Exports and Cross-National Corruption: A Disaggregated Examination

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ABSTRACT

This paper examines the nexus between a country's export structure and corruption, incorporating disaggregated data on exports for a recent time period over a large set of nations. We ask whether various types of exports (e.g. agricultural, mineral, manufacturing and fuel) exert similar influences on corruption across nations, and whether raw materials affect corruption in a similar way in least- and most-corrupt nations. Our results suggest that fuel exports consistently affect corruption significantly, while the effects of ore and manufacturing exports are statistically insignificant. Overall agricultural exports tend to decrease corruption. Our quantile regression results suggest that fuel exports spur corruption in most-corrupt nations, while the effect of agricultural exports on corruption is statistically insignificant across various corruption levels. Our findings for fuel exports demonstrate that the impact of fuel exports is sensitive to the prevailing corruption level, and this finding is novel in the literature. In other results, corruption decreases as nations attain prosperity, as economic and political freedoms increase, and with a larger government size. Transition countries, ceteris paribus, are also found to be more corrupt. Ethnic and linguistic fractionalizations exert opposite influences on corruption, while religious fractionalization does not seem to matter. The findings are generally robust to the use of an alternate measure of corruption. We conclude with a discussion of policy implications.

Keywords: corruption; exports; resource curse; government; quantile regression

JEL codes: H11, K42, O13

1. INTRODUCTION

Most of the effects of corruption on economic activity are undesirable. Despite ample evidence that corruption tends to hamper economic growth (see e.g. Bulte and Damania, 2008; Davis and Tilton, 2005; Kronenberg, 2004; Leite and Weidmann, 1999), it appears that in some cases corruption can actually improve economic efficiency in countries with rudimentary institutional set-ups (see e.g. Lui, 1985; and Meon and Weill, 2008). Study of corruption is important both because of its prevalence and an increasing consensus that coordinated corruption control is needed at the international level to deal with countries struggling to stay competitive in a global economy.[1]

We are interested here in studying the connection between a country's exports and corruption. There are many ways a nation's resource exports may affect corruption. Torvik (2002) develops a model where increased resource endowments increase the number of entrepreneurs engaged in rent-seeking related to those resources. The result is that entrepreneurs try to obtain quotas or entitlements to natural resources rather than focus on direct production. This increased competition can motivate entrepreneurs to offer bribes or government officials to solicit bribes. In empirical studies, prevalence of mineral wealth is often associated with the intensity of corruption, although there is some debate surrounding this issue (for a literature review, see Stevens, 2003). Oil and other hydrocarbon fuels get frequent mention. When a country has readily accessible oil reserves, for example, a fight over rights to exploit them can lead to more corruption. More generally, intense competition to capture economic rents accruing from exploitation of natural resources creates ample opportunities for corruption.[2] The situation may be worst in countries with poor-quality institutions or in a highly fractionalized society. Bulte and Damania (2008, p. 5) argue that, under certain conditions, resource

[1] Lambsdorff (2006) and Treisman (2000, 2007) provide summaries of studies in this field.
[2] As a rule, tax rates on personal income are low in countries with large resource endowments. This may make public officials less accountable towards the general public, and may lead to greater tolerance of corruption.

endowments in a country permit governments to "extract greater surplus (bribes)." The present research is an attempt to bring empirical evidence to bear on these issues.

Detailed incorporation of the role of exports at the disaggregated level, including agricultural, mineral, manufacturing and fuel exports, over a fairly large set of nations in a recent time period may be viewed as the main contribution of this work. Focus on possible agriculture exports-corruption nexus has been especially missing. We uniquely ask whether various types of exports exert similar influences on corruption across nations, and whether raw materials affect corruption in a similar manner across least- and most-corrupt nations. Our underlying rationale here is that understanding the role of various export types on corruption may help in the formulation of effective policies to control corruption.

To obtain some background on the variations in cross-country exports, we first present a summary of the underlying data.

