Effects of Democratic Institutions on Climate Change Mitigation

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1 Introduction

The need for international cooperation has become more important than ever in world politics with the globalization and interdependence of the world economies. At different times, the world's nations established processes to address this need, first through the World Council until the first World War and then through the United Nations since World War II which still holds today. Although it is far from perfect, it acknowledges the fact that there exist issues which cannot be solved by a single country and requires international cooperation to some sort of degree.

Inspiring the international community to assist in an agenda can prove to be difficult. Countries will decide to cooperate when there is a benefit to do so and abstain otherwise based on their own political and societal values. One of the hallmarks of different countries is the adoption of different political systems, mainly democracy vs autocracy. Since World War II there has been a struggle to prove the superiority of the democratic system over others, mainly communism. Much literature has been devoted to the study of the democratic effects on society, covering everything from poverty reduction (Ross, 2006) to peace (Dorussen and Ward, 2008). The focus of our study, however, will be based on the effect of democratic institutions on environmental issues.

The basis of this paper begins with the power of democracy in encouraging nations to work together towards a common goal. As can be expected from such a broad topic, the literature is inconclusive depending on the specific policy being analysed and how the study is organized. For example, while democracies have a tendency to escalate trade disputes (Busch, 2000) they also have positive effects on peace (Dorussen and Ward, 2008). In terms of environmental contributions, the literature remains fairly divided. Payne (1995) boldly claims that the better informed citizens and freer press of democratic nations makes them naturally more effective in dealing with climate change. The real answer, however, is more likely to lie with Desai (1998a) when he said: "whether democracies are more likely to be environmentally friendly is not entirely clear".

This study offers a light extension of the model put forth by Bättig and Bernauer (2009). In it, they focus on the implications of democracy on the provision of global public goods with an empirical focus on climate change. Over the past few decades, climate change has evolved from speculation to an established global phenomenon, even leading to the creation of the Intergovernmental Panel on Climate Change (IPCC) in order to provide a means for the international community to address the issue. The IPCC claims that human induced activity is largely to blame for the increases in average global temperatures and its consequences (asymmetrical rainfall, social disruptions, etc.). In order for both the environment and human societies to adapt to the changes in the

world's climate, large scale greenhouse gas (GHG) emission reductions are necessary to curb and reverse the global warming effect (on Climate Change, 2007).

We contribute to their study in a few ways. First, in our analysis of the democratic effect on policy output and emission levels, we use a longer time frame (1990-2013, or the most recent year available) rather than 2005. This will help iron out some nuances that were present in older studies since many geopolitical events in the developing world have occurred during these eight years. Second, we use different data sources, in particular our measure for the Climate Risk Index which we take from Germanwatch who uses a calculated method of determining which countries are most at risk of climate change. Lastly, and perhaps our greatest contribution to their work, is an analysis of whether or not democracies were more likely to ratify the Kyoto Protocol, if at all. Adapted from Beron et al. (2003) to fit our analysis, this model adds a new depth to our study in addition to seeing if whether or not democracies had a positive effect on global climate.

Cross-national comparison makes it easy to study the level of commitment in mitigating global warming between different countries and the actual outcomes achieved. Table 1 provides a brief summary of select countries, their political commitment level (described in subsequent sections), and the change in their per capita CO_2 emission output from 1990-2010. The first point one notices is the vastly different trend across countries. Countries such as Canada, France, Romania, and the United States have decreased per capita emissions over the 20 year period. With the exception of the United States, these countries also have relatively high commitment levels in comparison to bigger polluters. However, some countries on this list such as Brazil, India, and Saudi have high commitment levels but saw increases in their per capita emission growth.

Table 1: Climate Change Policy and Outcomes Across Countries

Countries	Commitment	CO_2/cap change 1990-2010 (%)
Australia	0.688	0.50
Brazil	0.866	53.6
Canada	0.914	-9.40
China	0.918	185.2
France	0.883	-18.6
Haiti	0.550	50.0
India	0.820	111.2
Romania	0.936	-43.2
Saudi Arabia	0.811	26.7
United States	0.648	-8.10

The variety of results in Table 1 provides a justification to separate and analyse countries based on their political institutions, and in particular, their democratic levels. Another major factor in the decision to cut emission levels could be the free riding problem. If free riding is present, then we should expect to see smaller, less polluting countries make fewer commitments to reducing greenhouse gasses. To test what influences emissions

output, we run our empirical analysis on 177 countries from 1990-2013 (or the most recent year available). The data used makes it possible to simultaneously study the effects of political output along with the policy outcomes. From these results, we can simply take the difference between stated policy and output realization to find if democracies truly have a positive effect on climate change mitigation.

