Environmental Decentralization and Political Centralization

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Abstract

Does the level of political centralization affect the outcome of environmental decentralization? Using a cross section of up to 110 countries and a propensity score estimation approach, we find that political centralization as measured by the strength of national level political parties tends to improve the result of the decentralization of environmental policies addressing local environmental problems. This supports Riker's (1964) prediction regarding decentralization and public good provision. However, we find the opposite effect of political centralization for environmental policies addressing global environmental problems such as climate change.

Keywords: Environmental regulations; federalism; political institutions; party strength; propensity score.

JEL Codes: Q58; D72; D78; H23.

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I. Introduction

In a seminal study, Riker (1964) argues that the result of decentralized policymaking depends on the level of political centralization. Riker predicts that the outcome of decentralization will be more welfare enhancing in countries where national political parties are stronger and thus the political systems are more centralized. Strong national parties are more likely to strike an appropriate balance between the various effects that emerge due to decentralization. Fundamental issues to consider are possible informational advantages at the local level (Hayek, 1948; Sigman, 2003), the level of preference homogeneity (Oates, 1972), inter-jurisdictional competition for mobile resources (Tiebout, 1956; Kunce and Shogren, 2002, 2005), transboundary spillovers (Oates, 1972; Silva and Caplan, 1997), accountability via local elections (Seabright, 1996), avoiding majority bias (Fredriksson et al., 2010), and possible differences in special interests' influence at the local and central government levels, respectively (Bardhan and Mookherjee, 2000; Blanchard and Schleifer, 2001). Political centralization affects policy decentralization by better aligning the incentives of politicians at lower levels with national interests; thus, narrow local interests are less likely to distort policymaking.

In this paper, we provide a first empirical analysis of the effect of political centralization on environmental policy decentralization ("environmental federalism") in a cross-section of countries, based on Riker's prediction.[1] We believe such an analysis may provide valuable insights for the ongoing debate in the literature and among policymakers on whether (and where) authority over environmental policymaking should be allocated to lower or central levels of government.

[1] As discussed by, e.g., Salmon (1987), Fan et al. (2009) and Voigt and Blume (2010), it is conceivable that a unitary (non-federal) state is highly decentralized while a federal state may have a high level of centralization. In this paper, we attempt to take this into account.

The theoretical literature predicts a number of effects of environmental decentralization (disregarding the degree of political centralization).[2] A large literature studies interjurisdictional capital competition, transboundary pollution spillovers and environmental policymaking in federal systems. Most models suggest that inefficiently weak policies will result (see, e.g., Ulph, 2000; Oates and Portney, 2003). However, the literature contains a multitude of results (Kunce and Shogren, 2002, 2005). For example, a seminal paper by Oates and Schwab (1988) find that both centralized and decentralized policymaking yield the first-best policy when no political incentives are present. However, in a decentralized setting with a heterogeneous population policy may be too weak or too strict, and with a Leviathan (revenue maximizing) ruler policy will be weaker than optimal. Using a median-voter model, Roelfsema (2007) finds that in a decentralized system environmental regulation may be either too weak or too strict due to strategic delegation by the median voter (see also, e.g., Lockwood, 2002; Besley and Coate, 2003). Fredriksson and Gaston (2000) find that while individual groups' lobbying incentives differ across decentralized and centralized regimes, in the aggregate the incentives are equal. This results in equivalent policies across institutional approaches. Esty (1996) suggests that decentralized environmental policymaking gives better-financed industry groups an advantage over environmental groups as they are able to cover the high fixed costs involved with having an office in each lower level jurisdiction. On the other hand, Revesz (2001) argues that at the national level a minimum spending level must be achieved which implies that centralization favors industry; grassroots environmental groups have a comparative advantage at the local level.

[2] Space constraints make it infeasible to discuss all effects in detail here. Rauscher (2000), Oates and Portney (2003), Levinson (2003), and Dijkstra and Fredriksson (2010) provide surveys of different aspects of the theoretical and empirical literatures on regulatory environmental federalism (decentralization).

In sum, several ambiguous theoretical effects may occur due to increased environmental decentralization (see also below), and one contribution of this paper is to clarify its empirical nature. The area of environmental policy and outcomes appears to be well suited for testing Riker's prediction due to the various spillover effects that occur between jurisdictions.

The empirical literature on environmental federalism has so far not studied Riker's hypothesis. This literature reports that President Reagan's decentralization of environmental policymaking to the states during the 1980s had no effect on pollution levels (see List and Gerking, 2000; Millimet, 2003; Millimet and List, 2003; Fomby and Lin, 2006). Fredriksson and Millimet (2002), Levinson (2003), and Konisky (2007) report that U.S. states are engaged in strategic interaction in their environmental policymaking, although it is not completely clear whether this leads to a race-to-the-bottom or race-to-the-top. A number of studies find evidence of free-riding behavior both among countries and among U.S. states, including Sigman (2002, 2005), List et al. (2002), Helland and Whitford (2003), and Gray and Shadbegian (2004) (see, however, Gray and Shadbegian, 2007; Konisky and Woods, 2010).

The studies most closely related to the present paper are Sigman (2007, 2008). Sigman's (2007) empirical analysis of environmental decentralization uses a panel-data study of 47 countries. She finds evidence that increased decentralization (measured as the decentralization of expenditures to lower levels of government) raises one form of water pollution (biochemical oxygen demand, BOD) but not another (fecal coliform).[3] An indicator of federal constitution has

[3] Cutter and DeShazo (2007) study the devolution of regulatory power over underground storage tank spill inspections under RCRA in California. The regulatory effort levels under three different policy designs are evaluated using estimation and simulation techniques: (*i*) Under RCRA, a lower level government such as a city can petition a higher level government such as a county to gain authority over environmental policymaking. The higher level government has the power to veto such a petition. As alternative policies (to RCRA), policy authority is (*ii*) automatically given to all petitioning cities, or (*iii*) only counties are given the authority. Interestingly, in their simulation, the authors found that under alternative (*ii*), the inspection rate would have fallen compared to the RCRA (i.e., (*i*)) because the additional cities would have few environmental lobby groups. This would have led to

no effect on either measure. Using cross-country data from up to 34 countries, Sigman (2008) finds evidence that decentralization of environmental expenditures is associated with reduced access to sanitation facilities, greater levels of habitat protection (land conservation), but no effect on wastewater treatment or SO_2 concentrations. A federal constitution has no effect on either of these measures. However, Sigman (2007, 2008) does not investigate the role of political institutions for environmental decentralization.[4]

Decentralization of government can take several forms in practice, and we focus on constitutional federalism, vertical decentralization and personnel decentralization, respectively. Federal states have according to Riker's (1964) definition (i) at least two levels of government, and (ii) each level has at least one area in which it can take autonomous action. Federal states may choose the preferred degree of environmental decentralization. The U.S. has a strong legislative and enforcement presence at the national level, in which states are given the opportunity to enforce laws and cover areas not regulated at the federal level (Mazur, 2011). In Austria, Germany, Spain and Switzerland, on the other hand, sub-national governments have the authority to issue regulations (under national environmental laws) and have discretion in their implementation.

The degree of vertical decentralization is reflected by the number of tiers (layers) of government.[5] Treisman (2002) classifies a layer of government as a tier if it has a political executive at that particular tier which meets three conditions: (i) it is funded from the public budget; (ii) it has authority to administer a range of public services; and (iii) it has a territorial

lower inspection rates. The authors conclude that policymakers were correct to give counties veto power over cities' petitions for regulatory authority.

[4] Sigman (2007) also provides a test of the argument that decentralization enables local jurisdictions (which may also have better information about local conditions) to better match regulations with their preferences. She finds some evidence that the level of variation in pollution levels is greater in more decentralized systems. She attributes this finding to free riding behavior.

[5] In unitary countries such as Finland, Italy, Japan, Korea and Sweden, e.g., sub-national governments cannot establish regulations, but implement the ones developed at the central government level (Mazur, 2011).

jurisdiction. A tier may be an autonomous decision making body or an administrative agent of a higher tier. Vertical decentralization has several ambiguous effects which have not been extensively discussed in the literature on environmental federalism, to our knowledge. While such decentralization enables environmental decisions to be tailored to local conditions (Mazur, 2011), there is according to Fan et al. (2009) the risk of a greater competition between government units for bribes leading to a "double marginalization" externality effect (which is absent with one tier only) as the number of regulators increase, increasing bribery. The supply of a public good such as environmental quality will also suffer from a free riding problem when provided by multiple tiers, as voters will credit all government tiers with increases even if only one tier supplies the good (Treisman, 2002). Voters may not be well informed of the exact nature of responsibilities of various tiers of government (Salmon, 1987). Each tier will set its marginal benefit (in terms of votes) equal to marginal cost, while a fully centralized government would set all government units' marginal benefits equal to marginal costs. Thus, with more tiers the provision of public goods will be lower, in particular when the tiers have autonomous regulatory authority. Multiple tiers may also cause duplication and waste, especially if each tier involves fixed costs (Rousseau, 1762).

On the other hand, decentralization may also induce local officials to refrain from taking bribes in order to compete for promotions to higher tiers (Myerson, 2006). Moreover, vertical decentralization creates beneficial "yardstick" competition between tiers of governments (Salmon, 1987). A larger number of tiers should, according to Thomas Jefferson (author of the Declaration of Independence and 3rd President of the U.S.), reduce the abusive power of the central government and facilitate the allocation of decision making power to the most

appropriate level (Appelby and Ball, 1999). Seabright (1996) also argues that while policy decentralization hampers coordination among districts, it raises government accountability.

The level of personnel decentralization reflects that share of government workers that are employed at sub-central tiers. With a larger number of local inspectors and enforcement personnel, environmental policy outcomes should improve as the costs and benefits of regulation are balanced to the local situation (Mazur, 2011). However, if local officials are more amenable to bribery than their central colleagues, perhaps due to closer interactions with firms (Bardhan and Mookherjee, 2000), personnel decentralization may lead to weaker environmental policies. Local governments may also lack the capacity to set appropriate policies (Mill, 1991). However, voters may also be better informed about the activities of local officials than about their central counterparts, counter-weighing the negative effect (Fan et al., 2009).

The level of party strength is an indicator of the level of centralization of the political system, according to Enikolopov and Zhuravskaya (2007). Greater political centralization leads local politicians and Congressional level legislators to pay more attention to the opinions of their national party bosses because their political careers depend on it (Riker, 1964; Enikolopov and Zhuravskaya, 2007; Primo and Snyder, 2010). Legislative leaders of strong parties often have control over appointed posts within the national government, and over campaign funds and political support that are crucial during re-election campaigns. A strong party is likely to have a better organized party machine at the grassroots and national levels (Enikolopov and Zhuravskaya, 2007; Keefer and Khemani, 2009). Thus, national leaders of strong parties have the ability to promote or hamper a legislator's career prospects, and the decisions are conditional on the legislator's individual behavior. Thus, a more national perspective among legislators as a result of political centralization may be expected to improve environmental policymaking. In

particular, we argue that political centralization should bring environmental policy stringency closer to the optimal policy as coordination improves and negative effects of environmental decentralization are more likely to be addressed.

