

# Political and Economic Freedom and the Environment: The Case of CO<sub>2</sub> Emissions

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## *Abstract*

In this paper we investigate what effect political and economic freedom has on emissions of CO<sub>2</sub>. The estimated models predict that CO<sub>2</sub> is always increasing in GDP even at high level of GDP, which confirms the results of earlier studies. Moreover, we find that political freedom decreases CO<sub>2</sub> emissions. This positive relation between democracy and environmental quality has been found for several other pollutants, and we confirm the results for CO<sub>2</sub> emissions. Increased economic freedom, in terms of lower government size, decreases CO<sub>2</sub> emissions when the size of the government is small but increases emissions when the size is large. An increased use of market or increased freedom to trade decreases CO<sub>2</sub> emissions. Increased price stability and legal structure has no effect on emissions. The results hold for both linear and log-linear specifications, except for the freedom of trade variable that is significant in the linear case. The result is also robust to the sample. Hence, the direct effects of economic freedom on CO<sub>2</sub> emissions are mainly decreasing except for the government size effect, which increases emissions at high levels of freedom.

**Keywords:** Political Freedom, Economic Freedom, Carbon Dioxide.

**JEL classification:** O10, O40

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## 1. Introduction

Among economists, there is a rather strong consensus that economic, but also political, freedom is positively correlated with economic growth. These hypotheses have also been supported in several studies (see e.g. Barro, 1991; Islam, 1996; Gwartney et al., 1999).<sup>1</sup> However, some authors have questioned the significance of the importance of political freedom for growth, arguing that there could even be a negative effect (especially for low-income countries), and that economic freedom should be prioritised (see e.g. Barro, 1996). In the light of these results, and its policy implications of promoting political and economic freedom, it is of interest to empirically test how increased freedom affects environmental quality. Two interesting questions are whether income is positively correlated with environmental quality and whether economic and political freedom is positively correlated with environmental quality. The first question has been studied in the environmental Kuznets curve literature (see e.g. Grossman and Krueger, 1995; Selden and Song, 1994; Shafik, 1994) and will therefore not be considered here. The purpose of this study is to analyse the second question, i.e. the direct effect from changes in political and economic freedom on the environment.

We investigate the effect of political and economic freedom on the level of carbon dioxide (CO<sub>2</sub>) emissions, using a panel data set of 75 countries on CO<sub>2</sub> emissions from 1975-1995. Since global warming has been put forward as one of the major environmental problems and since the institutional factors such as political and economic freedom are accepted as crucial for economic development, the relation is of great importance.

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<sup>1</sup> However, it should be noted that the stability of the results have been questioned (see e.g. Levine and Renelt, 1992; de Haan and Sturm, 2000; Carlsson and Lundström, 2001).

The paper is organised as follows. The relations between political and economic freedom and the environment, in general and in the CO<sub>2</sub> case, are discussed in Section 2. The data is presented in Section 3. Section 4 contains the model specification. In Section 5 the results of the estimations are reported and discussed. The final section concludes the paper.

## **2. Freedom and the Environment**

### *2.1 Political Freedom*

A political and civil system in which individuals' demand for environmental quality can be expressed might be crucial for changes in environmental quality. However, from this does not follow that there has to be a positive correlation between political freedom and environmental quality. The reason why a more democratic regime could have a negative effect on environmental quality, at least for low-income countries, may be explained by the same arguments as Barro (1996) uses to explain why restrictions on the political freedom can be good for the growth. In a democratic system with majority voting there is a threat of rich-to-poor redistribution, including land redistribution, which may discourage investments. Moreover, in a system with representative legislature the role of interest groups is enhanced. If these effects are biased against environmentally unfriendly solutions, the quality of the environment could decrease with political freedom. The effect of political freedom may also be insignificant; in particular if it is a global environmental problem since the individual country has an incentive to free-ride. At the same time, emissions of global pollutants can be correlated with other environmental problems, so there could still be an effect of political freedom. There can

also be an indirect effect on global emissions because of the potential effect of political freedom on income, which in turn effects emissions.