United Nations Framework Convention on Climate Change (UNFCCC)

Our study revolves around the United Nations Framework Convention on Climate Change (henceforth UNFCCC). Beginning in 1990, it was the first time that climate change truly appeared on the world's political agenda. The criteria in determining the framework for the convention was designed by keeping in mind that climate change is a global commons problem and in the absence of a world government, nations must be induced into voluntarily reducing emissions.

Responding to these needs, the UNFCCC established several criteria in designing their framework. The first, and arguably most important, is environmental effectiveness. Any agreement signed must be successful in mitigating climate change. According to the UNFCCC article 2 (Unfccc, 1992), success in this case is defined as the stabilization of GHG emissions to a level such that the global ecosystem has time to naturally adjust to the increased levels of GHG in the atmosphere. In addition, food production should not be compromised and economic development must remain sustainable. Later, the Copenhagen and Cancún agreements set a goal of limiting global warming to 2°C above pre-industrial revolution levels.

Building off of this, the second criterion is aggregate economic performance measured by cost effectiveness. This, according to Jaffe and Stavins (1995) means that taking the environmental policy as a constant, it should be achieved at the lowest possible cost while also considering technological innovation. The benefit of analysing cost effectiveness is that there is no requirement to attach a monetary value to environmental performance benefits. Therefore, in the case of climate change analysis, it may be more feasible to use cost effectiveness rather than cost efficiency. However, aggregate economic performance will include issues affected by the policy which are not environmental in nature and so economic efficiency must be used. For this, the UNFCCC uses cost-benefit analyses to find the difference between total social benefits and total social costs.

The third criterion deals with distributional and social impacts of the policy. Uneven distribution will threaten distributional equity and potentially undermine the entire policy. To avoid this, the benefits of mitigating climate change must be shared across nations or at the very least not put any one region at a disadvantage. It may even be that countries could be indirectly affected by the policies of other countries. For instance, if wealthier countries improve renewable sources of energy to reduce emissions in compliance with the UNFCCC, demand for

fossil fuels will be less and so prices will drop causing developing countries to use more and potentially increase their GHG emissions.

With these criteria set, policy makers then turned their sights on creating a viable framework. Most importantly, the UNFCCC had to design a central authority due to the lack of an international government and determine how to delegate emissions rights between countries. The first option is a "top-down" approach as described in Dubash and Rajamani (2010). In this scenario, the UNFCCC mandates a high degree of cooperation between countries to reach different goals such as emission targets. The second potential method is the "bottom-up" approach whereby individual actors contribute on their own with little international coordination (Dubash and Rajamani (2010); Victor et al. (2005)). This central authority uses a combination of both top-down and bottom-up command as was seen at the Cancún Agreement.

Basing the agreement off of these criteria and building a detailed authority framework, the UNFCCC has set up the most comprehensive international coalition for environmental protection in history. However, the extent to which the UNFCCC operates does not end here. The organization also considers the ramifications of goal sharing, multilateral agreements, trade, future technologies, and private investment on international cooperation. It builds off of the work done by the Montréal Protocol to reduce Chlorofluorocarbon (CFC) emissions and other GHG and offers the flexibility to be changed when needed such as the Cancún Agreement and Doha Amendment.

2 Theory

The issue of climate change, in its essence, begins at the free rider problem. From the vantage point of the industrialized world, reducing emissions may imply a reduction in total output, thereby hurting economies. From the viewpoint of the majority of the developing world, however, any action they do is fruitless without reductions from the largest polluters. In addition, it may seem unfair to limit the polluting capabilities of developing economies and preventing them from becoming wealthier before they even have the chance to develop. However, we see a trend between some countries cutting back emissions voluntary, implying that the free rider problem may not exist in this context. Bättig and Bernauer (2009) raise the point that many small island nations show great political commitment in reducing emissions. Similarly, several countries including Germany, the United Kingdom, the United States, and Japan have all been reducing their GHG/capita since 1980–long before there were any binding contracts to do so.

