Documents de travail

« Determinants of corruption: Can we put all countries in the same basket? »

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Blaise Gnimassoun[*] and Joseph Keneck[**]

Abstract

This paper aims to study the determinants of corruption by examining specificities relating to the region and the level of economic development. Starting from a cross-sectional study on 130 countries, we rely on the Bayesian Model Averaging (BMA) approach to address the issue of model uncertainty and identify the key determinants of corruption according to the level of development and the region. Our results highlight the need for specific remedies in the fight against corruption given the regional, sociocultural, economic and institutional specificities. Indeed, the key determinants of corruption in sub-Saharan Africa are not the most relevant in the East Asia and Pacific region. Similarly, the most important determinants in developed countries are not the most worrying in developing countries.

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1. INTRODUCTION

The literature abounds with arguments and empirical evidence on the negative effects of corruption.[1] Corruption is considered among others as a factor inhibiting domestic and foreign investment (Mauro, 1995; Tanzi and Davoodi, 1998; Campos et al., 1999; Wei, 2000; Habib and Zurawicki, 2002; Méon and Sekkat, 2005; Beekman et al., 2014), restricting economic growth (Mauro, 1995; Tanzi and Davoodi, 1998; Mo, 2001; Gyimah-Brempong, 2002; Méon and Sekkat, 2005; Aidt et al., 2008) and worsening inequality and poverty (Gupta et al., 2002; Gyimah-Brempong, 2002; Jong-Sung and Khagram, 2005; Alesina and Angeletos, 2005; Glaeser and Saks, 2006; Apergis et al., 2010). All governments, whether of developed or developing countries, hold up the fight against corruption as a priority objective of their economic policy. For developing countries, this commitment is sometimes a condition for receiving financial support from development partners. Despite these pledges, the level of corruption remains high and heterogeneous between countries.

As treatment and healing are dependent on the diagnosis, several studies have striven to study the determinants of corruption by focusing on the historical, socio-cultural, institutional and economic factors[2] that could explain it (Shleifer and Vishny, 1993; La Porta et al.,1999; Leite and Weidmann, 1999; Ades and Di Tella, 1999; Adsera et al. 2000; Treisman, 2000; Van Rijckeghem and Weder, 2001; Persson et al., 2003; Acemoglu and Verdier, 2000; Fisman and Gatti, 2002; Paldam, 2002; Adsera et al. 2003; Brunetti and Weder, 2003; Knack and Azfar, 2003; Serra, 2006; Pellegrini and Gerlagh, 2008; Fan et al. 2009; Henderson and Kuncoro, 2011). This paper is no different, but has the particularity of making a specific diagnosis according to the level of development and the region. Indeed, while it can be accepted that some common factors may explain corruption regardless of the level of economic development or the region, it is also plausible that regional specificities in terms of natural resource endowments and socio-cultural and historical conditions add special features to the determinants of corruption. Despite growing interest among studies on the determinants of corruption, this view has not been explored. However, there are several reasons to think that the determinants of corruption depend on the level of economic development of countries[3] and their geographical location (their region).

First, all cross-country analyses on the determinants of corruption show that corruption decreases with the level of economic development. This is the only point of consensus among authors on the determinants of corruption (Serra, 2006). Likewise, in his contribution on the causes of corruption, Trieisman (2000) raised the question of regional specificity, which he analyzes through dummy variables for each region. According to his results, Africa, Eastern Europe, Asia, Latin America and the Middle East are perceived as more corrupt than Western Europe and North America. He also shows that Latin America and Asia are perceived as significantly more corrupt than the average of all other continents. More interestingly, he

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[1] We adopt the definition by Transparency International whereby corruption reflects the perception of the extent to which public power is used for personal gain.

[2] The factors discussed in the literature are developed in more detail in Section 2.

[3] The idea here is to distinguish between countries according to their income level according to the World Bank classification.

found that even after controlling for economic development, Latin America and Eastern Europe are significantly more corrupt than Western Europe and North America. These interesting results raise the question of the determinants of corruption according to the level of economic development and the region. In other words, are the poor results of developing countries in terms of reducing corruption not partly due to their specificity? Can we really consider the same causes of corruption across all countries as is generally presented in cross-country empirical works? If not, what are the particularities or the most relevant determinants depending on economic development and region? And finally what are the traits common to all countries? The answers to these questions bring a new lease of life to the literature on the determinants of corruption and have important implications for targeted anti-corruption policy.

Second, by allowing, as it is often the case in the literature, that corruption is decreasing with the level of economic development, it could be thought that the determinants of corruption also vary with the level of economic development of countries. Billger and Goel (2009) show from a quantile regression that certain determinants of corruption, such as democracy and economic freedom, are more or less important depending on the level of corruption. They show that for the most corrupt countries, a greater presence of government and greater economic freedom do not seem to reduce corruption, and this is not the case for the least corrupt countries.

Third, disagreements between authors about the influence of some of the determinants of corruption, such as the legal origin of the law, could be explained by the heterogeneity of the samples considered. For example, while some studies show that a socialist legal origin is associated with greater corruption and that an Anglo-Saxon legal origin would favor lower corruption (La Porta et al., 1999; Glaeser and Shleifer, 2002; Gerring and Thacker, 2005; Serra, 2006), other economists have their reservations or disagree with the results (Adsera et al., 2000; Brunetti and Weder, 2003; Pellegrini and Gerlagh, 2008).

This paper provides answers to these questions starting out from the broad literature on the potential determinants of corruption. To this end, it relies on variable selection techniques to address the issue of uncertainty regarding the model specification. These techniques are much better known in economics for addressing the issue of uncertainty in cross-country determinants of economic growth (Levine and Renelt, 1992; Sala-I-Martin, 1997; Fernandez et al., 2001; Masanjala and Papageorgiou, 2008). Specifically, we use the Bayesian Model Averaging approach (BMA), which, based on the observed data, identifies the most relevant determinants of corruption, without a priori concerning the corruption model specification. Applied to countries according to their level of development or their region, this method serves to isolate the most robust determinants specific to each country grouping.

Our paper contributes to the literature in several ways. Firstly, as data have become more available and accurate, particularly for developing countries, studies on the determinants of corruption are more likely to be more accurate and informative. However, as it is impossible to take into account all the potential determinants of corruption through a single theoretical model, an empirical approach starting with the set of determinants and then identifying the

most relevant of them seems to be the most optimal solution. Next, going further than previous papers on the determinants of corruption, we identify the determinants of corruption specific to the level of economic development and to the region. Finally, by providing a specific analysis framework to better understand the determinants of corruption according to economic development level and geographical location, this article allows governments as well as international organizations to better target the root causes of corruption in order to fight effectively against this scourge.

Based on a set of 130 developed and developing countries, our results show that while some determinants of corruption are common to all countries, others are specific to the level of economic development and to the region. Indeed, for developed countries, corruption is mainly determined by the "willingness to delegate authority,"[4] while for developing countries in general, factors such as the quality of education and GDP per capita determine corruption. Focusing on the specificity of sub-Saharan Africa, our results show that freedom of the press, the burden of regulation, linguistic fragmentation, political system, religion and political stability are the determinants of corruption peculiar to this region. In the region of East Asia and the Pacific, corruption is mainly explained by legal origin, religion, political stability and education. In Europe and Central Asia, we find as determinants of corruption freedom of information, the burden of government regulations, legal origin, religion, political stability and education. Regarding Latin America and the Caribbean, freedom of information and education were identified as determinants of corruption. Finally, in the Middle East and North Africa region, determinants of corruption are the political regime, political stability and education.

The rest of the article is organized as follows: Section 2 discusses the potential determinants of corruption. Section 3 presents the empirical approach. Section 4 is devoted to the presentation of results and comments. Section 5 provides a robustness analysis of the results. Finally, Section 6 concludes the paper.

2. POTENTIAL DETERMINANTS OF CORRUPTION

The determinants of corruption have been extensively addressed in the literature[5] since the early 1990s. These determinants can be broadly grouped into three main blocks: historical and cultural factors, economic factors and institutional factors.

2.1. Historical and sociocultural factors

In this block of factors, we can group the legal system and the colonial origin, religious culture, ethno-linguistic fragmentation and education.

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[4] This term refers to the extent to which senior managers (public and private) delegate decision-making to their subordinates. It could thus be approximated by decentralization of decision-making.
[5] Refer also to Lambsdorff (2006) for more detailed explanations on the causes of corruption.

The legal system. This is generally regarded as one of the leading determinants of corruption. Indeed, the cost of corruption in terms of probability of arrest, exposure and punishment depends on the efficiency of the legal system. Several authors highlight the fact that the common law system that characterizes Britain and its former colonies is more dissuasive than the civil law system which is present in continental Europe and its former colonies (La Porta et al. 1999; Treisman, 2000; Glaeser and Shleifer, 2002; Serra, 2006). For the proponents of this theory based on the historical roots of corruption, the former British colonies have a better code of public service because of the influence of the British bureaucracy. In this system, the functioning of the bureaucracy is focused on the procedural aspects of the law, which improves the ability of subordinates and judges to challenge the hierarchies in order to enforce the law, thereby reducing corruption (Treisman, 2000). However, the theory of the effectiveness of the British legal system is contested by several authors, such as Adsera et al. (2000), Brunetti and Weder (2003), Pellegrini and Gerlagh (2008). Moreover, like Treisman (2000), Serra (2006) shows that the colonial heritage of a country is an important determinant in explaining contemporary corruption. But colonial heritage is strongly linked with legal origin.

