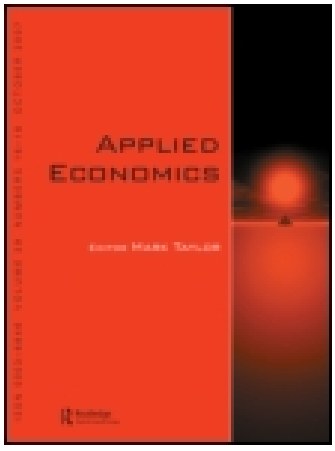

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Does democracy affect environmental quality in developing countries?

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This article examines the impact of democracy on environmental conditions in a large sample of developing countries for the period 1976–2003. This relationship is explored empirically using three indicators of environmental quality: carbon dioxide emissions, water pollution and deforestation damage. We find evidence that democracy is conducive to environmental improvement but that this result depends on the measure of the environmental quality that is used. We also find remarkable differences in results across our different sub-samples. The conclusion therefore is that there is no uniform relationship between democracy and the state of the environment.

I. Introduction

The poverty which afflicts much of the world's population is still prevalent despite decades of foreign aid and trillions of dollars in assistance. Poverty, of course, is not merely economic, but multidimensional and includes unequal opportunity for human development, low levels of participation in decision-making and a host of other deprivations. Often absent from this discussion is consideration of one important dimension of poverty that has received relatively less attention: the environmental quality faced by individuals in the developing world.

According to the United Nations *Human Development Report 2006*, more than 1 billion people are deprived of clean water and 2.6 billion people lack access to proper sanitation. Every year 1.8 million children die as the result of diseases caused by unclean water and inadequate sanitation. The poor health outcomes associated with deficits in water and sanitation undermine productivity, leaving the citizens of the Third World in a perpetual cycle of poverty. However, the problem is not just limited to water and sanitation. Excessive emission of greenhouse gases has led to global warming, which is having a pernicious impact on all countries, especially developing economies (see below). By all accounts, carbon dioxide (CO_2) is the primary anthropogenic engine of climate change.

Yet another measure of environmental change is the rate of forest degradation. It is agreed that deforestation is a major contributor to climate change since living trees absorb not only CO_2 but also sunlight which warms the earth. According to Walsh (2007), deforestation is responsible for about 20% of global carbon emissions, more than from all the cars, boats and planes in the world.

Discussion of the state of the environment around the globe and the potential costs of not preserving it has received widespread attention only since the

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release of the *Stern Review* to the British government in 2006. Among other things the *Review* warned that 'the poorest developing countries will be hit earliest and hardest by climate change' (Stern, 2007, p. 554) due to their large dependence on agriculture and their geography, since some are located in regions that are already climatically distressed.[1] Clearly at issue is not only unclean water, poor sanitation and unacceptable air quality, but also the loss of income and economic security that these bring. Droughts, floods and loss of crops undermine human development and exacerbate income inequalities that exist between rich and poor countries. Compounding this, as millions of women and girls must go in search of clean water for their families daily, gender inequalities in employment and education are also reinforced (United Nations, 2006).

In general, one would expect different measures of environmental quality in a poor country to be related to a number of factors, chief among them the level of income of the country and its stage of development.[2] Indeed, a number of recent papers show that as a country's income moves above a minimum level, its environmental quality improves. However, the discussion in these papers often ignores another possible determinant of the state of the environment, namely a country's level of democracy.[3] While democracy is likely to impact environmental quality, there is surprisingly limited formal empirical evidence on this issue. This article presents an empirical model that is used to investigate whether a developing country's level of democracy affects its environmental quality and therefore its citizens' overall well-being.

The remainder of the article proceeds as follows. The next section explains on theoretical grounds why there may be an association between environmental quality and democracy, and reviews the existing literature. Data sources, sample characteristics, the empirical model and the estimation technique are described in Section III. Section IV presents the results and their interpretation. From these results, it is clear that while democracy is generally conducive to environmental improvement, there is variation in results across the different sub-samples. Conclusions and policy recommendations are given in Section V.