One way to explain the degree of international cooperation is by the difference in the decision making process between democracies and nondemocracies. Democracies tend to elect officials who are responsible to the wider

public and so must cater to the median voter. In nondemocracies, however, decisions are made to please a small group of elites with little accountability to the general populace. In this type of system, private goods are provided in greater quantities than in democracies in order to buy loyalty from the upper-class. In democratic institutions, political survivability and loyalty is won by providing large amounts of public goods to the people. Since climate change falls under the category of public goods, it makes intuitive sense therefore to assume that its provision will be greater in democracies than in nondemocracies (Bueno de Mesquita et al., 2001).

Several reasons why democracies are better equipped to tackle the climate change issue were presented by Payne (1995). Firstly, nondemocratic institutions tend not to disregard individual property rights. It is easier, therefore, to organize environmentalists in democracies to support issues such as pollution reduction or climate change. Second, as mentioned above, democratic officials seek to be (re)elected and so making promises to benefit the environment at a time when in many countries climate change is widely accepted furthers their agenda. Third, information flows more freely both within and between democracies. Political parties can learn from each other and from scientists while foreign democracies can adopt similar policies as they often do during financial crises. Fourth, democracies cooperate with each other better than they do with autocratic regimes. With this in mind, international cooperation between democracies to tackle global emissions output should be easier to achieve. Lastly, free market economies make it easier to punish environmental wrong-doers and to reward businesses who preserve and improve the environment. Subsidies, taxes, property rights, and increased market shares are all tools which the government or environmental groups can use to improve environmental status.

Now that we have established that democracies are better at providing environmental goods than in autocratic regimes, we will look at the demand for these goods in both types of governments. It becomes more ambiguous here than in determining which government is better at supplying public goods because we need to analyse the differences between relevant median voters. Since the group influencing much of an autocratic regime is wealthier, more educated, and generally better off, the median voter will also be wealthier and better educated than the median voter in a democracy. By this standard, and assuming the environment is a normal good, one would assume that dictatorships would place more emphasis on climate change than a conventional democracy.

On the flip side, there are several arguments against these claims. Several studies, pioneered by Seymour Martin Lipset in *Political Man* (1963) links democratic institutions to increased wealth. For instance, he attributes poorer economic conditions in Latin America during the 1960's and 1970's to the authoritarian regimes that used to rule much of the region with little or no freedom. During this period, two-thirds of the continent was ruled by dictatorships. Today, much of Latin America is experiencing robust economic growth largely led by

Brazil and Mexico. Eight nations are classified as partly free while 22 nations are free and Cuba remains the last nondemocracy according to Freedom House (2014) . Due to the increased wealth of democracies, it may be that the median voter is wealthier than an aristocrat in an authoritarian regime.

Another reason why dictatorial elites may demand less public goods despite potentially being better off is due to the fact that they may be better equipped to deal with any adverse effects that a lack of public good provision may have. For instance, if there is no decent educational institution within their country, they may send their children to private or international boarding schools. In the example of environmental degradation, elites have the option of moving away from polluted areas of the city to anywhere he desires. Despite the fact that wealthy individuals in a democracy have the same option, an aristocrat in a dictatorship will likely be more influential than an individual in a democracy, thereby playing a larger role in the political outcome process.

In addition to the points above, we can also consider that the opportunity costs of accepting such welfare projects of the dictatorial median voter are higher than for their democratic counterparts. This implies that the expected net benefit of voting for climate change will be lower than in a democracy. Even if the autocratic median voter received greater utility from environmental policies than the democratic median voter, the higher opportunity costs of accepting such policies provide a disincentive to ratify international climate treaties or to take voluntary action.

The last counter argument suggests that democracies, by their nature, are more likely to cooperate with one another. In addition to common economic goals, they begin to learn and coordinate with one another. We see this phenomenon occurring in trade blocs such as NAFTA, political unions such as the European Union, and intergovernmental organizations such as CERN. Therefore, when democracies face a common problem such as climate change for instance, they are more likely to tackle the problem together.

With these arguments in mind, some critics have gone so far as to suggest that perhaps the median voter regardless of political system may in fact be less influential than we thought and that policy outcomes are largely influenced by special interest groups. In advanced democratic economies (OECD, for example), the keys of innovation and development lie in the hands of the business sector whose interests may or may not be aligned with the median voter. This argument is supported by authors such as Dryzek (1987) where he claims that the greed and interests of businesses will accelerate environmental degradation and halt any changes from the status quo, effectively creating a policy gridlock. There has been, however, much research pointing to the contrary: environmental interests have taken precedence over business ventures. Within the business sector, as Bernauer and Carduff (2004) claim, when firms are faced with higher environmental regulations then they will pass the extra costs onto the consumer in the form of higher prices. This was shown with the introduction of fuel efficient

cars for instance. International cooperation also shows us that environmental concerns are increasingly at the forefront of the global agenda. In 1986, the world's nations gathered in Montréal, Canada to sign a treaty banning the use of CFCs in the atmosphere. Since then, the hole in the Ozone layer has been recovering and this is hailed as a major success in international cooperation dealing with a global externality (Beron et al., 2003).

