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Democracy and Environmental Quality in Latin America: A Panel System of Equations Approach, 1995-2008

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Democracy and Environmental Quality in Latin America: A Panel System of Equations Approach, 1995-2008

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Introduction – I. Democracy and the Environment: Some of the Literature – II. Democracy and Environmental Quality: The Theory – III. Democracy and Environmental Quality: The Empirical Relationship – IV. Limitations of this Study

Resumen:

Esta investigación sugiere que un incremento del 10% en los niveles de democracia en América Latina reduce hasta en 0.6% el nivel de emisiones per capita de CO_2 (calidad ambiental). Esta relación se estima mediante un sistema de ecuaciones de panel de datos aplicado a 19 países latinoamericanos en el periodo 1995-2008. La democracia actúa como un medio para las crecientes demandas de calidad ambiental en América Latina causadas por el incremento en la población urbana y niveles de desarrollo. Sin embargo, esta investigación tiene, por lo menos, dos limitaciones: primero, no analiza la relación de largo plazo entre democracia y calidad ambiental en América Latina; y, segundo, este estudio supone que la democracia es un sistema político solo con consecuencias positivas.

Palabras clave: América Latina, calidad ambiental, democracia, emisiones per capita de CO_2, sistema de ecuaciones de panel.

Abstract:

This study finds that a 10% increase in the level of democracy in Latin America reduces (raises) CO_2 emissions per capita (environmental quality) by up to 0.6%. This relationship is estimated by using a fixed effects panel system of equations for 19 Latin American countries in the period 1995-2008. Democracy serves as a conduit for increasing demands on environmental quality in Latin America, due to increases in urban population and prosperity. Nevertheless, this study has, at least, two caveats: first it cannot unveil the long run relationship between democracy and environmental quality in Latin America; and, secondly, this study assumes that democracy entails positives outcomes for countries adopting this political system.

Key Words: Democracy, Environmental Quality, CO_2 Emissions per Capita, Latin America, Panel System of Equations.

JEL Classification: C33, N46, Q53, Q56

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Introduction

Democracy has a positive effect on environmental quality in Latin America. This paper will analyze this relationship and the other confounding factors that influence this outcome. Although previous papers have found positive, none and negative relationships between democracy and environmental quality this paper finds a positive relationship. Specifically, this paper finds that more democracy in Latin America reduces the levels of CO_2 emissions.

Finding a positive association between democracy and environmental quality in Latin America was expected. Democracy acts as a conduit allowing social demands to be set as priorities by policymakers. Since more democracy implies more political accountability, more political activism, more freedom of speech and more freedom of press, social movements and social coalitions then environmental sustainability may be incorporated in the political agenda. In fact, democracy guarantees that raising awareness is possible hence influencing public opinion and electoral outcomes. Therefore, public opinion influences public policies through democracy.

Although democracy is not the panacea or the cure of all evils for Latin America, it does vindicate political participation and protest as a legitimate way of influencing public policies. This leads to lower levels of corruption, higher commitment with social demands and more equality. Thus democracy encourages political participation and with it political accountability. This should be particularly effective in raising environmental awareness in a region with low levels of democracy in comparison with other regions of the world.

Hence, Latin America with an increasing urban population facing increasing urban environmental issues, besides global warming, should raise environmental concerns. Environmental awareness should translate into a higher demand for environmental quality democracy would serve as the conduit for influencing the policy agenda. Therefore, more democracy should lead to less pollution and more environmental quality.

In order to test the democracy-environmental quality relationship, this paper will estimate a panel data system of equations for 19 Latin American countries, for the period 1995-2008. This paper fills two gaps in the literature. First, to my knowledge, no previous paper has used this approach. Second, no previous paper has analyzed the case of Latin America.

Finally, this paper is divided as follows. Section I or Democracy and the Environment: Some Previous Findings, provides some of the previous literature on the topic as well as the research question and hypotheses. Section II lays out the theory for the positive relationship between democracy and environmental quality. Section III

estimates the empirical relationship and tests the theory. Section IV depicts some of the limitations of this study. Lastly some conclusions are presented.

I. Democracy and the Environment: Some of the Literature

A. Previous Findings

The relationship between democracy and the environment has been studied for quite some time. Yet the link between both variables is not an obvious one. In fact Mildarsky (1998) argues that the relationship between democracy and the environment is not one-dimensional. Furthermore, the author finds a negative relationship between democracy and carbon dioxide emissions, soil erosion by water and deforestation. Didia (1997) also finds a negative association between democracy and tropical deforestation. However, Li and Reuveny (2006) find that the effect of democracy on environmental quality varies across the different types of environmental degradation.

Although Mildarsky (1998) finds in most of his cases an unexpected and inverse relationship between environmental quality and democracy, after controlling for other factors, his study only accounts for cross-sectional data. Also, there are additional factors that are not controlled for and that a panel data approach could control for. In this regard, Carlsson and Lundström (2000) show that government size and pro-market policies affect the impact that democracy has on environmental quality. The authors find that a large government size reduces and may eliminate the impact of democracy on reducing CO_2 emissions. Nevertheless, Carlsson and Lundström's (2000) findings may be misleading. The authors acknowledge that economic freedom and political freedom have a relationship with GDP growth and GDP per capita (Carlsson and Lundström, 2000, p. 2), yet they include all these variables as independent factors in the same regression, thus individual effects are indistinguishable and imprecise. In conclusion, the author's individual estimates may be imprecise.

In contrast, Neumayer (2002) finds that more democratic countries sign more multilateral agreements favoring the environment. The justification for this finding, according to the author, is that the theory suggests that more democratic countries are more committed with a better environment. Nevertheless, international agreements may not be fully honored. The author also analyzes if the outcome varies for a sample of developing countries; however, the findings are robust.