Utilizing data from up to 110 countries we employ the method of propensity score estimation by Rosenbaum and Rubin (1983) and Wooldridge (2002). This methods uses a counterfactual approach that categorizes observations as if they had been randomized (Rubin, 2007). We utilize several measures from Fan et al. (2009) as measures environmental decentralization: (i) an indicator of a federal constitution (Forum of Federations, 2005); (ii) the number of government tiers (Fan et al., 2009), which measures vertical decentralization; (iii) an indicator of whether a country has four or more levels of government tiers (Treisman, 2002), a measure of vertical decentralization; and (iv) the share of all workers employed by the sub-central levels of government (excluding education, health, and police) (Schiavo-Campo et al., 1997), which measures personnel decentralization. While these measures are proxies only of the degree of environmental policy decentralization, they have recently been used in various parts of the literature studying fiscal and public good decentralization (Sigman, 2007; Treisman, 2002; Fan et al., 2009). They are likely to capture the organization of environmental policy making across countries.[6]

As a measure of party strength and level of political centralization, we follow Enikolopov and Zhuravskaya (2007) by using Beck et al.'s (2001) measure of party age. This measure is defined as the average age of the two main government parties and the main opposition party. Huntington (1968) argues that a higher age of the main political parties reflects a more stable

[6] For example, the average values of the environmental expenditure decentralization measure used by Sigman (2008) are 74.9 in federal countries and 57.77 in unitary countries, respectively. The average in countries with four or more tiers is 66.55, while it is 61.99 in the remaining countries. The correlation coefficient between Sigman's (2008) measure and our measure of personnel decentralization equals 0.2406.

party system and stronger parties. Local politicians take into account the expected life of their own party when determining their optimal effort allocation inside the party, and pay more attention to national party leaders when a more stable and lucrative career is at stake. We evaluate the effects of the above measures on eleven different measures of environmental policy stringency which include measures of both local and transboundary pollution policies (from CIESIN, 2002; Metschies, 2003; Frankel and Rose, 2005).

Our empirical results suggest that decentralization may be associated with stricter environmental policies in politically centralized systems, supporting Riker (1964). The effect applies primarily to policies addressing local environmental problems, and appears stronger in democracies (especially in those with proportional electoral systems). However, the effect is reversed for global pollutants.[7] Our results should help improve our understanding of institutional reforms. Decentralization of environmental policymaking may be expected to be more favorable in countries with more centralized political systems.

Our study complements the existing literature on fiscal decentralization and institutions. Enikolopov and Zhuravskaya (2007) also test Riker's prediction but address other public policy areas and use mostly other (proxy) variables. They report that fiscal decentralization combined with political centralization tends to result in higher quality of government (lower corruption) and improved public goods (immunization, infant mortality, student-teacher rates, and illiteracy) and GDP growth, thus lending support to Riker's (1964) hypothesis.[8] Blanchard and Schleifer (2001) argue that China's higher political centralization has allowed it to grow faster than

[7] The distinct results for national and global pollutants and policies may be a topic for future research.

[8] In related studies, Mayhew (1986) and Primo and Snyder (2010) report that distributive spending is smaller in U.S. states with strong party organizations. Keefer and Khemani (2009) argue that in India parties have stronger voter attachment if they have more credible ideological positions and well maintained party machines, leading to less pork spending (in our view, credibility and party machinery are likely to increase with party age). With strong voter party attachment, party leaders are more likely to select candidates who have the interest of the party at heart, not home district pork spending.

Russia.[9] Gennaioli and Rainer (2007) report a positive relationship between the degree of centralization of African countries' ethic groups' pre-colonial institutions and the later provision of education, health, and paved roads.

The paper is structured as follows. Section II describes the empirical approach. Section III outlines the data. Section IV reports the empirical results, Section V offers a robustness analysis, and Section VI provides a conclusion. Appendix I contains summary statistics and Appendix II provides variable definitions and sources.

II. Empirical Model

In this section we discuss the approach used to test whether decentralization of environmental policy leads to better environmental policy outcomes in countries with a higher degree of political centralization. A complication that arises in the measurement of the effects of environmental decentralization and political centralization on countries' environmental policies is that countries are not randomly assigned these features. Rather, each country has self-selected through a multitude of choices made, e.g., by political leaders who are in turn influenced by factors such as the prevailing culture and traditions throughout history and by geography.

In order to measure the treatment effect we therefore use the propensity score estimation method (PSM) by Rosenbaum and Rubin (1983), which according to Pearl (2009) is the "most developed and popular strategy for causal analysis in observation studies" (p. 406). PSM differs from OLS by its handling of observations that do not have sufficiently similar characteristics. PSM attempts to quantify these characteristics by calculating a conditional probability (propensity score) that the country belongs to the treatment group given a set of covariates (observable characteristics), and weighs the results based on these propensity scores. PSM

[9] Fan et al. (2009) find that a larger number of government tiers and local employees, respectively, yield more frequent bribery. They attribute this to "double marginalization" or "overgrazing".

therefore allows us to create subgroups for environmentally (politically) decentralized countries and environmentally (politically) centralized countries as if they were subject to randomization (Rubin, 2007).

The counterfactual framework used in PSM was pioneered by Rubin (1974) and extended by Heckman *et al*. (1997). The analysis of the treatment effect begins by using a counterfactual approach where each country has a value for the outcome variable (environmental policy stringency in country i, t_i) when treatment occurs (t_{i1}), and when no treatment occurs (t_{i0}). t_{i1}-t_{i0} captures the Average Treatment Effect (ATE) on the outcome. We take the difference between the two environmental outcomes and average the difference over all countries. Because we are not able to observe the outcome for both the treated and the untreated, the basic task is to create a suitable outcome for the counterfactual on the untreated (Rosenbaum and Rubin, 1983). The simple solution is to divide the sample of countries into two groups, and we can then measure the difference between the two groups. In this paper, we have two variables that can be categorized into two groups each, depending on the actual measures used: (i) environmentally decentralized and environmentally centralized countries; and (ii) politically decentralized and politically centralized countries. The analysis uses only one such treatment variable at a time.

Each country has a probability of assignment to the treatment group, given a vector of exogenous observable covariates, X. To reduce the dimensionality of the problem, Rosenbaum and Rubin (1983) suggest employing the propensity score, p(X) – the probability of receiving treatment conditional on the covariates. We then estimate the conditional probability that a country has received the treatment based on this set of observable covariates using a probit

model (Rosenbaum and Rubin, 1983).[10] The estimation using PSM allows us to attempt to overcome the issue of self-selection.[11]

The analysis is based on the following assumptions: (1) Unconfoundness; and (2) Overlap. Unconfoundness implies that the assignment of the treatment is independent of potential outcomes conditional on observed pretreatment variables. Unconfoundness assumes that all estimators are valid only if there are no unobservable attributes correlated with both the treatment status and the policy outcome.[12] A problem can result if there are unobserved attributes that affect both the treatment assignment and the outcome of interest; the reliability of the estimators may then be an issue. Therefore, variable choice plays an important role in the model specification.[13] Overlap implies that there is sufficient overlap in the distributions of the propensity score for each group. Rosenbaum and Rubin (1983) refer to the combination of these assumptions as "strongly ignorable treatment assignment."

Heckman *et al.* (1997) and Dehejia and Wahba (1999) show that omitted variables can significantly increase the bias of the results. To address this concern, researchers use a greater dimension of X, reducing the likelihood that key attributes have been omitted. Another counterweighing issue arises regarding the possible selection of too many irrelevant variables which may come with a greater dimension of X.

To test for the average treatment effect (ATE), we begin by estimating the propensity score in the first stage (the predicted probability that each observation belongs to the treatment group)

[10] Caliendo and Kopenig (2008) find that logit and probit models yield similar results and hence this choice does not appear crucial.

[11] One potential problem may arise if we were unable to fully correct for hard-to-observe cultural attributes which are correlated with the degree of environmental decentralization and/or political centralization, and may influence the attitude towards environmental protection.

[12] We assume the environmental policy outcome is independent of the treatment, conditional on these observables (i.e. $t_0, t_1 \perp SD|X$; $\perp$ denotes independence) (Heckman *et al.*, 1999).

[13] Different versions of assumption (1) are used throughout the literature: unconfoundness (Rosenbaum and Rubin, 1983); selection on observables (Heckman and Robb, 1985) or the conditional independence assumption (Lechner, 1999). We will use the term unconfoundness throughout the paper to avoid confusion.

utilizing a probit model, and in the second stage an OLS regression is estimated. We utilize the OLS regression to examine the impact of the treatment in question, e.g., an indicator of environmental decentralization (indicator of political centralization), taking political centralization (environmental decentralization) into account with the help of the respective continuous measure. The reason why we do not use the typical matching estimation is that we aim to explore an interaction with another variable; this interaction will have an impact on the estimation process. To allow for the interaction between variables, we instead utilize the propensity score estimation method to provide consistent estimates of the ATE. Rosenbaum and Rubin (1983) show that

$$t_i = \alpha + \tau_1 EnvlDecent_i + \tau_2 (EnvlDecent_i * PolitCent_i) + \lambda PolitCent_i + \beta_1 \hat{p}(x_i) + \beta_2 (\hat{p}(x_i) - \overline{\hat{p}(x_i)}) + \mu_i \quad (1)$$

can provide consistent estimates, where $\hat{p}(x_i)$ represents the predicted value of the propensity score, $\overline{\hat{p}(x_i)}$ is the sample mean, and μ_i is a well-behaved error term. The analogous models are used to provide consistent estimates of the effect when a continuous variable is utilized as measure of environmental decentralization and an indicator variable is used for political centralization.

III. Data

Data is available for a total of 110 countries from the late 1990's and the early 2000's. See Table A1 in Appendix I for descriptive statistics. We use eleven different dependent variables measuring environmental policy stringency. Our selection of multiple variables from different sources will serve to limit measurement error that may have occurred from the original sources. With a variety of outcome variables and sources, possible biases originating from the mis-measurement problems are more limited (see Millimet, 2010). Six of these environmental policy

indices come from CIESIN (2002) and were produced in collaboration with the Yale Center for Environmental Law and Policy, the Global Leaders of Tomorrow World Economic Forum, and Columbia University's Center for International Earth Science Information Network (CIESIN): (i) *Environmental Sustainability Index* (*ESI*); (ii) *Institutional Capacity*; (iii) *Environmental Governance*; (iv) *Global Stewardship*; (v) *International Participation*; (vi) *Greenhouse Gases*.