Furthermore, Beck (1986) and Aerni (2005) claim that in mature democracies, pro-environmental groups have greatly increased efforts at educating the public about environmental issues. This is in response to decreasing consumer confidence in business practices over the years thereby putting pressure on governments to distance themselves from business interests. On top of this, governmental reputation, both domestic and abroad often hinges on the perception of corruption. Catering to the needs of big business will have a major effect: if political output becomes largely dependent on business interests then we can expect to see fewer public goods provided and more concessions in favour of business, not unlike autocracies. In short, promoting pluralism can very well lead to the deliverance of more public goods.

Next we compare the efficacy of a democracy on the world arena. As shown above, democracies are more likely to better respond to public good issues within national borders since they are responsible to their citizens. However, with little to no accountability on the international stage, there is little incentive to engage in transborder environmental treaties (Paehlke, 1996). Nevertheless, our analysis will study the democracy effect on the likelihood of ratification and on performance in emissions reduction. If international performance is less compared with that of domestic performance, we expect that democracies will still fair better than dictatorial regimes for the reasons mentioned above.

This raises the notion of what Bättig and Bernauer (2009) describe as the the "words-deeds gap". Essentially, it is the difference between the policy output which a particular government proposes and the actual results achieved. It is well established in the literature (Neumayer (2002); Bättig and Bernauer (2009); Von Stein (2005)) that democracy has a positive effect on generating policy outputs to target climate change. This is simply due to the fact that politicians cater to the median voter who is more likely to demand such policies and that they are better equipped to deliver the desired level of public good provision.

The democracy effect on emissions, however, is more ambiguous. Although in theory policy output should target emission levels, the reality is that emissions are largely out of governmental control and include such factors as the properties of the resource, mitigation costs, and implementation efficiency. On one side, Congleton (1992) found democratic nations have higher methane and CFC levels per capita in a study conducted in 1989 on 118 nations. Likewise, Midlarsky (1998) found that democracies had higher CO_2 levels per capita in a 1990 study on 98 countries. Other literature finds the opposite results. Gleditsch and Sverdrup (2002) found that

democracies have less CO_2 emissions per capita. Bättig and Bernauer (2009) found that democracies reduce CO_2 emissions per capita as well as emission growth rates, although the latter result was insignificant.

Based on previous work in the literature, we put forth two hypotheses which we will empirically test in this paper:

H1: Democracies are more likely to engage in international climate change mitigation efforts.

H2: Democracies are more effective in reducing CO_2 emissions per capita but this result will be weaker than the ratification likelihood.

3 Empirical Design

Approach

The research in international cooperation essentially begins with chlorofluorocarbons (CFCs) in the 1980's. The global community faced then a similar problem as we currently face in that a global public externality had to be resolved. Therefore as a starting point, we will follow the methodology of Beron et al. (2003) where they determine if democracy played a significant role in a nation's choice to sign the Montréal Protocol banning the use of CFCs. Similarly, we want to determine if democracies are more likely to ratify the Kyoto Protocol. Nations will prefer to ratify treaties over simply voluntarily reducing emissions when the expected benefit of signing said treaties exceeds their expected costs. This makes it quite simple, then, to determine if democratic institutions really do play a significant role in treaty signing since we are looking at a binary choice specification (ratify or not ratify). Therefore, we propose the use of a probit model to test this hypothesis.

We start by letting y_i be the binary dependant variable where $y_i = 1$ if country i ratifies the Kyoto Protocol and $y_i = 0$ if not. In this model, we assume rational decision making on part of the players. Given the situation where a nation has positive net benefits by ratifying the treaty, we expect that they will make the rational choice and sign, thereby giving $y_i = 1$. If the expected net benefits, however, are less than or equal to zero then the rational choice will be to not sign the treaty and thus $y_i = 0$.