Religious culture. Since the work of Weber (1958) and Putnam (1993) on the importance of culture in the quality of institutions, studies have shown that religious culture may explain a significant share of corruption (Shleifer and Vishny, 1993; La Porta et al., 1999). The explanation is that religious traditions to some extent determine the relationships of individuals with social hierarchy, with the state and the family. For some authors, hierarchical religions such as Catholicism, Islam and Eastern Orthodoxy would be less stringent vis-à-vis the hierarchy. Similarly, the familialist traditions of some religions promote nepotism. From this point of view, Protestantism is perceived as more egalitarian and individualistic and less tolerant of abuses by public authorities. Thus, countries with a high proportion of Protestant worshipers would have a lower level of corruption (La Porta et al., 1999; Treisman, 2000; Serra, 2006; Pellegrini and Gerlagh, 2008). However, like Adsera et al., (2000), Melgar et al. (2010) find no influence of religious affiliation on corruption.

Ethnic and linguistic fragmentation. In a pioneering study, Mauro (1995) shows that countries with a strong ethno-linguistic fragmentation tend to be more corrupt. Similarly, some authors find the same effect with regard to ethnic fragmentation. In countries with high ethnic fragmentation, government officials are more likely to favor members of their ethnic group (Shleifer and Vishny, 1993; Pellegrini and Gerlagh, 2008). This effect is however not confirmed in Brunetti and Weder (2003).

Education. The shaping of the behavior of individuals, civic learning and the exemplary are favored by the school. Thus the quality and level of education are determining factors in the fight against corruption. Melgar et al. (2010) found that people who have completed at least secondary education are more likely to perceive the level of corruption than people with a primary education level. Similarly, Van Rijckeghem and Weder (2001) believe that good citizenship at school contributes to the reduction of corruption.

2.2. Economic factors

Among the economic factors whose influences on corruption are discussed in the literature, the level of development, government wage, natural resource rents and economic openness can all be put forward.

Economic development. This is the variable among the determinants of corruption on which there is a consensus in the literature. Corruption tends to be reduced with economic development (Paldam, 2002; Serra, 2006; Pellegrini and Gerlagh, 2008; Goel and Nelson 2010; Melgar et al., 2010). For example, Paldam (2002) shows that the level of corruption decreases when the country moves from being a poor country to a rich country. Similarly, according Melgar et al. (2010), the level of corruption tends to be reduced with the country's economic performance. For Treisman (2000) there is a causal relationship between the improvement in income level and the decline in corruption, from the level of economic development to corruption.

Government wage. The influence of wage on corruption has been theorized by Becker (1968). Van Rijckeghem and Weder (2001) show that the low level of salaries of civil servants in developing countries would be a serious explanation for their very high level of corruption, insofar as in the public service, it attracts dishonest officials who seek to compensate for foregone wages by corruption. Higher wages involve higher costs when a position in the public service is lost due to corruption. A cost-benefit analysis suggests that higher wages provide an incentive to refrain from corruption (Becker, 1968). However, the wage effect can be ambiguous because politicians and the most corrupt parliamentarians can award themselves the largest remuneration (La Porta et al., 1999; Treisman, 2000).

Natural resource rents. According to the "rent seeking" theory, rent seeking explains a large part of corruption. When a state is highly centralized and public officials may have additional resources, the level of corruption is high (Rose-Ackerman, 1999). Similarly, when rents are high in a country because of its abundance of natural resources, the level of corruption is high (La Porta et al., 1999; Leite and Weidmann, 1999; Ades and Di Tella, 1999; Acemoglu and Verdier 2000).

Trade openness. Several studies empirically support the thesis that government corruption is lower in countries where the intensity of international trade is stronger (Ades and Di Tella, 1997, 1999, Leite and Weidmann, 1999; Graeff and Mehlkop, 2003). However, the literature is very ambiguous on this issue. Azfar and Knack (2003) show that the empirical link between corruption and trade intensity is the result of selection bias. This relationship is weakened or disappears when the data used on corruption are more recent and cover a large sample of countries (Knack and Azfar, 2003; Graeff and Mehlkop, 2003). Treisman (2000) and Brunetti and Weder (2003) do not find any positive effect of trade intensity on corruption.

2.3. Institutional factors

In this group of determinants of corruption, we distinguish the factors related to political institutions, and those related to economic institutions.

Political institutions. In the literature, the most cited political variables are democracy, political stability, political regime, proportion of women in parliament and freedom of the press. For some authors, greater democracy promotes the reduction of corruption (Shleifer and Vishny, 1993 La Porta et al., 1999; Paldan 2000). For others, it is the duration of the democratic regime resulting in political stability that reduces corruption (Serra, 2006; Pellegrini and Gerlagh, 2008; Montinola and Jackman, 2002). So if democracy reduces corruption, political instability favors corruption (Melgar et al., 2010). Concerning the functioning of political systems, Rose-Ackerman and Kunicova (2001) indicate that a competitive electoral process helps reduce corruption. Persson et al. (2003) argue along similar lines and indicate that political competition within the government may lead to a decrease in corruption. According to Gerring and Thacker (2004), parliamentary political systems and unitary states (as opposed to the federal state) lead to a lower level of corruption. These results are also present in Treisman (2000), who shows that there is a negative correlation between corruption and federalism in a State. Concerning gender, some authors believe that a higher proportion of women in senior positions in the administration and parliament would help reduce corruption (Swamy et al., 2001; Dollar et al., 2001). As regards the influence of information on corruption, Adsera et al. (2000) see in newspaper circulation a major determinant of the fight against corruption. Indeed, when citizens are sufficiently informed and the media are free from all political powers, freedom of information contributes to the fight against corruption (Brunetti and Weder, 2003).

Economic institutions. In this category we include the decentralization of decision-making and the influence of the State, generally captured through government regulation. The structure of government in terms of degree of decentralization plays an important role in reducing corruption (Brunetti and Weder, 2003; Graeff and Mehlkop, 2003; Rose-Ackerman, 1999). When public officials have more, and more highly concentrated power, the level of corruption tends to increase (Leite and Weidmann, 1999). Like Shleifer and Vishny (1993), Fishman and Gatti (2002) show that corruption decreases as the level of decentralization increases. Arikan (2004) addresses this issue from a tax perspective and shows that fiscal decentralization leads to a lower level of corruption. Regarding government regulation, several authors point to the fact that an increase in the burden of government regulation causes more temptation for bribes, exacerbating corruption. Indeed, in order to limit costs associated with the proliferation of administrative procedures (e.g. custom procedures, number of procedures to start a business), the agents involved (companies in general) tend to bribe the officials in charge of the proper execution these procedures.

3. EMPIRICAL STRATEGY

While the previous section outlines the potential determinants of corruption, this section is first and foremost intended to address the issue of uncertainty in the most relevant determinants. Second, it looks at the question of endogeneity between corruption and level of development that is often noted but very little explored in previous studies. Finally, this section presents the data considered in this study.

3.1. Bayesian model averaging (BMA) methodology

No theoretical model is capable of taking into account all the determinants of corruption highlighted in the previous section. The empirical approaches are often criticized for their a priori choice of some determinants at the risk of missing the most relevant determinants. To shed light on the key determinants of corruption while considering the uncertainty associated with model specification given the relatively large number of potential determinants, we rely on the BMA method.[6] The interesting aspect of this approach is that it addresses two major issues that typically arise in empirical studies with a relatively large number of explanatory variables and limited data and for which classical regression models do not provide an effective response, namely: (i) which variables should be included in the model and (ii) their respective importance. We apply this technique to several subsamples of countries given their level of economic development and their region in order to identify the key determinants that are specific to them.

Let us consider the following cross-country empirical corruption model:

$$y = \alpha_\gamma + X_\gamma \beta_\gamma + \epsilon, \quad \epsilon \sim N(0, \sigma^2 I) \qquad (1)$$

where y is the level of corruption, X is the matrix of potential explanatory variables, α_γ is the constant, β_γ denotes the coefficients, ϵ is the error term and γ is an index for a specific model.

BMA addresses the problem of uncertainty in relation to model specification by estimating models for all possible combinations of $\{X\}$ and constructing a weighted average. Assuming that X contains K potential explanatory variables, this means estimating 2^K variable combinations and thus 2^K models, each with a certain probability of being the "true" model. Technically, this can be cumbersome to estimate when K is large but BMA allows this through Monte Carlo Markov Chain (MCMC) simulations. If θ is the quantity of interest, such as coefficients β, the associated posterior distribution given data D is:

$$p(\theta|D) = \sum_{\gamma=1}^{2^K} p(\theta|M_\gamma, D) p(M_\gamma|D) \qquad (2)$$

Thus, the posterior distribution of θ is an average of the posterior distribution under each of the models considered, weighted by their posterior model probability. For a model M_γ, the latter are obtained using Bayes' theorem:

$$p(M_\gamma|D) = \frac{p(D|M_\gamma)p(M_\gamma)}{\sum_{l=1}^{2^K} p(D|M_l)p(M_l)} \qquad (3)$$

where $p(D|M_\gamma)$ is the integrated likelihood of model M_γ. Like Fernandez et al. (2001), we choose a uniform prior probability which means a common prior model probability, i.e. $p(M_\gamma) = 2^{-K}$. This is a popular choice to represent the lack of prior knowledge. This implies that the prior probability of including a regressor is 1/2 independently of the other regressors included in the model. On this basis, we consider that a potential determinant of corruption

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[6] This technique is briefly presented in this paper. For more technical details, we refer the reader to some key references, such as Hoeting et al. (1997, 1999) and Fernandez et al. (2001) and also Gnimassoun (2015).

can be seen as a relevant determinant if its posterior inclusion probability is greater than or equal to 50%.