ESI measures the current environmental performance and the capacity for policy interventions in the future. *Institutional Capacity* measures the extent to which a country has in place institutions and underlying social patterns of skills, attitudes and networks for effective responses to environmental situations. *Environmental Governance* examines the institutions, rules and practices that shape environmental policy outcomes. *Global Stewardship* reflects the degree to which a country cooperates with others to address negative transboundary environmental impacts. *International Participation* measures the extent of participation by countries in global conventions and the contribution of financial resources in international financial arrangements. *Greenhouse Gases* measures reductions in CO_2 emissions per unit of GDP, and CO_2 emitted per capita. An alternative measure, *CO_2 Emissions*, measures CO_2 emissions per capita only, and comes from Frankel and Rose (2005). Note that a lower value for *CO_2 Emissions* represents a stricter environmental policy (contrary to the other measures). The prices of super gasoline and diesel in 2000 and 2002 come from Metschies (2003): *Super2000, Super2002, Diesel2000,* and *Diesel2002*).[14]

As measures of political centralization we use party age measures, following Enikolopov and Zhuravskaya (2007). The party age variable from Beck *et al*. (2001) is defined as the average age

[14] Gas tax data is available for OECD countries only; we therefore use gas prices (see Fredriksson and Millimet, 2004). While differences in gasoline prices across countries are affected by domestic demand and openness to international trade, environmental taxes, congestion taxes aimed at externalities, and possible other taxes, represent the major share of the variation in gasoline prices among OECD countries (OECD/IEA, 2000).

of the two main government parties and the main opposition party. We utilize a continuous measure *PolCentral*, and a *PolCentral Dummy* which takes a value equal to unity if the average party age is 30 years of higher, and zero otherwise. However, a cut-off equal to 35 years produces similar results, and so does 25 years although 25 years produces somewhat fewer significant coefficients (available upon request).[15]

We utilize two indicator variables and two continuous measures classifying our 110 countries into environmentally decentralized systems, and not environmentally decentralized. *Federal Dummy* equals 1 if the country is classified as a federation by Forum of Federations (2005); 0 otherwise. 21 out of 110 countries are classified as federations. Out of these 21 federations, the *PolCentral Dummy* takes a value of unity for 11 countries.

Both *Tiers Dummy* and *Tiers* measure the level of vertical decentralization. *Tiers* measures the number of layers of government including the central government level (Treisman, 2002, Fan et al., 2009). To be counted as a tier, a tier of government must have a political executive at that tier which (i) is funded from the public budget; (ii) has authority to administer a range of services; and (iii) has a territorial jurisdiction (Treisman, 2002). *Tiers* ranges from 1 for Singapore to 6 for Tanzania and Uganda. The effect of *Tiers* may not be monotone, however, and we create *Tiers Dummy* which takes a value of 1 if a country had four or more layers of government in the mid-1990s (Treisman, 2002). Out of 110 countries, *Tiers Dummy* takes a value of unity for 62 countries out of which approximately one quarter (14/62) are politically centralized (*PolCentral Dummy* = 1). *Tiers Dummy* takes a value of zero for the remaining 51 countries, out of which 28 have *PolCentral Dummy* = 1.

[15] The U.S. and Italy, e.g., have *PolCentral* observations equal to 144 and 32.91, respectively.

SubEmploy measures the share of total workers in the economy employed in civilian sub-central levels of government in the early 1990s and comes from Schiavo-Campo et al. (1997). *SubEmploy* reflects personnel decentralization, and is expected to measure the ability of lower levels of government to inspect and monitor emissions and implement environmental policies in general. With more manpower at lower levels of government, local conditions can more easily be taken into account leading to more optimal policy outcomes.

Sigman (2008) utilizes a more direct measure of environmental decentralization, calculated from IMF (2007): the ratio of subnational environmental expenditures to total environmental expenditures. The measure is available for 34 countries, which only enables us to run models using 20-23 observations (insufficient for our purposes). It is not likely to be a perfect measure of environmental decentralization. However, the average values of the environmental expenditure decentralization measure are 74.9 and 66.55 in countries where *Federal Dummy* = 1 (8 countries) and *Tiers Dummy* = 1 (15 countries), respectively. In countries where *Federal Dummy* = *Tiers Dummy* = 0, the corresponding averages are 57.77 and 61.99, respectively (26 and 17 countries, respectively). The correlation coefficient between the environmental expenditure decentralization measure and *Subemploy* equals 0.2406, while with *Tiers* it is -0.0755 (perhaps due to *Tiers*' discrete nature). Overall, these averages and correlations suggest that our measures may capture environmental decentralization in a reasonable fashion.

The first stage estimation (results available upon request) includes the same variables whether estimating the propensity score for environmental decentralization (*Federal Dummy*; *Tiers Dummy*) or political centralization (*PolCentral Dummy*). In both cases, the variables included are the percentage of population adhering to Islam in 2000 (*Muslim*), ethnolinguistic fractionalization (*ELF*), years of independence (*Independence*), UK colony dummy (*UK*

Colony), French colony dummy (*French Colony*), interactions between years of independence and the colony dummies (excluding the US), Africa (*Africa*), East Asia (*East Asia*), and Latin America (*Latin America*) dummies, dummies for legal origin (*UK, French, Scandinavian, German,* and *Socialist Legal Origin,* respectively) from La Porta et al. (2008), and dummies for a parliamentary system (*Parliament*), and a proportional electoral system (*Proportional*). Moreover, we use several measures from World Bank (2003): age distribution (*Age 15-64*) (proxy for the number of drivers), population (*Population*), population density (*PopDensity*), land area (*Land*); from Kaufmann et al. (2003) we use corruption (*Honesty*) and political stability (*Stability*). From CIA (2003) comes: GDP/capita (*GDP/Capita*), and the ratio of exports plus imports to GDP (*Trade Openness*) (see Appendix II for all sources).

IV. Results

Table 2 reports the main estimation results of Equation (1) using our sample of democracies only (broadly defined), i.e. countries classified as "free" or "partially free" by our *Democracy* variable from Freedom House (2006). While this limits our sample size, in our view the strength of political parties is most likely to play a role for policy outcomes in these countries. Table 3 displays the estimation results using all available observations. In each table, the first two panels use alternative dummy variable measures for environmental decentralization combined with a continuous measure for political centralization, and the interaction between the two, respectively. This pattern is reversed in panels 3 and 4. In each set of results, the first stage regression applies to the dummy variable, with the same first stage variables included irrespective of the probit model estimated.

A number of models in Table 2 suggest that political centralization improves the outcome of environmental decentralization, in particular for local pollutants. A total of 12 coefficients on the

interaction terms in columns (2)-(4) and (6)-(8) are significant with the expected positive sign, supporting Riker's hypothesis. Moreover, in these columns the direct impact of environmental decentralization is found to be negative for environmental policy in nine. In Panel 4, columns (1) and (3), the direct effect is positive and significant, however. Fig. 1 illustrates the effect of *TiersDummy* on *Institutional Capacity*, conditional on *PolCentral* (using the model in column (3) in Panel 2). This model suggests that for countries which are highly politically centralized, the marginal effect of *TiersDummy* is positive, while for low levels of political centralization the effect is nil, or even negative.

Next, note that eight significant interaction coefficients in column (9)-(11) in Panels 2-4 suggest that political centralization *worsens* the effect of decentralization, contradicting Riker (1964). These models all address the determinants of global pollution problems. However, five models in Panels 2-3 indicate that the direct effect of decentralization is a positive effect on policy stringency. A possible explanation for these sign reversals may be that countries with a high number of tiers tend to be developing countries. These may have received foreign aid aimed at combating climate change, captured by the environmental policy stringency measures. Such projects are more likely to be administered at the central level (as these are country level commitments and resulting from international negotiations). Multi-tiered aid recipient countries may also be so highly corrupt (Fan et al., 2009) that the *Honesty* variable in the first stage is unable to fully capture this effect (*Honesty* is not significant in the first stage). If corruption tends to be worse at the central government level (Bardhan and Mookherjee, 2000), political centralization reduces the positive impact of such projects.

Turning to Table 3 which includes all available observations, 15 interaction term coefficients in columns (2)-(8) are significant with the expected sign. Again, these models all address

national pollution problems. In these models, the direct environmental decentralization variables are significantly negative in only two models. The models studying global pollution problems in columns (9)-(11) again exhibit a reversal of the coefficient signs in seven cases.

The results in Tables 2 and 3 also suggest that the direct effect (disregarding political centralization) of having a federal constitution or more tiers of government (vertical centralization) tends to be negative on the stringency of environmental policies addressing local problems, while it tends to be positive for global pollutants. More government employment at sub-central layers of government (personnel decentralization) has little effect on environmental policy stringency.

Discussion

Why do our results tend to be reversed for the global pollutants in Columns (9)-(11)? We can here only speculate about the forces behind this result. However, one possible explanation is that climate change related foreign aid is channeled to multi-tier developing countries where the aid may more easily reach the local level. However, this is more difficult in politically centralized countries, especially if the central government is highly corrupt. Another possibility is that yardstick competition occurs between governments in decentralized system in the area of climate change (see Salmon, 1987). The literature indicates that local governments may sometimes be more active that the central government in this area (see, e.g., Lutsey and Sperling, 2008; Nakamura et al., 2011). Central governments may, however, prefer free riding and are better able to enforce this when political centralization is high.

V. Robustness Analysis

Tables 4-7 report the results of our robustness analysis. First, since *PolCentral Dummy* uses a cutoff of 30 years, relatively young countries appear less likely to have a *PolCentral Dummy*

equal to 1. Table 4 therefore focuses on the two models using *PolCentral Dummy* in Tables 2 and 3, respectively, but uses only countries being independent for at least 50 years (CIA, 2003). This allows political parties the time to reach a sufficient age and chance to be classified as strong. Panels 1 and 2 in Table 4 use democracies only, while Panels 3 and 4 use all observations. In Tables 5 and 6, we restrict the sample based on governance and electoral systems, in particular to parliamentary democracies and proportional democracies, respectively. The applied literature is debating the correct specification of the propensity score and variable choice (see, e.g., Millimet and Tchernis, 2009).[16] Our robustness analysis in Table 7 therefore includes results with square terms in the propensity score specification. However, due to the small sample size we cannot use square terms for all variables, and therefore include square terms only for the variables measuring country size (*Land, Population, GDP/Capita*).