The relation between political freedom and the environment has been studied in a number of papers. Most studies have found a positive relation between political freedom and environmental quality, but none of these have studied CO<sub>2</sub> emissions. Deacon (1999) discusses reasons for a positive correlation between political freedom and environmental quality, and argues that non-democratic regimes are more likely to underprovide public goods, such as environmental quality, compared to regimes that are more democratic. The underlying reason for this is the assumption that the political elite receives a disproportionate share of the country's income, which often implies that they bear a disproportionate share of the cost of the environmental regulation. At the same time, this group receives a proportionate share of the benefits of pollution control. In the empirical section Deacon finds that in most cases the least democratic regimes are also the worst when it comes to environmental policy levels and public good provision. Congelton (1992) presents a similar model with similar arguments as Deacon, and in addition argues that less democratic regimes tend to have a shorter planning horizon. He investigates the effect of democracy on the probability that a country has signed the Vienna convention and/or the Montreal Protocol concerning reduction of chlorofluorocarbons, and finds that democratic regimes are more likely to have signed these conventions. Fredriksson and Gaston (2000) found that the probability of signing the United Nations Framework Convention on Climate Change is positively related to the presence of civil liberties. Barrett and Graddy (2000) also find a positive relation between environmental quality and political and civil freedom for several air pollutants, but at the same time a negative relation for several water pollutants. Torras and Boyce

(1998) use three measures of democracy; the Gini coefficient of income distribution, literacy and an index of civil liberties. These indicators have in general a positive and significant effect on air and water quality, especially for low-income countries. They also find that the significance of the income variable decreases for several environmental measures when the democracy variables are included. However, Scruggs (1998) does not find any overall positive relation between water and air quality and political freedom.

## *2.2 Economic Freedom*

Economic freedom is often mentioned as a crucial component for improving incentives, productive efforts and an effective resource use. If economic freedom is good or bad for the environment depends largely on how these factors in turn affect the environment. We are here interested in how different economic freedom variables, that have been found to be important for economic growth, affect the environment. Another type of variables that are indirectly related to economic freedom are environmental regulations, but these are not included in our study (see e.g. Hilton and Levinson, 1998). The effect of economic freedom on the environment is clearly a complex issue. What we do in this section is to present a number of simplified hypotheses regarding the effects. (i) *The Government Size Effect*. The effect of government expenditures depends clearly on the composition of the expenditures, which in turn partly depends on the goals of the government. So, the question is if there is a relation between the size of the government and the composition of the expenditures. We hypothesize that the relation between the size of the government and emissions is hump-shaped. From low levels of the size of the government, increases in expenditures are likely to include, to a large extent,

expenditures and subsidies towards basic industry and infrastructure such as roads. At higher level of the government, increases are likely to include, to a larger extent, redistributive transfers, which results in increased income equality. This in turn has a positive effect on the demand for higher environmental quality (see e.g. Magnani, 2000).. Furthermore, if the environment is a luxury public good, it is likely that this type of good will only be demanded when the demand for other public goods have been satisfied, i.e. at large levels of the government size. (ii) *The Efficiency Effect*. Under the assumption that economic freedom results in efficient and competitive markets, we expect a positive correlation between economic freedom and environmental quality. First, this will result in an efficient use of resources that have a price. This price can of course be affected by for example a tax correcting for an externality. In the case of for example energy resources this implies lower emissions per produced unit. Second, an efficient and competitive market can more efficiently meet the political regulations. Third, an efficient market can better meet the desires from the consumers. The second and third reasons are simply due to competitive reasons; in order to survive firms have to react to changes in the market environment. Clearly, these two effects are only relevant if there are environmental regulations or a demand for cleaner production/goods from the consumers. (iii) *The Trade Regulation Effect*. Trade regulations are a type of restriction on economic freedom, through restrictions and taxes on trade. Trade liberalization may results in a more effective resource allocation, including environmental resources. This is a result of the competitive pressure in international markets. (iv) *The Stability Effect*. Lower inflation rate and clearer pricing signals lead to more efficient investment and consumption decisions. A stable macroeconomic environment also encourages longer investment horizons. Lack of price

