The Influence of Capitalism and Democracy on Air Emissions among OECD Countries*

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Introduction

In his famous treatise, Francis Fukuyama (1992) declares that history has shown how democracy and capitalism are the optimal institutions for promoting prosperity and human well-being in society. Many subsequent empirical studies within the political economy literature have sought to quantify the influence of these institutions on prosperity and well-being. For example, survey articles by Przeworski and Limongi (1993) and Mulligan, et. al. (2004) find broad empirical support that democracy promotes prosperity. Berggren's (2003) survey article finds broad empirical support that capitalism promotes prosperity. Lest it be misunderstood that prosperity, rather than institutions such as capitalism or democracy, is the significant determinant of human well-being in society, Stroup (2007) finds that after controlling for differences in per-capita income, capitalism and (to a lesser extent) democracy both tend to promote higher levels of many non-monetary measures of human well-being, such as longevity, educational attainment and disease prevention.

What about the influence that these two institutions exert on environmental quality in society? Congelton (1992), Torras and Boyce (1998) and Barrett and Graddy (2000) find that democracy promotes environmental quality. However, these studies did not attempt to control for the influence of capitalism. Indeed, there appears to be little empirical analysis in the literature that is designed to quantify the net influence that capitalism might have on environmental quality, even among the relatively democratic societies. This apparent void raises some interesting questions:

- If capitalism promotes prosperity, and society's demand for environmental quality is income elastic, would democratic countries that preserve the market freedoms of capitalism also tend to adopt a "greener" mix of economic activity?
- Is the economic opportunity cost of preserving environmental quality better reflected in the environmental policy of those democratic countries that have more fully embraced the institution of capitalism?
- Which of these two institutional freedoms has a greater net impact on lowering the level of environmental degradation per dollar value of GDP?

This empirical study seeks to address these questions. The following panel data analysis uses various measures of air pollution, water pollution and greenhouse gas

emissions among the OECD (Organization for Economic Cooperation and Development) countries over the 1980s and 1990s. A fixed-effects regression model uses a pair of institutional indexes reflecting the level of economic freedoms that promote capitalism in society, as well as the level of political rights that promote democracy in society, to explain cross-country variation in the level of these emissions per dollar value of GDP. The specification controls for the level of per-capita income, population, urbanization, and the proportion of the economy associated with manufacturing and agriculture. The specification also allows for the possible interaction between these two institutions to influence their respective impacts over these emission levels.

The results of the analysis imply that capitalism and democracy both exert a beneficial impact on environmental quality by decreasing undesirable emissions per dollar value of GDP. However, the net environmental benefit of additional economic freedoms in society appears to be greater than the net benefit from an equivalent increase in political rights. If these results are true and can be extended to countries outside the sample of OECD countries, then these findings have an intriguing implication for moderately developed countries pursuing both greater economic freedoms and more political rights. The environmental quality that society can expect to lose in its pursuit of economic prosperity may be minimized by raising the level of economic freedoms that promote capitalism by more than the level of political rights that promote democracy.

The Efficacy of Capitalism and Democracy in the Presence of Externalities

Under conditions of perfect information and in the absence of transactions costs, the neoclassical economic paradigm asserts that market processes achieve an efficient allocation of scarce resources among producers and consumers. Even in a world with incomplete information and transactions costs, Friedman (1962) and Hayek (1988) both argue that the unfettered, decentralized market institutions of capitalism work better than even democracy by allowing for a much broader range of consumer expressions of demand for consumption opportunities, and motivating entrepreneurs to accept more risk in discovering and employing a greater diversity of production technologies to satisfy that larger set of consumer demands. This combination allows for the resource allocation plans of consumers and producers to more easily and cheaply adapt and coordinate in

response to an unpredictable and dynamic world economy. Indeed, Baumol (2002) argues that those societies respecting private property rights and operating under the rule of law are much quicker in adapting new technologies and employing innovative production processes in response to significant changes to their economic environment.

Additionally, Wittman (1989) and Stiglitz (1989) argue that a representative democracy can create a Pareto efficient collection of public policy proposals that maximize the number of individuals in the electorate whose preferences are reflected in allocation of these unassigned social costs and benefits. Competition between political parties increases the number of options for social benefits allocation across the electorate, promotes platform identity over the relevant issues that lowers the voter's cost for expressing their resource allocation preferences, and decreases the transactions costs associated with making political trade-offs. This perspective implies that a representative democracy can produce an efficient, Coasian-style reassignment of social benefits across the many conflicting voices of the electorate.[1]

How might the two institutions of capitalism and democracy influence environmental quality in an imperfect world of incomplete information and transactions costs? In part, those societies preserving the institutional freedoms of capitalism would rely more upon the evolving rule of law rather than capricious statutory regulation to resolve disputes over externalities and allocating the unassigned social costs and benefits. For example, Posner (1998) argues that U.S. common law has developed a system of economically efficient property rights allocations when such rights have become ill-defined through technological advancement or other significant cultural changes in society. Yandle (1997), Meiners and Yandle (1998) and Brown and Meiners (2000) all cite cases where common law has improved both environmental quality and economic efficiency as civil court decisions have been levied against air, land and water polluters. They also illustrate many specific cases where regulatory actions by democratic governments have resulted in both substantial economic inefficiencies and significant environmental degradation.