Despite a sharp decline in the number of observations (particularly in Table 5) in Tables 4-6, the results reported in the earlier tables appear quite robust. Aggregating over all models in columns (1)–(8) in these three tables, 12, 8, and 19 interactions coefficients are significant and positive, respectively. This lends further support for Riker's prediction. The results in Table 6 appear particularly consistent, suggesting that the overall results may be driven at least to some degree by democracies with a proportional electoral system. Since in a proportional system a government needs 50 percent of the national vote to win, coordination may be particularly important.[17] The models in columns (9)-(11) (which address global pollutants) continue to show the reversed result in Tables 4-6. Moreover, personnel decentralization now appears to have a

[16] Bryson *et al*. (2002) find that too many irrelevant variables can cause an efficiency loss. Smith and Todd (2005) suggest that including too few or too many variables in the propensity score specification may yield biased estimates. Sianesi (2004) suggests including variables that either have high significance levels in the first stage, or variables used in previous studies. Millimet and Tchernis (2009) find that including irrelevant variables does not bias the propensity score measure significantly, while excluding relevant variables may potentially be harmful.

[17] Majoritarian electoral systems are more grounded in local interests (Persson and Tabellini, 1999; Milesi-Feretti et al., 2002), and a party needs only 50 percent of the vote in 50 percent of the districts to win an election, and thus it may ignore pollution spillovers and welfare in superfluous districts (Fredriksson and Millimet, 2004).

positive impact on environmental policy, particularly in older countries with democratic traditions (see Table 4).

Table 7 utilizes all available observations as in Table 3. The results are in a similar vein as the earlier tables. However, we not that the interaction of interest in Panel 4 using *SubEmploy* is now significant at a higher level than in Table 3 in four cases (out of eight significant coefficients), and in these cases the coefficient sizes have increased. Moreover, the results for the global pollutants in columns (9)-(11) now appear somewhat less robust.

In further robustness analysis we used several additional measures of environmental decentralization from Fan et al. (2009) (detailed results not reported, but available upon request). These are indicators of whether: (i) The executive at bottom tier directly elected or chosen by directly elected assembly; (ii) The executive at second lowest tier directly elected or chosen by directly elected assembly; (iii) Under the constitution, subnational legislatures have autonomy in certain specified areas, i.e. have constitutional authority to legislate, not explicitly subject to central laws; and/or subnational governments have residual powers to legislate in areas not explicitly assigned to other levels; and measures of: (iv) Average subnational revenues (as % of GDP) during years 1994-2000 (fiscal decentralization); and (v) Average surface area size of bottom tier units in 1000s of sq. km.

These decentralization measures produce between zero and two significant interaction coefficients of interest. The exception is the fiscal decentralization measure which has three significant and positive interaction coefficients (in the models with *Institutional Capacity*, *International Participation*, and *Global Stewardship*) in the sample of only democracies. However, only the coefficient in the *Institutional Capacity* model is significant in the full sample. These measures may not address environmental decentralization, and may suffer

severely from measurement error. In additional analysis we added a measure of oil reserves to the first stage probit, since this may drive countries' approach to, e.g., climate change. This caused the estimation procedure to fail for the models reported in Table 2 (democracies only, perhaps due to high correlations in the first stage. However, this did not have any effect on the results in the remaining tables. We conclude that our results are robust to adding oil reserves.

VI. Conclusion

Riker (1964) predicts that the outcome of fiscal decentralization is improved by political centralization. We test this hypothesis using cross-country data on environmental policy outcomes. We find that environmental decentralization tends to have a more positive effect on environmental policies addressing local (national) environmental problems when the level of political centralization is high. These findings lend support to Riker's prediction. However, our estimates also suggest that for global pollution problems, the effect of political centralization is negative for the outcomes of environmental decentralization. We also find that different forms of environmental decentralization affect environmental policy outcomes differently. In a politically decentralized country, for example, vertical decentralization (more tiers of government) and federal constitutions tend to have a negative impact on environmental policy stringency, while the effect of personnel decentralization is positive. Fewer layers of government but more government employees (such as plant inspectors) at the remaining sub-central tiers are policy recommendations that emerge from this study.

We believe these are novel results in the literature and can help improve our understanding of environmental policymaking and political institutions.

References

Appelby, J. and T. Ball, eds., (1999), *Jefferson: Political Writings*, New York: Cambridge University Press.

Bardhan, P. and Mookherjee, D. (2000), Capture and Governance at the Local and National Levels, *American Economic Review 90(2)*, 135-39.

Beck, T., Clarke, G., Groff, A., Keefer, P. and P. Walsh (2001), New Tools in Comparative Political Economy: The Database of Political Institutions, *World Bank Economic Review 15*, 165-176.

Besley, T. and S. Coate (2003), Central versus Local Provision of Public Goods: A Political Economy Analysis, *Journal of Public Economics* 87, 2611-37.

Blanchard, O. and A. Shleifer (2001), Federalism With and Without Political Centralization: China versus Russia, *IMF Staff Papers* 48(4), 171-79.

Breton, A. (1987), Expenditure Harmonization in Unitary, Confederal and Federal States, *European Journal of Political Economy* 3(1-2), 199-218.

Bryson, A., Dorsett, R., and Purdon, S. (2002), The Use of Propensity Score Matching in the Evaluation of Labour Market Policies, Department of Work and Pensions Working Paper 4.

Caliendo, M. and Kopeinig, S. (2008), Some Practical Guidance for the Implementation of Propensity Score Matching, *Journal of Economic Surveys* 22(1), 31-72.

Center for International Earth Science Information Network (CIESIN) (2002), *2002 Environmental Sustainability Index*, Yale Center for Environmental Law and Policy, Yale University, www.ciesin.columbia.edu.

CIA (2003), *The World Factbook*, CIA, Washington, DC.

Cutter, W.B. and J.R. DeShazo (2007), The Environmental Consequences of Decentralizing the Decision to Decentralize, *Journal of Environmental Economics and Management 53*, 32-53.

Dehejia, R.H. and Wahba, S. (1999), Causal Effects in Nonexperimental Studies: Reevaluating the Evaluation of Training Programs, *Journal of the American Statistical Association 94*, 1053-1062.

Dijkstra, B.R. and P.G. Fredriksson (2010), Environmental Regulatory Federalism, *Annual Review of Resource Economics 2*, 319-39.

Enikolopov, R. and E. Zhuravskaya (2007), Decentralization and Political Institutions, *Journal of Public Economics 91*, 2261-90.

Esty, D.C. (1996), Revitilizing Environmental Federalism, *Michigan Law Review* 95, 570-653.

Fan, C.S, C. Lin, and D. Treisman (2009), Political Decentralization and Corruption: Evidence from Around the World, *Journal of Public Economics 93*, 14-34.

Fomby, T.B. and L. Lin (2006), A Change Point Analysis of the Impact of "Environmental Federalism" on Aggregate Air Quality in the United States: 1948-98, *Economic Inquiry* 44, 109-20.

Forum of Federations (2005), www.forumfed.org.

Frankel, J.A. and Rose, A.K. (2005), Is Trade Good or Bad for the Environment? Sorting Out the Causality, *Review of Economics and Statistics 87*, 85-91.

Fredriksson, P.G. and N. Gaston (2000), Environmental Governance in Federal Systems: The Effects of Capital Competition and Lobby Groups, *Economic Inquiry* 38, 501-14.

Fredriksson, P.G., Matschke X. and J. Minier (2010), Environmental Policy in Majoritarian Systems, *Journal of Environmental Economics and Management* 59(2), 177-91.

Fredriksson, P.G. and D.L. Millimet (2002), Strategic Interaction and the Determination of Environmental Policy Across U.S. states, *Journal of Urban Economics* 51, 101-22.

Fredriksson, P.G. and D.L. Millimet (2004), Electoral Rules and Environmental Policy, *Economics Letters* 84, 237-44.

Freedom House (2006), *Freedom in the World*, www.freedomhouse.org.

Gennaioli, N. and I. Rainer (2007), The Modern Impact of Precolonial Centralization in Africa, *Journal of Economic Growth* 12(3), 185-234.

Gray, W.B. and R.J. Shadbegian (2004), 'Optimal' Pollution Abatement-Whose Benefits Matter, and How Much? *Journal of Environmental Economics and Management 47*, 510-34.

Gray, W.B. and R.J. Shadbegian (2007), The Environmental Performance of Polluting Plants: A Spatial Analysis, *Journal of Regional Science 47*, 63-84.

Hayek, F.A. (1948), *Individualism and Economic Order*, University of Chicago Press, Chicago.

Heckman, J.J., Ichimura, H. and Todd, P.E. (1997), Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Program, *Review of Economic Studies 64*, 605-654.

Heckman, J.J., Lalonde R.J. and Smith, J.A. (1999), The Economics and Econometrics of Active Labor Market Programs, in O. Ashenfelter and Card, D. (eds.), *Handbook of Labor Economics*, Vol. 3, Elsevier, Amsterdam.

Heckman, J.J. and Robb, R. (1985), Alternate Models for Evaluating the Impact of Interventions. In J. Heckman and B. Singer (eds.), *Longitudinal Analysis of Labor Market Data*, 154-246, Cambridge University Press, Cambridge.

Helland, E. and A.B. Whitford (2003), Pollution Incidence and Political Jurisdiction: Evidence from the TRI, *Journal of Environmental Economics and Management 46*, 403-24.

Huntington, S.P. (1968), *Political Order in Changing Societies*, Yale University Press, New Haven.

Kaufmann, D., Kraay, A. and M. Mastruzzi (2003), Governance Matters III: Governance Indicators for 1996–2002, World Bank Policy Research Working Paper No. 3106.

IMF (2007), *Government Finance Statistics CD*, International Monetary Fund, Washington, DC.

Keefer, P. and S. Khemani (2009), When Do Legislators Pass on Pork? The Role of Political Parties in Determining Legislator Effort, *American Political Science Review 103*, 99-112.

Konisky, D.M. (2007), Regulatory Competition and Environmental Enforcement: Is there a Race to the Bottom? *American Journal of Political Science 51*, 853-72.

Konisky, D.M. and N.D. Woods (2009), Exporting Air Pollution? Regulatory Enforcement and Environmental Free Riding in the United States, *Political Research Quarterly 63(4)*, 771-83.

Kunce, M. and J.F. Shogren (2002), On Environmental Federalism and Direct Emission Control, *Journal of Urban Economics 51*, 238-45

Kunce, M. and J.F. Shogren (2005), On Interjurisdictional Competition and Environmental Federalism, *Journal of Environmental Economics and Management 50*, 212-24.

Levinson, A. (2003), Environmental Regulatory Competition: A Status Report and Some New Evidence, *National Tax Journal 56*(2), 91-106.

Lechner, M. (1999), Earnings and Employment Effects of Continuous off-the-job training in East Germany after Unification, *Journal of Business & Economic Statistics 17*, 74-90.