3.2. Issue of endogeneity

Like all cross-national studies on the determinants of corruption, the BMA method is based on the OLS principle. It therefore does not directly consider the problem of endogeneity. But although it is often not considered in previous studies, the risk of endogeneity is present, especially as regards the relationship between the level of economic development and the level of corruption, because of the potential simultaneity bias between these two variables (Treisman, 2000). Specifically, if an improvement in the level of economic development can reduce corruption as shown by all the studies on the determinants of corruption, several studies also show that an increase in corruption hinders economic development (inter alia Mauro, 1995; Gray and Kaufmann, 1998; Wei, 1999). Because of this reverse causality, the OLS procedure provided biased and inconsistent results, because the explanatory variable (the level of economic development in our case) is correlated with the error term. To avoid reproducing this bias in our estimates, we use the method of instrumental variables. Indeed, instead of using the level of economic development as an explanatory variable in the equation of corruption, we rather use its estimated value from the exogenous variables that can simultaneously affect the level of economic development and the level of corruption but are not affected by the level of corruption.

The literature tells us that the level of development and the level of corruption can be influenced by common exogenous factors including geography and natural resource endowment. On geographical factors, it is now well known that tropical countries tend to have poor harvests, more disease and a suboptimal use of production technologies developed in more temperate zones; this negatively affects their level of economic development. Furthermore, because of its geographical position, a landlocked country is de facto limited in its economic development because it has limited access to large economic markets (Sachs and Warner, 1997). Regarding natural resource endowment, this is considered by Sachs and Warner (1997) as a factor that can influence the level of development of countries. Ultimately, tropical location, landlocked location and dependence on natural resource are considered factors that adversely affect the level of development (Sachs and Warner, 1997, Bloom and Sachs, 1998). Geographical factors are also considered by institutionalists as factors that explain the level of corruption through the establishment of sustainable institutions. For example, Hall and Jones (1999) and Easterly and Levine (2001), among others, argue that when the geographical position of countries allows them to have good crop yields, it helps establish sustainable and effective institutions to protect landowners. These institutions are also effective in the fight against corruption.

Based on these arguments, we estimate the level of economic development from geographical factors. The value estimated on this basis is then used in the regression of corruption and to address the problem of endogeneity. We do not consider natural resource endowment in the equation of economic development because the variables related to it, namely oil and mining

rents, are directly included in the regression of corruption. The relationship between the level of economic development and geographical factors is estimated and discussed in Appendix A.1 of the document. It should also be noted that the breakdown of our global sample into several subsamples according to the level of economic development to identify the key determinants of corruption, specific to the level of development, also de facto allows a correction of the endogeneity bias. Indeed, this can significantly mitigate the effect of the level of development since the countries grouped in a sub-sample have relatively similar levels of economic development.

3.3. Data

The data used cover 130 developed and developing countries. Regarding our dependent variable, we use the corruption index provided by the World Bank (Corrup_WGI) ranging between -2.5 (high corruption) to 2.5 (low corruption) and which is one of the most widely used indices in the literature. To avoid effects from a particular year and to obtain a large sample of countries with more reliable data, we consider an average of the index over the recent period from 2006 to 2013 for all countries in the study. We proceed in the same way for all variables except dummy variables.

Concerning the historical and sociocultural variables, we rely on data constructed by La Porta et al. (1999) on legal systems and religious culture. Legal systems are dummy variables that take the value 1 for a particular legal system and 0 otherwise. We consider the British system of common law (legor_uk), the French system of civil law (legor_fr), the system of socialist law (legor_so), the system of German law (legor_ge) and the legal system of Scandinavian law (legor_sc). Regarding religious culture, three religious denominations were considered, namely Catholic (catho80), Islam (muslim80) and Protestant (protmg80). The weight of each religious culture is measured by the proportion of the population adhering to this religion. In the same category of historical and sociocultural variables, we consider ethnic fractionalization (ethnic) and linguistic fragmentation (language) as constructed by Alesina et al. (2003). Finally, we add to this category quality of education (qual_educ) as built by the World Economic Forum (WEF).

The economic variables that we consider are trade openness (openness) measured by the sum of exports and imports as a ratio of GDP, mining rents (mineral_rent) and oil (oil_rents), obtained from the WDI database of the World Bank. These rents, which capture the influence of natural resources, are the difference between the value of production resources (mining and oil) at world prices and total costs of production. GDP per capita in purchasing power parity, expressed in logarithm (lgdppc_ppp) is also obtained from the WDI database. However, to account for the endogeneity problem between this variable and the dependent variable, it is its estimated value that we introduce into estimates, as mentioned earlier.

In the category of institutional variables, we rely on several variables in line with the literature. We take the Freedom House democracy index (polity_right). The political stability index (ps_wgi) is provided by the World Bank through the Worldwide Governance Indicators. The type of political system (parliamentary or presidential) is captured by a dummy variable

that takes the value 1 for a given plan and 0 elsewhere. It is obtained from the updated database of Keefer et al. (2001) on political institutions (Database of Political Institutions 2013). The effect of gender in the political sphere is taken into account by the ratio of women parliamentarians to men (Rwpseats) obtained from the Human Development Report. Freedom of information (Free_info) indicating the degree of freedom of the press, radio and television is constructed by Freedom House. Willingness to delegate authority (Wildg_aut), which is a measure of decentralization of power, is provided by WEF. The presence of government in the economy (gov_reg) is understood as the burden of government regulation and is also obtained through the WEF. All the data used and their sources are summarized in Table A.1 in the Appendix.

4. EMPIRICAL RESULTS

To begin with, we present the results from our regressions for the whole sample. Then the results are presented by country sub-groups to show the relevant determinants depending on the level of development and region.

4.1. Broader determinants of corruption

Table 1 shows the results of the BMA obtained from the whole sample consisting of 130 countries. These results are based on 22 potential determinants and thus the results of several million regressions (exactly $2^{22} = 4{,}194{,}304$ regressions).[7] The dummy variable "Developing" we then added captures the specificity of developing countries compared to developed countries. It takes the value 1 for developing countries and 0 for developed countries. The relevance of each variable in explaining corruption in all regressions $(P(\beta_k \neq 0|D))$ is given by the "PIP" column, which represents the posteriori inclusion probability (PIP), that is, the sum of the posterior probabilities of the different regressions in which the variable is included. A variable is considered to be relevant in explaining corruption if its PIP is greater than or equal to 50%. In other words, this variable has at least a 50% chance of being included in the explanatory model of corruption. Columns "Post Mean" and "Post SD" represent the posterior mean and the posterior standard deviation of the parameter β for each variable.

Based on these elements, several lessons can be drawn from the results of Table 1. These findings identify eight key determinants of corruption for the whole sample, namely freedom of the press, level of economic development,[8] regulatory burden, judicial system, political system, political stability, quality of education and willingness to delegate authority. These results are fairly standard in the literature. Indeed, the negative sign associated with the freedom of the press shows that more press freedom allows for a lower level of corruption, as

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[7] We do not include all the determinants, especially dummy variables for perfect colinearity reasons. This is the case for example of the variables on the legal system in which the Scandinavian legal system (legor_sc) is not included in the regression.

[8] This is the estimated level of economic development to account for the endogeneity problem. Alternatively, we used the latitudinal distance from the equator. We get similar results that are presented in Table A.3 in the Appendix of the paper.

has been demonstrated by several authors (Brunetti and Weder 2003 Pellegrini and Gerlagh, 2008). The role of the level of economic development is a matter of consensus in the literature (see Sierra, 2006) and the positive sign associated with it shows that corruption decreases with improving economic development level. The burden of regulation is also identified as a main cause of corruption, particularly because of the bribery phenomena it generates (Shleifer and Vishny, 1993). Our results also show that the socialist legal system is more permeable to corruption, as shown by La Porta et al. (1999). However, an improvement in the quality of education would reduce corruption, which is consistent with the results of Melgar et al. (2010). Similarly, a parliamentary political system compared to a presidential system would be associated with lower corruption. Like Serra (2006), we find that political stability enables a reduction in corruption. Finally, the favorable influence of decentralization captured by the willingness to delegate authority is consistent since we find that a greater proportion of power to delegate is associated with lower corruption.

While these results are interesting and consistent with previous studies, they are very general and in fact not very informative because they fail to grasp the specificities linked to economic development level or those related to the region that are essential for conducting specific diagnostics. For example, these results clearly show what is often referred to as the "tragedy of developing countries" because of their level of corruption that is higher than that of developed countries. However, without a specific study, no one is able to state that the determinants of corruption that are relevant to developed countries are also valid for developing countries. The following analyses are intended to address these limitations.