[1] Sutter (2002) offers an enlightening discussion of the methodological differences between the Neoclassical and Public Choice perspectives on the efficiency of democracy.

If Hayek's and Friedman's perspectives are correct, in that capitalism increases the size and scope of efficient resource allocation possibilities that can coordinate the plans of both consumers and producers in society, and if Wittman's and Stiglitz's perspectives are accurate about representative democracy's ability to efficiently reflect the public interest in minimizing the true opportunity cost of simultaneously achieving environmental quality and economic prosperity, then this implies democratic governments which more strongly embrace capitalism would generally rely less on regulatory actions and more on improving the definitions of property rights to deal with unforeseen externalities and unassigned social costs and benefits. As a result, these countries should enjoy a larger set of efficient environmental policy solutions to chose from for addressing the often inevitable trade-offs between economic prosperity and environmental quality.

However, if the efficacy of capitalism and democracy in achieving "greener" prosperity for society is constrained by the traditional assumption of diminishing returns, the marginal benefits from attaining additional levels of one type of institutional freedom in society will diminish as the level of the other type of freedom increases. This diminishing marginal benefit of institutional advantage should manifest itself in the form of lower environmental damage being observed per dollar value of GDP in the presence of relatively low values of the other institutional freedom. Yet, this benefit should diminish as the level of the other institutional freedom increases.

Indeed, Copeland and Taylor's (2004) comprehensive review of the economic literature surrounding the income elasticity of environmental demand concluded that institutional characteristics are likely to play a significant part in explaining observed cross-country variation in the levels of pollution:

> "While incomes per capita are likely to be an important determinant of pollution policy (or pollution supply), actual pollution outcomes reflect the impact of other national characteristics as well (since they determine pollution demand)… Recent research finding a sensitivity of the environmental Kuznet's curve to time periods or data may reflect the workings of important excluded national characteristics… Moreover, at a theoretical level, it is still not well understood how the income effect interacts with the policy process, particularly in the context of political economy influences." (pg. 66)

Measuring Capitalism, Democracy and their Effect on the Environment

Gwartney, Lawson and Block (1996) were among the first to systematically quantify the level of those institutional characteristics thought to promote economic freedoms in society and aggregate these values into an index for each country (herein called the EFI).[2] This index ranges in value from 1 (the least economically free) to 10 (the economically most free) for each country. The non-profit organization Fraser Institute first updated and published this index every five years, starting in 1975. After the year 2000, the index was then updated and published annually.

Gastil (1987) was among the first to quantify various institutional characteristics thought to promote the level of political rights that foster democracy in society. The non-profit organization Freedom House has aggregated these values into an annual index of political rights (herein called PRI) for over 100 countries and reports these indexes annually.[3] This index ranges in value from 1 (the most politically free) to 7 (the least politically free) for each country. For this analysis, the PRI has been converted to the same 1-to-10 scale as the EFI, with a higher value indicating more political freedom.

These two sets of institutional indexes make it much easier for social scientists to use panel data to estimate the influence of the institutions of capitalism and democracy on prosperity, human well-being and environmental quality in society. However, there must be sufficient variation in both indexes for estimating any potential interaction effects between these two indexes. Figure 1, below, illustrates the average value of EFI and PRI for the thirty OECD countries across the four annual observations used in this analysis (1980, 1985, 1990 and 1995). This scatter diagram reveals that some countries, such as Poland and Turkey, have exhibited relatively lower levels of both political and economic freedoms in society. Other countries, such as Switzerland and the U.S., have exhibited relatively higher levels of both freedoms. Interestingly, countries like Greece and Iceland each have exhibited a relatively high level of political freedom, but relatively low levels of economic freedom. Despite the fact that the 30 OECD countries exhibit relatively high levels of both democracy and capitalism compared to the rest of the world, the correlation

[2] Appendix A contains a brief explanation of the components of the EFI.
[3] Appendix B contains a brief explanation of the components of the PRI.

coefficient between the average value of these two indexes over the time period examined herein is only +0.68.