List, J.A., E.H. Bulte, and J.F. Shogren (2002), "Beggar Thy Neighbor": Testing For Free Riding in State-level Endangered Species Expenditures, *Public Choice 111*, 303-15.

List, J.A. and S. Gerking (2000), Regulatory Federalism and Environmental Protection in the United States, *Journal of Regional Science* 40, 453-71.

Lockwood, B. (2002), Distributive Politics and the Costs of Centralization, *Review of Economic Studies* 69, 313-37.

Lutsey, N. and D. Sperling (2008), America's Bottom-up Climate Change Mitigation Policy, *Energy Policy* 36, 673-85.

Mazur, E. (2011), Environmental Enforcement in Decentralized Governance Systems: Towards a Nationwide Level Playing Field, OECD Environment Working Papers No. 34, OECD Publishing, Paris.

Mill, J.S. (1991), *On Liberty and Other Essays*, ed., J. Gray, Oxford University Press, New York.

Myerson, R. (2006), Federalism and Incentives for Success of Democracy, *Quarterly Journal of Political Science* 1(1), 3-23.

Mayhew, D. (1986), *Placing Parties in American Politics*, Princeton University Press, Princeton, NJ.

Metschies, G. (2003), *International Fuel Prices*, 3rd Edition, Eschborn, Germany: Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ), www.zietlow.com/docs/Fuel-Prices-2003.pdf.

Milesi-Feretti, G.M. Perotti, R. and M. Rostagno (2002), Electoral Systems and Public Spending, *Quarterly Journal of Economics* 117, 609-57.

Millimet, D.L. (2003), Assessing the Empirical Impact of Environmental Federalism, *Journal of Regional Science* 43, 711-33.

Millimet, D.L. (2010), The Elephant in the Corner: A Cautionary Tale about the Measurement Error in Treatment Effects Models, forthcoming, *Advances in Econometrics: Missing Data Methods*, 27.

Millimet, D.L. and J.A. List (2003), A Natural Experiment of the 'Race to the Bottom' Hypothesis: Testing for Stochastic Dominance in Temporal Pollution Trends, *Oxford Bulletin of Economics and Statistics* 65, 395-420.

Millimet, D.L. and R. Tchernis (2009), On the Specification of Propensity Scores, with Applications to the Analysis of Trade Policies, *Journal of Business & Economic Statistics 27*, 397-415.

Nakamura, H., Elder, M., and H. Mori (2011), The Surprising role of Local Governments in International Environmental Cooperation, *Journal of Environment & Development* 20(3), 219-50.

Oates, W. (1972), *Fiscal Federalism*, Harcourt, New York.

Oates, W.E. and Portney, P.R. (2003), The Political Economy of Environmental Policy, in K.-G. Mäler and J.R. Vincent (eds.), *Handbook of Environmental Economics*, Vol. 1, Elsevier, Amsterdam.

Oates, W.E., and R.M. Schwab (1988), Economic Competition Among Jurisdictions: Efficiency Enhancing or Distortion Inducing? *Journal of Public Economics* 35(3), 333-54.

OECD/IEA (2000), *Energy Policies of IEA Countries, 2000 Review*, Organization for Economic Cooperation and Development and International Energy Agency, Paris.

Pearl, J. (2009), *Causality: Models, Reasoning and Inference*, 2nd edition, Cambridge University Press, Cambridge.

Persson, T. and Tabellini, G. (1999), The Size and Scope of Government: Comparative Politics with Rational Politicians, *European Economic Review* 43, 699-735.

Persson, T. and Tabellini, G. (2002), Do Constitutions Cause Large Governments? Quasi-experimental Evidence, *European Economic Review 46*, 908-918.

Primo, D.M. and J.M. Snyder, Jr. (2010), Party Strength, the Personal Vote, and Government Spending, *American Journal of Political Science 54(2)*, 354-370.

Rauscher, M. (2000), Interjurisdictional Competition and Environmental Policy. In *International Yearbook of Environmental and Resource Economics* 2000/2001, eds. T. Tietenberg and H. Folmer, pp. 196-230, Edward Elgar, Cheltenham.

Reversz, R. (2001), Federalism and Environmental Regulation: A Public Choice Analysis, *Harvard Law Review* 115(2), 553-641.

Riker, W.H. (1964), *Federalism: Origins, Operations, Significance*, Little, Brown and Co., Boston.

Roeder, P.G. (2001), Ethnolinguistic Fractionalization (ELF) Indices, 1961 and 1985, visited April 1, 2010. http//:weber.ucsd.edu\~proeder\elf.htm.

Roelfsema H. (2007), Strategic Delegation of Environmental Policy Making, *Journal of Environmental Economics and Management* 53, 270-75.

Rosenbaum, P. and Rubin, D. (1983), The Central Role of the Propensity Score in Observational Studies for Causal Effects, *Biometrika 70*, 41-55.

Rousseau, J.J. (1762). *The Social Contract*, in *Political Writings* (1986), edited and translated by F. Watkins, University of Wisconsin Press, Madison.

Rubin, D. (1974), Estimating Casual Effects of Treatments in Randomized and Nonrandomized Studies, *Journal of Educational Psychology 66*, 688-701.

Rubin, D. (2007), The design versus analysis of observational studies for casual effects: Parallels with the design of randomized trials, *Statistics in Medicine, 26(1)*, 26-36.

Salmon, P. (1987), Decentralization as an Incentive Scheme, *Oxford Review of Economic Policy* 3(2), 24-43.

Schiavo-Campo, S., D. de Tommaso and A. Mukherjee (1997), *An International Statistical Survey of Government Employment and Wages*, Policy Research Working Paper No. 1806, The World Bank, Washington, DC.

Seabright, P. (1996), Accountability and Decentralisation in Government: An Incomplete Contracts Model, *European Economic Review* 40, 61-89.

Sianesi, B. (2004), An evaluation of the Swedish system of active labour market programmes in the 1990's, *Review of Economics and Statistics 86(1)*, 133-155.

Sigman, H. (2002), International Spillovers and Water Quality in Rivers: Do Countries Free Ride? *American Economic Review* 92, 1152-59.

Sigman, H. (2003), Letting States do the Dirty Work: State Responsibility for Federal Environmental Legislation, *National Tax Journal 56*, 107–22.

Sigman, H. (2005), Transboundary Spillovers and Decentralization of Environmental Policies, *Journal of Environmental Economics and Management* 50, 82-101.

Sigman, H. (2007), Decentralization and Environmental Quality: An International Analysis of Water Pollution, NBER Working Paper #13098, Cambridge, MA.

Sigman, H. (2008), A Cross-Country Comparison of Decentralization and Environmental Protection, in G.K. Ingram and Y.-H. Hong, *Fiscal Decentralization and Land Policies*, Lincoln Institute of Land Policy, Cambridge, MA.

Silva, E.C.D. and A.J. Caplan (1997), Transboundary Pollution Control in Federal Systems, *Journal of Environmental Economics and Management 34*, 82-101.

Smith, J.A. and Todd, P.E. (2005), Does Matching Overcome LaLonde's Critique? *Journal of Econometrics 125*, 305-353.

Tiebout, C. (1956), A Pure Theory of Local Expenditures, *Journal of Political Economy* 64(5), 416-24.

Treisman, D. (2002), Decentralization and the Quality of Government, mimeo, University of California, Los Angeles.

Ulph, A. (2000), Harmonization and optimal Environmental Policy in a Federal System with Asymmetric Information, *Journal of Environmental Economics and Management 39*, 224-41.

Voigt, S. and L. Blume (2010), The Economic Effects of Federalism and Decentralization – A Cross-country Assessment, forthcoming, *Public Choice*.

World Bank (2003), *World Development Indicators 2003*, CD Rom, The World Bank, Washington, DC.

Wooldridge, J.M. (2002), *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge, MA.

Appendix I

Table A1. Summary Statistics

	Obs	Mean	S.D	Minimum	Maximum
Treatment Variables					
Federal Dummy	110	0.18	0.39	0	1
Tiers Dummy	92	0.57	0.50	0	1
Tiers	92	3.72	0.99	1	6
SubEmploy	69	2.71	2.93	0	15.1
PolCentral	110	32.91	28.79	2	144
PolCentral Dummy	110	0.37	0.49	0	1
Outcome Variables					
ESI	99	50.6	8.70	33.2	73.9
Institutional Capacity	99	49.33	17.01	20.9	91.5
Environmental Governance	99	0.037	0.63	-1.31	1.47
Global Stewardship	99	52.37	12.36	13.1	73
International Participation	99	0.12	0.55	-1.31	1.27
Greenhouse Gases	99	0.12	0.75	-3.05	0.97
CO_2	110	4.05	4.88	0.02	25.45
Super 1998	105	59.22	28.48	1	121
Super 2000	101	63.90	25.79	3	119
Diesel 1998	105	42.54	23.62	1	111
Diesel 2000	101	48.22	23.34	3	122
Independent Variables					
Proportional	110	0.57	0.50	0	1
Parliament	110	0.42	0.50	0	1
GDP/Capita	110	8686	9118	510	36400
Trade Openness	110	31.52	10.08	2.3	1031
Population (millions)	110	49.25	158.47	0.28	1273
Land	110	944.74	2391	0.65	16955
Population Density	110	66.38	507.62	0.25	5298
Age 15-64	110	60.74	6.55	47.34	72.055
Age 65+	110	7.16	5.02	2.18	18.34
Independence	110	0.46	0.35	0.028	1
Protestant	110	18.68	23.20	0	91
Muslim	110	25.24	33.98	0	100
Africa	110	0.31	0.45	0	1
East Asia	110	0.15	0.35	0	1
Latin America	110	0.21	0.41	0	1
UK Colony	110	0.20	0.35	0	0.9

French Colony	110	0.33	0.39	0	0.98
ELF	110	0.46	0.28	0.003	0.98
Stability	110	0.06	1.00	-2.33	1.73
Honesty	110	0.15	1.12	-1.38	2.54
Democracy	110	3.26	1.76	1	7
UK Legal	110	0.31	0.46	0	1
French Legal	110	0.55	0.50	0	1
Scandinavian Legal	110	0.05	0.21	0	1
German Legal	110	0.1	0.30	0	1
Socialist Legal	109	0.01	0.10	0	1

Appendix II

Data Description

PolCentral. The average age of the two largest government parties and main opposition party, or the subset of these. Source: Beck *et al*. (2001).

PolCentral Dummy. A dummy variable equal to 1 if the two largest government parties and main opposition party, or the subset of these, is greater than 25 years. Source: Beck *et al*. (2001).

Federal Dummy. A dummy variable equal to 1 if the country is classified as a federation. Source: Forum of Federations (2005).

Federal Dummy. A dummy variable equal to 1 if the country has a federal political structure**.** Forum of Federations (2005).