Yet there may be other factors driving Neumayer's (2002) findings. In fact, Das and Dirienzo (2010) suggest an additional factor explaining the democracy and environmental quality relationship. These authors argue that countries with moderate ethnic diversity are societies with more civil engagement and thus more democracy. Therefore, ethnically homogenous countries exhibit higher environmental standards. The authors use a cross country approach to their research question and use the Environmental Performance Index developed by Columbia and Yale Universities, and the

World Economic Forum as their dependent variable. Moreover, Farzin and Bond (2006) argue that income inequality, age distribution, education, and urbanization all affect the democracy-environmental quality relationship and may reduce the importance of democracy as a conduit for reducing pollution levels. These additional factors may turn out being more important than democracy.

In accordance, Pelligrini and Gerlagh (2006) argue for the importance of corruption in establishing environmental quality as a societal priority. These authors highlight the relevance and need of including institutions in explaining the reasons for environmentally friendly countries. The authors show that by including corruption the effects of democracy disappear. Their main conclusion is that countries with a democratic tradition are also less corrupt and thus prone to uphold environmental regulations. Therefore, less corrupt countries with solid institutional arrays have better environmental quality; although Duit et al. (2009) are skeptic of the positive impacts on biodiversity. In fact, these authors conclude that none of the previously mentioned variables are as important as landscape transformations. In a more traditional approach that takes advantage of an Environmental Kuznets Curve approach, Gallagher and Thacker (2008) find a negative yet long run relationship between the "stock" of democracy and sulfur and carbon dioxide emissions. However, this study omits salient factors such as corruption that may alter the results, casting doubt on their findings.

Grafton and Knowles (2004), on the other hand, analyze the importance of social capital on environmental quality. The authors conclude that social capital is not necessarily a good thing for the environment. Moreover, if social capital encourages population density, then it might even have a negative effect on environmental quality, since the authors find a positive association between population density and environmental degradation. In contrast, Winslow (2005) suggests that democracy has a positive effect on reducing pollution but possibly limited to urban areas—where social movements are easier to consolidate and thus social demands may be harder to ignore. Winslow (2005) also finds that more democracy leads to a lower level of sulfur dioxide (SO_2), suspended particulate matter (SPM) and smoke in urban areas—where population density may be the highest.

Although a more indirect approach, Zavestoski et al. (2006) explain that democracy affects environmental policies—and thus environmental quality—through the use of more communication technologies. The authors outline the internet as a major contributor in harnessing environmental quality. The link is as follows. The internet allows for more communication and awareness of government policies, regulations and plans. Also, the internet provides an effective and cheap channel for exchanging ideas, raising awareness and creating communities sharing similar interests. This, in part, allows citizens to engage government or create virtual communities that may demand a cleaner environment. This political and social activism is only possible in democratic societies and thus puts pressures on policymakers (Martinez et al., 2008). In turn, policymakers accommodate or modify laws and regulations in order to satisfy public demands—giving civil liberties an important role in explaining the democracy-environmental quality

relationship (Bernauer and Koubi, 2004). This should lead to a higher environmental standard and quality (Fredriksson et al., 2005).

Finally, the relationship between democracy and environmental quality might depend on the sample of countries included in the empirical analysis. Arvin and Lew (2009), use a sample of developing countries in the period 1976-2003. The authors conclude that their results are dependent on the indicator of environmental quality that they use and on the sub-sample that they select. Their estimates are not consistent across sub-samples of developing countries leading them to conclude that a democracy-environmental quality relationship may be spurious (Walker, 1999).

B. Research Question and Hypotheses

Interestingly, the relationship between democracy and the environment has not been study in the Latin American case. This is focus is not serendipitous because of at least three reasons. Firstly, the diversity of levels of GDP per capita and democracy in Latin America makes it an appealing case for exploring additional theoretical underpinnings. Secondly, the availability of natural resources and biodiversity in Latin America may prove a paradoxical case where environmental quality may be low due to low levels of political participation. Thirdly, the diverse levels of income inequality in the region suggest that there may be also political inequalities that should influence the democracy and environmental quality relationship. Thus, this paper will try to answer the following research question: What is the impact of democracy on environmental quality in Latin America?

Additionally, the literature and theory (§ II) encourage exploring three hypotheses:

H1: An increase in democracy improves environmental quality, in countries with low levels of education.
H2: Higher levels of education increase environmental quality, in countries with low levels of democracy.
H3: An increase in GDP per capita reduces environmental quality.

This study closes three gaps in the literature regarding the relationship between environmental quality and democracy. First, no previous study has focused on Latin America. Second, this paper acknowledges the non-linear and indirect nature of democracy (via economic development). Third, this study provides policymakers with direct and indirect estimates of democracy on environmental quality and alternative conduits that may encourage environmental quality throughout the region.