II. Theoretical Background and Existing Evidence

Environmental quality embodies a set of characteristics that are best described as public goods. In the case of a public good, individuals do not have an incentive to pay their full personal valuation for the good and markets do not efficiently allocate resources. Government can then help ensure that the appropriate amounts of these goods (e.g. clean air, unpolluted rivers and lakes) are provided to the society. Given the income constraints faced by developing countries in particular, their governments can attempt to provide as high a level as possible of these goods. The key question in this article is whether the more democratic among these societies are able to achieve higher environmental qualities.

There are a number of reasons why the level of democracy should have a positive impact on environmental outcomes.[4] First is the public's greater access to information in a democracy, allowing them to be better aware of the environmental conditions and problems. This is facilitated in part by the existence of organizations that can operate unhindered to help inform and educate the public. Second is the public involvement in decision-making which may ensure that environmental priorities are conveyed to the decision-makers. An important element of this stage is the citizens' ability to protest against environmental transgressions. Third is the accountability of the parties involved beyond this point. On one level, polluters may be held accountable.[5] At another level, since the government is accountable to the people, it may fear adverse public reaction for not passing or enforcing laws that protect the environment. Fourth, totalitarian or autocratic regimes where leaders sometimes personally benefit from environmental

[1] See also Stern (2008). According to Conceicao (2003), if the concentration of CO_2 in the atmosphere reaches twice the pre-industrial era, the effect will be catastrophic, with developing countries losing 2 to 9% of their Gross Domestic Product (GDP).

[2] Of possible significance is also trade. For instance, Frankel and Rose (2002) find that increased trade may have a beneficial impact on certain forms of pollution. In the same vein, Shen (2008) finds that trade liberalizations in China increase air pollutants but reduce water pollutants.

[3] The impact of democracy has been discussed in the past, but the focus has been on whether more democratic governments have better prospects of extricating their nations from economic poverty or promoting their economic development. See, for example, Persson and Tabellini (2006) for a recent discussion.

[4] On theoretical grounds, democracy may also have a *negative* impact on the environment. Early writers such as Hardin (1968) and Heilbroner (1974) made the argument that freedom needs to be constrained to prevent environmental ruin – given an increasing resource scarcity and individuals' incentive to harvest the common good.

[5] Larger corporations have considerable economic and political powers. Democratic governments are in a better position to ensure that environmental interests of their citizens are not overridden by political pressures exerted by corporations.

degradation (e.g. through deforestation of lands owned by those in power or by the wealthy few with political clout) are more likely to have lower environmental standards and qualities. Finally, there may be a herd instinct among a collective of democratic governments (Arvin *et al*., 1998). That is, governments may attempt to stay within a 'club', matching each others' positive environmental actions.

Based on the theoretical discussion above, we posit that less democratic countries have worse environmental conditions.[6] Surprisingly, this proposition has only recently been formally empirically tested. For instance, Shafik (1994) finds that dissolved oxygen in rivers improves with political liberties. Bhattarai and Hammig (2004) find that the quality of governance is an important determinant of forest resource preservation, while their earlier study (Bhattarai and Hammig, 2001) examining the correlation between democracy and deforestation rates concludes that the results are region-dependent. Utilizing three types of urban air pollution, Winslow (2005) detects a negative relationship between the pollutant concentrations and the level of democracy. Pellegrini and Gerlagh (2006) analyse the relative importance of democracy and corruption as determinants of environmental policy. They find that while corruption is a significant determinant, democracy has an insignificant impact. Fredriksson and Wollscheid (2007) discover that democracy positively affects environmental policy stringency but that this result is largely driven by the parliamentary democracies (as opposed to the presidential-congressional, proportional or majority systems).