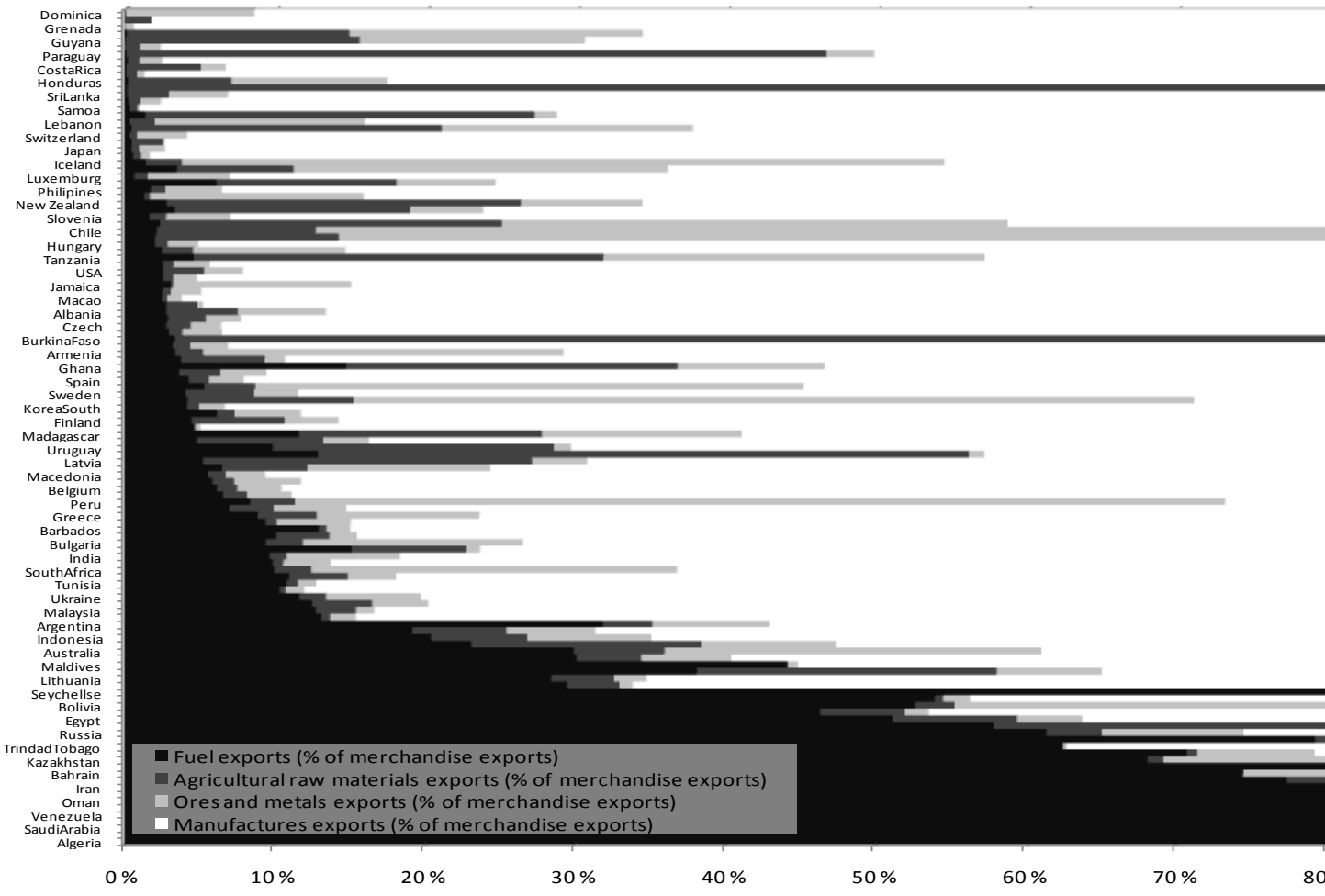

Figure 1: Exports by type

Figure 1 shows the share of various raw material exports across countries as a percentage of total merchandise exports in 2004. Two observations stand out. First, there are wide variations across export types and countries. In our sample, agricultural exports were highest in Burkina Faso forming 72.3% of the country's merchandise exports, while Algeria had the highest percentage of fuel exports at 97.4% of merchandise exports. Second, the quantitative differences in export shares mask qualitative differences across raw materials. Obviously, agricultural exports have a shorter shelf life than ores and metals, this distinction could crucially affect the rent-seeking opportunities associated with them (see Douoguih, 2005; and Gylfason, 2000). In addition, ease of extraction depends on the raw material involved and its location. For example, natural gas or oil extraction may require specific technical knowledge, but geographic and geological realities may force activity into fairly small areas, making operations easy to monitor. The same may be true for significant ore or mineral occurences (e.g. kimberlite intrusions). On the other hand, activities such as timber felling in a country with vast forests may be quite decentralized and thus more likely to evade the attention of corrupt (rent-seeking) officials. Thus a study of disaggregated exports and their potential impacts on corruption would be potentially quite useful to policymakers.

The paper is structured as follows. The second section provides some theoretical underpinnings for our empirical estimation. The third section presents the data, while the fourth section explains our estimation methodology. The fifth section discusses the results, and the final section concludes.

2. THEORETICAL BACKGROUND

In motivating the underlying theory we follow most of the literature in defining corruption as the abuse of public office for private gain (see, for example, Svensson, 2005). Theoretical

research on corruption has the advantage that it can borrow from the broader literature on the incentives for engaging in illegal activity, whereby rational law-breakers (bribe-takers and bribe-givers) weigh the relative costs and benefits of their actions (Becker, 1968). Law-breakers engage in a corrupt activity when the perceived benefits outweigh the expected costs. Benefits may include obtaining preferential treatment in obtaining government contracts, securing services one is not entitled to, or jumping the queue to receive services. In the case of natural resources, benefits may include entitlements or export quotas. The costs of engaging in the corrupt act may be a fine (penalty) or prison time. Social, institutional and cultural factors also affect the perception of what constitutes a corrupt act. Thus, the government's task in corruption control is two-fold: streamlining processes to lower leakages (benefits from corruption), while strengthening the apprehension and punishment of perpetrators. The more consistent the government is in its pursuit of corruption, the better the space of corrupt acts is defined.

Researchers on corruption have taken these basic arguments and incorporated the nuances of corrupt behavior to understand incentives for engaging in corrupt activities. This literature borrows from the literature on industrial organization and auctions to determine the effect of discretion with government officials in awarding favors and the role of competition between or among bribe-takers and bribe-givers (Rose-Ackerman,1999; and Shleifer and Vishny, 1993, 1999). In other words, the primary focus here has been on examining the incentives for engaging in corrupt practices. For purpose of this study, we draw on both the corruption determinants theories and the resource curse theories.

In contrast, we here emphasize the impact of various resource endowments on perceived corruption. The rationale for the linkage between resource endowments and rent-seeking behavior is that presence of resources shifts the focus of some entrepreneurs away from production to exploiting rents from the resources. Thus, contests for grabbing resources can merge (Wick and Bulte, 2006; also see Brunnschweiler and Bulte, 2007). Impatience or urgency in securing these rents leads to bribe offers (for theoretical models, see Baland and Francois, 2000; and Torvik, 2002; for a literature review,

see Stevens, 2003). In this context, qualitative differences across resources can affect propensities to acquire them, through legal or illegal (corrupt) means. For example, agricultural land can be looted or taxed less easily than, say, mines or oil wells (Mehlum et al., 2006).

Many studies focus on a small set of countries or use earlier data to compare the factors that crucially impact corruption (for literature surveys, see Jain, 2002; Svensson, 2005; Treisman, 2000; and Lambsdorff, 2006). From the set of factors affecting corruption, a few emerge as significant across multiple studies (Serra, 2006). In our empirical exercise, the control variables we apply are economic prosperity, the nature, strength, and efficacy of the government, as well as cultural and religious factors. It is an empirical regularity that more affluent societies have less corruption. The quality of public institutions will inevitably have an effect on corruption. In addition, there is empirical evidence that certain religious denominations can affect the level of corruption. All these considerations are brought to bear in the formal analysis of the causes of corruption in section 4 below.