Next, we let x_i be a 1 by k vector representing variables affecting the choice of nation i in ratification, and β is the k by 1 vector giving the relationship between and x_i and y_i. Lastly, we set ϵ_i as the error term in our equation. Note that ϵ_i is independent and identically distributed with zero mean and constant variance. Putting everything together gives:

$$y_i = x_i\beta + \epsilon_i \tag{1}$$

Since we are using this model to see if democratic nations were more likely to ratify the Kyoto Protocol, we use only the 1990 values of the variables (described in the next section) since this was the data available to each country at the time when they had to decide whether or not to join the UNFCCC.

The second part analyses the effect democracy has on policy output, CO_2 emission levels, and emission growth rate. We base our analysis on Bättig and Bernauer (2009) with some slight modifications. Whereas their sample covers 185 countries over a 15 year period starting from 1990, this study follows 177 countries from 1990-2013. It should be noted that both our models start in 1990 at the collapse of the Soviet Union but ours continues for a longer period. Therefore, despite similar models, we do not expect to have similar results. Since 2005, many ex- Soviet states have become more democratic, as well as in Latin America. This, coupled with increased global GDP since 2005, will put downward pressure on the effect of democracy on CO_2 emission levels. For the analysis, we use a simple OLS regression followed by a robustness check to test our hypotheses.

Variables

Democracy

We use a measure of democracy provided by Freedom House (2014) in which countries are scored based on political rights and civil liberties. Each category is ranked on a scale from 1 (most free) to 7 (least free). Nations are then further given a classification from not free (NF), partly free (PF), and free (F). Since in determining ratification likelihood we are interested in freedom levels using only 1990 data, we made a dummy variable equalling one if the country was free and zero otherwise. For the analysis in our OLS regressions, we are interested in a longer time frame so an average from 1990 to 2013 was used and the scale inverted so that average scores closer to seven indicate a greater amount of freedom.

Output

Our first dependent variable in the OLS regression, output, measures a country's commitment to the UNFCCC. It is modelled after Baettig et al. (2008) and updated for current years. This measure is composed of several indicators broken down into political willingness and punctuality. The first indicator, UNFCCC, assigns 0.5 points for countries that have joined the UNFCCC prior to 2006 and zero otherwise. In addition, countries that signed at the earliest possible date (July 1, 1992) are awarded an extra 0.5 points on a declining linear scale until

1998. The second indicator awards points if countries ratified the Kyoto Protocol by 2006 (0.5), and if they did it in April 1998 (0.5) on a declining linear scale until the end of 2005. Likewise, a reporting indicator measures if a country has submitted its latest report (0.5) and how fast (0.5). Finally, a finance indicator measures on a linear scale if a country has been regularly contributing to the UNFCCC in a timely manner. The scores for each country were then normalized on a zero to one scale where higher values indicate more cooperative behaviour.

Developing Nation

Under the UNFCCC, non-Annex I countries (ie. developing nations) are given more leniency in their commitments towards the treaty. For instance, they are granted extensions in submitting their status reports (Unfccc, 1992). This distinction between developed and developing nations was also present during the signing of the Montréal Protocol, under what was then called Article 5. This contrast between developed and developing countries provides a justification to include it in our regression and therefore, we set up a dummy variable equal to one if the country belongs to non-Annex I countries and zero otherwise.

CO_2 Emissions

Carbon Dioxide emissions constitute an explanatory vector in the ratification decision and two of the dependent variables in our OLS regressions. In the probit model, we used 1990 CO_2 emissions following the example of Beron et al. (2003). For the OLS regression, Emission Level represents the natural logarithm of average CO_2 emissions per capita from 1990-2010. Emission Trend represents the average annual growth rate of CO_2 emissions per capita of Emission Level. All data comes from the World Bank. Both dependent variables were standardized on a scale from zero to one, where one implies lower emission levels. Lastly, CO_2cap1990 is used as an explanatory variable in all the OLS regressions to represent CO_2 emissions per capita in 1990, at the start of the UNFCCC as a benchmark.

GDP

The idea behind the inclusion of GDP in our regressions stems from the assumption that environmental quality is a normal good. Given this, in theory, wealthier nations will have a greater demand in mitigating climate change (Cornes and Sandler, 1984). GDP is used here similar to CO_2 emissions. In the probit model, GDP per capita in 1990 is used as an explanatory variable and in the OLS regressions, GDP growth represents the average annual growth in GDP from 1990-2013.