stability is one problem for development since investments decline when the insecurity of prices increases. Many environmental investments pay off in the future, and will not be made without a belief that the economy will be stable until the profits are received. Hence, a stable macroeconomic environment can have a positive effect on the environment. Another important part of the stability effect is the property rights structure. The importance of security of property rights and viability of contracts has been emphasized in the growth literature and lately also in the growth-environment literature (see e.g. Panayotou, 1997). With more secure property rights individuals can make long-term investments. For example, farmers with less insecure title to their land will be more likely to invest in soil conservation and sustainable cultivation techniques. However, an increased stability will also result in increased investments and consumption in general, and some of these will have a negative effect on the environment. Which type of decisions that will be made depends partly on what phase of the structural change the economy is in.

As far as we know there has been no attempt to connect environmental quality with measures of economic freedom in cross-country comparisons, except for property rights/quality of institutions (Panayotou, 1997) and trade restrictions (Lopez, 1997). Panayotou found that the quality of policies and institutions can reduce environmental degradation at low income levels and speed up improvements at higher income levels. Lopez, analyzing the impact of trade liberalization on externalities from agricultural production in Ghana, find that increased trade liberalization is likely to result in losses of biomass and further deforestation. There have also been country specific investigations of the relation between economic policies and the environment. Munasinghe and Cruz (1995) conduct eleven case studies on mainly developing

countries. Their main findings are: (i) Removal of price distortions, promotion of market incentives and relaxation of other constraints will in general contribute to both economic and environmental gains. (ii) There can be side effects if some reforms are undertaken, while other policy, market or institutional imperfections persist. (iii) Macroeconomic stability will generally yield environmental benefits, since instability undermines sustainable resource use.

### *2.3 Freedom and CO<sub>2</sub> emissions*

In this paper we are specifically interested in CO<sub>2</sub> emissions. Since CO<sub>2</sub> is a global pollutant, there is a free-rider incentive for individual countries when it comes to reduction of emissions, which will affect the expected results. This becomes clear when looking at earlier studies of the relation between GDP growth and CO<sub>2</sub> emissions (see e.g. Cole et al., 1997; Holtz-Eakin and Selden 1995; Moomaw and Unruh 1997). Most of the studies have found a monotonically increasing relation between income and emissions although some of the studies have found a cubic, or N shaped, relation between emissions and income, but the turning points are often outside the observed sample.

Empirical studies have found a positive relation between political freedom and the probability to sign international conventions regarding reductions of global pollutants (Congleton, 1992; Fredriksson and Gaston, 1999). We therefore expect a negative sign between political freedom and CO<sub>2</sub> emissions, despite the fact that it is a global pollutant. For the economic freedom variables we expect the variables representing freedom to trade and market efficiency to have a negative relation with CO<sub>2</sub> emissions because of exposure to competition and efficient use of resources. For the government

size variable we expect an inverted U-shape between the size of government and emissions. If stability increases or decreases emissions is hard to predict since the outcome is mainly a function of private investments, which in turn depend on the structural phase of the specific country. Because of the public good character of CO<sub>2</sub> emissions it is not very likely that investments are primarily directed towards reductions of CO<sub>2</sub> emissions. At the same time, CO<sub>2</sub> emissions are directly related to energy use, and therefore changes in investments may still result in reduced emissions.

### **3. Data**

The CO<sub>2</sub> emissions per capita and GDP per capita data come from *1999 World Development Indicators CD-Rom* (World Bank, 1999). The data on CO<sub>2</sub> emissions is originally from the Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory. CO<sub>2</sub> emissions, measured in metric tons per capita, are emissions steaming from the burning of fossil fuels and the manufacture of cement. They include contributions to the carbon dioxide flux from solid fuels, liquid fuels, gas fuels, and gas flaring. The GDP data is converted into international dollars using purchasing power parities.

The political freedom variables are measures based on the Freedom House indices of political and civil freedom (Freedom House, 1999). The political freedom index measures whether a government came to power by election or by gun, whether elections, if any, are free and fair, and whether an opposition exists and has the opportunity to take power at the consent of the electorate. The civil freedom index measures constraint on the freedom of the press, and constraints on the rights of individuals to debate, to assemble, to demonstrate, and to form organizations, including

political parties and pressure groups. The indices have been reported annually since 1972, although not all countries are included since 1972. Since they are highly correlated we use the average of these two indices, henceforth called *Political freedom*. The political freedom index is measured on a scale between 1 to 7, where 7 is the highest level of freedom.