II. Democracy and Environmental Quality: The Theory

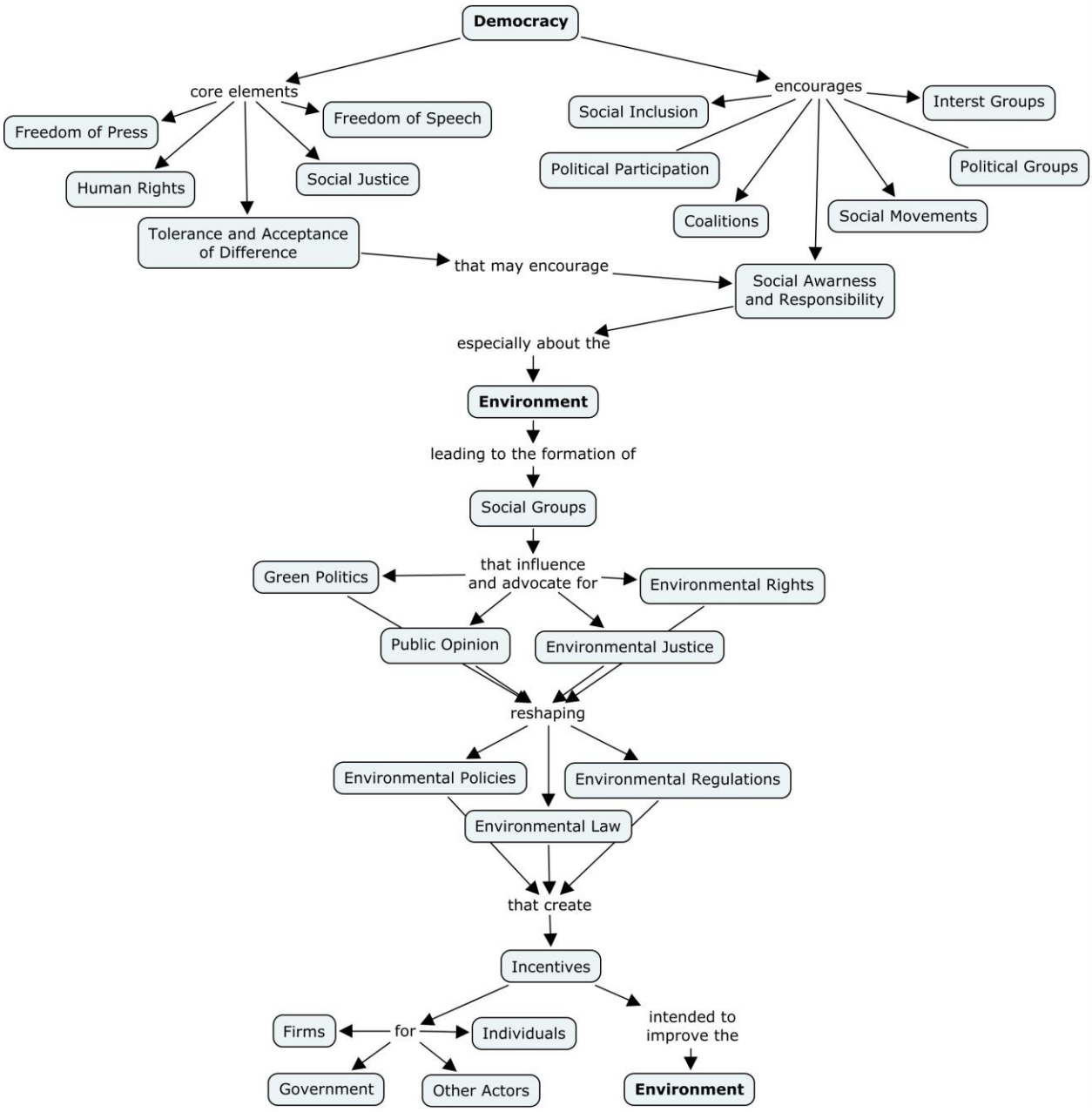
A. The Conceptual Framework

The relationship between democracy and environmental quality is not an obvious one. In fact, one may find arguments that both suggest a positive and a negative relationship. Mildarsky (1998) argues that democracies may be ineffective in increasing environmental quality if interest groups that favor less environmental regulation have an important role. In other words, lobbyists that favor low or no environmental regulations may influence government more that other societal actors. This is especially conceivable if those groups of individuals are linked to more votes, in comparison to other favoring groups of the environment.

Setting aside the compelling arguments against the positive relationship between democracy and environmental quality, this paper will focus only on the positive outcomes highlighted by the theory (Schultz and Crockett (1990); Congleton (1992) and Payne (1995)).

The argument on a positive relationship between democracy and environmental quality may be depicted as follows. More democracy implies more freedom of press, freedom of speech, human rights, equality and social justice. This creates a conduit that channels social needs through political participation. Moreover, more democratic countries also allow for an easier exchange of information amongst its citizens raising public awareness and influencing public opinion. Since societies demand more environmental quality as their income and quality of life increases, democracy becomes the channel connecting the needs of society and policymakers' agendas. Consequently, more democracy leads to regulations, international agreements and policies that foster a cleaner and less polluted environment. In conclusion, more democracy encourages higher environmental quality. Concept Map 1 summarizes this relationship.

Concept Map 1. Democracy and the Environment: A Comprehensive Approach



However, the literature highlights four additional and independent theoretical channels that positively link democracy and environmental quality. First, democracy should guarantee and encourage political rights and freedom of information for all individuals alike. This permits protests, social movements, opposition and raising awareness. This allows for the creation of all types of interest groups, including those that favor the environment. These groups would raise public concerns and foster public awareness about environmental issues. Indeed, this would encourage political parties to be formed or would encourage politicians to include the environment in their political

agendas in order to fulfill electoral preferences. Governments would then include these "demands" through legislation that is intended to protect the environment. This should result in a higher level of environmental quality.

