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Corruption and Climate Change Policies:

Do the Bad Old Days Matter?

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Abstract

We study the effect of countries' historical legacy with corruption on recent climate change policies and on global cooperation. Current policy outcomes build on policy choices made in previous years, and these choices were likely affected by the degree of corruption at the time. Our empirical findings using data for up to 131 countries suggest that accumulated historical experience with corruption is important for today's policy outcomes, and appears to be more important than the current level of corruption.

Keywords: Corruption; History; International Public Goods; Climate Change; Environmental Policy.

JEL Codes: Q54; Q58; H11; H23; H4

1. Introduction

Suppose a country is currently relatively free of corruption. Does it matter for environmental policy outcomes whether this country has had low corruption for an extended time period (the good old days), or has suffered a long history of widespread corruption (the bad old days) and improved only very recently? That is, does a country's path to today's level of corruption matter for climate change policies? The climate change policies in effect today are the result of a myriad of decisions taken during the last few decades, and the level of corruption at the time these decisions were taken likely played an important role. In this paper, we make a first attempt to answer the above question, thereby also providing a fresh perspective in the vast literature on the effects of corruption more generally.

Our approach is to create a measure of the "corruption-control capital stock". The corruption-control capital stock is here defined as a country's accumulated stock of historical experience with freedom from (i.e., control of) corruption, that is, the degree to which a country has accumulated experience with the absence (good old days) as opposed to the presence (bad old days) of corrupt practices in political, bureaucratic and economic activities, etc. The corruption control capital stock concept is similar to the "democratic capital stock" suggested by Persson and Tabellini (2009), defined as a country's accumulated stock of civic and social assets built by historical experience with democracy.

Our analysis sheds new light on the debate in the literature on whether corruption or democracy is the main determinant of environmental policy outcomes. Pellegrini and Gerlagh (2006) show that while current corruption is an important determinant of an index of agricultural environmental policy stringency (based on surveys completed by the relevant governments, business and non-governmental organization representatives), current democracy has a minor and statistically insignificant effect once corruption is included in the estimation model. We compare the effect of the corruption-control capital stock with the impact of the democratic control stock, which Fredriksson and Neumayer (2013) found to be an important determinant of climate change policies. We find that both corruption and democracy are statistically significant and substantively important determinants of climate change policies and global environmental cooperation efforts, even when simultaneously included in the estimation models.

Our empirical work utilizes two dependent variables. First, we use a composite index of multiple aspects of climate change policies, the Climate Laws, Institutions and Measures Index, created by Steves et al. (2011). Second, we employ a measure of the degree of global environmental cooperation from Esty et al. (2005). To create measures of the corruption control capital stock, we use two different corruption indices. These come from the International Country Risk Guide (ICRG) (time period 1982-2010) and the World Bank's Worldwide Governance Indicators project (www.govindicators.org) (time period 1996-2010), respectively. The advantage of the ICRG data is their longer temporal availability, but they are available for fewer countries. The reverse holds for the World Bank's indicators: they are available for more countries, but only for a shorter period of time. We have data for up to 131 countries, which in 2010 emitted almost 99 percent of all CO_2 emissions.

Our results lend support to the hypothesis that countries' historical experience with corruption matters for climate change policies, in particular global environmental cooperation. This suggests that corruption reform programs may not have immediate impacts on the propensity to cooperate on transboundary pollution problems, and patience is consequently warranted. Only over time will corruption-control yield results. On the other hand, an increase in the level of corruption (a reduction in corruption-control) may not have as severe effects in countries already benefiting from a large stock of corruption-control as part of their history. Finally, in contrast to Pellegrini and Gerlagh's (2006) result for current corruption and current democracy, we find that the democratic capital stock (years 1800-2010) is at least as robust a determinant of environmental policies as the corruption-control capital stock.

Potential policy implications are that it appears important to take history into account when selecting countries for corruption reform programs, and when designing such efforts. Our findings reinforce the recommendation by Mungiu-Pippidi (2006) that corruption reduction programs in developing countries and the transition economies need to address the root causes of corruption with deep and long-running reform programs that include the political sector.

The paper is structured as follows. Section 2 discusses the effects of corruption on the environment and develops our argument why the history of corruption-control matters, as well as the existing literature. Section 3 discusses our empirical approach and data. Section 4 reports our main results, while Section 5 presents our robustness analysis. Section 6 provides a conclusion.

2. Corruption and the Environment: Theory, Evidence, and Our Argument

The theoretical literature argues that corruption has a negative impact on social welfare by reducing environmental quality and resource conservation. Lopéz and Mitra (2000) study how corruption affects the Environmental Kuznets Curve (EKC). They find that corruption increases pollution levels above the socially optimal level and raises the income level at which the EKC turns downwards beyond the socially optimal level. Damania et al. (2003) and Fredriksson et al. (2004), e.g., provide models where the level of corruption is viewed as the relative importance of bribes versus social welfare to the government. With a greater emphasis on bribes, the government distorts environmental and energy policies away from the social optimum. Wilson and Damania (2005) consider political competition and corruption both among high-level politicians who set environmental policies, and lower-level bureaucrats who administer the resulting pollution standards. Lower-level corruption offers firms the opportunity to avoid the enforcement of environmental policies. Fredriksson and Svensson (2003) and Damania et al. (2004) discuss the interaction effects on environmental policy of corruption and political instability, and the latter paper in addition considers the role of the judiciary and regulatory compliance failures. Barbier et al. (2005) and Barbier (2010) show how corruption distorts resource conservation. Welsch (2004) and Cole (2007) argue that while a direct effect exists of corruption on environmental regulation, we should also consider an indirect effect. This indirect link goes from corruption to economic growth to pollution levels as suggested by the EKC hypothesis. Biswas et al. (2012) study the effect of the shadow economy (informal sector) and how it interacts with corruption in the determination of pollution levels.