Before these indexes were commonly used in the political economy literature, few empirical studies sought to identify the impact that these two institutional influences exert on environmental quality. However, these few efforts can be revealing. For example, Norton (1998) finds that sanitation levels, water quality and deforestation levels in developing countries are all negatively correlated with greater government protection of property rights and a greater reliance on the rule of law rather than statutory regulation—both key characteristics of economic freedom. Hettige, Lucas and Wheeler (1992) found that those developing countries that imposed fewer import and trade restrictions (greater market freedoms) within their own chemical manufacturing sectors emitted *less* pollution per dollar of manufacturing output. They argue that import and trade restrictions not only diminish economic freedoms in society, they also tend to displace the public interest in greater environmental quality with public policy that favors the special interests of those industries seeking protection from global competition. This results in the society relying more heavily on environmentally harmful production methods.

More recently, Barrett and Graddy (2000) use the afore-mentioned PRI value as an explanatory variable in their cross country analysis of environmental policy, in order to reflect any "induced policy response" (pg. 434). They assume that greater political rights in society tend to improve the ability of democratically formulated environmental policy to reflect the public interest. However, their empirical analysis did not account for any potential interdependence between both the institutions of capitalism and democracy.

Two Competing Paradigms for Analyzing Institutional Influence on Society

Milton Friedman, in his seminal work *Capitalism and Freedom* (1962), stated that "the relationship between political freedom and economic freedom is complex and by no means unilateral (p. 10)." He noted that the prevailing contemporary paradigms in the social sciences literature assumed that economic analysis and political analysis could be appropriately performed independently of one another. However, he postulated that these two types of freedoms were likely to be linked in their respective impacts on society and he called for a more critical analysis of the relationship between them. Today, two

separate analytical paradigms for considering these two institutional freedoms seem to coexist in the political economy literature: one that treats these two sets of institutional freedoms as independent and the other as interdependent.

As one example of the independent paradigm, Fukuyama observes how nations around the world are overwhelmingly embracing democracy as the optimal institution for creating public policy that best reflects the public interest (promoting equity) and capitalism as the optimal economic institution that best allocates scarce resources in society (promoting efficiency). His seminal treatise still motivates contemporary paradigms that presume a society can choose anywhere along a political spectrum ranging from authoritarianism to democracy independently of their choice along the economic spectrum from communism to capitalism. Societies are assumed to be free to choose any position along either institutional spectrum, regardless of its chosen position on the other spectrum.

As one example of the interdependent paradigm, Holcombe (2002) claims that if we more carefully considered the implications arising from this bifurcated, independent institutions perspective, an inherent conundrum is created. He describes how the maximum efficacy of democracy requires that some economic freedoms of the individual in society must be constrained. If society theoretically chooses the political arrangement for the maximum efficacy of democracy, this necessarily makes the full expression of capitalism unobtainable. Likewise, creating the maximum efficacy of capitalism requires significant restraints on the ability of a democratic government to limit the actions of its citizens who are otherwise voluntarily interacting in market exchanges. If society theoretically chooses the market arrangement for the maximum efficacy of capitalism, this necessarily makes the full expression of democracy unobtainable. A hypothetical institutional arrangement for achieving the greatest efficacy of both capitalism and democracy is not simultaneously achievable.

An important implication arises from the comparison of these two perspectives on capitalism and democracy: The interdependent perspective implies that any empirical analysis of how each institution influences prosperity, human well-being and environmental quality in society must allow for the potential interaction of the two institutions. The degree to which each type of institution is manifested in society can be

expected to affect the other institution's influence over the observed levels of human well-being or environmental quality they are expected to help explain. Therefore, the specification in such an analysis must reflect the potential for such interaction.

Model Specification and Empirical Analysis

The following empirical analysis seeks to determine whether the level of political rights promoting democracy and the level of economic freedoms promoting capitalism exert an interdependent influence over the variation in environmental quality across the relatively more democratic countries of the world. The specification uses various measures of air and water pollution, as well as greenhouse gas emissions, of the OECD countries to answer these questions: 1) What is the net impact of additional political rights on the level of emissions per dollar value of GDP, controlling for the level of economic freedom in society? 2) What is the net impact of additional economic freedoms on the level of emissions per dollar value of GDP, controlling for the level of political freedom in society? 3) Does the level of these two institutions appear to exert a synergistic or mitigating influence on air quality as a given society pursues economic prosperity?

Any empirical analysis seeking to answer these questions must also control for other possible influences over emissions arising from other characteristics of society. For example, countries with higher per-capita incomes may have better access to environmentally cleaner production technologies. Demographic differences across countries in total population or the degree of urbanization may affect the observed level of air emissions from traffic congestion or electric power generation and distribution. Some economies may exploit a comparative advantage in industries that happen to have cleaner production process (i.e., predominantly service industries versus manufacturing or agricultural industries). Therefore, the following specification controls for the level of real income per-capita, population, and urbanization, and the percent of GDP comprised of manufacturing industries and of agricultural industries.