The data on economic freedom is obtained from *Economic Freedom of the World: 2000 Annual Report* (Gwartney et al., 2000). The main components of the economic freedom index are personal choice, protection of property and freedom of exchange. The index of economic freedom is divided into seven categories. Each index is measured on a scale between 0 and 10, where 10 is the highest level of freedom. We use some of these categories that we think might have an effect on the environment according to the hypotheses presented in section 2. The category *Size of Government* represents the Government Size Effect. This category consists of two variables: 1) the share of government consumption expenditure and 2) the share of government transfers and subsidies as a percent of GDP. Countries with a large proportion of government expenditures or a large transfer sector receive lower ratings. The category *Economic Structure and Use of Market* represents the Efficiency Effect. This category is a measure of the share of government production and allocation, and it consists of four variables: 1) government enterprises and investment as a share of the economy, 2) the extent of price controls, 3) the top marginal tax rate and 4) the use of conscripts to obtain military personnel. The Trade Regulation Effect is represented by the category *International Exchange: Freedom to Trade with Foreigners*. This category consists of the two variables 1) Taxes on international trade and 2) Non-tariff regulatory trade barriers. The average of the two categories Monetary Policy and Price Stability and

Legal Structure and Property Rights, henceforth called *Price Stability and Legal Security* represents the Stability Effect. The category Monetary Policy and Price Stability measures the protection of money as a store of value and medium of exchange, and countries with a more stable monetary policy receive a higher rating. It contains the variables 1) average annual growth rate of the money supply during the last five years minus the growth rate of the real GDP during the last ten years, 2) standard deviation of the annual inflation rate during the last five years and 3) annual inflation rate during the most recent year. The category Legal Structure and Property Rights measures the security of property right and the viability of contracts and consists of three variables: 1) risk of confiscation, 2) risk of contract repudiation by the government and 3) institutions supportive to the principles of rule of law. Consequently, we have four measures of economic freedom. The economic freedom data has been reported every fifth year since 1970, and in addition the data is reported for 1997, but not all countries have been included since 1970.

The sample includes 75 countries for the period 1975-1995. The data is unbalanced, due to missing observations mainly on political and economic freedom.<sup>2</sup> Descriptive statistics are presented in Table 1. Note that CO<sub>2</sub> per capita is in kg emissions per capita and *GDP per capita* is in thousands of dollars per capita. CO<sub>2</sub> per capita is measured as a moving average of the current and the previous three years since the current level of emissions to some extent is a function of past levels of emissions.

[Table 1 about here]

The correlation matrices are presented in Table 2. We see that both political and economic freedoms are highly correlated. With the exception of the variable *Size of*

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<sup>2</sup> We also had data between 1985 and 1995, and 1990 and 1995 for a number of countries. However, since we estimated an autocorrelated error structure, many of these observations had to be excluded..

*government*, the political and economic freedom variables are positively correlated with *GDP per capita*.

[Table 2 about here]

#### 4. Model Specification

We assume that CO<sub>2</sub> emissions are a polynomial function of income, and a function of political and economic freedom. In the literature the two common specifications are a linear and a log-linear specification, and we therefore apply both specifications.<sup>3</sup> The following two models are therefore estimated

$$\ln(CO2_{it}) = \alpha_i + \beta_1 \ln(Y_{it}) + \beta_2 [\ln(Y_{it})]^2 + \beta_3 [\ln(Y_{it})]^3 + \lambda_1 PF_{it} + \sum_j \mu_{1j} EF_{it}^j + \mu_{21} (EF_{it}^1)^2 + \varepsilon_{it} \quad (1)$$

$$CO2_{it} = \alpha_i + \beta_1 Y_{it} + \beta_2 [Y_{it}]^2 + \beta_3 [Y_{it}]^3 + \lambda_1 PF_{it} + \sum_j \mu_{1j} EF_{it}^j + \mu_{21} (EF_{it}^1)^2 + \varepsilon_{it}$$