North

Geographic location may play a role in determining whether or not a nation will ratify a treaty. Many international discussions classify the world into two categories, an industrial north and a resource-rich south. The politics of a northern country are assumed to be in line with other northern countries, and similarly the politics of a southern country align with the global south. In addition, global warming poses a greater threat to some regions of the world more than others. Therefore, we include a dummy variable, North, which is equal to one if the country is at or above the Tropic of Cancer and zero otherwise.

Constant Risk Index

Another factor affecting a nation's willingness to curb CO_2 emissions is the threat posed by climate change. Nations in more fragile ecosystems or small islands under threat of rising sea levels would be more enthusiastic to mitigate global warming. To measure this effect, we use values produced by Germanwatch (2015). Their values for each country are derived from the average risk between 1994-2013. The values are calculated by assigning weights to the following categories: annual average death toll (1/6), death toll per 100,000 people (1/3), absolute losses in PPP $US (1/6), and losses in per unit GDP (1/3). We opted for this measure in lieu of the one used in Bättig and Bernauer (2009) which is based on the IPCC because of its incorporation of climate change effects on GDP. For our analysis, we normalized each country on a scale between zero and one, where one represents a greater risk of climate change.

Income

Income is constructed by taking the logarithm of the GDP per capita values mentioned above. We also include income squared in order to capture the effect of the environmental Kuznets curve. As poorer nations develop their economies, emissions output is high, but there comes a point where pollution begins to decline with income (Baettig et al., 2008). Since the parabolic property of pollution with respect to income only applies when studying emission levels, we omit income squared from the OLS model where policy Output is the dependent variable. This agrees with our theory that wealthier nations have a linear demand for environmental protection at any given level of wealth.

Trade Openness

Lastly, trade may play a role in determining how well a country can reduce emissions. We construct this measurement by taking imports plus exports and dividing the sum by total GDP ($2005). There is disagreement

in the literature as to whether or not increased trade between nations has positive or negative effects on the environment. This ambiguity is caused by trade effects on economic output, economic scale, and income, making it unclear which of these effects dominates or if they cancel each other out (Antweiler et al., 1998).

4 Results

We begin by estimating a probit model to determine if freedom level plays a role in the decision making process to ratify the Kyoto Protocol. Table 2 shows the results of this regression.

Table 2: Democracy Effect in Ratification

	Dependent variable:
	Kyoto Protocol
Democracy	1.982^{***}
	(0.553)
Developing	0.863^{*}
	(0.509)
$CO_2$1990	0.001425
	(0.00001)
GDPcap1990	−0.00002
	(0.00001)
North	0.328
	(0.297)
Constant	−0.248
	(0.548)
Observations	175
Log Likelihood	−66.261
Akaike Inf. Crit.	144.523
Note: Std. Errors in parentheses	* p<0.1; ** p<0.05; *** p<0.01

As can be seen, democracy is significant at the 1% level, indicating that the more democratic a nation was in 1990, the more likely it was to ratify the Kyoto protocol. Similarly, developing nations were more likely to ratify the treaty. Beron et al. (2003) expressed concerns that CO_2 levels might correlate with GDP per capita, although by omitting it we lose significance on the Developing indicator. In addition, including CO_2 into the regression removes statistical significance from the North variable. This implies that developing nations, with less income, emit less CO_2 than their northern counterparts.

The second part of our study looks at the direct effect of democracy on political output and emission levels. Based on our results, democratic nations have a positive and significant effect on policy output. A one point

increase in freedom levels on the 1-7 scale translates into a 2.9% increase in policy output. This supports the first hypothesis that democratic nations are more committed to climate change mitigation efforts. In the second model, Emission Level, democracy has a negative and significant effect on CO_2 emissions–implying democracies pollute more per capita. This result is opposite to that found in Bättig and Bernauer (2009), but in accordance with some other studies. We suspect this might be the case since former Soviet economies have undergone a simultaneous process of democratization and economic development, including many new entries into NATO and the EU. In addition, much of Latin America has become freer over the past two decades and seen strong economic growth. To put things into perspective, if the least free nation, Sudan, were to become as free as the most democratic nation (Canada, Switzerland, among others), it would have a policy output increase of 14.5% but would raise per capita emission levels by 5.5%. Lastly, democracy doesn't seem to influence trends in CO_2 growth per capita.