Table 1: Broader determinants of corruption (whole sample)

Determinants	PIP	Post Mean	Post SD	PIP	Post Mean	Post SD
Catho80	0.046	0.000	0.000	0.048	0.000	0.000
Developing	---	---	---	**0.903**	**-0.388**	**0.180**
Ethnic	0.105	-0.024	0.087	0.113	-0.029	0.099
Free_info	**0.681**	**-0.005**	**0.004**	**0.580**	**-0.004**	**0.004**
GDP_pc_bar	**0.995**	**0.234**	**0.061**	**0.920**	**0.181**	**0.079**
Gov_reg	**0.776**	**0.164**	**0.108**	**0.882**	**0.198**	**0.098**
Language	0.059	-0.006	0.042	0.072	-0.012	0.057
Legor_fr	0.051	-0.003	0.025	0.042	-0.002	0.022
Legor_ge	0.038	0.000	0.036	0.033	-0.002	0.035
Legor_so	**1.000**	**-0.708**	**0.135**	**1.000**	**-0.695**	**0.137**
Legor_uk	0.055	0.004	0.025	0.049	0.003	0.024
Mineral_rents	0.083	0.001	0.003	0.068	0.001	0.003
Muslim80	0.073	0.000	0.001	0.061	0.000	0.000
Oil_rents	0.069	0.000	0.001	0.075	0.000	0.001
Openness	0.070	0.000	0.000	0.042	0.000	0.000
Parl_system	**0.800**	**0.243**	**0.149**	0.452	0.109	0.137
Polity_right	0.079	0.001	0.015	0.069	0.001	0.013
Pr_system	0.173	-0.035	0.093	0.228	-0.042	0.091
Protmg80	0.042	0.000	0.000	0.037	0.000	0.000
PS_wgi	**1.000**	**0.442**	**0.067**	**1.000**	**0.410**	**0.065**
Qual_educ	**0.975**	**0.197**	**0.063**	**0.914**	**0.166**	**0.074**
Rwpseats	0.044	-0.005	0.051	0.040	-0.005	0.050
Wildlg_aut	**0.986**	**0.275**	**0.082**	**0.968**	**0.253**	**0.089**

4.2. Determinants of corruption by level of economic development

The results presented in Table 2 distinguish the determinants of corruption that are specific to developed countries from those specific to developing countries. Some determinants are common to both types of countries such as the burden of regulation, the legal system and political stability. However, other determinants such as quality of education are more relevant to developing countries. Indeed, the results show that the quality of education is a key determinant of corruption in developing countries with a posterior inclusion probability of nearly 100%. An improvement of the latter would reduce corruption in developing countries. For developed countries, the special feature is willingness to delegate authority, that is, decentralization. In other words, the developed countries with a greater level of decentralization appeared less corrupt than the others. Moreover, the level of economic development does not explain the differences in the perception of corruption in developed countries; this shows some homogeneity in their structural characteristics.

Table 2: Determinants of corruption according to level of development

| Determinants | Developing countries | | | Developed countries | | |
	PIP	Post Mean	Post S.D.	PIP	Post Mean	Post S.D.
Catho80	0.057	0.000	0.000	0.192	0.001	0.002
Ethnic	0.087	-0.019	0.081	0.049	-0.002	0.073
Free_info	0.247	-0.001	0.003	0.056	0.000	0.002
GDP_pc_bar	**0.990**	**0.260**	**0.073**	0.067	-0.006	0.033
Gov_reg	**0.571**	**0.116**	**0.118**	**0.625**	**0.163**	**0.154**
Language	0.079	-0.012	0.058	0.061	0.012	0.089
Legor_ge	---	---	---	0.049	-0.004	0.037
Legor_sc	---	---	---	0.049	-0.004	0.044
Legor_so	**1.000**	**-0.828**	**0.153**	**0.959**	**-0.583**	**0.196**
Legor_uk	0.081	0.008	0.039	0.093	0.015	0.061
Mineral_rents	0.075	0.001	0.003	0.117	0.008	0.026
Muslim80	0.104	0.000	0.001	0.082	0.001	0.006
Oil_rents	0.098	0.000	0.002	0.044	0.000	0.005
Openness	0.044	0.000	0.000	0.106	0.000	0.000
Parl_system	0.408	0.104	0.143	---	---	---
Polity_right	0.089	-0.003	0.013	0.058	0.001	0.030
Pr_system	0.353	-0.081	0.125	0.071	-0.011	0.059
Protmg80	0.045	0.000	0.001	0.052	0.000	0.001
PS_wgi	**1.000**	**0.486**	**0.069**	**0.865**	**0.315**	**0.162**
Qual_educ	**0.999**	**0.252**	**0.056**	0.045	-0.002	0.031
Rwpseats	0.097	-0.034	0.134	0.050	0.011	0.099
Wildlg_aut	0.094	0.011	0.044	**1.000**	**0.545**	**0.098**

The analysis of developing countries can be deepened since, within these countries, the level of wealth per capita significantly explains the differences in corruption. We therefore proceed to a distinction between sub-Saharan African countries and the other developing countries. The results obtained on this basis are presented in Table 3. These results show that the most relevant determinants of corruption for sub-Saharan Africa are freedom of the press, burden of regulation, linguistic fragmentation, political system, religion and political stability. Specifically, the presidential political regime appears favorable to corruption. Moreover, corruption appears lower in countries with a higher proportion of Protestant faithful.

This distinction also provides valuable additional information. As Sub-Saharan Africa (SSA) is without a socialist legal system, conclusions drawn previously on this variable for developing countries do not apply to it. The influence of the quality of education on corruption is much more important in the other developing countries outside sub-Saharan Africa. Moreover, the level of economic development does not appear to be a main determinant of corruption within SSA, indicating some homogeneity of the characteristics of member countries. Despite its relatively important influence in the other developing countries, we cannot go further in the disaggregation by distinguishing other developing regions such as sub-Saharan Africa because the number of countries is relatively limited in the other developing regions such as Latin America or Eastern Europe. Although this distinction cannot be made on the basis of all the potential determinants, we propose a way to go further in analyzing the specifics later in the document.

Table 3: Determinants of corruption in Sub-Saharan Africa

Determinants	Sub-Saharan African countries			Others developing countries		
	PIP	Post Mean	Post S.D.	PIP	Post Mean	Post S.D.
Catho80	0.096	0.000	0.001	0.115	0.000	0.001
Ethnic	0.058	-0.010	0.085	0.042	0.001	0.056
Free_info	**0.970**	**-0.012**	**0.003**	0.132	-0.001	0.003
GDP_pc_bar	0.053	0.002	0.022	**0.679**	**0.167**	**0.136**
Gov_reg	**0.892**	**0.266**	**0.125**	0.135	0.023	0.072
Language	**0.963**	**-0.609**	**0.189**	0.065	0.014	0.077
Legor_so	---	---	---	**0.999**	**-0.820**	**0.167**
Legor_uk	0.080	0.001	0.035	0.333	0.094	0.152
Mineral_rents	0.168	-0.001	0.003	0.160	0.004	0.011
Muslim80	0.064	0.000	0.001	0.064	0.000	0.001
Oil_rents	0.123	-0.001	0.002	0.108	-0.001	0.002
Openness	0.078	0.000	0.000	0.074	0.000	0.001
Parl_system	0.116	0.038	0.143	0.101	0.018	0.068
Polity_right	0.064	0.000	0.014	0.058	-0.001	0.013
Pr_system	**0.927**	**-0.484**	**0.170**	0.100	-0.016	0.065
Protmg80	**0.665**	**0.005**	**0.004**	0.050	0.000	0.002
PS_wgi	**0.983**	**0.223**	**0.075**	**1.000**	**0.582**	**0.077**
Qual_educ	0.279	0.026	0.049	**0.992**	**0.325**	**0.085**
Rwpseats	0.050	0.001	0.056	0.148	-0.100	0.291
Wildlg_aut	0.123	0.016	0.057	0.050	0.004	0.037

Note: The results are based on 500,000 draws and 100,000 burn-ins. For each simulation, we use a uniform model prior and the birth–death MCMC sampler. Statistics in bold are those for which the posterior inclusion probability is greater than or equal to 50%.

4.3. Determinants of corruption by geographic location

To further the analysis on the determinants of corruption, we distinguish several regions based on the number of countries that compose them.[9] Indeed, given the relatively high number of potential determinants, we cannot perform regressions for the regions[10] for which the number of countries, in our sample, is less than the number of explanatory variables. We thus adopt a two-step strategy.

First, we consider the two continents for which we have sufficient data to expect robust results, namely Africa and Europe. In addition to these two continents, we study the case of the Europe and Central Asia (ECA) region according to the division by the World Bank. This region serves as a reference later in our analysis. Since the case of Sub-Saharan Africa has been already studied, by considering Africa as a whole, to some extent we grasp the specificities of North African countries[11] while identifying the main determinants of corruption in the continent. Similarly, by considering Europe and the Europe and Central Asia region, we can by inference grasp the specifics of Central Asia, as the number of countries does not permit a specific regression for this region. Specifically, the differences in results between Europe and the Europe and Central Asia region will be allocated to Central Asia as we already know, a priori, the determinants of Europe. Second, based on the results of the first stage, and considering the previous results, we focus only on the most relevant determinants of corruption that have been identified irrespective of the level of economic development and of the region. By doing so, we can now conduct an analysis on regional specificities for several regions according to the division by the World Bank since the number of explanatory variables (potential determinants) is sufficiently reduced.