Most of these studies explore the relationship between the level of democracy and a single measure of environmental quality in the context of *all* countries – often with no particular focus on the developing world. They also use data from the 1980s and earlier.[7] By contrast, the present study spans nearly three decades, uses the most recent data available, considers a large sample of developing countries, and utilizes three distinct measures of the state of the environment.[8]

III. Data, Variables and Model Specification

The relationship between democracy and environmental quality is examined using the data from a total of 141 developing countries from 1976 to 2003.[9] As is apparent, our data is cross-section time-series. The obvious advantage of using panel data is that it provides a large number of data points, thereby increasing the degrees of freedom and reducing possible collinearity among the independent variables.[10]

Three measures of environmental quality are used: CO_2 emissions, water pollution emissions and deforestation damage. CO_2 and water pollution emissions are both measured in kilograms of discharge per capita. Deforestation damage is in constant 2000 US dollars per capita. While these measures are used seperately by different researchers in the field, to our knowledge this is the first study that treats these three indicators of environmental quality together. Data on all these measures are from World Bank (2007).

The democracy data is from the *Freedom in the World* database released by Freedom House (2007), which provides two sets of ratings for all countries: one on the basis of political rights and the other on civil liberties. Each of the two numerical ratings (given on a scale of one to seven) is generated based on a detailed assessment of country situations, with lower values indicating *freer* societies. This study uses the average of the political rights and civil liberties ratings as the measure of the level of democracy.[11]

In estimating the impact of democracy on the environment our empirical model also uses a number of control variables which are included to provide reliable parameter estimates. The first set of these controls is introduced to capture the level of economic development of a country as well as its pace of change. Thus, the natural logarithm of per capita GDP in constant 2000 US dollars, its square and the annual growth rate of real per capita GDP are introduced into the model. The second set of the control variables accounts for the possible benefit or harm to the environment through urbanization and

[6] Analogously, one may expect a positive correlation between corruption and environmental degradation. Recent discussions of a possible relationship include Lopez and Mitra (2000), Welsch (2004) and Damania (2005).
[7] Compared with earlier studies, Fredriksson and Wollscheid (2007) use more recent data, but their panel consists of data from the late 1990s only. Pellegrini and Gerlagh (2006) utilize a longer time span, but use only a few years from the 1990s.
[8] Conjointly, the article extends the literature by looking at more countries over a longer time period.
[9] Our data is an unbalanced panel. That is, some countries have more observations than others. The list of countries and the number of observations per country is available upon request.
[10] Hsiao (1986) and Baltagi (1995) *inter alia* discuss the advantages and shortcomings of using panel data analysis.
[11] Even though freedom and democracy are not synonymous, many of the questions that are used to generate the ratings address the notion of democracy directly. As the result, a number of recent studies (e.g. Barro, 1996; Arvin and Barillas, 2002) use the Freedom House ratings as their measure of democracy.

population growth. Hence, urban population as a percentage of total population and population per square kilometre are added to the model. Data on all these variables are obtained from World Bank (2007).

A brief justification for the inclusion of these variables is in order. As discussed in the literature on the environmental Kuznets curve, countries at the early stage of their development may suffer from an initial phase of environmental deterioration similar to the experience of many countries at the beginning of the Industrial Revolution: higher level of economic activity, creation of new transportation routes and use of inefficient sources of energy all lead to increased pollution. However, as the countries' incomes rise, they may be able to afford a higher level of environmental quality through setting and enforcing higher environmental standards since resources become available for environmental protection and cleanup where necessary. That is to say that beyond a minimum level of income, environmental quality becomes a normal good.[12] It is for this reason that our empirical model includes a squared income term to account for a possible Kuznets effect as found in earlier studies. Notwithstanding these arguments, it is also possible that the faster the pace of development of a country, the greater the strain on its environmental resources, explaining why the rate of income growth is also included as an explanatory variable in our model.

The likely impact of the second set of controls is equally complex. On the one hand, as people flock to cities for work, the demand on the environment and natural resources increases. Possible environmental consequences include the growth of slums and destruction of natural habitat, as well as water and air pollution. Thus, a higher degree of urbanization and population density may have a pernicious impact on the environment through the generation of additional greenhouse gases and stresses on forest resources and water supply. On the other hand, additional opportunities for education, productivity and income-generation for a formerly rural population may consequently have a positive impact on the environment. It is also easier to provide clean water to individuals living closer together than to those in dispersed rural communities.