With respect to the four dependent variables, each is expressed in emissions per billion dollars of real GDP, as measured in constant 2000 dollars. A 1999 study by the Organization of Economic Cooperation and Development (OECD) collated the annual

estimates of various types of air pollution data for its 30 member countries. The two dependent variables used from this source are sulfur oxides (SOX, in kilotons), and nitrous oxides (NOX, in kilotons). The World Bank (2007) compiles estimates of organic water pollutants emitted, BOD (in daily kilograms of Biochemical Oxygen Demand), as well as the emissions of the greenhouse gas carbon dioxide (CO2, in kilotons).

Each dependent variable was used in its own fixed-effects equation within a panel data set. The potential full sample for each regression equation consists of the thirty OECD countries with observations covering four separate years (1980, 1985, 1990, and 1995) for a total of 120 potential observations.[4] These four years were selected based on the limited availability of the EFI index over this time span. It should be noted that some countries were added to the OECD at different times across this sample. Data from these countries were included for all four years to maintain a balanced panel data set.

Equation 1, below, illustrates the specification that is used in each regression equation. All demographic explanatory variables come from The World Bank (World Bank, 2007) including: POP (population in millions), URBAN (percent of population living in urban centers), INCOME (log value of per-capita income, in constant 2000 dollars), MANUF and AGRI (percent of GDP comprised of manufacturing industries and agricultural industries, respectively). α is a vector of independent intercepts for each country in the sample and $\mathcal{E}$ is an error vector of error terms assumed to be distributed independent normal across both time and space dimensions.

Eq. 1 $Y = \alpha + \beta_1 POP + \beta_2 URBAN + \beta_3 INCOME + \beta_4 AGRI + \beta_5 MANUF + \beta_6 PRI + \beta_7 PRI{*}EFI + \beta_8 EFI + \mathcal{E}$

The variables PRI and EFI are the aforementioned political rights index and economic freedom index, respectively. The variable PRI*EFI is the cross-product of these two indexes. The interaction variable between these types of freedoms is included to reveal any interdependence that may exist between them in their respective influence

[4] Due to missing data, some OECD countries were excluded from each equation. A list of all 30 OECD countries, as well as a list of those excluded countries from each equation, appears in the caption for Table 1.

over the dependent variable. An interpretation of this interactive variable (see Greene, 1993, p. 239, or Sincich, 1996, p. 697) appears in the following section.

Interpreting the Empirical Results

Table 1, below, reveals the empirical results of the four separate fixed-effects regression equations designed to determine the net influence of economic freedoms and democratic freedoms on each of the four dependent variables. With respect to those control variables that generate a statistically significant coefficient estimate at the 5% level of confidence, all emissions diminished with the log value of real, per-capita income. This result implies that the demand for environmental quality is income elastic. Nitrous oxide emissions (NOX) diminished with larger populations and with agriculture's share of GDP. Organic Water Pollutants (BOD) increased with population levels but decreased with the degree of urbanization. Carbon dioxide emissions (CO2) decreased with agriculture's share of GDP but increased with manufacturing's share of GDP.

The EFI and PRI variables, as well as their cross-product variable, each influenced the dependent variable for all equations at the 1% confidence level. Given that the coefficient estimates from both freedom indexes are consistently negative, and that the coefficient estimates from their cross product is consistently positive, it appears that each freedom type has a mitigating impact on the other freedom's beneficial influence over each of these four emissions variables. This evidence supports Holcombe's perspective that their respective influences on social welfare are generally not mutually exclusive. This is also consistent with the notion that society can enjoy "greener" economic activity from higher levels of one institutional freedom, but that advantage tends to wane with the level of the other freedom.

While the level of both freedom indexes appears to decrease the level of unwanted emissions per dollar value of GDP, their interaction makes it unclear whether the *net* influence of additional economic freedom or additional democratic freedom would have a positive or negative impact on the dependent variable when controlling for the level of the other freedom variable. In order to properly evaluate the marginal impact that each type of freedom is estimated to have on the level of emissions per dollar of GDP, one can use the coefficient estimates from each regression equation to calculate the

value of the partial derivative of each dependent variable with respect to the level of each of the freedom variables. This partial derivative involves a cross product term between the two freedom indexes, such that the marginal impact of each freedom variable will need to be assessed using the value of the sample mean for other freedom variable.

