit	−2.83	−2.97	−2.99	−2.77
	(2.85***)	(2.78***)	(2.70***)	(2.75***)
GDP per capita	−3.41	−3.47	−3.53	−3.32
	(2.90***)	(2.82***)	(2.74***)	(2.79***)
Capital restrictions	2.57	2.63	2.74	2.50
	(2.81***)	(2.74***)	(2.67***)	(2.70***)
Number of countries	102	103	102	98
p-value	0.40	0.36	0.80	0.22
RMSEA	0.02	0.03	0.00	0.05
GFI	0.97	0.97	0.98	0.95
AGFI	0.92	0.92	0.95	0.89
NFI	0.98	0.98	0.99	0.97

Note. t-statistics in parentheses.
* Significance of the 10% level.
** Idem, 5%.
*** Idem, 1%.

variable is a cause or an indicator, we used the variable either way to test for the robustness of our results. As it turns out, the results are rather robust to exchanging causal and indicator variables. We also tried lagging the quantitative causal variables by one period to deal with potential endogeneity. Again, the results are not qualitatively affected by this.

The results are presented in Table 1.

Starting with the indicator variables, it can be seen that they are fairly consistent across all model specifications. As pointed out in Section 2, one of the coefficients of the indicators must be normalized for the estimated parameters to be identified. The choice of the indicator variable on which to normalize the latent variable is to some extent arbitrary. However, while the choice of indicator fixes the scale of the latent variable, the choice does not affect the qualitative results (Stapleton, 1978). We choose cement consumption for normalization as, theoretically, it is closely (and ideally directly) related to the underlying concept of corruption. All indicator variables are statistically significant at the 1 percent level and have the anticipated sign, with cement consumption being positively and financial development negatively related to corruption, respectively. Lower levels of GDP per capita and more restrictions on the capital account are also associated with higher corruption.

Turning to the causal variables, the results show that the rule of law has a negative effect on corruption that is statistically significant at the 5 percent level across all specifications. School enrollment, too, reduces corruption and so—recalling that school enrollment can be interpreted as a proxy for the effectiveness of democracy in a given country—countries with weak democratic institutions will be expected to have higher levels of corruption. This coefficient is significant at the 1 percent level in the specifications reported in columns (1) and (2), while it is significant at the 5 percent level in specifications (3) and (4). Columns (1) and (4) include latitude (a variable with ambiguous economic interpretation). At the 10 percent level of significance, latitude reduces corruption. Columns (2) and (4) also include a dummy for German legal origin, while the age of democracy is included in columns (3) and (4). Both variables negatively affect corruption at the 5 percent level of significance.[25]

In interpreting the relative effects of different explanatory variables, standardized coefficients are most useful.[26] The standardized coefficient is the expected change in standard deviation units of the latent variable when the other variables are held constant. According to the standardized coefficients of the full model (not reported in the table) of column (4), a one standard deviation increase in the rule of law leads to a reduction in corruption by 0.20 standard deviations. A one standard deviation increase in the school enrollment rate, latitude, and the age of democracy reduces corruption by 0.32, 0.12 and, 0.32 standard deviations, respectively.

Table 1 also reports goodness-of-fit statistics for the four model specifications. The chi-square test of exact fit accepts all models at least at the five percent level of significance.[27] The Root Mean Square Error of Approximation (RMSEA) accounts for the error of approximation in the population and has recently been recognized as one of the most informative criteria in covariance structure modeling (Steiger, 1990).[28] The RMSEA is smaller than 0.05 in the most recent period and still acceptable in the other three specifications. Other indices providing evidence of an acceptable fit are the Goodness of Fit Index (GFI), the Adjusted Goodness of Fit Index (AGFI) and the Normed Fit Index (NFI). These indices range from zero to one, with values close to one indicating a better fit.[29] Based on these goodness-of-fit statistics, we conclude that the model fits the data fairly well.

The next step is to derive the ranking for the countries in the sample in terms of their expected levels of corruption. The method of proceeding from the estimated parameters to the derivation

[25] When including non-continuous variables, the estimator is no longer consistent, Bollen (1989). This, however, does not seem to impose any problems here. The results are very similar when legal German origin is excluded from estimation. Note that the index of restrictions is continuous due to averaging and standardizing.

[26] These standardized coefficients are defined as $\hat{\gamma}^s_{ij} = \hat{\gamma}_{ij}\sqrt{\hat{\sigma}_{jj}/\hat{\sigma}_{ii}}$, and $\hat{\beta}^s_{ij} = \hat{\beta}_{ij}\sqrt{\hat{\sigma}_{jj}/\hat{\sigma}_{ii}}$ where the subscript s denotes the standardized coefficient, i is the 'dependent' variable, j is the 'independent' and $\sqrt{\hat{\sigma}_{jj}}$, $\sqrt{\hat{\sigma}_{ii}}$ are the model-predicted variances of the jth and ith variables, respectively.