where  $i$  is a country index and  $t$  a time index. The term  $\alpha_i$  reflects country  $i$ 's fixed effects such as geographical characteristics, fossil fuel availability and prices, energy endowments, output mixes and tastes.<sup>4</sup>  $CO2_{it}$  is per capita emissions of  $Y_{it}$  is per capita GDP.  $PF_{it}$  is the political freedom index,  $EF^j$  is economic freedom variable  $j$ , and  $\varepsilon_{it}$  is a stochastic error term. Since the squared term of the economic freedom variable *Size of government* often is significant in economic growth studies we include a squared term here also.

For each regression both a random and a fixed effect model was estimated, and in all cases a Hausman test resulted in a rejection of the null hypothesis that the individual

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<sup>3</sup> In a PE-test (Greene, 2000) we cannot reject any of the specifications in favor of the other.

<sup>4</sup> All these effects could of course change in the long run but are expected to be constant during the time period we study.

effects are uncorrelated with the other regressors. In addition, the fixed effects model is more appropriate since we only wish to draw inference on the set of observed countries, consequently we only report the estimates from the fixed effects models.

In both models we specify an autocorrelated error structure of the form

$$\varepsilon_{it} = \rho\varepsilon_{it-1} + v_{it}, \quad (2)$$

where  $v_{it}$  is i.i.d. across individuals and time. Consequently, we assume that the disturbances follow an AR(1) process.<sup>5</sup>

## 5. Results

Table 3 presents the results of the two estimations of the two model specifications.

[Table 3 about here]

All GDP per capita variables are significant, in both the linear and the log-linear specification. However, none of the models predicts a turning point over the relevant range of values of the GDP per capita variable, which is in line with earlier studies. Regarding the freedom variables the results differ between the linear and log-linear specification. The *Political freedom* variable is negative in both specifications, implying that increased political freedom results in reduced CO<sub>2</sub> emissions, but only significant in the log-linear specification. Earlier studies have found a similar, and significant, relation for other pollutants. In the linear model only the economic freedom variables *Size of government* and *Economic structure and use of markets* are significant. While in the log-linear model, the variable *Freedom to trade with foreigners* is also significant. The

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<sup>5</sup> For details on the estimation of an AR(1) model see e.g. Baltagi (1995).

estimated coefficients for the *Size of government* variables implies a hump-shaped relation between the freedom variable and CO<sub>2</sub> emissions, and the turning point is at an index value of 7.51 and 6.65 respectively, which is roughly at the mean value of the category index. Consequently, at low levels of economic freedom, in terms of a large government sector, an increase in the freedom (a reduction in the size of the government) increases emissions, while the opposite is true at high level of economic freedom.<sup>6</sup> All other significant economic freedom variables have a negative sign, indicating that increased freedom decreases CO<sub>2</sub> emissions.

We also test the stability of the results with respect to the sample. This is done by estimating the models, removing one country at the time, and consequently we run 75 estimations for each specification. Then we calculate the share of number of times each variable is significant at the 10% level. First, we wish to test if the choice of the sample influences the results. Second, we wish to test, in a crude manner, the possible impact of problems with multicollinearity in terms of sensitivity to the sample parameter estimates. For the log-linear model, Political freedom variable is insignificant in two of the estimations and *Freedom to trade* is insignificant in one of the estimations. For the linear model, *Economic structure and use of markets* is insignificant in one of the estimations. Consequently, we can conclude that the estimated parameters are highly stable with respect to the sample.

It is of course dissatisfying that the two model specifications gives slightly different results in terms of significance of the freedom categories. On the other hand, the two categories *Size of the government* and *Structure and use of markets* are significant in both specifications, and can perhaps be seen as more robust. Accepting the connections

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<sup>6</sup> Note that economic freedom is decreasing in the size of the government.

between the hypotheses presented in section 2.2, we may conclude the following in terms of increased economic freedom. The *Government size effect* is significant in both specifications and depends on the level of freedom. For countries with a low economic freedom, i.e. countries in which the government involvement is large, increased freedom actually increases emissions. It is only for countries with a small government sector that increased freedom results in decreased emissions. The *Efficiency effect* is significant in both specifications, with the expected decreasing effect on emissions. On the other hand, the *Trade regulation effect* is only significant, with the expected sign, for the log-linear specification. The *Stability effect* is not significant in any of the model specifications.