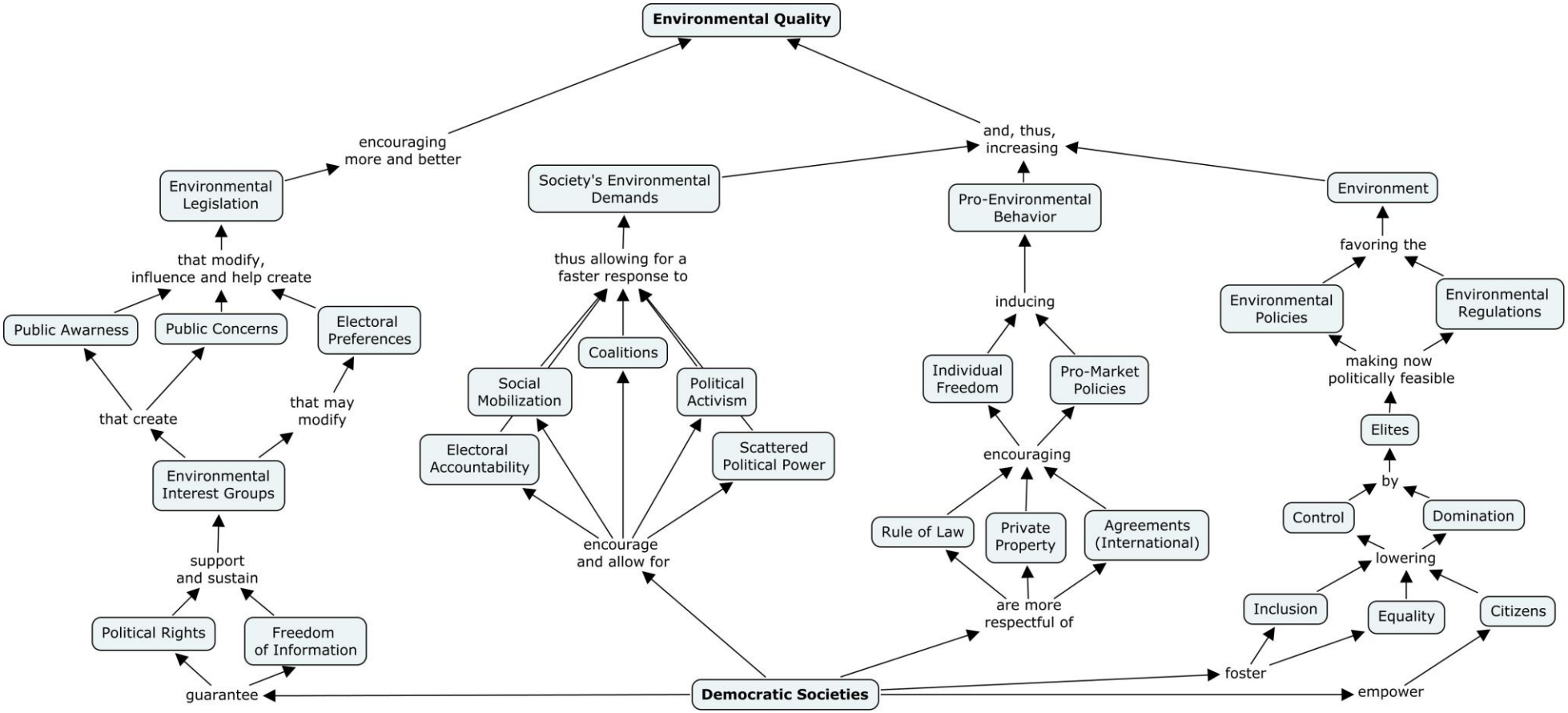
Second, democracy divides political power by empowering all citizens and not only a specific class like in other political systems. This encourages political activism, social mobilizations and social debates about social problems. This also promotes political coalitions that incorporate citizen's preferences about the environment. Perhaps, most importantly, democracy establishes mechanisms making policymakers accountable. These mechanisms encourage policymakers and governments to fulfill the requests of society concerning the environment. This should lead to a better environment.

Third, democratic societies are more respectful of rule of law, private property and international agreements. As pollution increases and affects private property through externalities, governments intervene and find ways of compensation that require acknowledging property rights. Also, as other countries advance and have a higher preference for the environment, more international agreements that bind more and more countries are signed—due to international political pressure. This is especially the case with the environment because of the negative externalities that one country may cause on another. These agreements require reducing pollution and making an adequate use of natural resources. Because of private property, governments implement pro-market policies and incentivize individuals without restricting their individual freedom. This should result in pro-environmental behavior that raises environmental quality.

Finally, more democracy may imply more social inclusion and economic equality. Also, citizens should be empowered because political power is divided evenly (a vote is a vote). This should reduce the controls and dominations of any ruling class or elites. In fact, this should encourage policymakers and governments to favor social interests over any group interests. In this specific case, environmental policies and regulations would affect all individuals in society equally. Thus, with low levels of corruption, corporations and conglomerates and elites would have to follow environmental regulations and adapt. These corporations would reduce their levels of contamination favoring the environment and consequently increasing environmental quality.

The previous relationships arising from democracy and leading to a higher level of environmental quality are summarized in Concept Map 2. Notice, however, that this study has omitted the negative impact that democracy may have on environmental quality by assuming the benefits overcome the costs. For instance, more democracy may allow for more lobbying and even for more intervention of government policies not from a dictator but from corporations. If corporations are heavy polluters, for example, then they have clear incentives to discourage any environmental policy that may affect them.

Concept Map 2. Theories linking Democracy and Environment Quality



B. Conceptual Elements for Testing the Theory

The previous section depicts the conceptual framework for this study. This framework suggests a positive relationship between environmental quality and democracy. Nevertheless it also emphasizes the role of social movements, freedom of information, political participation and economic development.

Environmental quality is a concept encompassing many aspects. This is especially true for the unit of analysis of this study: countries in Latin America. For this unit of analysis, environmental quality would include: deforestation; level and forms of natural resource exploitation; biodiversity stock; water, air and all other types of pollution in urban and rural areas; land use; access and use of water sources; and many other characteristics. This creates a first hurdle for determining the dependent variable of interest.

A first possibility is using the Environmental Performance Index developed by the Yale Center for Environmental Law and Policy. However, using this index would severely limit the sample size and accuracy of the analysis. The data is plagued with missing data for the period of analysis 1995-2008 and for a large group of Latin American countries.

A very attractive alternative is using CO_2 Emissions per capita as a proxy for environmental quality. This variable poses several advantages. First, with the world's awareness on climate change, it has become a primary target and concern for the public. Second, it is more perceptible in urban areas than other pollution indicators because car and buses are primary emitters. Third, carbon dioxide is linked to respiratory illnesses that reduce quality of life and thus raise concerns from the public. Fourth, transportation is a major concern in Developing Countries and especially in Latin America and the close connection of transportation to carbon emissions makes it an outcome in any government transportation policy. Thus, carbon emissions should raise local concerns on the environment; be perceived as an outcome variable to control for in any environmental policy; and be an indicator for citizens of the overall environmental quality, especially in urban areas.

Furthermore, data on carbon dioxide emissions should be relatively accurate given the importance of the issue on a worldwide scale and the availability of different sources. However, using CO_2 emissions is not without caveats. First, emissions are concentrated in urban areas, excluding policies and environmental programs targeted for rural areas. This is troublesome because many Latin American countries depend heavily on their mining sector. However, it should not be unreasonable to expect that environmental quality, policies and emissions in urban areas should be positively correlated with those in rural areas. Second, urban citizens may be more influenced by media and world media regarding the environment. This may skew their perceptions on the true impacts of emissions and on their perceived level of environmental quality.