Based on the discussion above, the reduced form empirical model used in this study is given by Equation 1:

$$E_{it} = \beta_i + \lambda_1 D_{it} + \lambda_2 Y_{it} + \lambda_3 Y_{it}^2 + \lambda_4 G_{it} + \lambda_5 U_{it} + \lambda_6 P_{it} + \mu_{it} \quad (1)$$

where the subscript i denotes each country in the sample and the subscript t refers to year. E_{it} is a measure of environmental quality, β_i is the intercept term for i, λ_j ($j = 1, \ldots, 6$) denotes the coefficients to be estimated, D_{it} is the index of democracy, Y_{it} is the log of per capita GDP, G_{it} is the growth rate of per capita GDP, U_{it} is the urban population percentage, P_{it} is the population density, and μ_{it} is a random error term satisfying the usual conditions.

Equation 1 is estimated using Generalized Least Squares (GLS) with a fixed effect per country and per year.[13] The fixed effect panel regression technique used here captures the structural idiosyncrasies and historical differences across countries by allowing each cross-section data set to have a separate intercept term.[14] At the same time, the technique permits estimation of the common coefficients for the explanatory variables (Greene, 2000). This procedure is most useful in cross-country studies where the sample is not randomly drawn from the population. Our regressions, of course, include adjustments to the SEs to accommodate heteroskedasticity and autocorrelation.

IV. Estimation Results and Discussion

The results of the regressions from Equation 1 are presented in Tables 1–3. As is evident from the tables, even though our model incorporates fixed effects, these are not reported as there are many and they are themselves uninteresting. The fixed effects merely act as controls in the model to provide reliable estimates of the impact of democracy on environmental quality.

Results are first presented for the entire sample of developing countries. The sample is then divided into

[12] Thus, the environmental Kuznets curve is an inverted U-shaped relationship between income (as the measure of the level of economic development) and environmental degradation (as defined by pollution, deforestation, etc.). The name originates from Kuznets' proposed inverted U-shaped relationship between income growth and income inequality. See, for example, Selden and Song (1994), Grossman and Krueger (1995), Holtz-Eakin and Selden (1995), Hilton and Levinson (1998), Lekakis and Kousis (2001) and Sobhee (2004) for a discussion.

[13] A GLS regression is superior to an Ordinary Least Squares (OLS) procedure in this case. In a GLS model, the fixed effects are estimated by weighted least squares. Under such procedure, the weight for each observation is different and is the reciprocal of the normalized SD of the disturbance for the observation obtained from an OLS estimation. By contrast, OLS gives an equal weight to each observation. GLS corrects for this by giving less weight to the outliers.

[14] By controlling for country fixed effects, the problem of omitted variables bias, which seriously afflicts cross-country regressions, is reduced.