Table 4 shows the results for the three blocks considered in the first step. Not surprisingly, the results for Africa as a whole are not very different from those obtained for SSA. Only the proportion of Protestants no longer seems very relevant with PIP falling to 34.5%. This result can be partially explained by the low presence of faithful Protestants in Northern Africa, which is mostly dominated by the Islamic religion. It should also be emphasized that the importance of certain determinants such as freedom of the press, the burden of regulation, linguistic fragmentation and political regime appears more pronounced in Sub-Saharan Africa than in North Africa. While freedom of the press does not appear to be a key determinant of corruption in developed countries, it nonetheless remains at the scale of Europe. However, even though it appears decisive with PIP at around 50%, the burden of regulation in Europe is not particularly decisive in explaining the perception of corruption among countries. As for developed countries, socialist legal origin and decentralization appear to be key determinants of corruption in Europe. Unlike the various cases studied so far, political stability does not appear to be an important determinant of corruption in Europe. The determinants identified for the Europe and Central Asia region are the same as those identified for Europe, which is

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[9] We cannot conduct the same analysis for all of the regions identified by the World Bank due to the relatively small number of countries for some regions. This would lead to false results due to the relatively large number of explanatory variables.
[10] We consider regions from the classification of the World Bank.
[11] We discuss the case of North Africa because it is the only region of Africa that is not taken into account when the sample consists of sub-Saharan African countries.

not a big surprise. However, the PIP associated with freedom of the press appears higher for the Europe and Central Asia region, while that related to the burden of regulation is lower. By inference, this is potentially a sign that the burden of regulation is less important in explaining the perception of corruption in Central Asia, while freedom of the press is of utmost importance.

Table 4: Determinants of corruption in Africa, Europe and Central Asia

Determinants	Africa			Europe			Europe & Central Asia		
	PIP	Post Mean	Post S.D.	PIP	Post Mean	Post S.D.	PIP	Post Mean	Post S.D.
catho80	0.132	0.000	0.001	0.467	0.001	0.002	0.315	0.001	0.002
Ethnic	0.142	-0.060	0.177	0.045	-0.002	0.061	0.065	-0.017	0.098
free_info	**0.898**	**-0.011**	**0.005**	**0.643**	**-0.012**	**0.010**	**0.841**	**-0.016**	**0.009**
GDP_pc_bar	0.224	0.036	0.077	0.067	0.006	0.033	0.053	-0.004	0.029
gov_reg	**0.554**	**0.134**	**0.139**	**0.712**	**0.194**	**0.148**	**0.509**	**0.124**	**0.141**
Language	**0.821**	**-0.444**	**0.253**	0.045	0.003	0.052	0.045	-0.003	0.059
legor_ge	---	---	---	0.043	0.001	0.031	0.044	0.003	0.037
legor_sc	---	---	---	0.049	-0.001	0.043	0.049	0.000	0.057
legor_so	---	---	---	**0.999**	**-0.593**	**0.138**	**0.995**	**-0.565**	**0.154**
legor_uk	0.056	0.003	0.032	0.044	0.001	0.038	0.042	0.002	0.042
Mineral_rents	0.057	0.000	0.002	0.047	-0.001	0.014	0.077	-0.005	0.026
muslim80	0.114	0.000	0.001	0.052	0.000	0.003	0.040	0.000	0.001
Oil_rents	0.281	-0.002	0.004	0.051	0.000	0.005	0.085	-0.001	0.005
openness	0.065	0.000	0.000	0.049	0.000	0.000	0.096	0.000	0.001
Parl_system	**0.804**	**0.387**	**0.228**	---	---	---	---	---	---
Polity_right	0.060	0.000	0.017	0.295	-0.052	0.092	0.110	-0.008	0.051
pr_system	0.196	-0.066	0.158	0.049	0.004	0.034	0.046	0.003	0.036
protmg80	0.345	0.003	0.004	0.073	0.000	0.001	0.219	0.001	0.003
PS_wgi	**0.985**	**0.274**	**0.092**	0.161	0.056	0.153	0.231	0.082	0.176
Qual_educ	0.466	0.061	0.075	0.041	-0.001	0.023	0.052	-0.005	0.034
rwpseats	0.045	0.005	0.068	0.048	-0.008	0.097	0.067	-0.029	0.161
Wildlg_aut	0.198	0.035	0.082	**1.000**	**0.554**	**0.091**	**0.999**	**0.478**	**0.108**

Note: The results are based on 500,000 draws and 100,000 burn-ins. For each simulation, we use a uniform model prior and the birth–death MCMC sampler. Statistics in bold are those for which the posterior inclusion probability is greater than or equal to 50%.

On the basis of results achieved so far, several variables appeared to be more fundamental in explaining the differences in perception of corruption. Irrespective of the specificities, the key determinants highlighted are the level of economic development, education, the burden of regulation, the political system, freedom of the press, decentralization, legal origin and, to a certain extent, religion. Considering only these variables, we study regional characteristics in order to measure the weight of each of these variables by region. The division performed by the World Bank groups all the countries into seven (07) geographical regions, namely East Asia and Pacific (EAP), Europe and Central Asia (ECA), Latin America and Caribbean (LAC), Middle East and North Africa (MENA), North America (NA), South Asia (SA) and Sub-Saharan Africa (SSA).[12] Although the cases of SSA and ECA have previously been

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[12] The different regions as well as countries components are presented in Table A.2 in the Appendix of the document.

studied, it is not redundant to review them here as the number of variables is now greatly reduced. Rather, it allows us to see if we get the same determinants for these regions on the basis of our new variables sample and thus serves as a control of previous results. Given the small number of countries in North America (two countries) and South Asia (five countries), these regions are not considered. However, the perception of corruption in all regions compared to Europe and Central Asia (ECA) is presented in Table A.4 in the Appendix. In this table, the "tragedy" of certain areas where the perception of corruption is greater clearly appears. Specifically, compared to the ECA region, corruption is higher in SSA, in LAC, in MENA and in SA. However, corruption is not significantly more pronounced in EAP and NA where it actually seems relatively lower.

Returning now to the regional characteristics presented in Table 5, we can draw several conclusions. Concerning EAP, the main determinants of corruption are legal system, religion, political stability and education. Specifically, the perception of corruption is higher in countries with a socialist legal system as well as those with a high proportion of Muslim worshipers. However, corruption is lower in countries with a high proportion of Protestant faithful, greater political stability and a better quality of education. The results for the ECA region are consistent with those presented in Table 4, confirming previous findings. Indeed, the perception of corruption in this region is mainly determined by freedom of the press, burden of regulation, legal system and willingness to delegate authority. Regarding LAC, corruption is mainly explained by freedom of the press and quality of education. In this region, corruption is lower in countries where there is more freedom of the press and where the quality of education is higher. For the MENA region, the differences in the perception of corruption are explained by linguistic fragmentation, political system, political stability, quality of education and willingness to delegate authority. Specifically, corruption appears to be lower in countries with a parliamentary political system, greater political stability, higher quality of education and greater decentralization of authority. However, contrary to expectations, linguistic fragmentation seems to reduce corruption in the region. This could possibly be explained by the fact that linguistic fragmentation in this region does not necessarily create the dominant groups and that the groups in power are controlled by others. Finally, the results for Sub-Saharan Africa also support those in Table 3. Indeed, the differences in the perception of corruption in this region are explained by freedom of the press, burden of regulation, linguistic fragmentation, political system, religion and political stability. The least corrupt countries in this region are those in which the freedom of the press is higher, the burden of regulation is lower, linguistic fragmentation is lower, the proportion of Protestants is higher and political stability is greater. In contrast, countries with a presidential political system are those with the highest level of corruption.

Table 5: The main determinants of corruption by region

Determinants	EAP PIP	EAP Post Mean	ECA PIP	ECA Post Mean	LAC PIP	LAC Post Mean	MENA PIP	MENA Post Mean	SSA PIP	SSA Post Mean
Catho80	0.095	0.000	0.406	0.002	0.267	-0.006	0.192	0.001	0.132	0.000
Free_info	0.405	-0.008	**0.973**	**-0.018**	**0.675**	**-0.022**	0.346	-0.005	**0.994**	**-0.012**
GDP_pc_bar	0.464	-0.281	0.108	-0.008	0.170	0.051	0.245	-0.132	0.090	0.003
Gov_reg	0.132	0.013	**0.608**	**0.149**	0.219	0.070	0.373	-0.040	**0.943**	**0.277**
Language	0.139	-0.040	0.091	-0.008	0.093	0.034	**0.875**	**0.896**	**0.994**	**-0.630**
Legor_so	**0.719**	**-0.839**	**0.991**	**-0.542**	---	---	---	---	---	---
Muslim80	**0.901**	**-0.021**	0.084	0.000	0.099	-0.002	0.316	0.003	0.095	0.000
Parl_system	0.143	0.017	0.094	-0.006	0.325	0.567	**0.638**	**0.701**	0.155	0.044
Pr_system	0.469	-0.402	---	---	0.267	0.392	0.324	0.211	**0.919**	**-0.477**
Protmg80	**0.823**	**0.027**	0.284	0.001	0.370	-0.020	0.327	0.145	**0.743**	**0.005**
PS_wgi	**0.871**	**0.577**	0.208	0.055	0.428	0.267	**0.757**	**0.180**	**0.987**	**0.217**
Qual_educ	**0.852**	**0.802**	0.098	-0.009	**0.644**	**0.399**	**0.964**	**0.365**	0.388	0.037
Wildlg_aut	0.104	0.003	**0.995**	**0.456**	0.267	0.163	**0.867**	**0.420**	0.176	0.021

Note: The results are based on 500,000 draws and 100,000 burn-ins. For each simulation, we use a uniform model prior and the birth–death MCMC sampler. Statistics in bold are those for which the posterior inclusion probability is greater than or equal to 50%.