For example, the partial derivative of the dependent variable SOX with respect to a change in the level of the level of political freedom (PRI) can be expressed as Equation 2, below. The coefficient estimate for PRI is added to the product of: 1) the coefficient estimate for PRI*EFI and 2) the sample mean of the variable EFI:

Eq. 2) $\delta(SOX)/\delta(PRI) = -9.553 + 1.452(6.55) = -0.042$

Likewise, the partial derivative of the dependent variable SOX with respect to a change in the level of economic freedom (EFI) can be expressed as Equation 3, below.

Eq. 3) $\delta(SOX)/\delta(EFI) = -14.866 + 1.452(9.33) = -1.319$

The equations for the marginal impact of each freedom variable on the value of each of the three remaining dependent variables can be derived in similar fashion. Table 2, below, reveals the calculated net influence of a one-unit increase in the freedom index from each type of freedom on each of the four dependent variables, as evaluated at the mean value of the other freedom index. Table 2 reveals that an incremental increase in the political rights index evaluated at the sample mean of EFI would decrease the level of sulfur oxides and organic water pollutant emissions per dollar of GDP, but would increase nitrous oxides and greenhouse gas emissions. An incremental increase in the economic freedom index evaluated at the sample mean of PRI would decrease the level of sulfur oxide, nitrous oxide and organic water pollutant emissions per dollar of GDP but would increase greenhouse gas emissions. Yet, this increase would be only a quarter of that caused by the same incremental increase in political rights.

If the environmental benefits of one freedom type diminish with the level of the other freedom type, this implies that countries with relatively lower levels of economic freedom can enjoy a decline in emissions per dollar value of GDP from an incremental increase of political rights in society. However, this also implies that those countries with relatively high levels of economic freedom will see much less benefit, and may even suffer *increases* in such emissions resulting from greater political rights. This begs the

question: At what level of PRI would the expected net impact reach a tipping point where additional economic freedoms would begin to raise emissions per dollar of GDP? At what level of economic freedom would the expected net impact reach a tipping point where additional political rights would begin to raise emissions? Could this tipping point for economic freedoms be relatively higher than for greater political rights?

Figure 2, below, illustrates the incremental impact of an increase in political rights on each of the four emissions variables for all possible levels of EFI, rather than calculated only at the sample mean. This graph reveals that the EFI tipping point value where additional political rights begin increasing emissions per dollar value of GDP is approximately 6.0. Likewise, Figure 3, below, illustrates that the PRI tipping point value where additional economic freedoms begin increasing the emissions per dollar value of GDP is approximately 9.0 (though the impact on organic water pollutant emissions would always be negative). Comparing Figure 2 with Figure 3 reveals that the tipping point for additional economic freedoms to turn negative occurs at higher value of the opposing index than for additional political rights. This implies that the efficacy of economic freedom to protect environmental quality per dollar value of GDP appears to be more robust than the efficacy of political rights, relative to the existing level of the other freedom type.

Conclusion

This analysis seeks to quantify the respective influence of capitalism and democracy on environmental quality, as measured by the level of undesirable emissions produced per dollar value of GDP in the economy. The institution of democracy is assumed to better reflect the public interest in preserving the environment and the institution of capitalism is assumed to generate a greater scope of potential outcomes for coordinating consumer and producer objectives in society. Democratic societies that protect the market freedoms of capitalism are therefore assumed to promote greater economic prosperity and greater demand for environmental quality, as well as being able to choose from a greater scope of public policy options that more accurately reflect the public interest in minimizing the opportunity cost of achieving both environmental protection and economic prosperity. This implies that relatively democratic countries that

retain a higher level of institutional freedoms that promote capitalism would exhibit lower levels of undesirable emissions per dollar value of economic activity, but this marginal environmental benefit is also assumed to diminish for higher levels of political rights in society that promote democracy.

This theory is tested by examining air and water pollution, as well as greenhouse gas emission levels per dollar value of GDP across the OECD countries over the prior two decades. The analysis attempts to quantify the respective impact of the institutions of capitalism and democracy on the level of environmental quality. A panel data set using an index of political rights (PRI) from the Freedom House and an index of economic freedom (EFI) from the Fraser Institute is used to explain the emission levels per dollar value of GDP for sulfur-oxides, nitrous-oxides, organic water pollutants and carbon-dioxide. The specification controlled for income per capita, population, urbanization, and industry composition, as well as allowed for the potential interactive effects of capitalism and democracy on emission levels.

The empirical results indicate that both capitalism and democracy appear to decrease emissions levels per dollar value of GDP. However, the interaction between the two institutions is negative, indicating that the beneficial effect on the environment of each institutional freedom declines with the existing level of the other institutional freedom in society. In other words, the data support the notion that the efficacy of both democracy and capitalism diminishes as the existing level of the other institution increases. Further, the beneficial environmental influence associated with the level of political rights turns to a detrimental influence at a much lower tipping point value for the existing level of EFI in society, relative to the same tipping point value of PRI in society where the influence from economic freedoms that promote capitalism turn negative.