On the independent side of the equation, the theory suggests social movements as a first element. Social movements act as channels through which citizens raise awareness about their environmental problems. These movements are pivotal in reshaping state policies and influencing voting preferences. However, data on social movements is difficult to acquire and especially in a panel data context for Latin America. Thus a proxy is in order. Youth has a pivotal role in shaping society (Youniss et al. 2002); younger individuals are more risk taking (France, 2000) and thus more inclined towards civic engagement and political participation; younger and more educated individuals are more inclined toward environmental social movements than other groups of the population (Standbu and Krange, 2003); and teenagers are highly interested in issues related to the environment (Hager, et al. 2007). Therefore it is reasonable to proxy social movements with the percentage of youth in the population.

However, education also plays a crucial role in fostering social movements and raising awareness. Rather than youth being the sole proxy for social movements, education should be included as a factor that also promotes efficacy and advocacy. Yet education is an abstract concept. What level of education or should all levels be included? Tertiary education is most effective in encouraging civic engagement and political participation (Hoskins et al., 2008; World Bank, 2002, p. 32). Therefore, it seems reasonable to proxy education with tertiary education.

As also mentioned in the theory, the level of political activism is not only influenced by the level of education and social movements but by the percentage of the population located in urban areas. Urban areas enable networking and social relations that also encourage gathering and social mobilizations. Indeed, a high concentration of population in one area facilitates social mobilization. Thus, the percentage of urban population is included as one of the factors that may explain environmental quality. Also, higher concentrations of population may allow for more economic and environmental efficiency in the provision of goods and services leading to lower levels of emissions. Hence, a negative relationship is expected between the percentage of urban population and environmental quality.

Another factor to consider from the theory is economic development. Societies with higher levels of economic development are associated with less economic inequality —although not linearly—(Kuznets, 1976), and more available resources in society that may finance programs intended to improve the environment (Shafik, 1994, p. 758). This should allow for more political participation that leads to higher levels of environmental quality. How to measure economic development? This study adopts GDP per capita as a proxy for economic development. Although not a perfect measure, it is a reliable indicator, easier to explain by other components and assess indirect impacts as expected in this study.

Nevertheless, the theory also suggests that corruption affects the level of environmental quality by reducing the effectiveness of democracy. Corruption enables interest groups to influence the political agenda in an unfairly manner. Besides, it provides corporations, institutions and individuals an alternative for breaking the law,

perhaps without getting caught. This specifically allows maintaining or increasing pollution even if the current legislation requires a reduction.

Although corruption may highlight the disparities of power and income in society, inequality serves as a better factor in measuring those disparities. Countries that are more unequal enable power disparities to grow, especially in the political arena. Thus, some "privileged" groups may accommodate policies to favor them and hurt the powerless. This may result in a political agenda that gives priority to the interest of those with power. Since the "dominant" groups can plan and "protect" themselves from negative environmental outcomes, then environmental protection may be down in the agenda. For example, perhaps polluting plants and factories are located close to their workers in low income communities generating no problems for those in power. Since environmental justice may be ineffective, then there are incentives for low environmental quality.

In summary, based on the conceptual framework for democracy and environmental quality, the dependent variables explaining environmental quality are: democracy, economic development, social movements and political participation (including freedom of information and of press). However, these concepts are proxied through variables available and measured for Latin America. The proxies are: a democracy index, percentage of youth, gross percentage of the population in tertiary education, perceived corruption, level of inequality, percentage of the population that lives in urban areas and GDP per capita. Thus the primary equation to estimate and its expected signs are:

$$\underset{}{CO_2 \text{ Emissions per capita}} = \underset{}{f(\underset{-}{\text{Democracy}}, \underset{-}{\text{Youth}}, \underset{-}{\text{Education}}, \underset{+}{\text{Corruption}}, \underset{+}{\text{Inequality}}, \underset{-}{\text{Urban Population}}, \underset{+}{\text{GDP per capita}})} \quad (1)$$

However, this equation does not capture the indirect effects that spur from Democracy through GDP per capita and documented in the literature (Goldsmith, 1995; Barro, 1996; Sala-i-Martin, 1997; Feng, 1997; Rivera-Batiz, 2002). However, the GDP per capita democracy relationship would be inaccurate if only democracy is included in the equation. Thus, including growth components suggested by the neoclassical theory of growth (Solow, 1956; Becker et al., 1990; Grossman and Helpman, 1990; Barro, 1991) would point to a second equation as follows:

$$\text{GDP / Population} = \text{GDP per capita} = f(\underset{+}{\text{Education}}, \underset{+}{\text{Democracy}}, \underset{+}{\text{Capital}}, \underset{+}{\text{Trade}}) \quad (2)$$

In conclusion, a comprehensive analysis of the effects of democracy on environmental quality should at least include the indirect effect from economic growth. Furthermore, democracy should also affect the level of environmental quality through the

economic growth equation. This indirect effect should be considered if one does not want to overestimate the effect of democracy on environmental quality.

III. Democracy and Environmental Quality: The Empirical Relationship

A. The Data

The appendix provides the descriptive statistics for all the variables employed in this study. The source for CO_2 data is CDIAC (2010) and World Bank (2010). The variables youth and education were taken from World Bank (2010) and Economic Commission for Latin America and the Caribbean—ECLAC—(2010). The variable youth is the percentage of people between ages 15-24 for a specific year and country. Education is the tertiary gross school enrolment rate.

The variable democracy is taken from the Polity IV database (Marshall and Jaggers, 2010), that defines democracy as a form of government that "relies mainly on the use of 'positive sanctions/incentives' (i.e., legitimate authority) to manage the political agenda and to ensure social order" (Marshall and Jaggers, 2010). This variable ranges originally from -10 to +10, where +10 indicates the highest level of democracy and -10 a hereditary monarchy. However, this index for democracy takes only positive values for the Latin American countries in the sample for the period 1995-2008.