In summary, our results clearly show that there are regional particularities as well as specificities related to levels of economic development that should be considered when conducting an analysis on the determinants of corruption. Attempts in some studies to consider them through dummy variables only serve to capture the perception of corruption by region, but are not sufficient to identify the particularities that may be decisive in specific diagnoses.

5. ROBUSTNESS ANALYSIS

To test the robustness of our results, several robustness analyses were performed. First, we change the indicator of the perception of corruption by considering not the Kaufmann indicator, but the perception of corruption indicator of Transparency International (TI).[13] Second, we consider an alternative method for dealing with model uncertainty and identifying the most relevant determinants of corruption. Finally, due to the unavailability of data for all the countries in our sample, we study the influence of wages on corruption in the case of 89 countries, in line with the previous literature. While the latter analysis is not really a proof of robustness, given the purpose of our paper, it has the advantage of testing the sensitivity of the overall results (without specificity of income level and of region) with respect to the introduction of the variable representing the remuneration of officials (government wage).

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[13] It should be noted that other measures of corruption exist such as the ICRG (International Country Risk Guide) measurement. But because of their low coverage in terms of number of countries, we prefer, for the robustness analysis, the Transparency International indicator for which we have complete coverage of our sample of countries.

5.1. Alternative measure of corruption perception

To examine whether the choice of the measure of corruption influences our results, we consider the Transparency International Index (Corrup_CPI) as an alternative measure of corruption perception. This indicator whose value varies between 0 (highly corrupt) to 10 (low corruption) is a composite index based on surveys indicating the extent to which public power is used for personal gain. The results obtained on the basis of this new measure are presented in the tables in Appendix B.[14] These results are very similar to previous results obtained with the Kaufmann indicator. Indeed, as shown in Table B.1 in the Appendix, seven of the eight major determinants of corruption identified with the total sample (those with a PIP greater than or equal to 50%) appear with a PIP greater than 50%; the eighth is the freedom of the press whose PIP is 37% with the TI indicator. This similarity between results is not surprising since both indicators of corruption are highly correlated (with a correlation coefficient of about 0.99). The differences lie in the posterior means, which are almost twice as high with the TI indicator. This difference comes from the coding differences between the two institutions. It should be noted that only the PIP really matters because it is what determines the importance of each potential determinant in explaining corruption. Regarding the determinants of corruption according to the level of development, the results presented in Table B.2 also support the results in Table 2. The same determinants of corruption perception among the countries are identified, underlining the strength of our results.

5.2. Alternative to BMA: General-to-Specific (GETS) approach[15]

As a robustness analysis, we use the automated General-to-Specific (GETS) approach as an alternative to BMA to deal with model uncertainty. GETS, just like BMA, is one of the most influential econometric and statistical approaches for handling uncertainty modelling (see Ding and Knight, 2011). Roughly speaking, while BMA addresses model uncertainty by estimating models for all possible combinations of explanatory variables leading to thousands (or millions) of regressions, GETS addresses the same problem only relying on a single model, namely the general unrestricted model (GUM). The latter, which contains all the potential explanatory variables, is subjected to a series of step-wise statistical tests (see Hendry and Krolzig, 2004), leading to the removal of empirically unimportant variables to arrive at the proposed specific or final model. The validity of a selected model is mainly subject to the suitability of GUM to the data generation process (DGP). Thus it is important to rely on economic theory and previous empirical findings to determine the "prior general model" as we did in Section 2.

Implementing this approach leads to the specific (or final) models presented in tables B.3 and B.4 in Appendix B. These results are similar to previous results (Tables 1 and 2). Indeed, the determinants retained in the final models of the GETS approach are exactly those whose PIP

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[14] For page restriction reasons, we do not present all the results of the previous sections. However, these results are available upon request from the authors.

[15] This approach is briefly discussed here. For details, see among others Krolzig and Hendry (2004), Hoover and Perez (2004), and, for a practical implementation, see Owen (2003) for OxMetrics and Clarke (2014) for Stata.

are greater than or equal to 50% in the BMA approach both for the whole sample and for subsamples of developed and developing countries. All this confirms previous findings and shows that our results are robust to the variable selection method.

5.3. Influence of government wage

Although its influence is controversial, government wage is often cited among the main determinants of corruption. Our previous analyses have not included this variable because it is not available for many of the countries in our sample (41 out of 130 countries). However, to study the influence of this variable, we apply the BMA to the 89 countries for which this variable is available. The results of this procedure are presented in Table B.5 in Appendix B and clearly show that the government wage has no influence on the level of corruption across countries. These results are not very surprising because although it is generally believed that low wages relative to living standards can increase corruption temptations, it is also true that the most corrupt politicians are also generally those who share the highest salaries, as stressed by Triesman (2000). Thus an increase in wages does not necessarily lead towards a reduction in corruption. Furthermore, determinants whose PIP is more than 50% in this reduced sample are the same as those of the total sample, confirming once again the strength of our results.

6. CONCLUSION AND DISCUSSION

If corruption is a scourge that plagues all societies, its root causes have been the subject of quantitative studies over recent years as data have become available, particularly on institutional variables, including corruption itself. Indeed, several authors have focused on identifying the causes of corruption through cross-country empirical studies. These studies have enriched the literature by proposing discussions on economic, institutional, socio-cultural and historical determinants of corruption. However, the question of specific groups or regions is generally ignored, suggesting that one could "put all countries in the same basket." This paper proposes to enrich the literature on the determinants of corruption by addressing the issue of specificities relating to the level of economic development and the region. More concretely, we start from the premise that the causes of corruption can evolve with the level of development or may vary from region to region. Is it likely for example that the determinants of corruption in Sub-Saharan Africa are the same as the determinants of corruption in Europe?

To investigate this issue and consider the potential differences that there might be in the explanation of corruption, we study the determinants of corruption according to level of development and region. To this end, we rely on the existing literature to obtain a relatively large number of potential determinants without discriminating between these variables. On this basis, and considering the problem of model uncertainty, we use a BMA approach to identify the most relevant determinants according to economic development level and region. The results clearly show that differences exist according to the level of economic development and the region and that we cannot apply the same treatment to all countries. Corruption in SSA is not explained by the same factors as in Europe. Our paper contributes to

the literature on the determinants of corruption not only by analyzing these specificities, but also by addressing the issue of model uncertainty due to the relatively large number of potential determinants. It is thus helpful to have a model according to development level and region. By identifying these peculiarities, our study also provides the possibility of a specific treatment of this common scourge. Our results are also robust to several tests, including tests on the dependent variable and the method for the treatment of model uncertainty.

Appendices

A.1: Economic development and geography

We regress the level of economic development of countries on two geographic variables that are well known in the literature: latitudinal distance from the equator, and landlocked location, captured by a dummy variable. The estimated equation is thus specified as follows:

$$\ln(GDP\_PC)_i = c + Latitude_i + landlocked_i + \varepsilon_i \qquad (4)$$

where GDP_PC_i denotes the economic development of country i measured by GDP per capita expressed in purchasing power parity; $Latitude_i$ refers to the latitudinal distance of country i relative to the equator and $landlocked_i$ is a dummy variable that takes the value 1 if the country is landlocked and 0 otherwise. c and ε respectively denote the constant and the error term. The estimation of this equation by OLS provides the following results:

VARIABLES	(1) $\ln(GDP\_PC)$	(2) $\ln(GDP\_PC)$
landlocked	-0.826***	-0.846***
	(0.191)	(0.235)
latitude	4.171***	0.578***
	(0.422)	(0.125)
Constant	8.103***	10.23***
	(0.190)	(0.179)
Observations	130	129
R-squared	0.445	0.266

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In the results in (1), the latitudinal distance from the equator is not included as a logarithm. In (2), this variable is expressed as a logarithm. Since the latitudinal distance of the Democratic Republic of Congo (DRC) to the equator is zero, we lose an observation (DRC) through the log. These results are very interesting because they show that the distance from the equator is favorable to economic development while the landlocked location reduces the level of economic development. This confirms the results of several authors such as Sachs and Warner (1997) and Bloom and Sachs (1998). We can consider that these geographic factors are good instruments for the economic development level in the regression of corruption. Thus, the estimated level of economic development (GDP_PC_bar) from these results is used instead of the observed level of economic development in the regression of corruption to correct or significantly reduce the simultaneity bias. Figure 1 shows the correlation between the observed level of development and the estimated level of development.