Many empirical studies have shown that prosperity is positively correlated with economic freedom (Berggren, 2003) and political rights (Przeworski and Limongi, 1993 and Mulligan, et. al., 2004). Other cross-country studies have shown that democracy is positively correlated with environmental quality (Congelton, 1992, Torras and Boyce, 1998 and Barrett and Graddy, 2000). However, few studies have revealed the influence of capitalism on environmental quality, particularly among relatively democratic countries. If these empirical results can be applied to countries outside the sample of OECD

countries herein, this implies that those developing countries with only modest levels of political rights and economic freedoms can expect to achieve economic prosperity with a lower negative impact on their environments by raising the level of economic freedoms in society more than the level of political rights.

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Figure 1. Economic Freedom versus Political Freedom

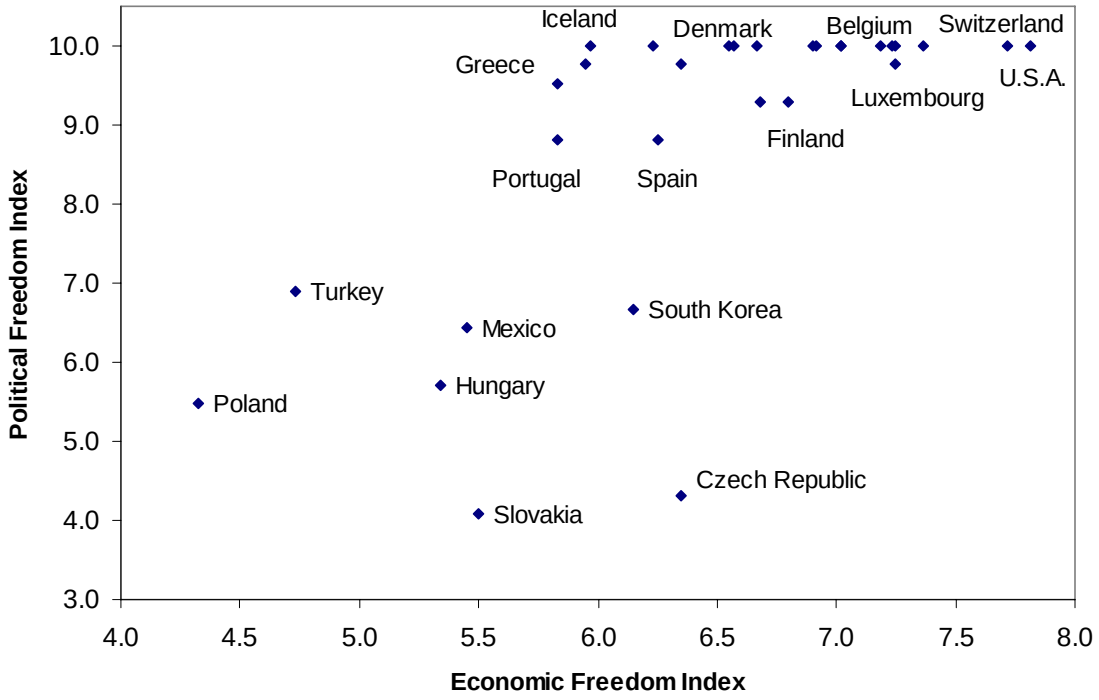


Table 1. Panel Data Analysis Results

Dep. Variable	**SOX**	**NOX**	**BOD**	**CO2**
Mean of Dep. Var.	4.172	2.721	985.5	649.1
No. of Observations	84	88	92	104
(No. of Countries)	(21)	(22)	(23)	(26)
Independent Variable	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)
POP	-0.006	-0.025*	0.010*	0.031
	(0.046)	(0.012)	(0.005)	(2.863)
URBAN	0.193	0.052	-31.627*	12.044
	(0.181)	(0.037)	(13.588)	(7.216)
INCOME	-6.959**	-2.215**	-464.443*	-750.173**
	(2.239)	(0.576)	(216.01)	(116.22)
AGRI	-0.227	-0.094*	-14.583	-22.645**
	(0.163)	(0.043)	(14.823)	(8.731)
MANUF	0.082	0.026	10.103	12.021**
	(0.087)	(0.022)	(8.363)	(4.440)
PRI	-9.553**	-0.981**	-443.263**	-303.374**
	(1.263)	(0.311)	(110.527)	(67.229)
PRI∗EFI	1.452**	0.154**	64.452**	49.747**
	(0.233)	(0.054)	(19.453)	(11.841)
EFI	-14.866**	-1.599**	-755.730**	-458.951**
	(2.374)	(0.545)	(197.212)	(119.875)
Adj. R-squared	**0.96**	**0.93**	**0.97**	**0.94**
Std. Error of Regression	**1.25**	**0.34**	**134.62**	**82.91**

** denotes statistical significance at the 5% level and ** denotes the 1% level.*

The 30 OECD countries include: Austria, Australia, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, South Korea, Luxemburg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States.