3. DATA

In our estimations, we use data culled from various sources (a summary of our data and data sources appears in Table 1). Our corruption variable is based on Transparency International's Corruption Perceptions Index (CPI), a compilation of expert comments and opinion surveys of perceived corruption in 180 countries. Although the time-series properties of the index may be susceptible to the number and frequency of surveys in any given country, its cross-sectional value is quite good (which is why it has been used in numerous studies of corruption over the past decade). The CPI value for each country also tends to change little from one year to the next. These properties of the CPI are the main reason for our choice of a cross-sectional investigation. The CPI ranges from zero to ten with higher values showing a lack of corruption. To facilitate interpretation of results and conform to our underlying regression assumptions, the index was rescaled and unbounded (our dependent

variable is ln[(10-CPI)/CPI]), so that a higher score signifies higher corruption. We are mainly interested in the effects of different resource endowments on corruption. Taking data from the World Bank Development Indicators, we measure the share of four product categories in a country's total exports:

- exports of agricultural raw materials (AGexp),
- fuel exports (FLexp),
- exports of ores and metals (ORexp), and
- manufacturing exports (MNexp).

Economic prosperity and political freedom (democracy) in a country have been widely used as control variables in studies of causes of corruption. The general consensus is that the level of corrupt activity declines as nations become more prosperous (GDPpc) and democracy grows (DEM).[3] The underlying rationale here is that the desire to circumvent legal channels via corrupt means decreases with greater prosperity and the rising opportunity cost of being caught. More prosperous nations might also have strengthened mechanisms for monitoring and punishing the abuse of public office.

Further, greater press freedom and civil liberties (the two main components of political freedom) in a democracy act as checks against corruption if they cause government officials to fear exposure of their corrupt dealings (see Bulte and Damania, 2008). Greater economic freedom (EF) entails less government intervention in the economy (e.g. banking and trade restrictions, regulatory bottlenecks, or corporate tax rates), thereby reducing the opportunities for government officials to solicit bribes (fewer "tollbooths" in the parlance of Shleifer and Vishny, 1999). Our measures of

[3] Our use of GDP data for 2005, while employing the CPI for 2007, helps make the prosperity variable somewhat predetermined.

economic and political freedom are widely used in the relevant literature (see Table 1 for details). Open economies usually have fewer controls, so we employ the degree of openness of an economy as another measure of the level of economic freedom. We postulate that openness of the economy (OPEN, sum of exports and imports as share of GDP) could affect corruption as a determinant of susceptibility to corruption. Indeed, in their examination of the relative effects of economic and political freedoms on corruption across countries, Goel and Nelson (2005) find that greater economic freedom is more effective at reducing corruption than greater political freedom, although both reduce corruption.

The government plays a crucial role in corruption as it has monopoly control over the provision of many services. This control presents rent-seeking opportunities to bureaucrats in charge of disbursing government goods and services. The size of the government (GCONS) captures the magnitude of government machinery. Greater size could imply higher spending on monitoring and policing, but it could also imply more red tape (Rose-Ackerman, 1999). In our sample, government size in 2005 ranged from 4.1% of GDP in Cambodia to 44.6% of GDP in Eritrea. Cross-country studies generally find that the level of corrupt activity goes down with a larger government size (Goel and Nelson, 2005).

Ethnic, linguistic and religious differences within and across nations might dictate the prevalence of corrupt practices (Paldam, 2002). For example, Japan is ethnically and linguistically more homogeneous than, say, the United States. We thus argue it may be easier to formulate corrupt relations in certain contexts (Lambsdorff and Teksoz, 2004) and harder in others where religious or ethnic beliefs see certain acts as corrupt. Fractionalization of a society can give rise to clan-based behavior, where members of an ethnic, linguistic or religious group favor each other over outsiders. This kind of behavior can increase corruption. To capture these differences consistently across nations, we employ three indices of fractionalization:

- ETHNIC is an index of ethnic fractionalization,

- LANG is an index of linguistic fractionalization, and
- RELG is an index of religious fractionalization in a country.[4]

These data and the corresponding details are available from Alesina et al. (2003).

Turning to the role of exports, we disaggregate a country's exports into four categories:[5]

- exports of agricultural raw materials (AGexp),
- fuel exports (FLexp),
- exports of ores and metals (ORexp), and
- manufacturing exports (MNexp).

As shown in Figure 1 above, there are wide variations in the share of these exports across nations. Further these materials are qualitatively different, which might affect the rent-generating opportunities associated with them. For instance, the perishable nature of agricultural exports would add a sense of urgency to these transactions, while manufacturing or metals exports do not face similar limitations. Further, the non-renewability of certain fuels would add another qualitative dimension of associated transactions, corrupt or otherwise. Whereas there is some research that examines the nexus between exports and corruption, examination of exports at a disaggregated level is rather rare.[6] To our knowledge, no study has yet examined whether the different types of exports equally affect most- and

[4] Many studies use composite indices that capture the ethnolinguistic fractionalization in countries. Our use of separate fractionalization indices is more revealing and we find different effects across fractionalization types (see below).

[5] Obviously, our categorization of exports includes the main categories and does not exhaust all possibilities.

[6] In the study of Petermann et al. (2007), the authors examine the effect of ore and fuel exports on corruption across countries with different income levels (see also Bulte and Damania, 2008; Douoguih, 2005; and Leite and Weidmann, 1999). Our study differs substantially from Petermann et al. in that we:

- use a greater degree of export disaggregation,
- focus on the determinants of corruption across nations with different corruption levels,
- employ more control variables,
- use a sample of countries nearly twice as large, and
- base our work on newer data.

least-corrupt nations. Thus, we also check whether these effects are different in the more and less affluent countries. This question goes to the heart of whether blanket corruption control policies across nations are advisable.

Recognizing that the data might be unable to capture certain subtle differences across groups of countries, we use two dichotomous control variables. TRAN is a dummy variable identifying transition countries to see whether there are some unique characteristics in these nations that spur corruption (Kronenberg, 2004). There might be disproportionate rent-seeking opportunities in initial years due to large-scale privatization or underdeveloped checks and balances. Institutions might also be underdeveloped in the least-developed nations (Bardhan, 1997). However, rent-seeking opportunities (i.e. size of the discretionary pie) might be small in these countries. On the other hand, least-developed nations might be more eager to control corruption in order to qualify for foreign assistance. To see whether these influences matter, we include DEV as a dummy variable that identifies least-developed nations as classified by the United Nations.[7]

The data include cross-sectional country level observations for about 130 nations for 2007 (or the closest year available). Details about the variables used, definitions and data sources are provided in Table 1. Next, we will briefly examine the underlying data. Table 2 gives the basic statistical indicators for different variables. Figure 2 shows that there is a negative correlation between per capita GDP and the level of corruption. This correlation has been documented in the literature before. However, our research will add to this dicussion by examining whether the correlation holds when a number of pertinent variables, especially exports under various categories, are taken into account.