As an indicator of economic progress, this study uses GDP per capita. This variable is taken from World Bank (2010) and Economic Commission for Latin America and the Caribbean—ECLAC—(2010). The base year for this variable is 2000 and it is measured in U.S. dollars. Similarly, capital is the amount of fixed capital in the economy and is also measured in 2000 year dollars. This variable—capital—is taken from the Economic Commission for Latin America and the Caribbean—ECLAC—(2010). Despite the criticism of using this variable, using investment rather than capital is not free of drawbacks as well. Trade is the level of trade openness in the economy or imports plus exports by GDP, and its source is also World Bank (2010) and ECLAC (2010).

The data on corruption is taken from Transparency International (2010). This index or the corruption perception index is measured in a 0 to 10 scale where a higher value represents a lower level of corruption or more transparency. Transparency International defines corruption as "as the abuse of entrusted power for private gain." Yet the level of disparities and asymmetries of power are captured through income inequality. The data is taken from United Nations University–World Institute for Development Economics Research (2010) data base on income inequality.

However, the possibility of social movements, provision of public services and political participation may be more effective in urban areas. This paper uses the percentage of urban population taken from World Bank (2010) and ECLAC (2010) to measure the percentage of people living in urban areas.

All variables are available for the 19 Latin American countries in the data set and for the period 1995-2008. The following are the 19 Latin American countries: Argentina, Bolivia, Brazil, Costa Rica, Chile, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela. Only for the case of Jamaica, data on capital was imputed using historical data on capital and balance of payment. Although several critics can be made, imputed data on capital was compared with actual data for the other countries in the region and, in general, imputed and actual data were correlated and without significant statistical difference. Furthermore, all estimations were consistent and robust to eliminating Jamaica from the data set.

B. Estimation Strategy

Democracy and environmental quality (CO_2 Emissions per capita) should have a positive (negative) relationship. Latin America is an interesting case to analyze because of unique characteristics in terms of democracy and economic development. Since the data is available for countries and several years, the most efficient way is panel data and fixed effects.

The use of panel data increases degrees of freedom and allows for the incorporation of information of cross-sectional and time series nature simultaneously. The fixed effects approach allows controlling for unobservable confounding factors that may otherwise skew and invalidate the estimates and statistical inference.

The system of equations to be estimated has as dependent variables the logarithm of CO_2 Emissions per capita and the logarithm of GDP per capita. The following is the system to be estimated:

$$\begin{aligned}\text{Log}(CO_2\text{ Emissions per capita})_{it} = {} & \beta_{10} + \beta_{11}*\text{ Log}(\text{Democracy})_{it} + \beta_{12}*\text{Log}(\text{Youth})_{it} + \\ & \beta_{13}*\text{Log}(\text{Youth})*\text{Log}(\text{Democracy})_{it} + \beta_{14}*\text{Log}(\text{Education})_{it} + \\ & \beta_{15}*\text{Log}(\text{Democracy})*\text{Log}(\text{Education})_{it} + \beta_{16}*\text{ Log}(\text{Youth})* \\ & \text{Log}(\text{Education})_{it} + \beta_{17}*\text{Log}(\text{Corruption}) + \beta_{18}*\text{Log}(\text{Inequality}) + \\ & \beta_{19}*\text{Log}(\text{Urban Population}) + \beta_{20}*\text{Log}(\text{GDP per Capita})_{it} + \varepsilon_{1it}\end{aligned} \quad (3)$$

$$\begin{aligned}\text{Log}(\text{GDP per capita})_{it} = {} & \beta_{20} + \beta_{21}*\text{ Log}(\text{Education})_{it} + \beta_{23}*\text{Log}(\text{Democracy})_{it} + \\ & \beta_{24}*\text{Log}(\text{Capital})_{it} + \beta_{25}*\text{Log}(\text{Trade})_{it} + \varepsilon_{2it}\end{aligned} \quad (4)$$

Nevertheless, equation 3 is estimated first and separately in order to confirm the robust nature of the estimates. However, this study acknowledges that estimating only equation 3 would provide an incomplete assessment and would overestimate the effect of the independent variables on environmental quality (CO_2 Emissions per capita). Since democracy affects the level of GDP per capita and through it the level of environmental quality, any estimation should control for that effect if estimates are to be accurate and not overestimated. The same line of reasoning applies for education.

Notice that education is proxied with tertiary education. Tertiary education is the most effective level of academic formation in encouraging civic engagement and political participation (Hoskins et al., 2008; World Bank, 2002, p. 32). However, the extent to which civic and politic engagement affect policy are constrained by the participation of youth, thus an interaction term for education and youth is included. Similarly, the level of democracy also limits the possibility of civic engagement and efficacy to influence policy and environmental regulations. Moreover, education may foster civic engagement, but this is only possible if it is democratically feasible. In other words, higher levels of education but in a dictatorship reduce the possibilities for civic engagement. Consequently, this requires for interaction terms between democracy with youth and education.

Yet Ordinary Least Squares (OLS) may not be the most efficient estimation method. Notice that equations 3 and 4 are affected by exogenous shocks that have incidence on the value of all variables. Specifically, the Mexican peso crisis that began in December of 1994 impacted commerce throughout the region; the 1997 Asian Financial Crisis and the 1998 Russian Financial Crisis that ignited the 1998 Brazilian Financial Crisis altered the financial stability of Latin America. This exogenous effect acts in each equation through the error terms suggesting that both equations should be related. Thus, the most efficient strategy is estimating this system of equations using Seeming Unrelated Regression (Zellner, 1962 and 1963). This method will provide consistent estimates with more accuracy than OLS.

C. Findings and Estimates

Table 1 provides the estimates for a one equation panel data model. The dependent variable is CO_2 Emissions per capita that serves as a proxy for environmental quality. All estimates are significant—for models 1 through 3—and suggest a negative relationship between democracy, youth and education, evaluated at sample means—due to interaction effects. This is consistent with this study's conceptual framework. Also, GDP per capita has a positive relationship with emissions, consistent with theory as well (§ II). In contrast, corruption, inequality and urban population are not significant.