Consistent with theory, the empirical literature shows that corruption has a negative effect on the stringency of environmental and energy policies, increases deforestation and air pollution, limits the access to public goods such as drinking water and sanitation, decreases natural capital, and affects Kyoto Protocol ratification (see, e.g., Fredriksson and Svensson, 2003; Damania et al., 2003; Fredriksson et al., 2004, 2007; Welsch, 2004; Barbier et al., 2005; Cole, 2007; Anbarci et al., 2009; Barbier, 2010; Leitão, 2010; Ivanova, 2011; Biswas et al., 2012).[1] Burgess et al. (2012) provide evidence of short run substitution between different forms of government corruption in Indonesia, in particular illegal deforestation and oil and gas revenue sharing. Pellegrini and Gerlagh (2006) show that while corruption is a highly important determinant of environmental policy outcomes, the level of democracy is of less importance: once corruption is included in the estimation, the size of its point estimate falls by at least 50 percent and ceases to be statistically significant. Oliva (2014) show how bribery enables drivers of older cars to circumvent car emission regulations in Mexico City. The literature has to the best of our

[1] See Holmberg et al. (2009) for a survey of the effects of governance and corruption on environmental sustainability.

knowledge not studied the effect of historical experience with corruption on environmental or any other policies.

Corruption: Why Should Historical Experience Matter?

The theories discussed above focus on the policy and environmental effects of the current corruption level. However, the environmental policies and pollution levels existing today are to a great extent the result of numerous historical policy, monitoring and enforcement choices, all influenced by the level of corruption at the time. Differences in current policy outcomes are therefore likely due to different historical experiences with corrupt activities, as previous policy and enforcement decisions set the stage for the next round of policy choices. Coate and Morris (1999) argue that interest groups will pursue strategies that raise their benefits from distorted policies. As they become more wedded to these policies over time, there is a higher probability that these policies persist. Thus, suppose a country is currently suffering from widespread corruption, but that it previously has experienced lower corruption levels. The policies determined under the earlier regime may persist as policies may not be dismantled immediately (Coate and Morris, 1999). Conversely, if a country is plagued by a history of corruption, even recent improvements in current corruption-control may be insufficient for changing policy outcomes. This view is reminiscent of the criticism leveled by Mungiu-Pippidi (2006) of corruption reduction programs in developing countries and the transition economies. If corruption is deeply entrenched in a "particularistic" political culture, reform programs that just borrow "best practices" from developed countries do not do enough to address the root causes of the problems. Deep and long-run reform programs that include the political sector appear to be needed.

One particular avenue through which the corruption-control capital stock may influence environmental policy making is by affecting expectations that a similar level of corruption-control will continue in the future (Damania et al., 2004). Damania et al. suggest that reform of the judiciary is a gradual process and improvements may be delayed due to bribery. If corruption is expected to remain high in the future (as the country has a small corruption-control capital stock) political advocates in favor of stricter environmental policies should have a lower incentive to expand effort and resources, as any policy reforms are unlikely to remain in future time periods.

Another reason why improvements in corruption levels may not have immediate effects is that environmental policy may be considered a "secondary policy" (List and Sturm, 2006). This policy area may not be the first policy priority, and a delay may therefore be expected in the upgrading of environmental standards and policies.

3. Empirical Approach and Data

We will test the hypothesis that a higher stock of corruption-control capital increases the stringency of climate change policies and global environmental cooperation. Our first and main dependent variable is a measure of the stringency of climate change policies across countries, namely Steves et al.'s (2011) Climate Laws, Institutions and Measures Index (*CLIMI*), based on the 2005-2010 annual national communications to the UNFCCC. *CLIMI* seeks to measure the policies countries have adopted to address climate change through mitigation (and not adaptation). The components of *CLIMI* are (relative weight and within-component sub-weights within parenthesis): international cooperation (0.1) (subgroups: Kyoto ratification (0.5), Joint Implementation or Clean Development Mechanism host (0.5)), domestic climate framework (0.4) (subgroups: cross-sectoral climate change legislation (0.33), carbon emissions target (0.33), dedicated climate change institution (0.33)), significant sectoral fiscal or regulatory measures or targets (0.4) (subgroups: energy supplies/renewables (0.3), industry (0.2), forestry (0.17), agriculture (0.13), transport (0.13), buildings (0.07)), and additional cross-sectoral fiscal or regulatory measures (0.1). *CLIMI* takes values between 0 and 1, where higher values represent stricter policies. Tonga has the lowest *CLIMI* score at 0.011, while the UK has the highest at 0.801. *CLIMI* is derived from information collected over the period 2005-2010. All values for our explanatory variables are averages over this time period. The second dependent variable is a measure of global environmental cooperation from Esty et al. (2005), the Global Environmental Cooperation Index (*GLOBAL*). This index is a combination of information pertaining to a country's number of memberships in environmental intergovernmental organizations, contribution to international and bilateral funding of environmental projects and development aid, and participation in international environmental agreements.

The independent variables of main interest are *ICRG* (*WB*) *Corruption-Control Current* and *ICRG* (*WB*) *Corruption-Control Capital*, with data taken from www.prsgroup.com/ICRG.aspx and www.govindicators.org, respectively. Corruption-control capital accumulates each year with an amount equal to the ICRG (WB) score, and depreciates at a rate $(1-\delta)$ per year. That is, a share δ remains of the prior year's capital stock. Let $h_{i,t}$ be the stock of democratic capital of country *i* in year *t*; $c_{i,t}$ is the corruption-control variable of country *i*. Corruption-control capital accumulates according to $h_{i,t} = c_{i,t} + \delta h_{i,t-1}$, where $h_{i,t_0} = 0$. We calculate and utilize values for ICRG and WB corruption-control capital for $t_0 = 1982$ and $t_0 =$ 1996, respectively, and assume $(1-\delta) = 0.06$, consistent with our measure of democratic capital, discussed below. However, our results are robust to using alternative assumptions about the depreciation rate (see section 5). Note that contrary to the democratic capital stock measure in Persson and Tabellini (2009) in which a dichotomous accumulation variable (a country is democratic or not) is used, we cannot use a dichotomous cut-off for corruption control since there is neither agreement in the literature where such a cut-off might lie, nor would any cut-off suggest itself in the source data. Both stock variables are re-scaled to fall into the 0 to 1 interval. For both *Corruption-Control Current* and *Corruption-Control Capital*, we therefore use the categorical ICRG data, which vary from 1 (most corrupt) to 6 (least corrupt), and the continuous WB data, which vary from -1.44 (most corrupt) to 2.45 (least corrupt).