Moving on, risk of climate change plays a positive role in a nation's commitment to mitigating climate change. Since we used a normalized scale to measure climate change risk, a one percent increase in risk leads to a policy output increase of about 12%. The CRI is insignificant with respect to emission levels and growth most likely because many of the at-risk nations are small and/or underdeveloped islands. For instance, the top five countries most at risk of climate change, Honduras, Myanmar, Haiti, Nicaragua, and the Philippines are not major economic powerhouses or a significant source of pollution. Their status as developing nations could be playing a role in increasing emissions output in accordance with the Kuznets curve.

Income has the expected effects as our theory predicted. It is positive in determining policy output, albeit insignificant. It has a negative, significant effect on emission levels indicating that richer countries emit more. In this case, a one percent increase in GDP per capita results in an emissions increase of .20 metric tons per capita. The significance of income squared indicates the presence of an environmental Kuznets curve. Therefore, as we predicted, emissions increase initially with wealth, reach a maximum, then eventually decrease at high levels of income. The effects have the same direction in the Emission Trend model, although they are insignificant.

GDP growth has a significant, negative effect on policy output and emission levels. This falls in line with the findings in Bättig and Bernauer (2009) for policy output (although it was insignificant) and they derived a positive effect for Emission Levels rather than negative. From our regression, a 1% increase in the average annual GDP growth rate results in a 0.7% decrease in policy output and a 1.3% increase in per capita emissions. The CO_2 per capita levels in 1990 are significant in both the Emission Level and Emission Trend models. Higher 1990 per capita emissions correspond to greater emission levels and slower growth rates. Finally, Trade Openness is insignificant in all our models.

Table 3: Effects of Democracy on Policy Output and Emission Levels

	Dependent variable:		
	Output	Emission Level	Emission Trend
	(1)	(2)	(3)
Democracy	0.029***	−0.011**	0.004
	(0.010)	(0.004)	(0.005)
CRI	0.121**	0.002	0.032
	(0.064)	(0.035)	(0.032)
Income	0.026	−0.200**	−0.062
	(0.182)	(0.072)	(0.094)
Income^2		0.010**	0.002
		(0.010)	(0.006)
GDP growth	−0.007**	−0.013***	−0.001
	(0.003)	(0.003)	(0.002)
CO_2/cap	0.001	−0.006***	0.006**
	(0.004)	(0.002)	(0.002)
Trade Openness	0.002	−0.0004	0.0003
	(0.001)	(0.0003)	(0.001)
Output		−0.009	0.033
		(0.033)	(0.039)
Constant	−1.180	1.495***	1.237***
	(0.758)	(0.327)	(0.389)
Observations	177	177	177
R^2	0.208	0.640	0.063
Adjusted R^2	0.175	0.622	0.019
Residual Std. Error	0.194 (df = 169)	0.083 (df = 168)	0.099 (df = 168)
F Statistic	6.345*** (df = 7; 169)	37.255*** (df = 8; 168)	1.423 (df = 8; 168)

Note: Std. Errors in Parentheses *p<0.1; **p<0.05; ***p<0.01

Next, we seek to analyse one of the most important policy contributions of this study: the words-deeds gap by countries. The goal here is to find out if democratic nations are more likely to live up to their political commitments than authoritarian regimes. To do this, we construct a new dependent variable, Words-Deeds Gap, by following the example put forth in Bättig and Bernauer (2009). We sum together Emission Levels and Emission Trends, normalize the result to a 0-1 scale, then subtract our Output variable. This gives a score between -1 and +1 for every country. A lower score (for example Namibia = −0.825) implies the country makes more promises than it can keep and a higher score (for example, Afghanistan = 0.784) means the country takes more voluntary actions than it promises. Afterwards we run the regression on all explanatory variables except Output due to multicollinearity. The regression results are shown in Table 4.

From the regression, we get significant and negative effects of democracy and income on words-deeds gap. This means that wealthy, democratic nations are better at giving political promises than they are at reducing emissions. However we note that the two extreme countries (Namibia and Afghanistan), seem more like the exception than the rule. Namibia has the highest political commitment to emission reduction ratio but is not very rich nor is it the most democratic. Afghanistan on the other hand has been embroiled in war for much of the sampling period and is not the first nation that comes to mind when one thinks about emission reductions. Nevertheless, the trend holds and follows through with our theory outlined above.