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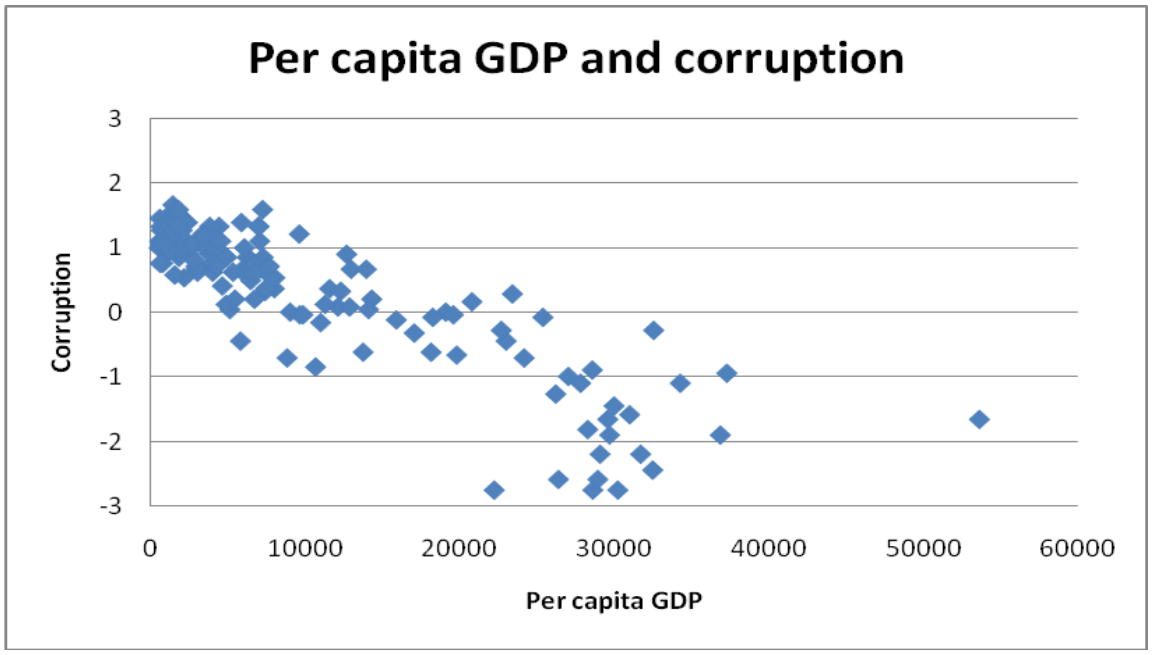
[7] As a check of robustness, DEV is replaced below by a dummy variable identifying sub-Saharan countries (SAHARA).

Figure 2: Per capita GDP and corruption



4. ESTIMATION

Following the above discussion, we arrive at the following general estimation model. The level of corrupt activity in a nation is determined by the factors outlined in equation (1) below, including economic, social, political, and governmental

$$\text{Corruption}_i = f(\text{Economic prosperity}_i, \text{Political freedom}_i, \text{Economic freedom}_i, \text{Government size}_i, \text{Fractionalization}_{ij}, \text{Exports}_{ik}) \quad (1)$$

i = 1,…, 132

j = ETHNIC, LANG, RELG

k = AGexp, FLexp, ORexp, MNexp

A number of specific variables are used in this study to capture the right-hand-side control variables mentioned in (1). They are discussed in detail below, with additional technical details provided in Table 1.

As was explained above, our dependent variable is a transformation of the corruption perceptions index (CPI) from the Transparency International, ln[(10-CPI)/CPI]. Therefore, in our estimation and the subsequent discussion, an increase in the corruption index means increase in corruption. We control for political and economic freedom, as well as per capita GDP, government size and different measures of fractionalization.

The main focus of our study is the effect different exports have on corruption. To reiterate, we use our four export categories: exports of agricultural raw materials (AGexp), fuel exports (FLexp), exports of ores and metals (ORexp) and manufacturing exports (MNexp). As shown in Figure 1 above, there are wide variations across nations in the share of these exports. Further these materials are qualitatively different, which might affect the rent-seeking opportunities associated with them. Whereas there is some research that examines the nexus between exports and corruption (see Jain, 2001; and Lambsdorff, 2006), examination of exports at a disaggregated level is rare.

The estimation is conducted using the STATA software package. In keeping with the requirements of the study and the nature of the data, three different estimation methodologies were employed:

- ordinary least squares or OLS (Tables 2 and 3),
- quantile regression (Table 4), and
- two-stage least squares (2SLS) (Table A1).

5. RESULTS

Tables 2-4 and A1 present different variations of equation (1) using appropriate estimation techniques. The overall fit of the all the models estimated is quite good. We discuss the findings of each table below.[8]

Baseline Models

The baseline models include a number of factors affecting corruption that have been used elsewhere. However, our sample size is larger and the data are more recent. We do not include resource disaggregation in these models as our primary objectives here are to provide a benchmark and facilitate comparison with the extant literature.

The results show that greater economic prosperity reduces corruption, a finding consistent with the extant literature (Serra, 2006; Svensson, 2005). Both greater economic and greater political freedom reduce corruption, albeit the coefficient on DEM is statistically insignificant in one case. The findings with respect to economic freedom are robust whether economic freedom is measured via an index (EF) or through the degree of openness (OPEN). The relative effectiveness of economic freedom over political freedom in controlling corruption has been shown in earlier studies (Goel and Nelson, 2005). Ceteris paribus, larger government size seems to curb corruption. Apparently, larger government is associated more with checks and balances to reduce corruption and less with increased red tape. The coefficient on GCONS is negative and statistically significant in models 2A-2C estimated in Table 2.[9] To capture whether more affluent nations have more effective large governments, model 2D adds an interaction term between per capita GDP and government size. In this case, the coefficient on GDPpc loses statistical significance. Interestingly, now the coefficient on GCONS changes sign (and is

[8] Since the dependent variable (and some control variables) is measured via an index, appropriate caution should be exercised in the interpretation of the findings.