As control variables, we include measures of the democratic capital stock and the current level of democracy, both building on the *polity2* variable from the Polity IV data set (Marshall and Jaggers, 2007). We create *Democratic Capital* using the 1800-2010 time period. *Polity2* takes values between -10 (strict autocracy) and 10 (consolidated democracy). We define democracies as those countries having a positive *polity2* score, following Persson and Tabellini (2009). *Current Democracy* is the average *polity2* value for years 2005-2010. Note that while democracy and corruption are not uncorrelated with each other, the two do not measure the same latent construct, either theoretically or empirically (current democracy correlates at r = .25 with *Corruption-control Current* if measured by ICRG and at r = .32 if measured by the WB measure). Following Persson and Tabellini (2009), the democratic capital stock accumulates in years in which a country is a democracy (an increase of one) but not when an autocracy, defined as a *polity2* values of 0 or below. Democratic capital depreciates at the same rate as corruption-control capital, $(1-\delta)$ per year. Let $z_{i,t}$ be the stock of democratic capital of country *i* in year *t*; $a_{i,t}$ is an indicator variable which takes a value of unity in years when country *i* is a democracy; zero otherwise. Democratic capital then accumulates according to $z_{i,t} = a_{i,t} + \delta z_{i,t-1}$, where $z_{i,t_0} = 0$. We calculate and utilize values for *Democratic Capital* for $t_0 = 1800$ and use

$(1-\delta) = 0.06,$. The resulting values are rescaled to lie in the range 0 to (converging to) 1 (by multiplying all calculated values by $(1-\delta)$), following Persson and Tabellini.

We measure lobbying and voters' incentives using two different variables. *CO_2 per capita emissions* (from World Bank, 2012) reflects consumers' incentive to bring about lower fossil fuel prices, and the fossil fuel producers' lobbying incentive to weaken climate change policies. Consequently, *CO_2 per capita emissions* reflects the amount at stake for CO_2 emitters, and their incentive to undertake lobbying activities. However, higher levels of per capita CO_2 may also imply lower marginal abatement costs (Fredriksson et al., 2007). While *CLIMI* and *GLOBAL* may already have affected *CO2 per capita emissions*, the resulting reverse causality should be sufficiently small not to create strong concerns about endogeneity. For example, our results are not affected by dropping this variable. *KP Commitment* measures the emission reduction commitment in percent emission reductions relative to 1990 (or an alternative base year) of Annex I countries under the Kyoto Protocol. Countries with a Kyoto Protocol commitment may be expected to set stricter climate change policies, as shown by Aichele and Felbermayr (2012). In the estimations reported below, *KP Commitment* equals zero for all non-Annex 1 countries as they do not have any emission reduction targets. The results are however fully robust toward setting this variable to -8 for all non-Annex 1 countries. -8 is the observed minimum among Annex 1 countries in the sample (Australia was permitted to increase its emissions by 8 percent, hence it scores -8).[2] We recognize that similarly to *CO_2 per capita emissions*, *KP Commitment* could also be subject to reverse causality if countries which anticipated to undertake future climate change policies were more willing to sign up to more stringent commitments under the

[2] Results for this alternative operationalization of *KP Commitment* are available upon request.

Kyoto Protocol. In the absence of plausibly valid instruments, in additional estimations we dropped this variable and found that the results uphold.

To control for the effect that non-Annex 1 countries have on this variable, we include a *Non-Annex 1 dummy*. *GDPpc* is per capita income in US$ in purchasing power parity (thousands), and captures the increased demand for environmental quality as income rises (World Bank, 2012). Table 1 provides descriptive statistics, including a number of further control variables included in our robustness tests.

In sum, we estimate variants of the following model using ordinary least squares (OLS):

$$
\begin{aligned}
CLIMI_i = {} & \alpha + ß_0 \, Corruption\text{-}control\ Current_i + ß_1 \, Corruption\text{-}control\ Capital_i \\
& + ß_2 \, KP\ Commitment_i + ß_3 \, Non\text{-}Annex\ 1\ dummy_i + ß_4 \, CO_2\ per\ capita\ emissions_i + ß_5 \, GDPpc_i \\
& + ß_6 \, Current\ Democracy_i + ß_7 \, Democratic\ Capital_i + \varepsilon_i \,, \qquad (1)
\end{aligned}
$$

where α is a constant, *i* denotes country, $ß_i$, i=0,.,7 are variable coefficients, and ε_i is the error term. The identical model is estimated for *GLOBAL* as dependent variable.

Since our sample is cross-sectional, we cannot control for unobserved country heterogeneity with the help of country fixed effects. We have attempted to account for the possibility that *Corruption-control Capital* is correlated with the error term by instrumenting for it in two-stage least squares, using as instruments either corruption-control in neighboring countries or a measure of the remoteness of the capital city based on Campante and Do (2010). However, in all instrumental variable regressions the instruments are weak, making it infeasible to present such models.