[27] The chi-square statistic tests the specification of the model against the alternative that the covariance matrix of the observed variables is unconstrained, where smaller values indicate a better fit. In other words, a small chi-square does not reject the null hypothesis that the model reproduces the covariance matrix.

[28] Expressed differently, the RMSEA measures how well the model fits based on the difference between the estimated and the actual covariance matrix (and degrees of freedom). Values of the RMSEA less than 0.05 indicate good fit, values as high as 0.08 represent reasonable fit, values from 0.08 to 0.10 indicate mediocre fit, and those greater than 0.10 indicate poor fit (MacCallum et al., 1996).

[29] These indices are based on comparison with a null model predicting all covariances to be zero. The NFI relates the chi-square of this null model to the chi-square of the actual model. It should be greater than 0.90. The GFI and the AGFI compare the loss function of the null model with the loss function of the actual model, with AGFI adjusting for the complexity of the model.

of the index was outlined in Section 2. Specifically, the estimated parameters together with the observations for the country-specific causes and indicators are used to derive the latent scores and, in turn, the values for the index across the countries in our sample.[30] The results for the final model are reported in the first column of Table 2, where the parentheses contain the index.

Table 2
Ranking and indices of corruption, 1976–1997

Country	1991–1997	1991–1997$_P$	1986–1990$_P$	1981–1985$_P$	1976–1980$_P$
Switzerland	1 (−0.9165)	1 (−0.9047)	n.a.	n.a.	n.a
Japan	2 (−0.8801)	2 (−0.8705)	1 (−0.6238)	1 (−0.5633)	1 (−0.276)
Norway	3 (−0.5489)	3 (−0.5346)	4 (−0.3966)	4 (−0.3646)	4 (−0.1984)
Denmark	4 (−0.5409)	4 (−0.5232)	2 (−0.4231)	2 (−0.3924)	2 (−0.2405)
Germany	5 (−0.5193)	5 (−0.5142)	3 (−0.4007)	n.a.	n.a.
Netherlands	6 (−0.5005)	6 (−0.5058)	7 (−0.3635)	6 (−0.3502)	5 (−0.1889)
Austria	7 (−0.4953)	7 (−0.4904)	8 (−0.3548)	5 (−0.3507)	8 (−0.1821)
Sweden	8 (−0.472)	8 (−0.4723)	5 (−0.3898)	3 (−0.3725)	3 (−0.2012)
United States	9 (−0.4615)	9 (−0.4589)	6 (−0.3635)	7 (−0.3404)	6 (−0.183)
France	10 (−0.4322)	10 (−0.4281)	10 (−0.3226)	8 (−0.3349)	7 (−0.1825)
Belgium	11 (−0.4209)	11 (−0.4148)	12 (−0.2665)	11 (−0.2524)	9 (−0.1493)
Hong Kong, China	n.a.	12 (−0.3926)	n.a.	n.a.	n.a.
Finland	12 (−0.3894)	13 (−0.386)	9 (−0.3369)	9 (−0.3)	11 (−0.1471)
Singapore	14 (−0.3419)	14 (−0.3452)	15 (−0.1988)	13 (−0.178)	19 (−0.0404)
Iceland	13 (−0.3471)	15 (−0.3323)	11 (−0.2874)	10 (−0.2651)	12 (−0.1449)
United Kingdom	15 (−0.2864)	16 (−0.2948)	14 (−0.2256)	14 (−0.1598)	16 (−0.0751)
Canada	17 (−0.2583)	17 (−0.2614)	13 (−0.2288)	12 (−0.2322)	13 (−0.1167)
Australia	16 (−0.2588)	18 (−0.259)	16 (−0.1901)	15 (−0.1546)	14 (−0.0858)
Italy	18 (−0.2206)	19 (−0.2207)	17 (−0.1608)	16 (−0.1433)	15 (−0.0778)
Ireland	19 (−0.2009)	20 (−0.203)	21 (−0.0986)	19 (−0.0845)	20 (−0.0302)
New Zealand	20 (−0.1909)	21 (−0.1991)	18 (−0.1532)	17 (−0.1336)	17 (−0.0712)
Spain	21 (−0.1382)	22 (−0.1436)	20 (−0.1043)	n.a.	n.a.
Kuwait	22 (−0.1191)	23 (−0.1212)	19 (−0.1061)	18 (−0.1214)	10 (−0.1482)
Israel	23 (−0.0924)	24 (−0.0872)	23 (−0.0769)	20 (−0.0828)	18 (−0.0435)
Cyprus	24 (−0.0682)	25 (−0.0748)	24 (−0.0253)	24 (0.0151)	n.a.
Portugal	25 (−0.0346)	26 (−0.043)	26 (−0.009)	23 (−0.0213)	22 (−0.003)
Korea, Republic	26 (−0.0334)	27 (−0.0419)	28 (0.0073)	26 (0.0552)	26 (0.0491)
Bahamas	n.a.	28 (−0.02)	22 (−0.0856)	n.a.	n.a.
Bahrain	27 (0.001)	29 (−0.0054)	27 (0.0002)	22 (−0.0294)	n.a.
Greece	28 (0.0139)	30 (0.0155)	25 (−0.0183)	21 (−0.0392)	21 (−0.03)
Malta	n.a.	31 (0.029)	29 (0.0383)	30 (0.0711)	n.a.
Malaysia	29 (0.0866)	32 (0.0677)	31 (0.0426)	27 (0.058)	32 (0.068)
Czech Republic	n.a.	33 (0.0856)	n.a.	n.a.	n.a.
Argentina	30 (0.0966)	34 (0.092)	35 (0.0845)	28 (0.061)	23 (0.0155)
Slovenia	n.a.	35 (0.1001)	n.a.	n.a.	n.a.
Barbados	n.a.	36 (0.103)	30 (0.0412)	n.a.	n.a.
Oman	31 (0.1259)	37 (0.118)	n.a.	n.a.	n.a.
Trinidad & Tobago	32 (0.1411)	38 (0.1292)	34 (0.0835)	31 (0.0716)	27 (0.0492)
Panama	34 (0.1485)	39 (0.1321)	33 (0.0802)	29 (0.0613)	28 (0.0496)