Table 4: Estimating the Words-Deeds Gap

	Dependent variable:
	Words-Deeds Gap
Democracy	-0.035^{***}
	(0.010)
GDP growth	-0.005
	(0.004)
Income	-0.572^{***}
	(0.194)
Income^2	0.031^{***}
	(0.012)
CRI	-0.085
	(0.067)
CO_2/cap	-0.006
	(0.005)
Trade Openness	-0.002
	(0.003)
Constant	2.678^{***}
	(0.807)
Observations	177
R^2	0.261
Adjusted R^2	0.231
Residual Std. Error	0.207 (df = 169)
F Statistic	8.540^{***} (df = 7; 169)
Note: Standard Errors in Parentheses	*p<0.1; **p<0.05; ***p<0.01

We subjected our results to a few consistency checks. First in the probit model, we tested eliminating outlying countries with respect to their GDP per capita levels in 1990. The idea was that the wealthiest countries, with the exception of a few Persian Gulf states, were more likely to be democracies, and thus skew the results. Omission of these countries did not change the results so we opted to keep them in. Second, we updated the Output variable in the OLS model to include the latest indicator of political will, the Doha Amendment,

measuring it by the same standard as the Kyoto Protocol. Since not enough countries have signed yet to ratify the amendment, we awarded the countries that did sign an extra 0.5 points. Running the same regression did not change any results, implying that political willingness has remained relatively constant throughout our time frame. Therefore we omitted the Doha Amendment indicator from Output for simplicity.

To check the robustness of our analysis, we ran a Ramsey Reset test. This tests if non-linear combinations of the explanatory variables help to better explain the dependent variable (Ramsey, 1969). If so, then the model is misspecified. Running this model, we see that for every one of our models, the explanatory variables suffice in describing the dependent variables and so we work with our current models. Next, we run a Breusch-Pagan Test to check for the presence of heteroskedasticity. Under normal conditions, OLS is BLUE (best linear unbiased estimator) but in the case of heteroskedasticity, OLS loses its efficiency. Running the Breusch-Pagan test on our three OLS models tells us that both the Output and the Emission Level models suffer from heteroskedasticity. We therefore used Huber-White robust standard errors in the first two OLS models to ensure efficiency while leaving the Emission Trend model as is.

Studies have shown that more democratic nations are wealthier which could lead to multicollinearity in our regressions since both democracy and income are explanatory variables. To test that our regressions were fine, we checked the correlation between democracy and income and found it to be 0.447, thereby eliminating the potential of severe multicollinearity. As a secondary precaution, we found the variance inflation factor (VIF) of each independent variable. All variables had a VIF of less than three, and so there was no need to eliminate any variable on the basis of multicollinearity as explained by Zuur et al. (2010).

5 Conclusion

Climate change is a major issue of the 21st century, being no nation's responsibility yet affecting every individual. While no single country can handle burden of eliminating pollution, the problem can be solved through international cooperation. The UNFCCC has been set up for this purpose as a de facto authority and to provide effective leadership in mitigating climate change. Even though we face challenges such as free riding and inducing voluntary contributions despite the uneven distribution of results, the treaty is so far proving to be effective in reducing emission levels.

By including a probit model to test if democracies are more likely to ratify the Kyoto Protocol, we added a depth to the study of Bättig and Bernauer (2009) since ratification is the first step to political commitment and ultimately emission reductions. The significant coefficient on democracy confirms our hypothesis and further

supports the literature that democratic institutions have strong, positive effects in working towards solving the emissions problem.

The second part of the study looked at the democratic effect on 177 countries over a 23 year period. Similarly, democracy was significant both for policy output and emission levels, albeit weaker for the latter. Countries with democratic institutions can expect to have a positive outcome with respect to their political willingness in participating towards mitigating climate change. The trade off, however, is that democratic countries have higher CO_2 emission levels per capita than autocratic regimes, *ceteris paribus*. The first result backs up what has been repeatedly found in the literature and the second confirms some studies while contradicting others.

The policy implications for this research are given in the final analysis concerning the "words-deeds" gap. With a significant negative coefficient, our results show that democracies have a tendency to not deliver all the promises which they make. The obvious remedies would be either to promise less or to deliver more. Unfortunately this decision is not so simple to make. Promising less may have negative consequences on the global effort to reduce emissions while delivering more gives incentives for other countries to free ride. Nevertheless, there is evidence that democracies are taking the second route and increasing their efforts. This comes naturally as a side effect of democracies becoming wealthier than other nations. Coupled with the environmental Kuznets curve, more countries will eventually cross a point where income is high enough to eventually begin reducing emissions. Given current trends, we can one day hope to live in a prosperous and clean world.

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