4. Empirical Results

The first set of OLS results are presented in Table 2. Due to the high correlation between *Corruption-control Current* and *Corruption-control Capital* (r = .88 for ICRG and r = .92 for WB measure), we start by including only the former. In Table 3, we include both. Models 1-4 use *CLIMI*, while Models 5-8 use *GLOBAL*. We start with the *CLIMI* models. In addition to our basic control variables, Models 1 and 3 use the ICRG and WB *Corruption-control Stock* measure, respectively, while Models 2 and 4 include the ICRG and WB *Corruption-control Current* measures, respectively. While the ICRG measures do not significantly affect *CLIMI*, both WB measures in Models 3-4 have positive and statistically significant effects.[3] Turning to the *GLOBAL* models, Models 5 and 7 use the ICRG and WB *Corruption-control Stock* measure, respectively, while Models 6 and 8 include the ICRG and WB *Corruption-control Current* measures, respectively. Models 5-8 all exhibit significant positive coefficients on the corruption-control measures.

Thus, overall we find evidence that both the current level of corruption-control and the stock of corruption-control matter for climate change policies and cooperation. However, we cannot determine which of these measures dominates. The WB corruption-control measures consistently have statistically significant effects, perhaps due to a higher number of observations. Another potential reason for these findings is that the World Bank measure is an aggregate composite of multiple sources and might thus provide a more reliable measure of a country's level of corruption control than the ICRG measure, which is based on experts' opinions with a view toward informing potential foreign investors.

[3] In additional estimations (available upon request), we find that this difference in results is not due to the larger sample size using the WB measures. If we artificially restrict Models 3-4 to the samples used in Models 1-2, the corruption-control measures based on the World Bank source continue to be statistically significant.

Turning to the control variables in Table 2, a number of our control variables are generally significant with the expected signs, including *KP Commitments*, *GDP per capita*, and *Democratic Capital*. *CO2 per capita emissions* was expected to have ambiguous effects. We find that it is consistently negative in all models, suggesting that higher emissions intensity makes voters and firms exert downward pressure on environmental policy stringency and cooperation.

In Table 3, we enter measures of both the current and the stock of corruption-control in each model. As mentioned above, the current and stock measures are highly correlated and estimation models with both included show relatively high variance inflation factors. We also add a *Current Democracy* dummy in four of the models. Overall, it appears that our two measures of corruption-control stocks (ICRG and WB) are more important than the corresponding measures of current corruption-control. *Corruption-control Stock* (ICRG) is significant in Models 3-4, while *Corruption-control Stock* (WB) is significant in Models 7-8; current corruption-control is significant only in Model 7 (and with a negative sign). Only models using *GLOBAL* exhibit significant corruption-control coefficients. Apart from a larger number of observations for these models than the *CLIMI* models (123 and 139 versus, respectively, 82 and 93), one has to keep in mind the high correlation between the current and stock of corruption-control variables. In our view, it is notable that despite this high correlation, *Corruption-control Stock* remains statistically significant in the models using *GLOBAL*, consistent with Table 2.

We note that our measures of corruption are not without criticism, and our findings should be interpreted in this light (see, e.g., Knack, 2007; Ko and Samajdar, 2010; Donchev and Ujhelyi, 2014; and the references therein).[4] One potential issue is, e.g., that past corruption may affect current values. While this is a concern, since our study seeks to take countries' historical

[4] The main contribution of this paper is to propose a measure of corruption which takes historical experience into account (using existing corruption measures) in the determination of climate change policies. We leave it for future research to study the possible advantages of alternative corruption measures for this line of research.

experience with corruption into account, we believe it is preferable to use a weighted average of past values rather than to simply use current values of corruption (which are possibly affected by historical experience, but to an uncertain degree). Moreover, since our results indicate that *Corruption-Control Capital* is a significant predictor when controlling for *Corruption-Control Current*, it appears likely that the former variable matters in addition to the latter variable.

The control variables in Table 3 show a pattern similar to Table 2. In particular, *Democratic Capital* is significant in all models. *Current Democracy* is marginally significant in only two models, and then with a negative sign. Once we control for *Democratic Capital Stock*, any apparent positive effect of *Current Democracy* on *GLOBAL* disappears, consistent with Fredriksson and Neumayer (2013).

5. Robustness Analysis

In Tables 4-6 we test the robustness of our inferences toward plausible changes in model specification. Table 4 adds a number of additional control variables to the estimation models reported in Table 2. We include *GDP per capita growth* (an average over the 2005-10 time period) since the growth rate may affect the likelihood of adopting stronger climate change policies. We additionally include a measure of *Climate Vulnerability* from Wheeler (2011) since more vulnerable countries might engage in stronger climate policies. However, note that *CLIMI* refers to mitigation measures rather than adaptation policies. A *Small Island State* dummy takes into account the urgency of policymakers to take action in countries threatened by sea-level rise; it comes from World Bank (2012). Again, however, since *CLIMI* refers to mitigation rather than adaptation, it is unclear whether one would expect a significant effect of this variable, not least given that small island nation states are typically not large emitters of greenhouse gases. *Trade Openness* is taken from World Bank (2012), measured as imports plus exports divided by GDP. Neumayer (2002) provides evidence that more open countries co-operate more on global environmental problems. *Political Stability*, sourced from Beck et al. (2001), affects the time horizon of politicians and thus their propensity to incur short-term cost in order to obtain long term benefits (Bohn and Deacon, 2000; Fredriksson and Wollscheid, 2014). Political stability fosters investment in "state capacity" (Besley and Persson, 2011), which in turn increases the provision of public goods. Legal origin has been shown to influence policymaking, institutions and economic growth in fundamental ways (La Porta et al., 1999); we utilize dummies for *French*, *Socialist*, *German*, and *Scandinavian Legal Origins* (*British Legal Origin* is the excluded category).

The results in Table 4 are fully robust toward the inclusion of further control variables.[5] Faster-growing countries tend to set stricter climate policies, though note that the effect is only marginally statistically significant in two regressions. Neither climate vulnerability nor small island status exert a significant effect. More politically stable countries have better climate policies, but generally do not co-operate more on global environmental issues. Trade openness does not matter, while countries with a French or Scandinavian legal origin are relatively more committed to global environmental co-operation. A socialist legal origin (somewhat surprisingly) appears to put more stringent climate policies in place.