(*continued on next page*)

30 In the economics literature the normalized coefficients are sometimes multiplied by the corresponding (standardized) data to derive an estimate of the latent variable (Frey and Weck-Hannemann, 1984 and Loayza, 1996). The results reported are robust to this procedure. As noted earlier, we have opted to use the methodology of Jöreskog (2000) which uses more structural information.

Table 2 (*continued*)

Country	1991–1997	1991–1997$_P$	1986–1990$_P$	1981–1985$_P$	1976–1980$_P$
Uruguay	33 (0.1414)	40 (0.136)	32 (0.0714)	25 (0.0479)	25 (0.0449)
Thailand	35 (0.1522)	41 (0.1374)	40 (0.1156)	37 (0.1325)	39 (0.0868)
South Africa	36 (0.1809)	42 (0.1762)	37 (0.1011)	n.a.	n.a.
Chile	37 (0.1822)	43 (0.1803)	41 (0.1256)	34 (0.1178)	33 (0.0775)
Indonesia	40 (0.1988)	44 (0.1806)	44 (0.1334)	41 (0.1476)	55 (0.1008)
Mexico	38 (0.1913)	45 (0.1829)	48 (0.1463)	39 (0.1402)	30 (0.0612)
Mauritius	39 (0.192)	46 (0.1849)	45 (0.1355)	50 (0.1624)	n.a.
Tunisia	42 (0.2057)	47 (0.1957)	43 (0.1293)	n.a.	n.a.
Hungary	41 (0.1997)	48 (0.1991)	36 (0.0868)	35 (0.1228)	n.a.
Jordan	45 (0.2152)	49 (0.2051)	38 (0.1133)	33 (0.113)	38 (0.0853)
Costa Rica	43 (0.2118)	50 (0.2062)	51 (0.1552)	45 (0.1531)	31 (0.0653)
Venezuela	44 (0.2135)	51 (0.2104)	39 (0.1133)	32 (0.0803)	24 (0.0361)
Slovak Republic	n.a.	52 (0.2184)	n.a.	n.a.	n.a.
Peru	48 (0.2275)	53 (0.2185)	67 (0.1754)	44 (0.1511)	35 (0.0791)
Jamaica	47 (0.2272)	54 (0.22)	47 (0.1436)	40 (0.1459)	36 (0.0797)
Brazil	46 (0.2216)	55 (0.225)	42 (0.1271)	36 (0.1271)	29 (0.0601)
China	50 (0.2361)	56 (0.2256)	46 (0.1425)	n.a.	n.a.
Turkey	49 (0.2325)	57 (0.2286)	49 (0.1472)	n.a.	n.a.
Philippines	51 (0.2455)	58 (0.2362)	63 (0.1739)	42 (0.1478)	41 (0.0871)
Guatemala	54 (0.2474)	59 (0.2389)	58 (0.1681)	56 (0.1735)	37 (0.0832)
Paraguay	52 (0.2461)	60 (0.2401)	69 (0.1759)	54 (0.1717)	49 (0.0929)