[9] It is worth pointing out that the size of the governments masks other, possibly relevant, governmental attributes such as the structure and form of the government. Incorporation of government quality measures is beyond the scope of this paper.

statistically significant), while that on the interaction term (GCONS*lnGDPpc) is negative. This implies that, while a larger government might contribute to corruption by adding more bureaucracy, more affluent nations benefit from the corruption-reducing aspects of government size. In other words, the marginal effectiveness of greater economic prosperity may be non-constant and sensitive to the size of the government.

Again, ceteris paribus, corruption in transition countries (TRAN) is higher suggesting the influence of disproportionate rent-seeking opportunities and perhaps underdeveloped systems of checks and balances. Interestingly, the coefficient on DEV that identifies the least-developed nations is negative and statistically significant. This implies that, with the level of GDP per capita held the same, either the least-developed nations were heeding international pressures in curbing corruption or there was greater mis-measurement in the corruption indices in these cases.[10] The results are qualitatively similar when DEV is replaced by a dummy variable identifying sub-Saharan nations (SAHARA), although the coefficient on SAHARA has a relatively lower statistical significance than that on DEV (comparing models 2B and 2C to 2E and 2F in Table 2)

Turning to the indices capturing the degrees of fractionalization, greater ethnic fractionalization seems to increase corruption, while more linguistic and religious fractionalizations have negative signs, with the sign on religious fractionalization statistically insignificant. Greater ethnic fractionalization can lead to more corruption in cases where there is lack of general trust across different ethnicities and money is used to grease relations and build trust. On the other hand, linguistic differences may curb corruption where the inability to communicate acts as a barrier to the formation of corrupt contracts.

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[10] It should also be borne in mind that the overall size of the rents that can be potentially sought is relatively small in developing nations.

Natural Resources and Corruption

Table 3 reports OLS results when exports are disaggregated across our four categories (AGexp, FLexp, ORexp, and MNexp) to reveal differential influences in these categories on corruption. The findings with respect to GDPpc, DEM, GCONS and TRAN mirror those from Table 2. Specifically, greater economic prosperity, greater economic and political freedoms, and larger government size all reduce corruption. In terms of the magnitude of impact, a one percent increase in per capita GDP leads to a roughly half percent reduction in corruption, as denoted by ln ((10-CPI)/CPI). Again, corruption was higher in transition countries.

Turning to the effects of various exports, agricultural exports seem to reduce corruption, while higher fuel exports increase corruption. The effects of ore and manufacturing exports are statistically insignificant.[11] In terms of magnitude, the absolute value of the coefficient on AGexp is nearly twice that on FLexp. It might be the case that the nature of these commodities affects the relative discount rates of bribe-payers and bribe-givers with different impacts on the level of corrupt activities. For instance, we can infer that perishable agricultural goods would warrant that transactions be executed expeditiously reducing the time for formulation of corrupt contracts. Also, agricultural production tends to be more dispersed, making it more difficult for corrupt officials to monitor. This positive impact of agricultural exports can be seen as supporting the notion that some resources can be a "blessing" (Stevens, 2003). On the other hand, the scarcity and relative longevity (shelf-life) of fuels might turn out to be conducive to corruption, and their relatively concentrated extraction makes it easier to demand bribes.

[11] In a study comparing the relative effects of fuel and non-fuel mineral exports, Petermann et al. (2007) note mixed effects of mineral exports on corruption. This somewhat contradicts the earlier study of Douoguih (2005), which finds the effects of non-fuel mining to be significant under certain situations.

Further, to account for possible nonlinearities between democracy and resources, models 3G and 3H include interaction terms between DEM and AGexp and FLexp, respectively. Coefficients on both the interaction variables are statistically insignificant. This implies that the effect of natural resource endowment does not depend on the degree of democracy.

The overall finding that when it comes to corruption, not all type of exports are alike and this has important implications for the formulation of effective domestic and international corruption control policies.

Natural Resources and Different Corruption Levels

To learn more about the effects of the two significant types of exports (AGexp and FLexp), we perform the quantile regression presented in Table 4.[12] This technique enables us to determine whether corruption determinants are equally effective across countries with different corruption levels. In Table 4, q50 denotes the median, while q10 represents least-corrupt nations. The results show that greater economic prosperity reduces corruption, irrespective of the existing level of corruption. The effect of democracy is negative, but statistically insignificant in least-corrupt countries (and in one instance, most-corrupt countries), and the magnitude of the (negative) coefficient on DEM is the smallest in the most corrupt nations. Larger government size reduces corruption, especially in the relatively less-corrupt nations.

Fuel exports spur corruption in the most-corrupt nations (although the resulting coefficient is positive in all instances), while the negative effect of agricultural exports on corruption is statistically insignificant across various corruption levels. Both fuel exports and agricultural exports are insignificant in the median regression (q50). Further, the magnitude of the positive effect of fuel exports on corruption is most pronounced in nations with greatest corruption. Note that the effect of

[12] See Koenker and Hallock (2001) for background on quantile regression.

agricultural exports, while maintaining the same sign as Table 3, becomes insignificant when an alternate estimation technique is employed. This calls for appropriate caution in the interpretation of results. The key insight from Table 4 then is that all types of exports are not alike when it comes to their impact on corruption, and countries at different corruption levels tend to respond differently to exports. Thus, to be effective, corruption control policies need to be commodity-specific and revised over time as national levels of corruption fall or rise.

To get an idea as to how important a country's export structure can be to the level of corruption, we can calculate how corruption would change in a country as the share of fuel or agricultural exports changes. Holding everything else constant, in model 3A one standard deviation (9.6%) increase in the share of agricultural exports would lead to decrease of roughly 0.09 in the transformed corruption perception index (the average of the transformed corruption index (i.e, ln((10-CPI)/CPI) is 0.42, with a standard deviation of 1.03). Conversely, a one standard deviation change (25.9%) in the share of fuel exports would increase the corresponding index by 0.13 (model 3B). Thus, in addition to agricultural and fuel exports exerting opposite influences on corruption, a one standard deviation variation in the latter has a greater effect on corruption than a similar variation in the former.[13]

Robustness Checks

We perform two robustness checks on our findings. The first involves allowing for endogenous government size. The second uses an alternate dependent variable, the corruption index from the World Bank. The corresponding results are reported in the Appendix.

[13] Appropriate caution, however, should be exercised in interpreting the changes in corruption because of the nature of the underlying index.