In Table 5, we report results from regional jackknife robustness tests, where we drop the countries from one region (as defined by the World Bank) at a time. The purpose is to see whether the results are driven by any particular region. Due to space constraints, we apply the regional jackknife test to Models 1, 3, 5 and 7 of Table 2 only, i.e. the models that include the *Corruption-control Stock* (but not those that include *Corruption-control Current*). All other

[5] One may be concerned that because corruption-control capital is set to zero for all countries in the first year of each sample, we could under-estimate the effect of corruption-control capital considering that the actual experience with corruption started at an earlier point in time. In an additional robustness test we explore whether this initial under-estimation threatens our inferences. We set the initial value of corruption-control capital to the first available value of the corruption-control level rather than to zero. Our results are fully robust.

control variables are included in the estimation model, but their results are not reported. The results reported in Table 5 echo those in Table 2. We can therefore be quite certain that our inferences are not driven by countries from any one particular region.

In Table 6, we report results for alternative *Corruption-control Capital* depreciation rates (1%, 3%, 9%, and 12%) using the corresponding models from Table 2. The rationale is that it is unclear what a reasonable depreciation rate is, hence we use a range of depreciation rates from very low to very high to test whether our results depend on the specific rate of 6% assumed in the baseline model. Table 6 shows that this is not the case: The results are again fully robust.

6. **Conclusion**

This paper introduces the concept of a corruption-control capital stock, which takes a country's history of fighting corruption into account. We find that this historical measure of corruption affects current climate change policies and global environmental cooperation in (up to) 131 countries. An accumulated history of being relatively free of corruption facilitates achieving global cooperation on environmentally sustainable development (see Barbier and Markandya, 1990). The policy implications are that corruption reforms need to be deep and comprehensive and have a long term perspective, otherwise the effects of the bad old days are likely to persist.

References

Aichele, R., and G. Felbermayr (2012). Kyoto and the carbon footprint of nations. *Journal of Environmental Economics and Management* 63, 336-54.

Anbarci, N., M. Escaleras, and C.A. Register (2009). The Ill Effects of Public Sector Corruption in the Water and Sanitation Sector, *Land Economics* 85(2), 363-77.

Barbier, E.B. (2010). Corruption and the political economy of resource-based development: A comparison of Asia and Sub-Saharan Africa, *Environmental and Resource Economics* 46, 511-37.

Barbier, E.B. and A. Markandya (1990). The conditions for achieving environmentally sustainable development. *European Economic Review* 34(2), 659-669.

Barbier, E.B., R. Damania, and D. Léonard (2005). Corruption, trade and resource conversion. *Journal of Environmental Economics and Management* 50, 276-99.

Beck, T., G. Clarke, A. Groff, P. Keefer, and P. Walsh (2001). New tools in comparative political economy: the database of political institutions. *World Bank Economic Review* 15, 165–76.

Besley, T., and T. Persson (2011). *Pillars of Prosperity*. Princeton University Press, Princeton.

Biswas, A.K., M.R. Farzanegan, and M. Thum (2012). Pollution, shadow economy and corruption: Theory and Evidence. *Ecological Economics* 75, 114-25.

Bohn, H., R.T. Deacon (2000). Ownership risk, investment, and the use of natural resources. *American Economic Review* 90, 526-49.

Burgess, R., M. Hansen, B.A. Olken, P. Potapov, and S. Sieber (2012). The Political Economy if Deforestation in the Tropics, *Quarterly Journal of Economics* 127(4), 1707-54.

Campante, F.R., and Q.-A. Do (2010), A Centered Index of Spatial Concentration: Expected Influence Approach and Application to Population and Capital Cities, mimeo, Kennedy School, Harvard University.

Coate, S., S.E. Morris (1999). Policy Persistence. *American Economic Review* 89, 1327-36.

Cole, M.A. (2007). Corruption, income and the environment: An empirical analysis, *Ecological Economics* 62, 637-47.

Damania, R., P.G. Fredriksson, and J.A. List (2003). Trade Liberalization, Corruption, and Environmental Policy Formation: Theory and Evidence, *Journal of Environmental Economics and Management* 46(3), 490-512.

Damania, R., P.G. Fredriksson, and M. Mani (2004). The Persistence of Corruption and Regulatory Compliance Failures, *Public Choice* 121(3-4), 363-90.

Donchev, D. and G. Ujhelyi (2014). What Do Corruption Indices Measure? *Economics & Politics* 26(2), 309-31.

Farzin, H. Y. and Bond, C. A. (2006). Democracy and environmental quality. *Journal of Development Economics* 81, 213-35.

Fredriksson, P.G. and E. Neumayer (2013). Democracy and Climate Change Policies: Is History Important? *Ecological Economics* 95, 11-19.

Fredriksson, P.G. and J. Svensson (2003). Political Instability, Corruption and Policy Formation: The Case of Environmental Policy, *Journal of Public Economics* 87, 1383-1405.

Fredriksson, P.G., Neumayer, E., and G. Ujhelyi (2007). Kyoto Protocol Cooperation: Does Government Corruption Facilitate Environmental Lobbying? *Public Choice* 133, 231-51.

Fredriksson, P.G., H.R.J. Vollebergh and E. Dijkgraaf (2004). Corruption and Energy Efficiency in OECD Countries: Theory and Evidence, *Journal of Environmental Economics and Management* 47(2), 207-31.

Fredriksson, P.G., and J.R. Wollscheid (2014). Political Institutions, Political Careers and Environmental Policy, *Kyklos* 67(1), 54-67.

Holmberg, S., B. Rothstein, and N. Nasiritousi (2009). Quality of Government: What You Get, *Annual Review of Political Science* 12, 135-61.