Morocco	53 (0.2474)	61 (0.2401)	68 (0.1756)	59 (0.1799)	52 (0.0965)
Bolivia	56 (0.2548)	62 (0.2468)	64 (0.1749)	73 (0.2053)	51 (0.0957)
Nicaragua	59 (0.2624)	63 (0.2523)	88 (0.207)	61 (0.1808)	45 (0.09)
Colombia	55 (0.2544)	64 (0.2533)	60 (0.1715)	52 (0.1649)	40 (0.087)
Sri Lanka	60 (0.2645)	65 (0.2554)	72 (0.1789)	63 (0.185)	58 (0.1026)
Poland	57 (0.2565)	66 (0.2575)	54 (0.1585)	n.a.	n.a.
Papua New Guinea	61 (0.2673)	67 (0.2605)	53 (0.1573)	51 (0.1644)	n.a.
Botswana	58 (0.2581)	68 (0.2617)	61 (0.1716)	70 (0.1992)	n.a.
Haiti	66 (0.2735)	69 (0.264)	73 (0.1791)	58 (0.1761)	53 (0.0971)
Ecuador	62 (0.2684)	70 (0.2652)	62 (0.1729)	48 (0.1619)	42 (0.0884)
Cote d'Ivoire	65 (0.2731)	71 (0.2666)	52 (0.1561)	38 (0.1396)	n.a.
Dominican Republic	63 (0.2698)	72 (0.2668)	59 (0.1708)	55 (0.1732)	47 (0.0914)
El Salvador	64 (0.2708)	73 (0.2668)	79 (0.1926)	n.a.	44 (0.0886)
Honduras	67 (0.2742)	74 (0.2676)	65 (0.1749)	53 (0.1713)	43 (0.0885)
Senegal	68 (0.2771)	75 (0.27)	55 (0.1587)	43 (0.148)	48 (0.0927)
Guyana	70 (0.2789)	76 (0.2746)	n.a.	n.a.	n.a.
Egypt	69 (0.2787)	77 (0.2753)	74 (0.1796)	65 (0.1895)	60 (0.1047)
Cameroon	73 (0.2861)	78 (0.2806)	57 (0.168)	46 (0.1543)	50 (0.0948)
Niger	75 (0.289)	79 (0.2814)	71 (0.1775)	68 (0.1958)	62 (0.1116)
Kenya	74 (0.289)	80 (0.2839)	70 (0.1764)	57 (0.1744)	57 (0.1018)
Bulgaria	72 (0.2859)	81 (0.2848)	n.a.	n.a.	n.a.
Namibia	71 (0.2821)	82 (0.2862)	n.a.	n.a.	n.a.
Zimbabwe	77 (0.291)	83 (0.2876)	82 (0.1976)	64 (0.1891)	56 (0.1013)
Benin	79 (0.2934)	84 (0.2876)	n.a.	n.a.	n.a.
Pakistan	78 (0.2932)	85 (0.289)	n.a.	n.a.	n.a.
Iran	76 (0.2892)	86 (0.2901)	56 (0.1634)	49 (0.1621)	34 (0.0778)
Bangladesh	81 (0.2959)	87 (0.2908)	n.a.	n.a.	n.a.
India	83 (0.2961)	88 (0.2918)	66 (0.1753)	60 (0.1801)	59 (0.1033)
Mali	84 (0.2982)	89 (0.2929)	78 (0.1898)	n.a.	n.a.

Table 2 (*continued*)