Table 1. Latin America: Panel Data Estimations exploring the relationship between CO_2 Emissions per capita and Democracy, 1995-2008

	Model 0	Model 1	Model 2	Model 3
Log(CO_2 Emissions per capita)				
Log(Democracy)	-6.164*	-5.926*	-6.916*	-2.811**
	(-2.440)	(-2.670)	(-3.150)	(-2.520)
Log(Youth)	-4.284*	-4.293*	-3.843*	-1.771**
	(-3.030)	(-3.300)	(-3.060)	(-2.350)
Log(Youth)*Log(Democracy)	1.496**	1.424*	1.719*	0.797**
	(2.450)	(2.600)	(3.200)	(2.530)
Log(Education)	-1.725*	-1.846*	-0.622*	-0.067**
	(-2.970)	(-3.500)	(-2.600)	(-2.120)
Log(Democracy)*Log(Education)	0.273**	0.277*	0.261**	---
	1.980	(2.520)	(2.420)	---
Log(Youth)*Log (Education)	0.308**	0.340*	---	---
	(2.210)	(2.650)	---	---
Log(Corruption)	-0.057	---	---	---
	(-1.510)	---	---	---
Log(Inequality)	0.056	---	---	---
	(0.410)	---	---	---
Log(Urban Population)	0.077	---	---	---
	(0.210)	---	---	---
Log(GDP per Capita)	0.503*	0.499*	0.457*	0.474*
	(4.840)	(4.750)	(4.560)	(4.760)
Country Fixed Effects	Yes	Yes	Yes	Yes
R-square	0.6108	0.5971	0.5871	0.5824
Observations	266	266	266	266

Notes: * Significant at 1%. ** Significant at 5%. T-statistics are in parentheses. Time fixed effects were not significant. Constants are included but are not shown. Random effect models provided similar estimates. Pooled effects and random effects were tested but not reported; results suggested fixed effects over the other two.

The estimates from model 1 in Table 1 imply that the level of democracy, education and youth matter in determining the impact of these variables on environmental quality—proxied by CO_2 Emissions per capita (providing evidence for H1 and H2, § I) . This means that increasing democracy as a way of improving environmental quality is ineffective in countries with high levels of education (evidence in favor of H1, § I). This implies that education provides an alternative conduit for channeling environmental demands of the population and thus improving environmental quality.

Similarly, the results also suggest that democracy may prove ineffective in reducing emissions in countries with a high percentage of youth. Indeed, youth are also a natural alternative for increasing environmental quality. In part this is because a youth encourages more social movements related to the environment than any other age group.

Also, a higher percentage of youth may ignite altruistic behaviors among older age groups of the population indented to preserve the environment so that future generations can enjoy of it (meaning youth).

Also, GDP per capita is positive and significant, suggesting that more development may lead to less environmental quality (evidence in favor of H3, § I). Although the Kuznets hypothesis suggests that this relationship is non-linear and after a threshold higher levels of development should lead to more environmental quality, this first set of estimations do not find evidence of such.

Nevertheless, Table 1 does not include the indirect effects of democracy on environmental quality through GDP per capita. Democracy affects GDP per capita and through it affects environmental quality. In order to estimate these effects, Table 2 uses a panel data system of equations to capture the indirect effect of democracy via GDP per capita. Thus, Table 2 has two equations with the following dependent variables: CO_2 Emissions per capita and GDP per capita. In Table 2 all estimates are significant at a 5% level and have the expected signs.

Table 2. Latin America: Panel System of Two Equations Estimates exploring the relationship between CO_2 Emissions per capita and Democracy, 1995-2008

	Model 1			Model 2			Model 3			Model 4		
Equation 1	*Coefficient*	*z-score*	*P>|z|*	*Coefficient*	*z-score*	*P>|z|*	*Coefficient*	*z-score*	*P>|z|*	*Coefficient*	*z-score*	*P>|z|*
Log(CO_2 Emissions per capita)												
Log(Democracy)	-5.964	-2.530	0.011	-6.972	-2.950	0.003	-2.515	-2.130	0.033	-2.598	-2.140	0.032
Log(Youth)	-4.278	-3.360	0.001	-3.823	-2.980	0.003	-1.580	-2.070	0.038	-2.067	-2.840	0.005
Log(Youth)*Log(Democracy)	1.409	2.480	0.013	1.710	3.020	0.003	0.712	2.140	0.032	0.742	2.170	0.030
Log(Education)	-1.933	-3.730	0.000	-0.685	-2.440	0.015	-0.074	-2.040	0.042	---	---	---
Log(Democracy)*Log(Education)	0.303	2.360	0.018	0.286	2.190	0.028	---	---	---	---	---	---
Log(Youth)*Log(Education)	0.346	2.840	0.004	---	---	---	---	---	---	---	---	---
Log(GDP per Capita)	0.561	6.180	0.000	0.515	5.680	0.000	0.525	5.770	0.000	---	---	---
Country Fixed Effects	Yes			Yes			Yes			Yes		
R-square	0.490			0.490			0.490			0.489		
Equation 2												
Log(GDP per Capita)												
Log(Education)	0.058	4.710	0.000	0.058	4.720	0.000	0.059	4.730	0.000	0.062	5.020	0.000
Log(Democracy)	0.053	3.370	0.001	0.053	3.380	0.001	0.053	3.380	0.001	0.054	3.420	0.001
Log(Capital)	0.314	25.820	0.000	0.314	25.840	0.000	0.314	25.820	0.000	0.312	25.600	0.000
Log(Trade)	0.086	5.210	0.000	0.085	5.130	0.000	0.085	5.110	0.000	0.079	4.770	0.000
Country Fixed Effects	Yes			Yes			Yes			Yes		
R-square	0.498			0.498			0.498			0.498		
Observations	266			266			266			266		

Notes: All coefficients are significant at a 5% level. Time effects were not significant. Constants were included in all models but are not reported. All models were fitted using Seemingly Unrelated Regression. Additional estimations included a quadratic term for *Log(GDP per Capita)* to test Kuznets's Environmental Curve Hypothesis. The results, *Log(CO_2 Emissions per capita)* = 3.149**Log(GDP per Capita)* – 0.162**Log(GDP per Capita)*^{2} including the other factors in Model 1, suggested a peak value of $16,984. Yet this value is beyond the maximum level of GDP per capita for any of the 19 Latin American countries in the sample and thus meaningless. Therefore, the squared term for GDP per capita is excluded from the models shown here.