Tiers Dummy. Tiers Dummy takes a value of 1 if a country had three or more layers of government in the mid-1990s, based on the variable "Tiers2". Source: Treisman (2002).

Tiers. The number of layers of government in the mid-1990s, based on the variable "Tiers2". Source: Treisman (2002).

Subemploy. The share of total workers in the economy employed at sub-central levels of government in the early 1990s. Source: Schiavo-Campo et al. (1997).

ESI. The current environmental performance and capacity for future policy interventions. Source: CIESIN (2002).

Institutional Capacity. The extent to which a country has in place institutions and underlying social patterns of skills, attitudes and networks that foster effective responses to environmental situations. Source: CIESIN (2002).

Environmental Governance. A measure that examines the institutions, rules and practices that shape environmental policy. Source: CIESIN (2002).

Global Stewardship. How a country cooperates with other countries to reduce negative transboundary environmental impacts. Source: CIESIN (2002).

International Participation measures the extent of participation by countries in global conventions and participation in international financial funds. Source: CIESIN (2002).

Greenhouse Gases measures CO_2 emissions per unit of GDP and CO_2 emitted per capita with higher values represents lower emissions. Source: CIESIN (2002).

CO_2 Emissions measures the average CO_2 emissions per capita from 1990-1995. Source: Frankel and Rose (2005). http://faculty.haas.berkeley.edu/arose.

Super2000. The price of super gasoline in 2000 in US cents per liter. Source: Metschies (2003).

Super2002. The price of super gasoline in 2002 in US cents per liter. Source: Metschies (2003).

Diesel2000. The price of diesel gasoline in 2000 in US cents per liter. Source: Metschies (2003).

Diesel2002. The price of diesel gasoline in 2002 in US cents per liter. Source: Metschies (2003).

Proportional. A dummy variable equal to 1 if the winning party needs to gain a majority of the districts to gain power and *Democratic* equals 1. Source: Persson and Tabellini (2002).

Parliament. A dummy variable equal to 1 if the country has a parliamentary form of government. Source: Persson and Tabellini (2002).

PopDensity. Population divided by land area, 2000. Source: World Bank (2003).

Population. Measures the total population for the country, 1999. Source : World Bank (2003)

Age15-64. Percentage of the total population between 15 and 64 years old, 1999. Source: World Bank (2003).

Age65+. Percentage of the total population over the age of 65, 1999. Source: World Bank (2003).

GDP/Capita. Per capita gross domestic product in US dollars. Source: CIA (2003).

Land. Land area in thousands of km^2. Source: World Bank (2003).

Trade Openness. Trade in good as a percent of GDP. Total Export and Total Imports divided by GDP, 2000. Source: CIA (2003).

Muslim. Percent of population following the religion of Islam, 2000. Source: www.factbook.net/muslim_pop.php.

Democracy. The average score for the Freedom House indices Civil Liberties and Political Rights. Measured 1-7; 1 represents the highest degree of freedom, 7 the lowest. Countries whose combined averages equal 1.0-2.5 are designated "free"; 3.0-5.5 "partly free"; 5.5-7.0 "not free". Source: Freedom House (2006).

Independence. (250 - number of years independent from 1748)/250. Source: CIA (2003)

ELF. Ethnolinguistic fractionalization, the probability that two randomly selected individuals will belong to different ethno-linguistic group. Source: Roeder (2001).

UK Colony. Interaction between a dummy for a country being a UK colony (excluding the US) and (250 – the number of years of independence from 1748)/250. Source: Persson and Tabellini (2002) and CIA (2003).

French Colony. Interaction between a dummy for a country being a UK colony (excluding the US) and (250 – the number of years independent from 1748)/250. Sources: Persson and Tabellini (2002) and CIA (2003).

Africa. A dummy equal to 1 if the country is located on the continent of Africa.

East Asia. A dummy equal to 1 if the country is located in East Asia.

Latin America. A dummy equal to 1 if the country is located in Latin America or South America.

Democracy. A dummy equal to 1 if a country is classified as "Free" or "Partly Free" in 2000. Source: Freedom House (2006).

Honesty. A measure that measures the lack of corruption. Source: Kaufman *et al*. (2003).

Stability. A point estimate that measures the likelihood that the government in power will be destabilized or overthrown. Source: Kaufmann *et al*. (2003).

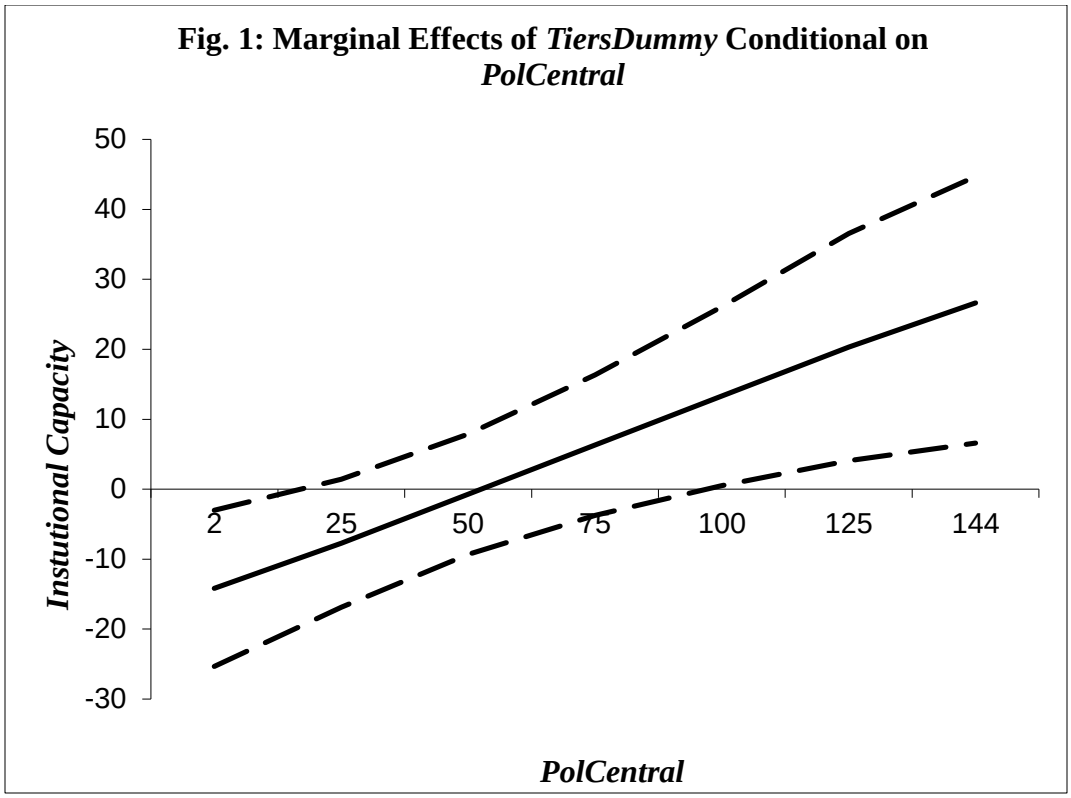
UK Legal. A dummy equal to 1 if the law is based on common law traditions. Source: La Porta *et al*. (2008).

French Legal. A dummy equal to 1 if the law is based on law traditions from France. Source: La Porta *et al.* (2008).

Scand Legal. A dummy equal to 1 if the law is based on Scandinavian law traditions. Source: La Porta *et al.* (2008).

German Legal. A dummy equal to 1 if the law is based on law traditions from Germany. Source: La Porta *et al.* (2008).

Social Legal. A dummy equal to 1 if the law is based on socialist law from Soviet Union. Source: La Porta *et al.* (2008).



Notes: Dotted lines represent the 90% confidence interval.

Table 2. Democracies only

Treatment Variable	Outcome Variable										
	ESI	Environm'l Governance	Institutional Capacity	Super 1998	Super 2000	Diesel 1998	Diesel 2000	International Participation	Global Stewardship	Greenhouse Gases	CO_2 Emissions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Federal Dummy	-6.63 (1.57)	**-0.65**** **(2.07)**	**-14.09*** **(1.86)**	-21.62 (1.45)	**-24.92*** **(1.96)**	**-23.58*** **(1.94)**	**-25.72**** **(2.24)**	-0.38 (1.38)	-10.91 (1.49)	-0.25 (0.55)	-0.07 (0.03)
Interaction	0.04 (0.71)	**0.001**** **(2.14)**	**0.22**** **(2.21)**	-0.09 (0.43)	-0.25 (1.38)	0.16 (0.96)	0.08 (0.47)	**0.009**** **(2.41)**	-0.03 (0.30)	-0.001 (1.66)	**0.06*** **(1.74)**
PolCentral	**0.08**** **(2.36)**	**0.005*** **(1.81)**	**0.17***** **(2.84)**	0.14 (1.11)	**0.23**** **(2.20)**	0.10 (1.01)	0.15 (1.59)	0.001 (0.61)	-0.03 (0.49)	-0.003 (0.78)	**0.05**** **(2.38)**
Obs	82	82	82	90	86	90	86	82	82	82	92
Tiers Dummy	-1.42 (0.38)	**-0.63**** **(2.24)**	**-14.74**** **(2.16)**	-9.57 (0.66)	-14.69 (1.04)	-8.82 (0.75)	-13.15 (1.09)	**-0.47**** **(2.04)**	**10.65*** **(6.13)**	**0.66*** **(1.86)**	-3.71 (1.64)
Interaction	-0.02 (0.30)	**0.01***** **(3.22)**	**0.28**** **(2.74)**	0.18 (0.83)	0.09 (0.48)	0.22 (1.25)	0.24 (1.50)	**0.01***** **(3.79)**	**-0.26***** **(2.79)**	**-0.02***** **(3.52)**	**0.11***** **(3.33)**
PolCentral	**0.09**** **(2.38)**	0.001 (0.20)	0.09 (1.14)	0.02 (0.11)	0.09 (0.67)	0.05 (0.42)	0.08 (0.65)	-0.002 (0.82)	0.07 (1.03)	0.004 (0.98)	0.009 (0.08)
Obs	71	71	71	75	72	75	72	71	71	71	77
Tiers	-0.87 (1.19)	-0.14 (1.61)	**-4.13**** **(2.14)**	-4.02 (1.02)	-3.80 (1.05)	-0.07 (0.02)	-0.16 (0.05)	-0.09 (1.25)	**4.07**** **(2.04)**	**0.41***** **(3.72)**	**-2.46***** **(3.96)**
Interaction	**0.57**** **(2.65)**	**0.58***** **(3.07)**	**11.56***** **(2.70)**	**19.03**** **(2.05)**	3.92 (0.46)	**16.58**** **(2.23)**	10.66 (1.48)	**0.62***** **(4.07)**	**-7.53*** **(1.70)**	**-0.72***** **(2.95)**	**5.84***** **(4.08)**
PolCentral Dummy	2.15 (10.11)	**-2.10***** **(2.95)**	**-37.12**** **(2.27)**	**-59.74***** **(1.78)**	15.48 (0.51)	**-60.45***** **(2.25)**	-40.23 (1.55)	**-2.24***** **(3.88)**	**30.77*** **(1.82)**	**0.41***** **(3.72)**	**-21.93***** **(4.01)**
Obs	71	71	71	75	72	75	72	71	71	71	77
SubEmploy	**1.67**** **(2.33)**	0.05 (1.05)	**2.22*** **(1.93)**	3.04 (1.14)	2.09 (0.73)	-0.07 (0.03)	-0.38 (0.16)	0.05 (1.15)	-0.44 (0.32)	-0.03 (0.43)	-0.02 (0.05)
Interaction	**-2.08*** **(1.71)**	0.13 (1.47)	2.09 (1.08)	2.41 (0.50)	2.97 (0.64)	5.16 (1.41)	**6.58*** **(1.70)**	**0.17**** **(2.41)**	-0.63 (0.27)	-0.08 (0.71)	**1.45**** **(2.38)**
PolCentral Dummy	5.74 (1.47)	-0.43 (1.53)	-5.52 (0.88)	-0.90 (0.05)	-12.17 (0.80)	-18.27 (1.46)	-20.61 (1.63)	**-0.57**** **(2.58)**	4.76 (0.64)	0.34 (0.94)	-3.23 (1.46)
Obs	50	50	50	54	52	54	52	50	50	50	57