Country	1991–1997	1991–1997 $_P$	1986–1990 $_P$	1981–1985 $_P$	1976–1980 $_P$
Congo, Republic	82 (0.2959)	90 (0.2933)	n.a.	n.a.	n.a.
Uganda	86 (0.3003)	91 (0.2949)	84 (0.2021)	74 (0.2131)	n.a.
Togo	85 (0.2989)	92 (0.295)	75 (0.1807)	62 (0.1824)	54 (0.0998)
Algeria	80 (0.2947)	93 (0.2959)	50 (0.1509)	47 (0.1564)	46 (0.0901)
Sierra Leone	89 (0.3025)	94 (0.2971)	76 (0.187)	71 (0.2049)	n.a.
Ukraine	87 (0.3004)	95 (0.3001)	n.a.	n.a.	n.a.
Romania	88 (0.3017)	96 (0.3029)	n.a.	n.a.	n.a.
Malawi	91 (0.3105)	97 (0.3067)	81 (0.1959)	67 (0.1933)	n.a.
Madagascar	90 (0.3103)	98 (0.3074)	77 (0.189)	n.a.	n.a.
Chad	92 (0.3166)	99 (0.3143)	86 (0.2039)	72 (0.205)	n.a.
Zambia	93 (0.3186)	100 (0.3178)	85 (0.2022)	n.a.	n.a
Ghana	94 (0.3198)	101 (0.3188)	91 (0.2125)	77 (0.2221)	63 (0.1119)
Congo, Dem. Rep.	n.a.	102 (0.3201)	87 (0.2047)	75 (0.2146)	65 (0.1143)
Central African Rep.	95 (0.3211)	103 (0.3202)	83 (0.2011)	69 (0.1991)	n.a.
Syria	96 (0.3261)	104 (0.329)	89 (0.2092)	76 (0.2154)	64 (0.1135)
Nigeria	97 (0.3326)	105 (0.334)	80 (0.1941)	66 (0.1926)	61 (0.1092)
Guinea-Bissau	98 (0.3424)	106 (0.3453)	90 (0.2113)	n.a.	n.a.

Notes. (1) The subscript P denotes the parsimonious model. (2) The number in parentheses represents the index of corruption. (3) The ranking and indices of corruption have been sorted according to the ranking and index of the parsimonious model of 1997.

The ranking, to a large extent, is not surprising, the developed countries being typically reported as countries with lower corruption and developing countries with higher corruption. The world's least corrupt country is Switzerland, followed by Japan, Norway, Denmark, and Germany. With the exception of Japan, Singapore and the US, only Western European countries are among the 15 least corrupt nations. At the bottom of the scale, Guinea-Bissau, Nigeria, Syria, and the Central African Republic are found to be the most corrupt. As can be seen, sub-Saharan African countries dominate the bottom of the scale, with the exception of Syria, Ukraine, and Romania. Latin American and Caribbean countries can be found at ranks between 31 and 71. To get a better understanding of those regional differences, we also calculated average corruption indices according to region. Corruption is by far lowest in Western Europe, with an average index of −0.36. The ranking for the other regions is as follows: East Asia Pacific (−0.05), Middle East and North Africa (0.16), Latin America and Caribbean (0.22), East Europe and Central Asia (0.26), sub-Saharan Africa (0.29) and South Asia (0.29). Within Western Europe, Greece is the most corrupt country followed by Portugal and Cyprus. The most corrupt South Asian countries are Papua New Guinea, Philippines, and China. In the Middle East and North Africa, Kuwait and Israel are the least, and Syria and Algeria the most, corrupt countries. The least corrupt sub-Saharan Africa country is South Africa. In what follows, we will explore the developments of these patterns over time.

4.2. Corruption 1976–1997

We now explore how corruption has changed over time since 1976. However, in doing this, there are several drawbacks. First, the further back in time, the less data there is available in terms of country coverage. For each sub-time period the model is estimated, the sample size reduces considerably (for the periods 1986–1990, 1981–1985 and 1976–1980 the sample reduces to 91, 77 and 65 countries, respectively). The second issue relates to the countries we lose from the sample; typically those countries for which data is absent will be the less developed ones where corruption may be expected to be high.[31] In this case, it is likely that the estimated model will give less statistically significant coefficients for the earlier periods.

To deal with these issues, the basic specification of the model included all causal variables discussed in Section 3. However, for different time periods, not all variables were statistically significant. Therefore, to provide consistency in our specification across sub-periods, we estimate a more parsimonious version of the model to the one that was presented in Table 1.[32] In choosing the most parsimonious version of the model, we relied on the variables that would be statistically significant across all time periods and the goodness-of-fit statistics. While all the indicator variables continued to perform well, the number of statistically significant causes was reduced to two: the rule of law and the school enrollment rate. The results for the estimation of the model for each sub-period (including the 1991–1997 period) are presented in columns (2)–(4) of Table 3.