Table 1. Results for CO_2 emissions

			By income group					
	Full sample		1		2		3		4	
Democracy index	0.1648***	(0.0265)	−0.0125	(0.0133)	0.1666***	(0.0374)	0.3475***	(0.0620)	−0.0373	(0.6908)
Per capita GDP	−15.7017***	(4.0557)	−9.3900***	(2.5383)	−19.2963***	(3.2688)	−21.7540***	(4.1367)	−113.6344**	(51.7339)
Per capita GDP-squared	1.1077***	(0.2607)	0.7211***	(0.1799)	1.3180***	(0.2105)	1.4333***	(0.2511)	6.1563**	(2.7191)
Growth rate	−1.2950***	(0.4275)	−0.5369**	(0.2445)	−1.4093***	(0.4117)	−1.9578**	(0.8870)	−4.6486	(5.7352)
Urban pop percentage	0.0279	(0.0196)	0.0386***	(0.0066)	0.0545***	(0.0088)	−0.0305*	(0.0187)	0.3022*	(0.1717)
Population density	−0.0007	(0.0005)	−0.0002	(0.0003)	0.0082***	(0.0025)	0.0260***	(0.0065)	−0.0013	(0.0010)
Observations	3428		1256		1109		809		254	
	By region									
	Central Asia		East Asia and Pacific		Eastern Europe		Latin America and Caribbean			
Democracy index	−0.1293	(0.1240)	0.0876**	(0.0410)	0.2956***	(0.0911)	0.0719*	(0.0414)		
Per capita GDP	−4.0585	(5.5192)	−17.4520***	(1.4778)	−27.0531***	(3.9084)	−8.1692*	(4.8021)		
Per capita GDP-squared	0.3752	(0.3638)	1.2047***	(0.0982)	1.7677***	(0.2395)	0.5582*	(0.2905)		
Growth rate	−0.7228	(1.4383)	−0.5205	(0.5559)	−0.2713	(0.7520)	0.8032	(0.7004)		
Urban pop percentage	0.1588**	(0.0728)	0.0459***	(0.0107)	0.0236	(0.0428)	−0.0251*	(0.0137)		
Population density	0.0040	(0.0458)	−0.0012***	(0.0004)	0.0057	(0.0054)	0.0055***	(0.0018)		
Observations	131		438		395		813			
	Middle East and North Africa		South Asia		Sub-Saharan Africa					
Democracy index	−0.1906	(0.3843)	0.0103	(0.0072)	−0.0158	(0.0161)				
Per capita GDP	−44.6638***	(14.5472)	−7.9588***	(2.0376)	−12.2557***	(1.7280)				
Per capita GDP-squared	2.6837***	(0.8739)	0.6152***	(0.1359)	0.8770***	(0.1218)				
Growth rate	−2.4710	(2.6679)	−0.1918	(0.1757)	−0.5022	(0.5020)				
Urban pop percentage	0.0362	(0.1027)	0.0672***	(0.0112)	−0.0589***	(0.0152)				
Population density	0.0058	(0.0038)	−0.0007***	(0.0002)	0.0042***	(0.0016)				
Observations	394		140		1117					

Notes: SEs are shown beside the coefficients. The income groupings are: 1: low-income countries; 2: lower middle-income countries; 3: upper middle-income countries; 4: high-income countries.
*, ** and *** denote significance at 10, 5 and 1% levels, respectively.

Table 2. Results for water pollution emissions

			By income group					
	Full sample		1		2		3		4	
Democracy index	0.4589***	(0.0652)	0.0729*	(0.0431)	0.7521***	(0.1270)	0.2425***	(0.0862)	0.2938	(0.3134)
Per capita GDP	5.8957***	(2.2927)	−37.3418***	(6.6523)	−5.0347	(5.7425)	12.8505	(28.3841)	3.5365	(13.8976)
Per capita GDP-squared	−0.2102	(0.1412)	2.7493***	(0.4537)	0.4102	(0.3718)	−0.5471	(1.6186)	−0.1642	(0.7184)
Growth rate	−1.7718***	(0.6218)	−1.9696**	(0.9144)	−1.3831	(0.9814)	−0.6405	(1.5430)	−1.2251	(2.4575)
Urban pop percentage	0.0918***	(0.0187)	0.0753***	(0.0227)	0.2343***	(0.0355)	0.0825**	(0.0376)	0.0452	(0.0531)
Population density	−0.0008***	(0.0003)	0.0046***	(0.0016)	0.0583***	(0.0120)	0.0770***	(0.0201)	−0.0007***	(0.0003)
Observations	1550		416		556		427		151	
	By region									
	Central Asia		East Asia and Pacific		Eastern Europe		Latin America and Caribbean			
Democracy index	0.5930*	(0.3239)	0.4113***	(0.0627)	0.9741***	(0.2168)	−0.0023	(0.0688)		
Per capita GDP	5.4673	(18.1475)	6.6708***	(2.4790)	4.2413	(7.7882)	48.9631***	(12.0882)		
Per capita GDP-squared	−0.3044	(1.1485)	−0.3769**	(0.1585)	−0.1647	(0.4801)	−2.7550***	(0.7023)		
Growth rate	−2.2702	(1.3563)	0.8137	(1.0566)	−2.7674	(1.8753)	1.3661	(1.2027)		
Urban pop percentage	0.1928	(0.2058)	0.1347***	(0.0356)	0.0131	(0.1739)	0.0245	(0.0416)		
Population density	0.0204	(0.0727)	−0.0005	(0.0004)	0.0239***	(0.0077)	0.0429***	(0.0096)		
Observations	63		197		251		369			
	Middle East and North Africa		South Asia		Sub-Saharan Africa					
Democracy index	−0.1703*	(0.0897)	−0.2235***	(0.0595)	−0.0071	(0.0479)				
Per capita GDP	−0.7444	(5.2703)	−25.5781	(24.6865)	−16.8986***	(3.8924)				
Per capita GDP-squared	0.1628	(0.2816)	1.4465	(1.6421)	1.2138***	(0.2624)				
Growth rate	−0.0444	(0.8670)	7.1026**	(3.4387)	0.8671	(0.6971)				
Urban pop percentage	0.1330***	(0.0284)	−0.1482	(0.1561)	−0.0333	(0.0281)				
Population density	−0.0214***	(0.0055)	0.0027	(0.0038)	0.0149	(0.0130)				
Observations	214		85		371					