Ivanova, K. (2011). Corruption and air pollution in Europe, *Oxford Economic Papers* 63, 49-70.

Kauffman, D., Kray, A., Mastruzzi, M. (2009). Governance matters VIII: aggregate and individual governance indicators, 1996-2008. World Bank Policy Research Working Paper No. 4978.

Knack, S. (2007). Measuring corruption: A critique of indicators in Eastern Europe and Central Asia. *Journal of Public Policy* 27(3), 245-91.

Ko, K. and A. Samajdar (2010). Evaluation of international corruption indexes: Should we believe them or not? *Social Science Journal* 47, 508-40.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A. Vishny, R. (1999). The quality of government. *Journal of Law, Economics & Organization* 15, 222-79.

Leitão, A. (2010). Corruption and the environmental Kuznets Curve: Empirical Evidence for sulfur, *Ecological Economics* 69, 2191-2201.

List, J. A. and D. M. Sturm (2006). How Elections Matter: Theory and Evidence from Environmental Policy, *Quarterly Journal of Economics* 121(4), 1249-81.

López, R. and Mitra, S. (2000). Corruption, Pollution and the Kuznets Environment Curve, *Journal of Environmental Economics and Management* 40(2), 137-50.

Mungiu-Pippidi, A. (2006). Corruption: Diagnose and Treatment, *Journal of Democracy* 17(3), 86-99.

Neumayer, E. (2002). Does trade openness promote multilateral environmental cooperation? *World Economy* 25, 815-32.

Oliva, P. (2014). Environmental Regulations and Corruption: Automobile Emissions in Mexico City, forthcoming, *Journal of Political Economy*.

Pellegrini, L. and R. Gerlagh (2006). An empirical contribution to the debate on corruption, democracy and environmental policy, *Journal of Environment and Development* 15(3), 332-54.

Persson, T. and G. Tabellini (2009). Democratic Capital: The nexus of political and economic change. *American Economic Journal: Macroeconomics* 1, 88-126.

Steves, F., Treisman, D., and A. Teytelboyn (2011). The Political Economy of Climate Change Policy in the Transition Region, Ch. 4 in The Low Carbon Transition, EBRD and The Grantham Research Institute on Climate Change and the Environment, LSE.

Wheeler, D. (2011). Quantifying vulnerability to climate change: implications for adaptation assistance. Working Paper 240. Center for Global Development.

Wilson, J.K., Damania, R. (2005). Corruption, political competition and environmental policy. *Journal of Environmental Economics and Management* 49, 516-35.

Table 1. Summary Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
CLIMI	88	0.36	0.23	0.02	0.80
GLOBAL	131	0.05	0.72	-1.69	1.74
KP Commitments	131	1.61	3.30	-8	8
Non-Annex 1 dummy	131	0.74	0.44	0	1
CO_2 *emission per capita*	131	4.63	5.74	0.02	31.16
GDP per capita	131	12.52	13.65	0.38	57.79
GDP per capita growth	131	0.03	0.03	-0.08	0.15
Democratic Capital	131	0.56	0.36	0	0.99
Current Democracy	130	0.73	0.43	0	1
Climate Vulnerability	131	19.27	18.64	-7.74	100
Trade Openness	129	84.96	36.89	0.22	203.83
Political Stability	130	0.12	0.10	0	0.5
Small Island State	131	0.02	0.12	0	1
French Legal Origin	131	0.44	0.50	0	1
Socialist Legal Origin	131	0.24	0.43	0	1
German Legal Origin	131	0.03	0.17	0	1
Scandinavian Legal Origin	131	0.03	0.17	0	1
Corruption-control Stock (ICRG)	115	0.36	0.15	0.12	0.77
Corruption-control Current (ICRG)	115	2.57	1.12	0.81	6
Corruption-control Stock (WB)	131	0.21	0.11	0.07	0.49
Corruption-control Current (WB)	131	-0.12	1	-1.63	2.45

Table 2. Main regressions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*
KP Commitments	0.0173***	0.0183***	0.0173***	0.0176***	0.0257*	0.0288*	0.0167	0.0190
	(0.00463)	(0.00475)	(0.00478)	(0.00476)	(0.0144)	(0.0163)	(0.0189)	(0.0177)
Non-Annex 1 dummy	-0.0483	-0.0314	-0.0363	-0.0381	0.303*	0.393**	0.323	0.327
	(0.0583)	(0.0585)	(0.0546)	(0.0544)	(0.161)	(0.180)	(0.201)	(0.198)
CO_2 per capita emissions	-0.0132***	-0.0117**	-0.0107**	-0.0111***	-0.0375***	-0.0402***	-0.0415***	-0.0438***
	(0.00458)	(0.00490)	(0.00423)	(0.00421)	(0.00975)	(0.0114)	(0.0110)	(0.0115)
GDP per capita	0.00830***	0.00718***	0.00497**	0.00550**	0.00976*	0.0129*	0.00576	0.0121
	(0.00195)	(0.00220)	(0.00237)	(0.00235)	(0.00549)	(0.00699)	(0.00802)	(0.00858)
Democratic Capital	0.131*	0.136**	0.116**	0.121**	0.339*	0.497***	0.568***	0.609***
	(0.0658)	(0.0616)	(0.0499)	(0.0506)	(0.185)	(0.177)	(0.180)	(0.185)
Corruption-control Stock (ICRG)	0.100				2.744***			
	(0.152)				(0.381)			
Corruption-control Current (ICRG)		0.0286				0.307***		
		(0.0227)				(0.0669)		
Corruption-control Stock (WB)			0.571**				3.983***	
			(0.249)				(1.027)	
Corruption-control Current (WB)				0.0540**				0.339***
				(0.0259)				(0.110)
Constant	0.175*	0.128	0.115	0.236***	-1.253***	-1.257***	-1.272***	-0.478*
	(0.0927)	(0.100)	(0.0813)	(0.0767)	(0.214)	(0.270)	(0.277)	(0.252)
Observations	77	77	88	88	115	115	131	131
Adj. R-squared	0.664	0.671	0.703	0.700	0.486	0.431	0.471	0.443