Endogeneity of Government Size

It has been argued that corruption might be endogenous with respect to some of its determinants. In other words, some factors that cause corruption might in turn themselves be affected by the level of corrupt activity.[14] Arguably the most prominent of these factors is the government size (GCONS in Table 1). On the one hand, a large government affects corruption by increasing rent-seeking opportunities (as potential bribe-seekers offer money to circumvent bottlenecks) and via greater spending on monitoring and enforcement. On the other hand, greater corruption may bloat the government machinery through increased red tape as "tollbooths" are set up.

To account for the possible simultaneity between corruption and government size, we ran a version of the baseline models presented in Table 2 (Model 2A), by allowing government size to be endogenous. The corresponding two-stage least squares (2SLS) results, using population (POP) as an additional instrument, are reported in the Table A1. A Sargan test confirmed our choice of the instrument to be valid. The results are similar to Model 2A. Specifically, greater economic prosperity and more economic freedom reduce corruption, while, other things being the same, corruption is greater in transition nations. The size of government, however, fails to attain statistical significance in this instance. The effect of political freedom or democracy is statistically insignificant.

Using the World Bank Corruption Index

Another corruption perceptions index is available from the World Bank. We use this index instead of the CPI to check the robustness of our findings. Both corruption indices use some of the same underlying information sources and the correlation between them is high. The corresponding

[14] For instance, over time there might be some feedback from institutional quality (Brunnschweiler and Bulte, 2007). However, such endogeneity is relatively less of a concern for a cross-sectional study like ours.

quantile regression results, which mimic Table 3, are reported in Table A2 in the Appendix. The findings are remarkably similar to those in Table 3. Fuel exports specifically increase corruption in the most-corrupt nations, while agricultural exports do not have a significant bearing on countries at different corruption levels (except in the median regression). The effects of other variables are qualitatively similar.

6. CONCLUDING REMARKS

Using recent data from a large sample of countries, this paper studied the connection between a country's natural resource endowments and corruption. Earlier empirical studies found that prevalence of mineral wealth was often associated with higher corruption levels (see Stevens, 2003). Here, we incorporated the role of exports at the disaggregated level for a large set of nations and during a recent time period. Focus on possible agriculture exports-corruption nexus has been especially missing. Our main thesis was that understanding of the role of various raw material types on corruption can help in the formulation of effective corruption-control policies. We asked whether various types of raw material endowments exert similar influence on corruption across nations, and whether various exports are equally influential regarding corruption in least- and most-corrupt nations. To our knowledge, these questions have not been answered in the literature before.

Based on several estimates with different estimation methodologies, the following conclusions emerge. The baseline models (Table 2) show that corruption decreases:

- as nations attain prosperity,
- as economic and political freedoms increase, and
- with larger government size.

Focusing on the possible differential effects across export types (Table 3), it seems that only agricultural and fuel exports significantly affected corruption. The effects of ore and manufacturing exports were statistically insignificant. Interestingly, while higher fuel exports increased corruption, greater agricultural exports had the opposite effect. In terms of magnitude, the absolute value of the coefficient on agricultural exports is nearly twice that on fuel exports. It might be the case that fuel endowments presented opportunities for rent-seeking behavior, while agricultural contracts were relatively more decentralized and in such cases the level of corrupt activity actually went down. However, it should be noted that there is much more variation in the share of fuel exports as measured by its standard deviation. The interactions of these resources with democracy failed to produce statistical significance (models 3G and 3H). The effects of the other variables, including economic prosperity, democracy, government size and transition nation status, reinforced the findings from Table 2. Further, the signs and magnitudes of these variables were quite robust to model specifications across the eight variations reported in Table 3.

Since two types of exports, agricultural and fuel, significantly affected corruption in Table 3, we examined the robustness of these findings by studying whether there were differences in the impacts of these resources across most- and least-corrupt nations. The corresponding results, using quantile regression, are presented in Table 4. The results show that greater economic prosperity reduces corruption, irrespective of the existing level of corruption, while transition nations are generally more corrupt. Increasing democracy also reduces corruption, but the effect is statistically insignificant in the least-corrupt nations (and the most-corrupt in one instance). Larger government size reduces corruption, especially in the relatively less corrupt nations. Fuel exports spur corruption in the most-corrupt nations, while the negative effect of agricultural exports on corruption is statistically insignificant across various corruption levels. Thus, while the findings with respect to fuel exports echo those of Petermann et al. (2007), the present study uniquely demonstrates that the impact of fuel

exports is sensitive to prevailing corruption levels. Only countries at certain corruption levels are affected by fuel exports. These findings were robust to the use of an alternate measure of corruption (Table A2).

The findings with respect to economic freedom were robust across two different measures. Transition countries were more corrupt, ceteris paribus, while corruption was lower in the least-developed nations. Degrees of ethnic and linguistic fractionalizations had opposite effects on corruption, while religious fractionalization did not seem to matter. The different relative impacts of the various types of fractionalization provide a richer insight compared to studies that employ composite fractionalization indices. Overall, the findings of the benchmark models generally support those in the literature (see Lambsdorff, 2006), albeit with more recent and larger data and in some cases with more detailed control variables.

Turning to the policy implications of our findings, it appears that different resource types affect corruption differently. Not all resource types can be seen as a curse, and some might well be a blessing. The signs and magnitudes of the resource effects vary in terms of their impact on corruption. Therefore policies to combat corruption need to be tailored to fit each country's unique circumstances, but it appears that reducing corruption will be significantly more difficult in economies where fuels are the dominant export category.

Further, the findings reinforce some policy recommendations from the literature that as nations achieve greater economic prosperity, the level of corrupt activity declines. However, corruption in the least-developed nations was lower, pointing perhaps to nonlinearities in the relation between wealth and corruption, or the inability of dichotomous variables to capture subtle institutional differences. Improvements in economic and political freedoms also seem beneficial for corruption control. The extra bureaucracy associated with larger governments does not seem to contribute to corruption. Rather, a larger government lowers corruption by strengthening checks and balances,

especially in the most affluent nations. Policies paring government size are not supported with respect to corruption control. It seems that transition nations face peculiar issues regarding corruption control and would warrant special attention be given to such countries.