Notes: SEs are shown beside the coefficients. The income groupings are: 1: low-income countries; 2: lower middle-income countries; 3: upper middle-income countries; 4: high-income countries.
*, ** and *** denote significance at 10, 5 and 1% levels, respectively.

Table 3. Results for deforestation damage

			By income group							
	Full sample		1		2		3		4	
Democracy index	−0.1344***	(0.0332)	−0.1117***	(0.0442)	0.0698	(0.0476)	−0.2405***	(0.0726)	−0.1744	(0.2533)
Per capita GDP	0.1786	(1.2706)	2.0030	(3.0847)	0.3281	(3.4527)	−3.8471	(4.2492)	41.0459***	(16.0405)
Per capita GDP-squared	−0.0438	(0.0807)	−0.1507	(0.2114)	−0.0677	(0.2113)	0.2125	(0.2585)	−2.2061***	(0.8380)
Growth rate	1.5477***	(0.4571)	0.3896	(0.4889)	0.0112	(0.7396)	5.0518***	(1.2276)	3.8626**	(1.8931)
Urban pop percentage	−0.0066	(0.0085)	0.0781***	(0.0167)	0.0196	(0.0143)	−0.0601***	(0.0175)	−0.0126	(0.0366)
Population density	0.0002	(0.0001)	−0.0009	(0.0009)	−0.0043	(0.0028)	−0.0235***	(0.0063)	0.0009***	(0.0002)
Observations	3441		1360		1119		750		212	
	By region									
	Central Asia		East Asia and Pacific		Eastern Europe		Latin America and Caribbean			
Democracy index	−0.0242	(0.0374)	−0.1980**	(0.0813)	−0.7526***	(0.2155)	0.0545*	(0.0325)		
Per capita GDP	−1.1840	(1.4567)	1.7196	(3.3834)	−5.1778	(9.8054)	6.3713**	(2.6159)		
Per capita GDP-squared	0.1161	(0.1016)	−0.1283	(0.2084)	0.3003	(0.5916)	−0.3687**	(0.1577)		
Growth rate	0.6319	(0.3929)	0.3849	(1.0146)	1.1826	(2.2005)	1.1580	(0.8135)		
Urban pop percentage	−0.0648**	(0.0287)	−0.1025***	(0.0296)	−0.6162***	(0.1199)	0.0072	(0.0095)		
Population density	0.0340***	(0.0126)	0.0002	(0.0003)	0.2279***	(0.0812)	−0.0032*	(0.0019)		
Observations	119		439		351		768			
	Middle East and North Africa		South Asia		Sub-Saharan Africa					
Democracy index	−0.0010	(0.1042)	0.0503***	(0.0166)	−0.2015***	(0.0550)				
Per capita GDP	8.1927**	(4.2232)	11.4476***	(3.3215)	2.9571	(1.9046)				
Per capita GDP-squared	−0.4786**	(0.2396)	−0.7124***	(0.2173)	−0.2335*	(0.1214)				
Growth rate	−0.2629	(0.6012)	−1.1438*	(0.6672)	0.1572	(0.5424)				
Urban pop percentage	0.0501***	(0.0161)	0.0126	(0.0222)	0.0694***	(0.0139)				
Population density	−0.0006	(0.0008)	−0.0014***	(0.0003)	0.0131***	(0.0031)				
Observations	392		150		1222					