Notes: t-statistics in parenthesis. Indicators of significance levels follow established conventions.

Table 3. Full Sample

Treatment Variable	Outcome Variable										
	ESI	Environm'l Governance	Institutional Capacity	Super 1998	Super 2000	Diesel 1998	Diesel 2000	International Participation	Global Stewardship	Greenhouse Gases	CO_2 Emissions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Federal Dummy	-4.18 (0.98)	-0.32 (1.26)	-9.13 (1.42)	-3.66 (0.26)	-3.80 (0.34)	**-16.42*** **(1.72)**	-14.93 (1.56)	-0.20 (0.90)	-2.25 (0.35)	0.15 (0.51)	-1.10 (0.79)
Interaction	0.04 (0.54)	**0.01**** **(2.49)**	**0.25**** **(1.98)**	0.09 (0.33)	-0.10 (0.51)	**0.29*** **(1.65)**	0.18 (0.92)	**0.01**** **(2.58)**	0.02 (0.17)	-0.01 (1.28)	0.05 (1.13)
PolCentral	**0.08**** **(2.15)**	0.003 (1.05)	**0.16**** **(2.05)**	0.08 (0.55)	0.18 (1.57)	0.03 (0.21)	0.09 (0.65)	0.001 (0.39)	-0.04 (0.68)	-0.003 (0.82)	0.05 (1.35)
Obs	95	95	95	101	97	**101**	**97**	95	95	95	104
Tiers Dummy	1.74 (0.52)	**-0.48*** **(1.87)**	-5.62 (5.97)	-3.36 (0.28)	-7.38 (0.65)	-11.68 (1.18)	-15.11 (1.53)	-0.05 (0.23)	**11.00**** **(2.07)**	0.44 (1.49)	-2.44 (1.34)
Interaction	-0.06 (1.02)	**0.01***** **(2.67)**	**0.18*** **(1.75)**	0.10 (0.49)	0.04 (0.21)	0.25 (1.45)	**0.28*** **(1.70)**	**0.008**** **(2.09)**	**-0.26***** **(2.88)**	**-0.02***** **(2.98)**	**0.09***** **(2.87)**
PolCentral	**0.12***** **(2.84)**	0.002 (0.52)	**0.17**** **(2.24)**	0.05 (0.30)	0.09 (0.63)	-0.02 (0.18)	-0.001 (0.08)	0.002 (0.56)	0.06 (0.86)	-0.0001 (0.05)	0.03 (1.25)
Obs	81	81	81	84	81	84	81	81	81	81	87
Tiers	-0.40 (0.35)	-0.13 (1.57)	-3.10 (1.64)	-2.89 (0.72)	-2.81 (0.75)	-1.48 (0.46)	-0.33 (0.11)	-0.04 (0.53)	2.88 (1.57)	**0.29***** **(2.87)**	**-1.85***** **(3.33)**
Interaction	-3.17 (1.32)	0.15 (0.89)	0.67 (0.17)	3.96 (0.47)	-5.63 (0.73)	5.85 (0.87)	2.20 (0.33)	0.20 (1.32)	**-9.76**** **(2.57)**	**-0.40*** **(1.90)**	**3.11***** **(2.74)**
PolCentral Dummy	12.91 (1.45)	-0.68 (1.10)	1.20 (0.08)	-14.57 (0.48)	14.19 (0.51)	-28.61 (1.17)	-16.43 (0.69)	-0.79 (1.41)	**33.13**** **(2.36)**	**1.45*** **(1.86)**	**-12.78***** **(3.05)**
Obs	81	81	81	84	81	84	81	81	81	81	87
SubEmploy	0.90 (1.60)	0.003 (0.10)	0.54 (0.63)	0.18 (0.09)	-0.79 (0.39)	-1.25 (0.79)	-2.09 (1.23)	0.03 (1.02)	0.08 (0.08)	-0.02 (0.43)	-0.05 (0.22)
Interaction	-0.69 (0.59)	**0.19**** **(2.46)**	**3.86**** **(2.16)**	**7.53*** **(1.76)**	**8.68**** **(2.21)**	**8.04**** **(2.42)**	**9.89***** **(2.99)**	**0.15**** **(2.56)**	-1.20 (0.58)	-0.07 (0.71)	**1.21**** **(2.74)**
PolCentral Dummy	2.52 (0.70)	**-0.65***** **(2.80)**	**-10.01*** **(1.82)**	-12.26 (0.91)	**-21.96*** **(1.81)**	**-20.06*** **(1.93)**	**-26.08**** **(2.55)**	**-0.63***** **(3.46)**	4.00 (0.63)	0.21 (0.71)	**-3.59**** **(2.27)**
Obs	58	58	58	62	52	62	52	58	58	58	57

Notes: t-statistics in parenthesis.

Table 4. Independence 50+ years

Treatment Variable	Outcome Variable										
	ESI	Environm'l Governance	Institutional Capacity	Super 1998	Super 2000	Diesel 1998	Diesel 2000	International Participation	Global Stewardship	Greenhouse Gases	CO_2 Emissions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Tiers	**-4.50****	-0.20	**-7.02***	**-17.78****	**-18.13****	-10.29	**-18.13****	**-0.25***	2.07	**0.34***	-2.31
	(2.03)	(1.17)	**(1.73)**	**(2.06)**	**(2.55)**	(1.40)	**(2.55)**	**(1.87)**	(0.55)	**(1.76)**	(1.63)
Interaction	1.87	**0.65****	**13.61****	**29.80****	13.82	**25.83****	13.82	**0.81*****	-7.51	**-0.75****	**5.28****
	(0.54)	**(2.47)**	**(2.16)**	**(2.22)**	(1.25)	**(2.24)**	(1.25)	**(3.86)**	(1.28)	**(2.49)**	**(2.42)**
PolCentral	-5.20	**-2.39****	**-45.34***	**-101.18***	-59.85	**-96.18****	-59.85	**-2.85****	25.56	**2.62****	**-18.16****
Dummy	(0.39)	**(2.36)**	**(1.88)**	**(1.97)**	(1.41)	**(2.19)**	(1.41)	**(3.56)**	(0.26)	**(2.27)**	**(2.17)**
Obs	48	48	48	48	48	48	48	48	48	48	49
SubEmploy	**1.87***	**0.11***	**3.39****	**9.11***	**8.46***	4.72	4.01	0.06	2.05	0.09	-0.04
	(1.84)	**(1.78)**	**(1.52)**	**(2.18)**	**(2.46)**	(1.35)	(1.29)	(1.07)	(1.16)	(0.99)	(0.08)
Interaction	-2.13	0.07	1.03	-6.24	-6.53	0.38	1.96	**0.16****	3.94	**-0.24***	**1.55***
	(1.45)	(0.76)	(0.47)	(1.04)	(1.32)	(0.08)	(0.44)	**(2.18)**	(1.55)	**(1.93)**	**(2.01)**
PolCentral	2.64	-0.45	-7.29	22.11	0.66	-9.61	-12.42	**-0.55****	6.95	0.44	-2.65
Dummy	(0.53)	(1.43)	(0.98)	(1.06)	(0.04)	(0.55)	(0.08)	**(2.13)**	(0.80)	(1.03)	(1.02)
Obs	36	36	36	36	36	36	36	36	36	36	36
Tiers	**-4.53***	-0.22	**-7.54***	**-17.85****	**19.58****	-11.61	**-15.60****	-0.23	1.93	**0.31***	-2.17
	(1.95)	(1.23)	**(1.85)**	**(2.01)**	**(2.64)**	(1.57)	**(2.40)**	(1.55)	(0.52)	**(1.71)**	(1.64)
Interaction	-0.90	0.24	4.10	15.76	7.76	15.49	**14.44***	**0.42****	**-11.67****	**-0.53****	2.93
	(0.27)	(0.93)	(0.71)	(1.25)	(0.73)	(1.47)	**(1.88)**	**(2.01)**	**(5.24)**	**(2.03)**	(1.56)
PolCentral	3.38	-1.03	-15.13	-66.14	-46.61	-63.40	**-72.52****	**-1.55***	**36.89***	1.66	-9.72
Dummy	(0.27)	(1.06)	(0.68)	(1.35)	(1.14)	(1.55)	**(2.02)**	**(1.93)**	**(1.81)**	(1.64)	(1.33)
Obs	53	53	53	52	52	52	52	53	53	53	54
SubEmploy	0.54	0.03	0.73	2.44	1.09	0.09	-0.84	0.02	1.62	0.07	-0.23
	(0.71)	(0.68)	(0.62)	(0.82)	(0.44)	(0.04)	(0.39)	(0.49)	(1.30)	(1.23)	(0.66)
Interaction	-0.22	**0.17***	**4.00***	1.86	3.38	6.60	**8.90****	**0.17****	-3.55	**-0.21****	**1.73****
	(1.41)	**(2.00)**	**(2.17)**	(0.35)	(0.76)	(1.54)	**(2.33)**	**(2.77)**	(1.56)	**(2.05)**	**(2.73)**
PolCentral	4.07	**-0.78****	**-15.63***	-15.54	**-35.00****	-27.47	**-39.77****	**-0.59****	8.35	0.33	-3.30
Dummy	(0.76)	**(2.42**	**(1.90)**	(0.67)	**(1.81)**	(1.47)	**(2.40)**	**(2.49)**	(0.97)	(0.84)	(1.37)
Obs	40	40	40	40	40	40	40	40	40	40	40

Notes: t-statistics within parenthesis. The first two panels use democracies only, while the last two panels use the full sample.