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

Table 3. Simultaneous inclusion of *Corruption-control Stock* and *Corruption-control Current*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*
KP Commitments	0.0185***	0.0184***	0.0171***	0.0173***	0.0274*	0.0268*	0.0130	0.0152
	(0.00471)	(0.00474)	(0.00475)	(0.00484)	(0.0155)	(0.0156)	(0.0178)	(0.0184)
Non-Annex 1 dummy	-0.0254	-0.0382	-0.0367	-0.0426	0.332*	0.238	0.288	0.212
	(0.0577)	(0.0615)	(0.0549)	(0.0576)	(0.174)	(0.179)	(0.191)	(0.197)
CO_2 per capita emissions	-0.0116**	-0.0120**	-0.0107**	-0.0106**	-0.0360***	-0.0372***	-0.0439***	-0.0424***
	(0.00495)	(0.00498)	(0.00422)	(0.00429)	(0.01000)	(0.0100)	(0.0103)	(0.0102)
GDP per capita	0.00729***	0.00713***	0.00508**	0.00482*	0.00825	0.00682	0.00640	0.00348
	(0.00226)	(0.00228)	(0.00234)	(0.00243)	(0.00585)	(0.00574)	(0.00738)	(0.00723)
Democratic Capital	0.148**	0.223*	0.116**	0.150*	0.344*	0.885***	0.586***	1.182***
	(0.0656)	(0.112)	(0.0502)	(0.0849)	(0.184)	(0.331)	(0.180)	(0.289)
Current Democracy		-0.0713		-0.0370		-0.495*		-0.554**
		(0.0965)		(0.0707)		(0.262)		(0.233)
Corruption-control Stock (ICRG)	-0.110	-0.155			2.386***	2.130***		
	(0.210)	(0.210)			(0.566)	(0.614)		
Corruption-control Current (ICRG)	0.0406	0.0399			0.0694	0.0497		
	(0.0315)	(0.0325)			(0.0908)	(0.0933)		
Corruption-control Stock (WB)			0.816	0.659			8.612***	7.229***
			(0.652)	(0.668)			(2.492)	(2.627)
Corruption-control Current (WB)			-0.0283	-0.0126			-0.519*	-0.407
			(0.0658)	(0.0670)			(0.279)	(0.285)
Constant	0.123	0.163	0.0587	0.109	-1.317***	-1.029***	-2.299***	-1.837***
	(0.100)	(0.118)	(0.161)	(0.175)	(0.247)	(0.283)	(0.585)	(0.645)
Observations	77	77	88	87	115	115	131	130
Adj. R-squared	0.667	0.666	0.700	0.693	0.484	0.498	0.481	0.500

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4. Robustness Tests: Further Control Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*
KP Commitments	0.0160**	0.0171**	0.0156**	0.0164**	0.0285**	0.0311**	0.0243	0.0263*
	(0.00711)	(0.00694)	(0.00647)	(0.00640)	(0.0128)	(0.0147)	(0.0165)	(0.0154)
Non-Annex 1 dummy	-0.0215	0.0172	0.0181	-0.000605	0.0822	0.0204	-0.0435	-0.0853
	(0.0903)	(0.0864)	(0.0780)	(0.0721)	(0.190)	(0.211)	(0.200)	(0.189)
CO_2/capita emissions	-0.00976*	-0.00859	-0.00830*	-0.00854*	-0.0232*	-0.0204	-0.0110	-0.0114
	(0.00554)	(0.00532)	(0.00421)	(0.00436)	(0.0123)	(0.0133)	(0.0132)	(0.0132)
GDP per capita	0.00995***	0.00922***	0.00718***	0.00757***	0.00495	0.00427	-0.00741	-0.00324
	(0.00269)	(0.00269)	(0.00253)	(0.00264)	(0.00679)	(0.00782)	(0.00793)	(0.00824)
GDP per capita growth	1.380	1.227	1.332*	1.444*	2.410	2.753	3.056	3.464
	(0.885)	(0.894)	(0.709)	(0.728)	(2.583)	(2.557)	(2.286)	(2.331)
Democratic Capital	0.127*	0.138*	0.119**	0.124**	0.328	0.418**	0.523***	0.539***
	(0.0717)	(0.0705)	(0.0535)	(0.0549)	(0.210)	(0.208)	(0.187)	(0.194)
Climate Vulnerability	0.000739	0.000767	0.000556	0.000519	0.00287	0.00269	0.00152	0.00160
	(0.00120)	(0.00120)	(0.00101)	(0.00109)	(0.00295)	(0.00360)	(0.00398)	(0.00419)
Trade Openness	-0.000157	-0.000258	-0.000415	-0.000356	-0.00137	-0.00134	-0.00116	-0.00102
	(0.000554)	(0.000546)	(0.000453)	(0.000438)	(0.00157)	(0.00168)	(0.00140)	(0.00146)
Political Stability	0.273*	0.306*	0.211	0.217	-0.260	-0.185	-0.356	-0.267
	(0.161)	(0.168)	(0.144)	(0.148)	(0.435)	(0.443)	(0.418)	(0.425)
Small Island State	0.0784	0.0984	0.0912	0.106*	-0.0862	-0.0994	-0.249	-0.238
	(0.0912)	(0.0937)	(0.0590)	(0.0605)	(0.247)	(0.254)	(0.227)	(0.237)
French Legal Origin	0.0867	0.101	0.108*	0.0990	0.225*	0.240	0.269**	0.270**
	(0.0713)	(0.0702)	(0.0585)	(0.0615)	(0.135)	(0.145)	(0.132)	(0.134)
Socialist Legal Origin	0.117	0.150*	0.164**	0.137*	-0.0476	-0.209	-0.298	-0.347*
	(0.0914)	(0.0881)	(0.0721)	(0.0737)	(0.224)	(0.235)	(0.201)	(0.204)
German Legal Origin	0.101	0.0982	0.102	0.0986	0.367	0.379	0.385	0.399
	(0.0869)	(0.0882)	(0.0817)	(0.0811)	(0.371)	(0.374)	(0.356)	(0.347)
Scandinavian Legal	0.113	0.0922	0.0897	0.0997	0.461**	0.568***	0.614***	0.668***
Origin	(0.0990)	(0.0909)	(0.0763)	(0.0764)	(0.176)	(0.187)	(0.163)	(0.157)
Corruption-control	0.158				2.145***			
Stock (ICRG)	(0.216)				(0.446)			
Corruption-control		0.0450				0.207***		
Current (ICRG)		(0.0316)				(0.0711)		
Corruption-control			0.836**				3.076***	
Stock (WB)			(0.348)				(0.992)	
Corruption-control				0.0714**				0.249**
Current (WB)				(0.0333)				(0.107)
Constant	-0.0518	-0.151	-0.172	0.0248	-0.947***	-0.727*	-0.800*	-0.170
	(0.161)	(0.167)	(0.134)	(0.110)	(0.343)	(0.422)	(0.407)	(0.344)
Observations	73	73	84	84	111	111	127	127
Adj. R-squared	0.673	0.686	0.730	0.722	0.486	0.445	0.521	0.501