Notes: SEs are shown beside the coefficients. The income groupings are: 1: low-income countries; 2: lower middle-income countries; 3: upper middle-income countries; 4: high-income countries.
*, ** and *** denote significance at 10, 5 and 1% levels, respectively.

several sub-groups based on the income and region. The income-based sub-samples, using the World Bank's definitions, are low-income countries, lower middle-income countries, upper middle-income countries and high-income countries. The sub-samples based on region divide countries into the categories of Central Asia, East Asia and Pacific, Eastern Europe, Latin America and the Caribbean, Middle East and North Africa, South Asia, and sub-Saharan Africa.

The first remarkable general observation about the results is the fact that there are differences among income-based groups. The fact that these differences are not accounted for by the GDP variables suggests the existence of complex income effects (see below).

Results of the model explaining water pollution and CO_2 emissions are provided in Tables 1 and 2, respectively. From the total sample regression it is evident that the coefficient on the democracy index is positive and statistically significant for both water and CO_2 pollution. That supports our main conjecture that less democratic countries have worse environmental qualities.

On the other hand, the coefficients on income variables are not always as expected. Hence, our findings *cannot* confirm the existence of the commonly reported Kuznets effect delineated in the previous literature. For CO_2, in the complete sample the per capita GDP coefficient is negative and significant and the square of per capita GDP is positive and significant indicating the *opposite* of the Kuznets effect. CO_2 emissions ultimately rise with increasing GDP. This is also true for all sub-groupings, both by income group and by region (except for Central Asia where the coefficients are insignificant).

For water pollution, in the complete sample the squared per capita GDP coefficient is insignificant though it is negative, while the per capita GDP coefficient is positive and significant. Therefore, there is a possible Kuznets effect, but it is not strong. Differences do appear when the sample is broken down either by income group or by region. For example, for income groups 1 (low-income) and 2 (lower middle-income) the signs are reversed on the coefficients on per capita GDP and its square, though they are significant only for income group 1. The signs are as expected (positive on per capita GDP and negative on its square) for income groups 3 (upper middle-income) and 4 (high-income) but they are not significant. By regions, where the coefficients are significant, they are of the expected signs in two out of three regions. That is, in East Asia and Pacific and in Latin America and the Caribbean, the Kuznets effect is evident; for sub-Saharan Africa, the opposite is true.

Results for CO_2 emissions by income group indicate that the coefficient on the democracy index is positive and significant for middle-income countries. Thus, greater democracy has a beneficial influence on CO_2 emissions in both upper and lower middle- income countries, but not in income groups 1 and 4 where the coefficient is negative and insignificant. Results for water pollution by income group are similar except that democracy is also significant for income group 1 with a positive coefficient. Thus, for both pollutants, democracy is not significant for the high-income group. It is possible that there is less variation in CO_2 and water emissions in this group so the coefficient on the democracy index for it is insignificant.

Results for CO_2 by region reveal that the coefficient on democracy is significant for only two regions – East Asia and Pacific, and Eastern Europe – and marginally significant for Latin America and the Caribbean. We conclude that since the results on democracy broken down by region are rather weak, but seem stronger (i.e. more consistent) by income group, then perhaps income effects are a stronger influence on CO_2 emissions than are regional differences.

For water pollution the regional effects are more pronounced. The democracy coefficients are positive and significant for Central Asia, East Asia and Pacific, and Eastern Europe. However, they are negative and significant for South Asia and marginally significant and negative for Middle East and North Africa. This suggests there may be important regional influences on the determinants of water pollution that are not captured in our model. In that sense, water pollution differs from air pollution – with the latter being more clearly influenced by the level of democracy.