## 6. Conclusions

The results we have found should be interpreted with some care. The data is rather unbalanced, mainly due to missing observations on political and economic freedom. Moreover, it is not possible to directly relate the economic freedom indices to the hypotheses in Section 2. Therefore it is difficult to reject or accept the hypotheses, and to know exactly what effects that drive the result. However, with this in mind, there are indeed some interesting results.

First of all the study does not predict a turning point for CO<sub>2</sub> emissions, which confirms the results of earlier studies. Moreover, we find that political freedom decreases CO<sub>2</sub> emissions. This positive relation between democracy and environmental quality has been found for several other pollutants, and we confirm the results for CO<sub>2</sub> emissions. Increased economic freedom, in terms of lower government size, decreases CO<sub>2</sub> emissions when the size of the government is small but increases emissions when

the size is large. An increased use of market or increased freedom to trade decreases CO<sub>2</sub> emissions. Increased price stability and legal structure has no effect on emissions. The results hold for both linear and log-linear specifications, except for the freedom of trade variable that is significant in the linear case. The result is also robust to the sample. Hence, the direct effects of economic freedom on CO<sub>2</sub> emissions are mainly decreasing except for the government size effect, which increases emissions at high levels of freedom, and the stability effect, which is insignificant.

A natural extension of this work is to study other types of environmental measures and their relation to political and economic freedom. The size and sign of these effects can be expected to differ depending on the public good character of the environmental good, or the character of the good from which the emissions occur.

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## Tables

**Table 1.** Descriptive statistics for countries included in the estimations.

	Mean	Std.	Min	Max
CO <sub>2</sub> , kg per capita	4523.8	4961.6	42.2	25267.0
GDP, 1000 dollar per capita	6.3	5.9	0.3	27.3
Political freedom (POL)	4.9	1.8	1.0	7.0
Size of government (EF1)	7.4	1.5	2.8	9.9
Freedom to trade with foreigners (EF2)	6.1	2.2	0	9.8
Structure and use of markets (EF3)	4.0	1.9	0	9.2
Price stability and Legal security (EF4)	6.5	2.2	0	9.9
Number of observations	347			

**Table 2.** Correlation matrices for variables included in estimations

	GDP	POL	EF1	EF2	EF3	EF4	CO <sub>2</sub>
GDP	1.00						
POL	0.58	1.00					
EF1	-0.61	-0.51	1.00				
EF2	0.62	0.40	-0.57	1.00			
EF3	0.44	0.30	-0.01	0.39	1.00		
EF4	0.62	0.47	-0.47	0.57	0.34	1.00	
CO <sub>2</sub>	0.71	0.45	-0.54	0.61	0.30	0.53	1.00

**Table 3.** Results of estimations, linear and log-linear specification.

	Linear		Log-linear	
	Coefficient	P-value	Coefficient	P-value
GDP	856.22	0.00		
GDP <sup>2</sup>	-53.70	0.00		
GDP <sup>3</sup>	1.14	0.00		
ln GDP			0.3382	0.00
(ln GDP) <sup>2</sup>			0.2459	0.00
(ln GDP) <sup>3</sup>			-0.0693	0.00
Political freedom	-60.96	0.45	-0.0240	0.06
Size of government (EF1)	2487.58	0.00	0.4013	0.00
EF1 <sup>2</sup>	-165.6	0.00	-0.0302	0.00
Freedom to trade with foreigners (EF2)	-34.53	0.60	-0.0228	0.03
Structure and use of markets (EF3)	-128.50	0.06	-0.0226	0.04
Price stability and Legal security (EF4)	-14.76	0.83	0.0082	0.45
Est. rho	0.0925		0.1877	
R-squared	0.97		0.99	
Turning point EF1	7.51		6.65	