Table 2. Net Impact of Each Freedom Type on the Dependent Variable, Evaluated at the Sample Mean of Other Freedom Type

Dep. Variable	SOX	NOX	BOD	CO2
Net Impact of Additional Political Freedom	-0.042	0.028	-21.102	22.469
Net Impact of Additional Economic Freedom	-1.319	-0.162	-154.393	5.189

** Denotes incremental impact of a one unit increase in the freedom index exceeding two standard errors of the regression.*

Figure 2. The Impact of Additional Political Freedom on the Level of the Pollutants, Conditional on the Existing Level of Economic Freedom

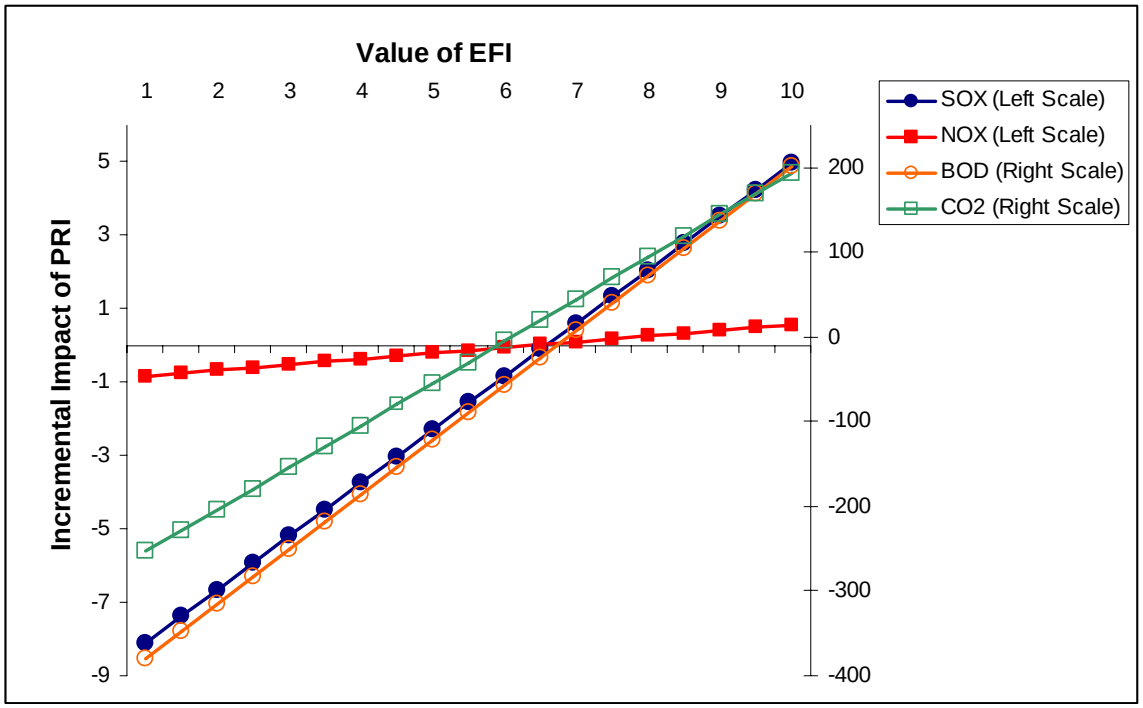
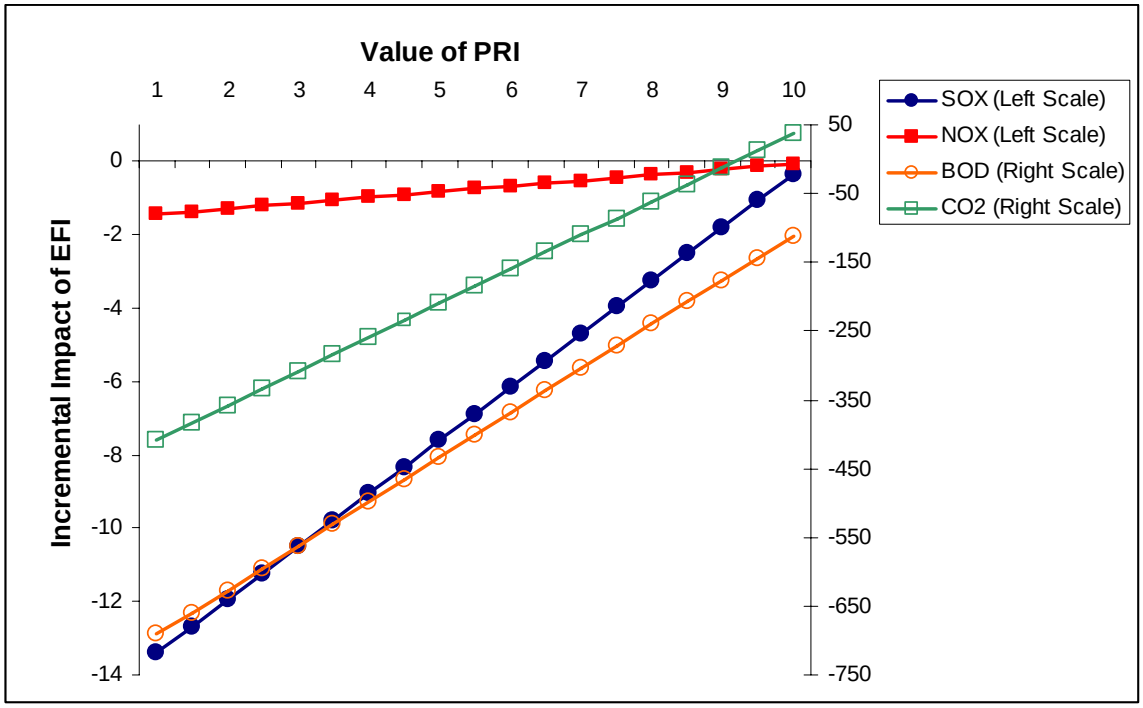