Notes: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 5. Robustness Tests: Regional jackknives

Excluded region:	East Asia & Pacific	Eastern Europe & Central Asia	South Asia	Middle East & North Africa	Sub-Saharan Africa	Western Europe	North America	Latin America & Caribbean
Dependent variable:	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*
Corruption-control Stock (ICRG)	0.0282	0.263	0.102	0.00892	0.230	0.0607	0.162	0.0946
	(0.151)	(0.228)	(0.152)	(0.174)	(0.141)	(0.194)	(0.144)	(0.150)
Observations	68	56	76	70	66	61	75	67
Adj. R-squared	0.729	0.669	0.665	0.653	0.697	0.382	0.709	0.689

Excluded region:	East Asia & Pacific	Eastern Europe & Central Asia	South Asia	Middle East & North Africa	Sub-Saharan Africa	Western Europe	North America	Latin America & Caribbean
Dependent variable:	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*
Corruption-control Stock (WB)	0.557*	0.811***	0.568**	0.416	0.572**	0.657**	0.635***	0.552**
	(0.287)	(0.292)	(0.250)	(0.302)	(0.239)	(0.320)	(0.237)	(0.268)
Observations	78	60	87	81	74	72	86	78
Adj. R-squared	0.754	0.706	0.704	0.700	0.734	0.454	0.744	0.726

Excluded region:	East Asia & Pacific	Eastern Europe & Central Asia	South Asia	Middle East & North Africa	Sub-Saharan Africa	Western Europe	North America	Latin America & Caribbean
Dependent variable:	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*
Corruption-control Stock (ICRG)	2.873***	2.845***	2.810***	2.342***	2.664***	2.491***	2.795***	2.880***
	(0.386)	(0.578)	(0.383)	(0.387)	(0.445)	(0.452)	(0.391)	(0.391)
Observations	103	95	111	102	88	99	113	94
Adj. R-squared	0.522	0.467	0.494	0.482	0.556	0.289	0.483	0.519

Excluded region:	East Asia & Pacific	Eastern Europe & Central Asia	South Asia	Middle East & North Africa	Sub-Saharan Africa	Western Europe	North America	Latin America & Caribbean
Dependent variable:	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*
Corruption-control Stock (WB)	4.112***	3.890***	4.460***	2.683***	3.883***	3.601***	4.010***	4.932***
	(1.098)	(1.125)	(1.060)	(0.963)	(1.167)	(1.140)	(1.044)	(1.192)
Observations	117	105	125	118	98	115	129	110
Adj. R-squared	0.486	0.467	0.482	0.474	0.555	0.293	0.467	0.510

Note: Robust standard errors in parentheses. All models contain control variables (not reported for space reasons).

Table 6. Robustness Tests: Different corruption-control capital depreciation rates

Depreciation rate:	1 %	3%	9%	12%
Dependent variable:	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*
Corruption-control Stock (ICRG)	0.260	0.124	0.101	0.106
	(0.495)	(0.213)	(0.139)	(0.137)
Observations	77	77	77	77
Adj. R-squared	0.664	0.664	0.665	0.665

Depreciation rate:	1 %	3%	9%	12%
Dependent variable:	*CLIMI*	*CLIMI*	*CLIMI*	*CLIMI*
Corruption-control Stock (WB)	2.697**	0.992**	0.435**	0.370**
	(1.148)	(0.426)	(0.193)	(0.166)
Observations	88	88	88	88
Adj. R-squared	0.704	0.704	0.703	0.702

Depreciation rate:	1 %	3%	9%	12%
Dependent variable:	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*
Corruption-control Stock (ICRG)	8.774***	3.827***	2.475***	2.368***
	(1.262)	(0.539)	(0.350)	(0.349)
Observations	115	115	115	115
Adj. R-squared	0.482	0.484	0.483	0.477

Depreciation rate:	1 %	3%	9%	12%
Dependent variable:	*GLOBAL*	*GLOBAL*	*GLOBAL*	*GLOBAL*
Corruption-control Stock (WB)	18.67***	6.887***	3.044***	2.594***
	(4.695)	(1.749)	(0.797)	(0.690)
Observations	131	131	131	131
Adj. R-squared	0.474	0.473	0.470	0.468

Note: Robust standard errors in parentheses. All models contain control variables (not reported for space reasons).