The results in Table 2 are consistent with previous results (Table 1). However, the indirect effect of democracy is now contemplated in the equation. Nevertheless, GDP per capita continues to have a positive relationship and linear (favoring H3, § I). A squared term for GDP per capita was included but it suggested a peak value of $16,984. However, this finding is inconsistent with the data, since the highest GDP per capita in the data set is $9,917. This value suggested by the estimation does not make sense and thus a squared term for GDP per capita was removed from all estimation.

The direct and indirect effects of democracy and education on environmental quality (negatively correlated with CO_2 Emissions per Capita) from Table 2 are summarized in Table 3.

Table 3. Latin America: Path Analysis or Total Effect of a 10% increase in Democracy or Education on CO_2 Emissions per Capita, 1995-2008

A 10% increase in	**Reduces CO_2 Emissions per capita in**	
	Model 1	*Model 2*
Democracy	-0.48%	-0.60%
Education	-0.73%	-0.71%

Note: These path coefficients are based on estimates provided in Table 2 and the overall sample means available in the appendix. Variables are assumed fixed at their sample mean. Estimates include direct and indirect effects.

Table 3 suggests that at sample mean values, a 10% increase in democracy and education may reduce CO_2 Emissions per Capita up to 0.60% and 0.73%, respectively. This implies a positive relationship between democracy, education and environmental quality. However, as suggested in Tables 1 and 2, these effects are conditioned by the level of education or democracy (evidence in favor of H1 and H2, § I). In other words, countries with high levels of education may find that democracy has little or no effect in reducing environmental quality. Similarly, countries with high levels of democracy may find that increasing education does not necessarily increase environmental quality. This emphasizes the fact that public policies targeted to improving environmental quality cannot be replaced by simply increasing the country's level of education or democracy. These aspects may help but should not be regarded as the main and much less the only mechanism for improving environmental quality.

IV. Limitations of this Study

This paper uses CO_2 emissions as and indicator of environmental quality; however this requires several words of caution. First several studies have shown that results may vary by environmental indicator. Thus the evidence presented in this paper is only suggestive of the impact of democracy and other factors on CO_2 emissions and not environmental quality. Furthermore, environmental quality encompasses much more than CO_2 emissions. These estimates should be interpreted with caution when addressing environmental quality directly. Second, the coefficients may be driven by recent concerns

about climate change that indicate CO_2 as its main cause. Consequently, policies in the period 1995-2008 may have targeted mostly CO_2 emissions overestimating the benefits.

Also, results should be interpreted with caution because such a short period (1995-2008) does not capture for the long term relationship between democracy and environmental quality. Furthermore, I have omitted important variables such as political participation, social movements, environmental agreements and regulations. This should not alter the results substantially because of the fixed effects approach; however, this approach impedes determining the empirical importance of these variables, already highlighted in the literature.

Finally, this paper has taken a positive view on the impact of democracy on environmental quality and for a country in general. Yet this may not be the case. In fact, the literature provides compelling arguments regarding the possible detrimental effects of democracy on society. For instance, a majority may choose to oppress the rest of the population. This may be consistent with a narrow definition of democracy (decisions based on a majority rule), but democracy nonetheless.

Conclusions

Democracy has a positive effect on environmental quality. The theory suggests that democracy sustains and encourages freedom of speech, freedom of press, political participation and social awareness. These elements provide a conduit for social demands. As urban population and income grow, citizens increase their demand for higher environmental standards and quality. The enactment of new policies and regulations that incentive individuals and firms may lead to a reduction in pollution, environmental degradation and deforestation; therefore, leading to a higher level of environmental quality.

This study analyzed 19 Latin America countries for the period 1995-2008. A panel data system of equations estimates suggest that a 10% increase in democracy may reduce CO_2 emissions per capita in 0.48% or 0.60% in Latin America. Similarly, a 10% increase in education may reduce emissions in 0.71% or 0.73%. These results suggest that democracy and education have a positive effect on environmental quality.

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Appendix. Latin America: Descriptive Statistics, 1995-2008

Variable		Mean	Std. Dev.	Minimum	Maximum	Observations	
Log (CO_2 Emissions per capita)	overall	0.544	0.637	-0.497	1.917	N =	266
	between		0.645	-0.326	1.800	n =	19
	within		0.101	0.153	0.834	T =	14
Log (Democracy)	overall	2.043	0.222	1.099	2.303	N =	266
	between		0.153	1.726	2.303	n =	19
	within		0.164	1.400	2.514	T =	14
Log (Youth)	overall	3.491	0.160	3.129	3.800	N =	266
	between		0.155	3.181	3.774	n =	19
	within		0.053	3.346	3.619	T =	14
Log (Youth)*Log(Democracy)	overall	7.123	0.748	3.863	8.128	N =	266
	between		0.503	6.011	7.851	n =	19
	within		0.566	4.732	8.810	T =	14
Log (Education)	overall	3.192	0.487	2.054	4.221	N =	266
	between		0.438	2.271	3.999	n =	19
	within		0.235	2.552	3.795	T =	14
Log (Democracy)*Log(Education)	overall	6.537	1.308	2.967	9.587	N =	266
	between		1.097	4.617	8.404	n =	19
	within		0.753	4.167	8.401	T =	14
Log (Youth)*Log (Education)	overall	11.091	1.418	7.232	13.696	N =	266
	between		1.259	8.568	13.155	n =	19
	within		0.709	8.994	13.284	T =	14
Log (GDP per Capita)	overall	7.923	0.665	6.493	9.202	N =	266
	between		0.675	6.657	8.969	n =	19
	within		0.097	7.663	8.228	T =	14

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