Figure 3. The Impact of Additional Political Freedom on the Level of the Pollutants, Conditional on the Existing Level of Economic Freedom



Appendix A

The Economic Freedom Index was developed and is published periodically (annually since the year 2000) by James Gwartney and Robert Lawson through the Fraser Institute. The index ranges from 1 (the least amount of economic freedom) to 10 (the highest amount of economic freedom). The latest index is 2003 was published in 2005 and can be found at: www.freetheworld.com/. Gwartney and Lawson use empirically observed values from within these seven categories to derive an index representing a relative measure of economic freedom. The following is an abbreviated description of the components used to derive the index.

1) *Size of a country's government*:
   a. Expenditures as a percentage of total consumption
   b. The total expenditures on transfers and subsidies as a percent of GDP
2) *Extent to which a country uses markets to allocate resources*:
   a. Government enterprises as a share of the economy
   b. Extent to which price controls are used
   c. Value of the top marginal income tax rate
   d. Use of military conscription (freedom of labor)
3) *The stability of a country's monetary policy and price stability*:
   a. Real annual growth rate of the money supply
   b. Level of inflation
   c. Variability of inflation
4) *The legitimacy of a country's own currency*:
   a. Freedom of citizens to own foreign currency
   b. Difference between official and black market currency exchange rates
5) *The country's legal structure and protection of property rights*:
   a. Security of private ownership of resources
   b. Viability of contract law
   c. Viability of civil law and legal institutions
6) *Freedom of a country's citizens to trade with foreigners*:
   a. Size and scope of the taxes on international trade
   b. Extent of non-tax regulatory restraints
7) *Freedom of a country's citizens to exchange in capital and financial markets*:
   a. Private ownership of banks and extension of private credit
   b. Extent of government interest rate controls other restrictions in capital transactions with foreigners

Appendix B

The political rights index, along with the civil liberties index, are each developed and published annually by The Freedom House. These indexes can be found on-line at: www.freedomhouse.org/. Each index is based on a scale of 1 (the greatest amount of political rights) to 7 (the least amount of political rights). The following are abbreviated descriptions of the components used to derive each index.

The *political rights index* is determined by aggregating expert survey results regarding the relative level of political rights within a country, based on the following criteria:

1) Is the head of state freely elected through a free and fair electoral process?
2) Are there legislative representatives elected through a free and fair electoral process?
3) Are there fair electoral laws, equal campaigning opportunities, fair polling, and honest tabulation of ballots?
4) Are the voters allowed to endow their freely elected representatives with real power?
5) Do the people have the right to organize in different political parties and is the system open to the rise and fall of these parties?
6) Is there a significant opposition vote and a realistic possibility for the opposition to increase its support or gain power through elections?
7) Are the people free from domination by the military, foreign powers, totalitarian parties, religious Hierarchies, economic oligarchies, or any other powerful groups?