In closing, we offer the caveat that, in the absence of the ability to measure actual corruption, we have proxied the level of corruption with an index of perceived corruption. Thus, while the CPI has gained wide acceptance and continues to improve over time, it is not without limitations (see Treisman, 2007). Further, the role of institutions is quite important in the context of their bearing on corruption (Knack and Keefer, 1995). However, not all these institutions are equally amenable to quantitative measurement. Finally, there is the fine, yet important, distinction between petty and grand corruption. Some countries have mainly grand corruption (e.g. the United States), while others have both grand and petty corruption (e.g. India and Nigeria). Differences in corruption types can crucially affect perceptions about corruption (and the resulting indices). This aspect deserves additional attention in the literature.

Table 1.
Variable Definitions, Summary Statistics and Data Sources

Variable	Definition (Mean; Std. Dev.)	Source
CPI	Corruption Perceptions Index, Transparency International (10 highly clean, 0 highly corrupt), 2007 (3.98; 2.09)	I
GDPpc	GDP per capita (PPP 2000 international $), 2005 (9649.41; 10498.98)	II
EF	Economic Freedom in a country, (% free), 2007 (60.56; 10.59)	III
DEM	Sum of a country's political rights and civil liberties scores, (higher score, more democratic), 2007 (-6.71; 3.83)	IV
GCONS	General government final consumption expenditure (% of GDP), 2005 (15.80; 6.76)	II
AGexp	Agricultural raw materials exports (% of merchandise exports), 2004 (4.44; 9.56)	II
FLexp	Fuel exports (% of merchandise exports), 2004 (16.51; 25.92)	II
ORexp	Ores and metals exports (% of merchandise exports), 2004 (5.79; 10.30)	II
MNexp	Manufactures exports (% of merchandise exports), 2004 (50.89; 30.72)	II
OPEN	Exports plus imports (% of GDP), 2004 (94.55; 54.02)	II
ETHNIC	Ethnic fractionalization (0.44; 0.26)	V
LANG	Language fractionalization (0.40; 0.28)	V
RELG	Religious fractionalization (0.43; 0.23)	V
POP	Population, 2005 (3.59E+07; 1.32E+08)	II
LIT	Literacy rate (% of literate population above age 15), 2006 (79.10; 20.75)	II
TRAN	Dummy variable = 1 if a country is a transition economy, 0 otherwise	VI

	(0.15; 0.36)	
DEV	Dummy variable = 1 if a country is considered least developed, 0 otherwise (0.26; 0.44)	VI
SAHARA	Dummy variable = 1 if a country is sub-Saharan, 0 otherwise (0.25; 0.43)	VI
WB	Corruption Perceptions Index, World Bank (+2.5 highly clean, -2.5 highly corrupt), 2007 (-0.07; 1.00)	VII
Note: All data are by country		

Data Sources

I. http://www.transparency.org/policy_research/surveys_indices/cpi/2007
II. World Development Indicators CDROM, 2007
III. http://www.heritage.org/research/features/index/countries.cfm
IV. http://www.freedomhouse.org/uploads/fiw08launch/FIW08Tables.pdf
V. Alesina et al. (2003)
VI. http://www.unpan1.un.org
VII. http://www.govindicators.org

Table 2.
Cross-Country Causes of Corruption: Baseline Models

(Dependent Variable: ln ((10-CPI)/CPI)

	2A	**2B**	**2C**	**2D**	**2E**	**2F**
ln GDPpc	-0.31** (7.1)	-0.64** (7.3)	-0.57** (9.0)	0.06 (0.4)	-0.57** (7.4)	-0.50** (8.1)
DEM	-0.02 (1.1)	-0.06** (4.1)	-0.07** (6.4)	-0.01 (0.5)	-0.07** (4.3)	-0.08** (6.4)
EF	-0.05** (6.8)			-0.05** (6.1)		
GCONS	-0.03** (4.0)	-0.02** (2.4)	-0.02** (2.5)	0.16** (2.1)	-0.02** (2.3)	-0.02** (2.4)
TRAN	0.44** (5.4)	0.41** (3.9)	0.43** (4.3)	0.41** (5.2)	0.42** (3.9)	0.46** (4.3)
ETHNIC		0.74** (2.2)	0.76** (2.3)		0.84** (2.5)	0.86** (2.5)
LANG		-0.55* (1.8)	-0.52* (1.7)		-0.59* (1.8)	-0.56* (1.7)
RELG		-0.21 (1.0)	-0.13 (0.7)		-0.07 (0.3)	0.002 (0.01)
DEV		-0.45** (3.2)	-0.44** (3.3)			
OPEN			-0.003** (2.0)			-0.003* (1.9)
GCONS* ln GDPpc				-0.02** (2.5)		
SAHARA					-0.24* (1.7)	-0.22 (1.4)
N	129	132	132	129	132	132
F-value	57.1**	34.0**	31.4**	63.9**	33.6**	30.7**
R^2	0.80	0.73	0.75	0.82	0.72	0.74

Notes: Variable definitions appear in Table 1. The numbers in parentheses are absolute values of t-statistics based on robust standard errors. ** denotes statistical significance at least at the 5% level and * denotes significance at the 10% level. All models included a constant term, but those results are not reported here to conserve space.

Table 3.
Natural Resources and Corruption

(Dependent Variable: ln ((10-CPI)/CPI)

	3A	**3B**	**3C**	**3D**	**3E**	**3F**	**3G**	**3H**
ln GDPpc	-0.62** (6.2)	-0.61** (6.5)	-0.58** (6.3)	-0.54** (6.0)	-0.58** (5.9)	-0.63** (5.0)	-0.61** (6.1)	-0.61** (6.3)
DEM	-0.07** (3.5)	-0.05** (2.0)	-0.07** (3.6)	-0.07** (3.7)	-0.06** (3.3)	-0.04* (1.7)	-0.07** (3.1)	-0.05* (1.7)
GCONS	-0.03** (2.1)	-0.03** (2.1)	-0.03** (2.1)	-0.03** (2.3)	-0.03** (2.2)	-0.03* (1.9)	-0.03** (2.1)	-0.03** (2.1)
TRAN	0.52** (4.9)	0.52** (5.1)	0.53** (5.0)	0.55** (5.1)	0.55** (5.1)	0.51** (4.8)	0.52** (4.8)	0.52** (5.1)
AGexp	-0.009** (2.4)				-0.01** (2.4)		-0.01 (0.7)	
FLexp		0.005* (1.9)				0.006 (1.5)		0.005 (0.6)
ORexp			-0.004 (1.2)					
MNexp				-0.002 (1.0)	-0.003 (1.3)	0.001 (0.4)		
DEM*AGexp							0.0002 (0.1)	
DEM*FLexp								0.00001 (0.02)
N	105	105	105	105	105	105	105	105
F-value	40.4**	37.2**	38.8**	39.0**	33.3**	31.2**	35.2**	30.8**
R^2	0.70	0.70	0.69	0.69	0.70	0.70	0.70	0.70

Notes: Variable definitions appear in Table 1. The numbers in parentheses are absolute values of t-statistics based on robust standard errors. ** denotes statistical significance at least at the 5% level and * denotes significance at the 10% level. All models included a constant term, but those results are not reported here to conserve space.