Figure 1: Correlation between the observed economic development and the estimated economic development

Table A.1: Data description and sources

Variables	Definition	N	mean	S.D.
	Corruption indicators			
Corrup_wgi	Corruption indicator of Kaufmann et al. (2004) (World Governance Indicators). The indicator ranges from -2.5 (most corrupt) to 2.5 (least corrupt) over the period 2006-2013.	130	0.00195	1.063
Corrup_cpi	Indicator of corruption of Transparency International, ranging from 1 (most corrupt) to 10 (least corrupt) over the period 2006-2013.	130	4.281	2.168
	Historical and sociocultural variables			
Catho80	The percentage of the population belonging to the Roman Catholic religion in 1980. The values are in percent (scale from 0 to 100). Source: La Porta et al. (1999))	130	33.13	36.34
Muslim80	The percentage of the population belonging to the Muslim religion in 1980. The values are in percent (scale from 0 to 100). Source: La Porta et al. (1999))	130	21.59	33.79
Legor_uk	The dummy variable for the origin of the legal system Common Law (Laporta et al., 1999)	130	0.300	0.460
Legor_fr	The dummy variable for the origin of the legal system French Civil Law (Laporta et al., 1999)	130	0.508	0.502
Legor_so	The dummy variable for the origin of the legal system Socialist Law (Laporta et al., 1999)	130	0.123	0.330
Legor_ge	The dummy variable for the origin of the legal system German Civil Law (Laporta et al., 1999)	130	0.0308	0.173
Legor_sc	The dummy variable for the origin of the legal system Scandinavian Law (Laporta et al., 1999)	130	0.0385	0.193
Protmg80	The percentage of the population of each Country belonging to the Protestant religion in 1980. The values are in percent (scale from 0 to 100). Source: La Porta et al. (1999).	130	12.26	20.79
Ethnic	The index of ethnic fractionalization that captures the probability that two randomly selected persons from a given country will not belong to the same ethnic group (Alesina et al. 2003)	130	0.452	0.268
Language	The index of linguistic fractionalization that captures the probability that two randomly selected persons from a given country will not speak the same language (Alesina et al. 2003)	126	0.400	0.300
Qual_educ	Quality of education, World Economic Forum (WEF)	122	4.434	0.802
	Economic variables			
Gov_reg	Burden of government regulation, 1-7 (best), World Economic Forum (WEF)	122	3.331	0.635
Openness	The proxy for the degree of country openness to international competition. It is the sum of merchandise exports and imports measured in current U.S. dollars divided by the value of GDP converted to international dollars using purchasing power parity (PPP) rates. Source: World Development Indicator	130	94.09	58.00
Mineral_rent	Mineral rents are the difference between the value of production for a stock of minerals at world prices and their total costs of production, 2006-2013. Source: World Development Indicators (CD-ROM 2015)	130	1.919	4.963

	Economic variables (Continued)			
Oil_rents	Oil rents are the difference between the value of crude oil production at world prices and total costs of production 2006-2013. Source: World Development Indicators (CD-ROM 2015)	130	5.535	12.79
Lgdppc_ppp	The logarithm of real GDP per capita in constant dollars 2006-2013. Source: The World Bank's World Development Indicators (CD-ROM 2015)	130	9.111	1.286
	Institutional variables			
Polity_right	Index of political rights. Higher ratings indicate countries that come closer to the ideals suggested by the checklist questions of: (1) free and fair elections; (2) those elected rule; (3) there are competitive parties or other competitive political groupings; (4) the opposition has an important role and power; and (5) the entities have self-determination or an extremely high degree of autonomy. Source: Freedom House.	128	3.400	2.055
Ps_wgi	The proxy for the possibility to have wrenching changes in Government. It ranges from around −2.5 to around 2.5 (higher values correspond to less political instability). Source: Kaufmann et al. (1999)	130	-0.123	0.918
Wildlg_aut	Willingness to delegate authority, 1-7 (best). Source: World Economic Forum (WEF)	122	3.809	0.794
Pr_system	Dummy Presidential system of governance (Data Base of Political Institution, 2015)	130	0.577	0.496
Parl_system	Dummy Parliamentary system of governance (Data Base of Political Institution, 2015)	130	0.354	0.480
Rwpseats	Parliamentary seats, female to male ratio: Percentage of parliamentary seats held by women expressed as a ratio of those held by men. Source: Human Development Report, UNDP	129	0.255	0.176
Free_info	The index of freedom of information provided by Freedom House on the basis of the following criteria: (1) laws and regulations that influence media content (2) political influence over media content; (3) economic influence over media content (4) repressive actions which constitute violations of press freedom. Values range from 0 (total freedom) to 100 (total repression). Source: Freedom House (2015)	129	48.00	22.16
Latitude	Absolute value of the latitude of the country (i.e., a measure of distance from the equator), scaled to take values between 0 and 1, where 0 is the equator. Source: La Porta et al. (1999).	129	-1.604	0.989
Landlocked	Equal to 1 if the country is landlocked and 0 otherwise.	130	0.200	0.401

Table A.2: Region and country

Sub-Saharan Africa	Europe & Central Asia	Latin America & Caribbean
Angola	Albania	Argentina
Benin	Armenia	Barbados
Botswana	Austria	Bolivia
Burkina Faso	Belgium	Brazil
Burundi	Bulgaria	Chile
Cameroon	Croatia	Colombia
Cabo Verde	Cyprus	Dominican Republic
Chad	Czech Republic	Ecuador
Congo. Dem. Rep.	Denmark	El Salvador
Congo. Rep.	Finland	Guyana
Cote d'Ivoire	France	Haiti
Equatorial Guinea	Germany	Honduras
Ethiopia	Greece	Jamaica
Gabon	Hungary	Mexico
Gambia. The	Iceland	Nicaragua
Ghana	Ireland	Panama
Guinea	Italy	Paraguay
Guinea-Bissau	Kazakhstan	Peru
Kenya	Latvia	Suriname
Lesotho	Luxembourg	Uruguay
Liberia	Netherlands	Venezuela. RB
Madagascar	Norway	
Malawi	Poland	**South Asia**
Mali	Portugal	Bangladesh
Mauritania	Romania	Bhutan
Mauritius	Russian Federation	India
Mozambique	Spain	Nepal
Namibia	Sweden	Pakistan
Niger	Switzerland	
Nigeria	Turkey	**North America**
Rwanda	Ukraine	Canada
Senegal	United Kingdom	United States
Seychelles	**East Asia & Pacific**	**Middle East & North Africa**
Sierra Leone	Australia	Algeria*
South Africa	Cambodia	Bahrain
Sudan	China	Djibouti*
Swaziland	Hong Kong SAR. China	Egypt. Arab Rep.*
Tanzania	Indonesia	Israel
Togo	Japan	Jordan
Uganda	Lao PDR	Lebanon
Zambia	Malaysia	Libya*
Zimbabwe	New Zealand	Malta
	Philippines	Morocco*
	Singapore	Oman
	Thailand	Qatar
	Vietnam	Saudi Arabia
		Syrian Arab Republic
		Tunisia*

Note: Countries marked with an * are North African countries which are added to sub-Saharan Africa to constitute Africa.

Table A.3: Broader determinants of corruption (whole sample)

	PIP	Post Mean	Post SD	PIP	Post Mean	Post SD
Catho80	0.046	0.000	0.000	0.041	0.000	0.000
Developing	---	---	---	**0.794**	**-0.305**	**0.194**
Ethnic	0.094	-0.019	0.077	0.088	-0.018	0.076
Free_info	**0.782**	**-0.006**	**0.004**	**0.679**	**-0.005**	**0.004**
Gov_reg	**0.874**	**0.194**	**0.098**	**0.928**	**0.215**	**0.089**
Language	0.104	-0.018	0.066	0.109	-0.020	0.069
Lat_abst	**1.000**	**1.207**	**0.252**	**0.991**	**1.032**	**0.285**
Legor_fr	0.044	0.001	0.030	0.038	0.001	0.026
Legor_ge	0.043	-0.004	0.042	0.042	-0.005	0.044
Legor_so	**0.999**	**-0.747**	**0.132**	**0.999**	**-0.737**	**0.132**
Legor_uk	0.049	0.003	0.029	0.045	0.003	0.027
Mineral_rents	0.062	0.000	0.002	0.057	0.000	0.002
Muslim80	0.055	0.000	0.000	0.048	0.000	0.000
Oil_rents	0.051	0.000	0.001	0.056	0.000	0.001
Openness	0.081	0.000	0.000	0.053	0.000	0.000
Parl_system	**0.714**	**0.201**	**0.150**	0.449	0.108	0.136
Polity_right	0.081	-0.001	0.014	0.075	-0.001	0.013
Pr_system	0.232	-0.048	0.103	0.257	-0.049	0.096
Protmg80	0.061	0.000	0.001	0.044	0.000	0.000
PS_wgi	**1.000**	**0.404**	**0.064**	**1.000**	**0.385**	**0.063**
Qual_educ	**0.954**	**0.179**	**0.065**	**0.902**	**0.156**	**0.072**
Rwpseats	0.046	-0.006	0.053	0.044	-0.006	0.054
Wildlg_.aut	**0.998**	**0.289**	**0.072**	**0.995**	**0.270**	**0.074**

Note: The results are based on 500,000 draws and 100,000 burn-ins. For each simulation, we use a uniform model prior and the birth–death MCMC sampler. Statistics in bold are those for which the posterior inclusion probability is greater than or equal to 50%.