Turning to results for deforestation (Table 3), it is apparent that there is a Kuznets effect in high-income countries as well as in countries in Latin America and the Caribbean, Middle East and North Africa, and South Asia. Elsewhere, the coefficients are insignificant. The key revelation from Table 3, however, is that the democracy coefficient is *negative* and significant for the complete sample regression compared to the positive and significant results obtained for CO_2 and water pollution. There are however some differences when the sample is broken down by income group and region, but there is no obvious pattern. For example, the democracy coefficient is negative for income groups 1 and 3, and insignificant for income groups 2 and 4; and the only two regions for which the democracy coefficient is significant and

positive are South Asia and Latin America and the Caribbean.[15] A plausible explanation for this result is that a stronger government can better regulate and therefore better manage the exploitation of a common resource. If the state enjoys some benefit from properly regulating forest management, it is possible to see less deforestation in more tightly controlled (i.e. less democratic) countries. The tight control does not lead to less water pollution and CO_2 emissions because the state itself receives no benefit from reducing emissions. There is a benefit from managing a renewable resource but no benefit and in fact a cost from reducing emissions.

Finally, from the full sample it is clear that higher growth rates for the economy reduce both water and CO_2 pollution, but increase deforestation – although these results are not robust and are sample-dependent. In the same vein, from the full sample urban population and population density are important determinants of water pollution, with no significant impact on air quality or deforestation. But, once again, the results change when the sample is divided by income group or region.

V. Concluding Remarks

This article contributes to the literature on the environmental Kuznets curve by examining the effect of income on three measures of environmental quality. Results indicate the presence of an *inverse* Kuznets curve for CO_2 emissions. For water pollution, the results are mixed, with both normal and inverse-shaped curves, depending on the sub-sample that is used. For deforestation, the Kuznets effect is present, but in only a few of the sub-samples. These results run counter to our expectation and to much of the recent literature supporting the existence of a Kuznets curve for the environment. Clearly, the results depend on the measure of the environmental quality that is used.

However, the core contribution of this study is its investigation of the relationship between the level of democracy and environmental quality. While our panel estimation suggests that a number of variables impact the quality of the environment, we fail to detect any uniform impact of democracy in this regard – although deforestation appears to have markedly different results in our full sample compared with CO_2 and water pollution. Given our mixed results on the relationship between democracy and various aspects of environmental quality, the commonly held sentiment concerning the positive effect of democracy on the environment has to be re-examined.

The fact that there are income and regional differences in the results can be attributed to the heterogeneity among developing countries and the multifaceted nature of the relationship between democracy and the state of the environment. Case studies probing deeper into the exact nature of this relationship may be a fruitful area for future research. Nonetheless, the results of this study should inform policy makers on the appropriate course of action towards developing economies. At a fundamental level, world leaders and activists ought not push for democracy in these countries on the presumption that this will necessarily lead to better environmental quality for the poor. For instance, according to our results greater democracy leads to cleaner air in middle-income countries, but not elsewhere. At the same time, higher democracy promotes cleaner water only in certain parts of Asia, the Pacific and Eastern Europe. Analogously, while promotion of democracy reduces deforestation in certain regions, elsewhere the result is the opposite. Somewhat surprisingly, more democratic conditions improve certain measures of environmental quality, but worsen others. Thus, our results should give pause to those who prescribe the same pill to cure the environmental maladies of the poorer countries and the planet as a whole.

Finally, the results of this article should to be interpreted in the spirit in which the exercise is conducted. That is, we do not offer specific policy recommendations for individual countries. Nonetheless, our cross-country study would be useful for validating or refuting some of the key results in the literature and in providing clues for the general direction of public policy towards developing countries.

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[15] Bhattarai and Hammig (2001) also find a diverse pattern of results in their study of the relationship between deforestation and regime type. However, their results with respect to different regions are different compared to ours. They find that in Africa and Latin America more democratic countries have less deforestation, with the opposite result being true for Asia.

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