Table 4.
Natural Resources and Corruption: Quantile Regression Estimates

(Dependent Variable: ln ((10-CPI)/CPI)

	q50	**q10**	**q25**	**q75**	**q90**
ln GDPpc	-0.47** (4.8)	-0.61** (3.4)	-0.50** (4.5)	-0.41** (4.3)	-0.45** (3.7)
DEM	-0.05** (2.1)	-0.03 (0.5)	-0.09** (2.7)	-0.04** (2.0)	-0.02 (1.0)
GCONS	-0.03** (2.1)	-0.07** (2.7)	-0.04* (1.7)	-0.02** (2.5)	-0.01 (0.9)
TRAN	0.36** (2.6)	0.87** (3.9)	0.66** (4.1)	0.24** (2.1)	0.25* (1.8)
FLexp	0.004 (1.5)	0.005 (1.0)	0.002 (0.6)	0.004 (1.5)	0.006** (2.6)
N	105	105	105	105	105
Pseudo-R^2	0.45	0.58	0.53	0.39	0.33
ln GDPpc	-0.47** (4.0)	-0.58** (3.0)	-0.52** (4.6)	-0.37** (3.4)	-0.39** (2.9)
DEM	-0.08** (4.3)	-0.09 (1.3)	-0.09** (3.4)	-0.08** (5.5)	-0.06** (3.1)
GCONS	-0.02 (1.3)	-0.07** (2.7)	-0.05** (2.4)	-0.02* (1.8)	-0.03* (1.8)
TRAN	0.47** (3.7)	0.74** (3.2)	0.60** (3.7)	0.26** (2.4)	0.23 (1.6)
AGexp	-0.006 (0.7)	-0.0005 (0.02)	-0.004 (0.4)	-0.002 (0.3)	-0.006 (0.7)
N	105	105	105	105	105
Pseudo-R^2	0.45	0.57	0.53	0.38	0.31

Notes: Variable definitions are in Table 1. Here q10 represents least-corrupt nations, while q90 denotes most-corrupt countries. The numbers in parentheses are absolute values of t-statistics based on 250 bootstrap iterations of standard errors. ** denotes statistical significance at least at the 5% level and * denotes significance at the 10% level. All models included a constant term, but those results are not reported to conserve space.

APPENDIX

Allowing for endogeneity of government size

TABLE A1.

Causes of Corruption: Allowing for Endogenous GCONS

(Dependent Variable: ln ((10-CPI)/CPI)

ln GDPpc	-0.40** (2.3)
DEM	-0.04 (0.9)
EF	-0.04** (2.5)
GCONS	0.01 (0.2)
TRAN	0.43** (3.5)
N	129
F-value	67.5**
First-stage F-value	5.2**
Sargan overidentification test (χ^2)	0.00

Notes: Variable definitions appear in Table 1. The reported results are the second stage estimates of a 2SLS regression, with POP as an additional instrument for GCONS. The numbers in parentheses are absolute values of z-statistics. ** denotes statistical significance at least at the 5% level and * denotes significance at the 10% level. The model included a constant term, but those results are not reported here to conserve space.

Using the World Bank Corruption Index

Table A2.
Natural Resources and Corruption: Quantile Regression Estimates

(Dependent Variable: ln ((5-WB)/WB) - World Bank Corruption Index)

	q50	**q10**	**q25**	**q75**	**q90**
ln GDPpc	-0.42** (5.6)	-0.63** (3.8)	-0.59** (4.7)	-0.32** (4.2)	-0.39** (4.7)
DEM	-0.07** (3.7)	-0.05 (0.6)	-0.06* (1.8)	-0.04** (3.0)	-0.04** (2.3)
GCONS	-0.02 (1.3)	-0.08** (2.0)	-0.04* (1.8)	-0.01 (1.4)	-0.002 (0.2)
TRAN	0.35** (3.4)	0.89** (3.6)	0.57** (3.2)	0.13 (1.4)	0.02 (0.2)
FLexp	0.002 (0.8)	0.003 (0.6)	0.005 (1.4)	0.002 (1.0)	0.005** (2.7)
N	103	103	103	103	103
Pseudo-R^2	0.41	0.54	0.46	0.38	0.36
ln GDPpc	-0.40** (4.3)	-0.68** (3.7)	-0.56** (3.6)	-0.32** (3.8)	-0.36** (4.3)
DEM	-0.07** (6.6)	-0.06 (0.9)	-0.09** (3.1)	-0.06** (4.5)	-0.06** (3.4)
GCONS	-0.02* (1.7)	-0.07** (2.0)	-0.03 (1.5)	-0.01 (1.4)	-0.01 (0.9)
TRAN	0.37** (3.4)	0.83** (3.6)	0.60** (3.1)	0.16* (1.7)	0.04 (0.4)
AGexp	-0.007** (2.2)	-0.003 (0.1)	-0.006 (0.7)	-0.005 (1.0)	-0.009 (0.9)
N	103	103	103	103	103
Pseudo-R^2	0.42	0.53	0.46	0.38	0.35

Notes: Since the WB index varies from -2.5 to +2.5, we added 2.5 to make the index range from zero to five. We then transformed the index [ln ((5-WB)/WB)] to conform it to the CPI used elsewhere in the paper. Variable definitions are presented in Table 1. Here, q10 represents least-corrupt nations, while q90 denotes most-corrupt countries. The numbers in parentheses are absolute values of t-statistics based on 250 bootstrap iterations of standard errors. ** denotes statistical significance at least at the 5% level and * denotes significance at the 10% level. All models included a constant term, but those results are not reported here to conserve space.

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