Table 3
Estimates of corruption for 1976–1997

	(1) 1991–1997	(2) 1986–1990	(3) 1981–1985	(4) 1976–1980
Causes				
Rule of law	−0.09	−0.09	−0.10	−0.05
	(2.35**)	(2.48**)	(2.04**)	(2.51**)
School enrollment	−0.16	−0.10	−0.11	−0.16
	(2.67***)	(2.51**)	(2.06**)	(3.65***)
Indicators				
Cement	1.00	1.00	1.00	1.00
Private credit	−2.88	−3.76	−3.34	−3.55
	(2.82***)	(2.65***)	(2.06**)	(3.53***)
GDP per capita	−3.31	−4.71	−4.64	−4.79
	(2.86***)	(2.70***)	(2.12**)	(3.86***)
Capital restrictions	2.57	3.30	3.17	2.23
	(2.78***)	(2.57**)	(2.02**)	(2.64***)
Number of countries	106	91	77	65
p-value	0.79	0.09	0.13	0.26
RMSEA	0.00	0.09	0.09	0.06
GFI	0.99	0.95	0.95	0.95
AGFI	0.96	0.87	0.86	0.87
NFI	0.99	0.96	0.96	0.96

Note. t-statistics in parentheses.
** Significance at the 5% level.
*** Idem, 1%.

31 According to the empirical analysis in Rosendorff and Vreeland (2006), democratic countries are more willing to provide data than are other regimes. The exception is Switzerland where data on capital account restrictions are not available for earlier periods. This is because Switzerland only became a member of the IMF in 1992.

32 Note that for the most recent period, the correlation between the full and the parsimonious model is 0.998. The quality of our results is thus not reduced by estimating a more parsimonious model.

The estimated parameters for both the causal and indicator variables are fairly consistent across each sub-period. The signs of the estimated parameters continue to hold (as in the less parsimonious model for 1991–1997 presented in Table 2) while the parameter values show little variation. Table 3 also reports goodness-of-fit statistics for our four models. The chi-square test of exact fit accepts all models at least at the five percent level of significance. The RMSEA is smaller than 0.05 in the most recent period and still acceptable in the other three specifications. The other indices that provide evidence of model fit (the GFI, the AGFI and the NFI), all indicate values relatively close to 1. Based on these goodness-of-fit statistics, we conclude that our model fits the sample data fairly well when estimated for each sub-period.

The indices of corruption derived from those estimates are presented in the last four columns of Table 2. There are two important results. First, levels of corruption seem to be fairly consistent over time, as are the relative positions of countries.[33] Second, there are some obvious regional patterns. Overall, corruption in Western Europe decreased since the mid-70s, whereas corruption increased in sub-Saharan Africa and Latin America/Caribbean. The pattern is more mixed in East Asia Pacific, where the huge decrease in Japan's level of corruption reduces the average level for the region, and the Middle East/North Africa, with decreases in corruption in Israel and Malta and increases in most other countries. The averages for the period 1976–1980 are −0.13 (West Europe), −0.01 (East Asia Pacific), 0.05 (Middle East and North Africa), 0.7 (Latin America and Caribbean), 0.1 (sub-Saharan Africa) and 0.1 (South Asia). It is also worth noting that, of the 10 most corrupt countries reported in Table 2, all witnessed an increase in corruption since the 1980s.

Comparing our results for the full model over the period 1991–1997 with the 1997 corruption perception-based index produced by Transparency International, five of the countries shown to be among the world's ten least corrupt countries according to our index, also appear among the first ten countries in the Transparency International index. No country of our ten least corrupt countries ranks below 21 in the Transparency International's listing. In spite of the high correlation, and the overall consistency, there are some interesting discrepancies. As one example, Chile ranks 37 according to our index, while Transparency International's ranking shows it to be 23. Given the different interpretations of the indices, Chile is thus perceived to be less corrupt than it actually is.

5. Further discussion

This study was predicated on the fact that perception-based indices of corruption have recently been criticized as potentially biased and inaccurate measures of corruption across countries, but are nevertheless widely used in the empirical literature on corruption due to their availability, their extensive country coverage and lack of alternative measures. As discussed in the introduction, those indices may not be reliable indicators of the degree of corruption. Instead, they may just reflect a general perception of a country's institutional quality. In this paper, we have addressed these potential shortcomings while retaining the advantages of cross-country coverage by employing a structural equation model that addresses many of the concerns raised with respect to the survey-based indices.

Of course, one may argue that the estimated model does not capture the extent of corruption. There are three ways to test for the validity of a structural model (Bollen, 1989). Firstly,

[33] In interpreting the ranking one has to keep in mind that in many cases a country moves up or down in the ranking because of missing data for other countries.

it is necessary to examine the fit of the model. Secondly, variables related to the latent variable in the theoretical literature should have the expected impact. We have dealt with these two validity tests above. Thirdly, the obtained latent variable should be correlated with other measures of the same concept. We, therefore, calculated the correlation of the resulting indices with the Corruption Perception Index of Transparency International (which is highly correlated with other perception-based indices). As Appendix Table A.1 shows, the resulting Spearman rank correlations for the respective time periods range from 0.79 for the period 1991–1997 to 0.85 in 1986–1990.[34] Overall, we can be reasonably confident that our latent variable is picking up the ranking of corruption across countries.