Tables A.4: Tables A.4: Perception of corruption by region

	PIP	Post Mean	Post SD
SSA	**1.000**	**-1.329**	**0.223**
LAC	**0.994**	**-1.023**	**0.272**
MENA	**0.911**	**-0.787**	**0.363**
SA	**0.836**	**-1.036**	**0.603**
EAP	0.260	-0.127	0.263
NA.	0.210	0.200	0.491
ECA	…	…	…

Note: The results are based on 500,000 draws and 100,000 burn-ins. For each simulation, we use a uniform model prior and the birth–death MCMC sampler. Statistics in bold are those for which the posterior inclusion probability is greater than or equal to 50%.

ECA is considered as a reference since we cannot introduce all regions due to perfect collinearity.

Appendix B: Robustness checks

Table B.1: Determinants of corruption (whole sample, TI indicator)

Determinants	PIP	Post Mean	Post S.D.	PIP	Post Mean	Post S.D.
catho80	0.049	0.000	0.001	0.047	0.000	0.001
developing	---	---	---	**0.989**	**-1.029**	**0.294**
Ethnic	0.071	-0.025	0.129	0.074	-0.028	0.136
free_info	0.374	-0.005	0.008	0.229	-0.003	0.006
gdppc_bar	**0.999**	**0.538**	**0.121**	**0.970**	**0.413**	**0.136**
gov_reg	**0.865**	**0.385**	**0.204**	**0.972**	**0.482**	**0.156**
Language	0.044	-0.004	0.062	0.048	-0.009	0.071
legor_fr	0.045	-0.004	0.045	0.040	-0.002	0.038
legor_ge	0.046	0.010	0.095	0.037	0.002	0.074
legor_so	**1.000**	**-1.398**	**0.262**	**1.000**	**-1.356**	**0.245**
legor_uk	0.044	0.003	0.040	0.041	0.003	0.037
Mineral_rents	0.052	0.001	0.004	0.045	0.000	0.003
muslim80	0.079	0.000	0.001	0.057	0.000	0.001
Oil_rents	0.044	0.000	0.002	0.041	0.000	0.001
openness	0.049	0.000	0.000	0.038	0.000	0.000
parl_system	**0.829**	**0.552**	**0.306**	0.402	0.182	0.253
Polity_right	0.083	0.005	0.035	0.064	0.003	0.028
pr_system	0.174	-0.079	0.207	0.278	-0.106	0.197
protmg80	0.043	0.000	0.001	0.042	0.000	0.001
PS_wgi	**1.000**	**0.878**	**0.126**	**1.000**	**0.781**	**0.112**
Qual_educ	**0.969**	**0.401**	**0.133**	**0.878**	**0.309**	**0.154**
rwpseats	0.043	-0.007	0.101	0.044	-0.011	0.105
Wildlg_.aut	**0.999**	**0.665**	**0.160**	**0.996**	**0.606**	**0.159**

Note: The results are based on 500,000 draws and 100,000 burn-ins. For each simulation, we use a uniform model prior and the birth–death MCMC sampler. Statistics in bold are those for which the posterior inclusion probability is greater than or equal to 50%.

Table B.2: Determinants by level of economic development (TI indicator)

	Developing countries			Developed countries		
	PIP	Post Mean	Post S.D.	PIP	Post Mean	Post S.D.
Catho80	0.063	0.000	0.001	0.316	0.003	0.004
Ethnic	0.101	-0.043	0.169	0.047	-0.002	0.154
Free_info	0.137	-0.001	0.004	0.054	0.000	0.004
GDP_pc_bar	**0.996**	**0.587**	**0.140**	0.082	-0.021	0.096
Gov_reg	**0.855**	**0.400**	**0.218**	**0.806**	**0.563**	**0.362**
Language	0.071	-0.016	0.095	0.049	0.009	0.165
Legor_ge	---	---	---	0.037	-0.001	0.064
Legor_sc	---	---	---	0.063	-0.024	0.144
Legor_so	**1.000**	**-1.560**	**0.279**	**0.705**	**-0.709**	**0.546**
Legor_uk	0.062	0.008	0.057	0.088	0.032	0.141
Mineral_rents	0.049	0.000	0.003	0.199	0.036	0.086
Muslim80	0.123	0.000	0.002	0.060	0.000	0.010
Oil_rents	0.051	0.000	0.001	0.041	-0.001	0.012
Openness	0.058	0.000	0.001	0.064	0.000	0.001
Parl_system	0.333	0.149	0.242	---	---	---
Polity_right	0.070	-0.002	0.019	0.055	0.005	0.072
Pr_system	0.392	-0.169	0.240	0.092	-0.043	0.173
Protmg80	0.049	0.000	0.002	0.048	0.000	0.001
PS_wgi	**1.000**	**0.896**	**0.120**	**0.551**	**0.360**	**0.375**
Qual_educ	**0.997**	**0.499**	**0.110**	0.040	0.003	0.068
Rwpseats	0.134	-0.108	0.340	0.049	0.029	0.240
Wildlg_aut	0.102	0.023	0.093	**1.000**	**1.347**	**0.240**

Note: The results are based on 500,000 draws and 100,000 burn-ins. For each simulation, we use a uniform model prior and the birth–death MCMC sampler. Statistics in bold are those for which the posterior inclusion probability is greater than or equal to 50%.

Table B.3: Specific model of corruption (all sample, GETS approach)

VARIABLES	(1) GETS 1	(2) GETS 2
Ps_wgi	0.418***	0.387***
	(0.0530)	(0.0519)
Legor_so	-0.648***	-0.654***
	(0.114)	(0.110)
Free_info	-0.00778***	-0.00613**
	(0.00238)	(0.00235)
Wildlg__aut	0.242***	0.219***
	(0.0671)	(0.0650)
Parl_system	0.258***	0.176**
	(0.0844)	(0.0851)
Qual_educ	0.196***	0.168***
	(0.0529)	(0.0516)
Gov_reg	0.272***	0.279***
	(0.0627)	(0.0604)
GDP_pc_bar	0.224***	0.177***
	(0.0525)	(0.0526)
Developing	---	-0.382***
		(0.120)
Constant	-4.303***	-3.450***
	(0.528)	(0.574)
Observations	121	121
R-squared	0.900	0.908

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$à 10%.

Table B.4: Specific model of corruption by level of economic development (GETS approach)

VARIABLES	(1) GETS 1	(2) GETS 2
Ps_wgi	0.490***	0.334***
	(0.0510)	(0.0921)
Legor_so	-0.827***	-0.621***
	(0.128)	(0.136)
Parl_system	0.267***	
	(0.0962)	
Qual_educ	0.256***	
	(0.0515)	
GDP_pc_bar	0.244***	
	(0.0626)	
Gov_reg	0.217***	0.211***
	(0.0688)	(0.0684)
Wildlg__aut		0.504***
		(0.0699)
Constant	-4.113***	-1.820***
	(0.642)	(0.324)
Observations	88	34
R-squared	0.726	0.928

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1à 10%.

Table B.5: Determinants of corruption, influence of government wage (whole sample)

	PIP	Post Mean	Post S.D.	PIP	Post Mean	Post S.D.
Catho80	0.036	0.000	0.000	0.030	0.000	0.000
Developing	---	---	---	**0.609**	**-0.251**	**0.233**
Ethnic	0.248	-0.114	0.227	0.305	-0.146	0.249
Free_info	**0.790**	**-0.009**	**0.006**	**0.816**	**-0.009**	**0.006**
GDP_pc_bar	**0.752**	**0.183**	**0.125**	**0.682**	**0.157**	**0.125**
Gov_reg	**0.588**	**0.151**	**0.146**	**0.766**	**0.223**	**0.149**
Language	0.109	-0.030	0.106	0.099	-0.027	0.100
Legor_fr	0.047	-0.003	0.040	0.043	0.000	0.040
Legor_ge	0.025	0.001	0.036	0.021	0.000	0.032
Legor_so	**0.936**	**-0.604**	**0.255**	**0.943**	**-0.574**	**0.241**
Legor_uk	0.036	0.003	0.028	0.033	0.003	0.029
Mineral_rents	0.031	0.000	0.002	0.027	0.000	0.001
Muslim80	0.200	0.001	0.002	0.184	0.001	0.002
Oil_rents	0.043	0.000	0.002	0.035	0.000	0.001
Openness	0.089	0.000	0.001	0.053	0.000	0.000
Parl_system	0.223	0.058	0.124	0.119	0.027	0.089
Polity_right	0.067	0.002	0.021	0.061	0.000	0.018
Pr_system	0.122	-0.024	0.075	0.078	-0.013	0.056
Protmg80	0.039	0.000	0.001	0.037	0.000	0.001
PS_wgi	**1.000**	**0.531**	**0.097**	**1.000**	**0.474**	**0.108**
Qual_educ	0.695	0.154	0.122	0.573	0.120	0.120
Rwpseats	0.086	-0.036	0.148	0.103	-0.047	0.167
Wage_gdppc	0.029	0.000	0.004	0.024	0.000	0.003
Wildlg_aut	**0.850**	**0.272**	**0.158**	**0.822**	**0.250**	**0.154**

Note: The results are based on 500,000 draws and 100,000 burn-ins. For each simulation, we use a uniform model prior and the birth–death MCMC sampler. Statistics in bold are those for which the posterior inclusion probability is greater than or equal to 50%.

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