Arguably, reflecting the nature of the data, the index derived in this paper is likely to be more appropriate to use in studies that evaluate the impact of corruption than are perception-based indices. There are two important aspects to this. First, since the index not only derives the rank but also the distance between countries in the corruption index, this has the potential to give a more accurate (or less biased) estimate of how the impact of corruption varies across countries and hence the dependent variable of interest. Second, since the index is derived on country fundamentals that vary over time, the ranking and the distance between countries can also vary over time. Moreover, the time aspect has the potential to deal with any endogeneity issues between corruption and the dependent variable since the lagged values of the corruption index may be exogenous to current fundamentals.[35]

The use of the index may also provide a different assessment of the likely impact of corruption to the one produced by perception-based indices.[36] Indeed, a simple example illustrates this point. Assessing the dependence of international cross-border acquisitions (the main form of foreign direct investment) on the quality of institutions using Transparency International's perception-based index, for the US and OECD as host countries and for the years 1997–2003, we found a substantial overestimation of the impact of corruption on cross-border mergers and acquisitions. More specifically, using the perception-based corruption index of Transparency International, the absolute value of the estimated standardized (beta-) coefficient is 0.16 which is substantially larger than the estimated coefficient of 0.02 produced when using the corruption index reported in this paper.[37]

Taken together, the corruption index based on the structural equation approach is likely to be of direct consequence to different user groups. One such group is the policy-based academic community which endeavor to evaluate the consequences of corruption. Since the measure derived here gives a measure of 'distance' as well as ranking of corruption across countries, it therefore has the potential to provide more reliable estimates of the impact of corruption than perception-based indices which provide the ranking but not the distance. As such, perception-based measures may provide biased estimates (as we note above). For various international or private sector organizations and non-government organizations who make decisions based on the institutional

[34] Table A.1 also reports the correlation between the latent variables and the causal and indicator variables used. As can be seen, correlations between the latent variable and the indicators varies from about 0.5–0.95.

[35] This is a well accepted procedure in the shadow economy literature.

[36] This feature comes from the fact that the derived index provides a ranking between countries but also a measure of distance. As such, it has the potential to more accurately estimate the impact of corruption on variables such as foreign direct investment.

[37] We make use of the index produced in Table 2 for the years 1991–1997 and the corruption perception-based index of Transparency International. The details are available upon request. The same pattern emerges in the study of electoral competition and corruption, Herger (2005).

environment of a particular country (e.g. the disbursement of aid or investment), the methodology for deriving an index outlined here would also be potentially useful. The main advantage for this constituent user is that it can monitor how corruption in a particular country varies over time. Even if the ranking of the country in the corruption index stays the same, this does not necessarily imply that corruption is not being controlled. Moreover, since the perception-based indices have an in-built bias insofar as perceptions may change little over time, countries may be denied aid and investment despite efforts to control corruption. Since the method outlined here is based on measurable causes and indicators that vary over time, this allows a country's measured performance in controlling corruption to improve.

Clearly, the MIMIC method of structural equation modeling as applied here is only an additional step in furthering our understanding about corruption. Generally, there is considerable scope for using the structural equation methodology to explore broader aspects of institutional governance and how it is linked to corruption. For example, Glaeser et al. (2004) and Rodrik et al. (2002) have argued that conventionally-used measures of institutional quality such as the rule of law are perception-based outcome measures that do not necessarily pick up the quality of governance that they purport to do. In this sense, applying the above methodology to measure institutional quality as a latent variable with appropriate causes and indicators could be fruitful. In addition, as already touched upon, the incidence of corruption may interact with measures of institutional quality such that there is a potential endogeneity issue: corruption may be high due to weak institutions, though the institutions may be weak because corruption is so pervasive. The structural equation methodology has the potential to account for this.[38]

6. Concluding remarks

Current policy focus on corruption around the world, as well as most empirical studies of corruption, employ perception-based indices to gauge the ranking between the most and less corrupt countries. The recent literature has revealed several problems in the interpretation of these indices. To this end, we employed a structural model of corruption that simultaneously deals with the causes and indicators of corruption within a unified framework.

There are clear advantages to using this framework to estimating corruption. First, the model is explicitly causal in nature such that the ranking one retrieves across countries is tied to the causal variables that were used to estimate the model. As such, the model produces a cardinal index of corruption rather than one that is solely ordinal. Secondly, dependent on data availability, the model can be estimated over different sub-periods to assess how corruption has changed over time for each country.

The methodology applied in this paper holds much promise for future research in the empirical analysis of corruption. For example, the impact of economic, political and economic reform on corruption is a potentially fruitful avenue of research and one that has received some attention for those who identify the role of institutions as a determinant of economic development (Acemolgu et al., 2001 and Rodrik et al., 2002). Moreover, the methodology reported here can be extended to the case where some of the exogenous variables are themselves inherently latent and interrelated (for example, with institutional reform, the rule of law and the hidden economy) which interact with the endogenous latent variable of corruption. For example, in

[38] For such a multiple latent approach see Dreher et al. (2006), who explore the link between the shadow economy and corruption in OECD countries.

measuring the size of the hidden economy which has been a previous focus of researchers using MIMIC, the estimates are likely to be picking up aspects of corruption (and vice versa). Separating these two aspects will provide a more accurate assessment of the relative importance of each of them.

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Appendix A

This appendix provides the definitions of the variables in Tables 1 and 3, and their sources.

Age of democracy: Number of years since 1900 a country has a democracy score continuously greater than zero. *Source*: Marshall and Jaggers (2000).

Cement: Cement consumption measured in thousand tons adjusted by GDP and population density. *Source*: Cembureau (1998, 1999).

GDP per capita: Domestic product divided by mid-year population. *Source*: World Bank (2003).

Latitude: Distance in degrees from the equator, Easterly and Sewadeh (2001).

Legal origin: Dummies for British, French, German and Socialist legal origin. *Source*: Easterly and Sewadeh (2001).

Private credit: Private credit by deposit money banks and other financial institutions as a share of GDP. *Source*: Beck et al. (1999).

Restrictions: Range 0 (no restrictions) to 4 (fully restricted). Consists of dummies for the existence of payments restrictions, multiple exchange rates, surrender requirements and restrictions on current transactions. *Source*: Dreher and Siemers (2005). This is a continuous variables, since it is averaged over seven (for the period 1991–1997) and five years (for the periods 1976–1990).

Rule of law: 0–10 (0 = low; 10 = high) score for the quality of the legal system and property rights. *Source*: Gwartney et al. (2003).

School enrolment rate: Ratio of total enrollment to the population of the age group that officially corresponds to the level of education shown. Secondary education completes the provision of basic education that began at the primary level. *Source*: World Bank (2003).

Table A.1
Spearman rank correlations

	1991–1997	1991–1997p	1986–1990p	1981–1985p	1976–1980p	Transpar. Int'l.	Cement	Private credit	Capital restrict.	GDP per capita	Rule of law	School enroll.	Latitude	Legal German origin	Age of democ.
1991–1997	1														
1991–1997p	0.9978	1													
1986–1990p	0.9512	0.9541	1												
1981–1985p	0.9379	0.9423	0.9757	1											
1976–1980p	0.9342	0.9337	0.945	0.9624	1										
Transparency International	−0.7911	−0.7985	−0.8513	−0.8495	−0.8269	1									
Cement	0.5169	0.5484	0.5571	0.5105	0.4982	−0.3644	1								
Private credit	−0.841	−0.8445	−0.8306	−0.8496	−0.7125	0.6478	−0.3757	1							
Capital restrictions	0.6668	0.6513	0.6319	0.602	0.605	−0.5666	0.284	−0.4559	1						
GDP per capita	−0.9465	−0.9417	−0.9428	−0.936	−0.9736	0.8238	−0.4338	0.7319	−0.4909	1					
Rule of law	−0.7125	−0.733	−0.6371	−0.7373	−0.786	0.7955	−0.3895	0.5741	−0.4962	0.6776	1				
School enrollment	−0.8142	−0.8065	−0.8518	−0.8205	−0.8248	0.7378	−0.4589	0.6835	−0.3716	0.8279	0.6374	1			
Latitude	−0.4108	−0.4237	−0.5258	−0.5334	−0.4808	0.3566	−0.3833	0.422	−0.2179	0.4544	0.376	0.5685	1		
Legal German origin	−0.3385	−0.3324	−0.2939	−0.2567	−0.2501	0.2541	−0.303	0.3226	−0.204	0.2965	0.2482	0.2586	0.2152	1	
Age of democracy	−0.5498	−0.5429	−0.5514	−0.6119	−0.621	0.6207	−0.4144	0.4805	−0.3489	0.6017	0.5445	0.5834	0.2665	0.2002	1

Note. Transparency International ranges between 10 (highly clean) and 0 (highly corrupt).

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