Table 5. Parliamentary System Democracies

Treatment Variable	Outcome Variable										
	ESI	Environm'l Governance	Institutional Capacity	Super 1998	Super 2000	Diesel 1998	Diesel 2000	International Participation	Global Stewardship	Greenhouse Gases	CO_2 Emissions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Federal Dummy	**-17.33****	-0.005	-4.67	-0.16	-7.71	-6.70	-11.00	0.009	2.03	0.51	1.47
	(2.60)	(0.01)	(0.33)	(0.01)	(0.35)	(0.30)	(0.54)	(0.02)	(0.15)	(0.56)	(0.30)
Interaction	**0.32*****	0.0007	0.13	-0.12	-0.15	0.05	-0.09	0.007	-0.001	-0.01	(0.51)
	(3.46)	(0.10)	(0.69)	(0.26)	(0.42)	(0.14)	(0.28)	(0.97)	(0.01)	(1.08)	-0.001
PolCentral	-0.03	**0.02*****	**0.41*****	**0.49***	**0.41***	**0.57*****	**0.55*****	0.007	-0.01	-0.0001	(0.01)
	(0.42)	**(3.10)**	**(3.12)**	**(1.81)**	**(2.01)**	**(2.75)**	**(2.91)**	(1.32)	(0.08)	(0.11)	**0.13***
Obs	33	33	33	39	38	39	38	33	33	33	**(1.90)**
											40
Tiers Dummy	-0.81	-0.64	**-17.97***	-18.61	-14.60	-7.04	**-15.78**	-0.62	11.98	0.53	-2.22
	(0.12)	(1.61)	**(1.90)**	(0.68)	(0.66)	(0.34)	**(0.77)**	(1.65)	(1.13)	(0.80)	(0.51)
Interaction	-0.10	-0.003	-0.21	-0.06	0.18	-0.19	0.07	0.003	**-0.35***	-0.02	-0.002
	(0.84)	(0.47)	(1.31)	(0.14)	(0.53)	(0.56)	(0.22)	(0.49)	**(1.96)**	(1.60)	(0.04)
PolCentral	**0.17***	**0.02****	**0.64*****	0.48	0.21	**0.62****	**0.45***	0.009	0.22	0.008	**0.10***
	(1.80)	**(3.62)**	**(4.84)**	(1.39)	(0.77)	**(2.34)**	**(1.80)**	(1.66)	(1.46)	(0.85)	**(1.77)**
Obs	30	30	30	34	34	34	34	30	30	30	36
Tiers	0.24	-0.08	-1.81	-8.22	-5.86	0.75	-0.25	-0.13	**6.20***	**0.75*****	**-3.64*****
	(0.10)	(0.15)	(0.48)	(1.20)	(1.07)	(0.14)	(0.05)	(0.99)	**(1.75)**	**(4.13)**	**(3.59)**
Interaction	1.46	**0.53***	8.80	**38.76*****	**25.80****	**22.72****	**19.43***	**0.70*****	-5.20	**-0.75****	**6.45*****
	(0.34)	**(2.03)**	(1.32)	**(2.76)**	**(2.28)**	**(2.05)**	**(1.80)**	**(3.01)**	(0.81)	**(2.39)**	**(3.18)**
PolCentral Dummy	-3.28	-1.51	-19.37	**-115.64****	**-83.61***	-70.29	-57.98	**-2.21****	28.75	**3.17****	**-24.82*****
	(0.19)	(1.45)	(0.72)	**(2.20)**	**(1.95)**	(1.69)	(1.41)	**(2.39)**	(1.01)	**(2.43)**	**(3.06)**
Obs	30	30	30	34	34	34	34	30	30	30	36
SubEmploy	2.20	**0.33*****	**7.64*****	4.10	4.76	-0.26	6.15	**0.23****	0.58	-0.08	-0.52
	(1.18)	**(3.76)**	**(3.57)**	(0.84)	(0.79)	(0.07)	(1.17)	**(2.37)**	(0.22)	(0.65)	(0.89)
Interaction	-1.94	**-0.20***	-4.66	3.31	1.99	6.49	0.36	-0.03	1.24	0.12	1.40
	(0.77)	**(1.75)**	(1.62)	(0.42)	(0.26)	(1.12)	(0.06)	(0.24)	(0.34)	(0.68)	(1.56)
PolCentral Dummy	3.15	0.42	11.38	14.16	-9.80	-9.82	-1.85	-0.13	-2.37	-0.18	-3.86
	(0.33)	(0.93)	(1.03)	(0.36)	(0.34)	(0.34)	(0.07)	(0.26)	(0.17)	(0.28)	(0.84)
Obs	25	25	25	28	25	28	25	25	25	25	30

Notes: t-statistics within parenthesis. The second stage is restricted to include only parliamentary countries. The first stage is the same as in Table 2.

Table 6. Proportional System Democracies

Treatment Variable	Outcome Variable										
	ESI	Environm'l Governance	Institutional Capacity	Super 1998	Super 2000	Diesel 1998	Diesel 2000	International Participation	Global Stewardship	Greenhouse Gases	CO_2 Emissions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Federal Dummy	-5.79 (0.83)	**-0.92*** **(1.80)**	**-29.00**** **(2.21)**	-21.84 (0.89)	-23.51 (1.13)	**-36.65**** **(2.00)**	**-34.73**** **(2.08)**	-0.58 (1.30)	**-26.38**** **(2.26)**	-0.82 (1.11)	4.97 (1.12)
Interaction	-0.02 (0.23)	**0.02**** **(2.35)**	**0.46**** **(2.65)**	0.35 (1.07)	-0.003 (0.01)	**0.75***** **(3.05)**	**0.55**** **(2.45)**	**0.01**** **(2.29)**	**0.31*** **(2.00)**	0.003 (0.32)	-0.03 (0.45)
PolCentral	**0.13***** **(3.05)**	0.003 (1.09)	**0.16**** **(2.03)**	0.17 (1.16)	**0.23*** **(1.78)**	0.06 (0.58)	0.06 (0.55)	-0.001 (0.05)	0.04 (0.59)	0.002 (0.43)	**0.05*** **(1.68)**
Obs	51	51	51	55	54	55	54	51	51	51	56
Tiers Dummy	0.31 (0.07)	-0.55 (1.38)	-15.49 (1.55)	-29.46 (1.52)	-27.20 (1.50)	-17.65 (1.11)	-24.09 (1.61)	**-0.68**** **(2.32)**	10.29 (1.18)	0.68 (1.27)	-3.44 (1.06)
Interaction	-0.05 (0.57)	**0.01*** **(1.97)**	**0.40**** **(2.09)**	**0.72*** **(1.92)**	0.32 (0.96)	**0.59*** **(1.92)**	**0.48*** **(1.77)**	**0.02***** **(3.70)**	-0.21 (1.25)	**-0.02*** **(1.71)**	0.10 (1.54)
PolCentral	**0.09*** **(1.93)**	0.003 (0.87)	0.14 (1.42)	0.001 (0.00)	0.08 (0.54)	0.07 (0.49)	0.06 (0.45)	-0.001 (0.46)	0.09 (1.04)	0.005 (1.06)	0.01 (0.43)
Obs	45	45	45	48	47	48	47	45	45	45	49
Tiers	0.63 (0.36)	-0.08 (0.65)	-3.00 (0.93)	-8.60 (1.33)	-5.00 (0.83)	-0.23 (0.04)	-2.70 (0.56)	0.02 (0.02)	3.51 (1.12)	**0.49**** **(2.68)**	**-2.22**** **(2.30)**
Interaction	-4.70 (1.30)	0.43 (1.65)	8.26 (1.24)	**26.84**** **(2.16)**	0.73 (0.95)	**20.31*** **(1.94)**	12.61 (1.36)	**0.53**** **(2.35)**	-4.92 (0.75)	**-0.80**** **(2.13)**	**4.05*** **(1.86)**
PolCentral Dummy	19.94 (1.38)	-1.61 (1.53)	-26.80 (1.01)	**-84.74*** **(1.86)**	-3.07 (0.07)	**-75.46*** **(1.97)**	-50.28 (1.49)	**-1.87*** **(2.10)**	18.41 (0.71)	**3.13**** **(2.10)**	**-14.94**** **(1.74)**
Obs	45	45	45	48	47	48	47	45	45	45	49
SubEmploy	**1.80*** **(1.89)**	0.04 (0.61)	1.61 (1.09)	5.86 (1.51)	5.14 (1.48)	1.19 (0.45)	1.09 (0.43)	0.005 (0.09)	0.16 (0.10)	0.03 (0.35)	0.20 (0.44)
Interaction	-1.95 (1.23)	**0.17*** **(1.74)**	3.44 (1.41)	4.42 (0.72)	3.06 (0.56)	**7.55*** **(1.79)**	**7.48*** **(1.87)**	**0.23**** **(2.58)**	0.80 (0.28)	-0.05 (0.40)	0.58 (0.88)
PolCentral Dummy	3.26 (0.57)	-0.40 (1.15)	-11.13 (1.26)	-6.11 (0.30)	-15.51 (0.84)	**-30.22**** **(2.13)**	**-29.30**** **(2.18)**	-0.53 (1.62)	-2.80 (0.27)	0.17 (0.36)	-0.77 (0.32)
Obs	29	29	29	29	29	29	29	29	29	29	31

Notes: t-statistics within parenthesis. The second stage is restricted to include only proportional systems. The first stage is the same as in Table 2.

Table 7. Squared Terms in the First Stage Regression

Treatment Variable	Outcome Variable										
	ESI	Environm'l Governance	Institutional Capacity	Super 1998	Super 2000	Diesel 1998	Diesel 2000	International Participation	Global Stewardship	Greenhouse Gases	CO_2 Emissions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Federal Dummy	-6.12	**-0.56***	-12.12	-9.27	-10.10	**-18.49***	-17.59	-0.24	-7.72	-0.05	-0.75
	(1.51)	**(1.81)**	(1.65)	(0.69)	(0.82)	**(1.70)**	(1.64)	(0.91)	(1.13)	(0.13)	(0.36)
Interaction	0.05	**0.01****	**0.24****	0.05	-0.15	**0.30***	0.18	**0.001****	-0.0001	-0.008	**0.06***
	(0.79)	**(2.30)**	**(2.28)**	(0.22)	(0.75)	**(1.70)**	(1.03)	**(2.39)**	(0.01)	(1.49)	**(1.77)**
PolCentral	**0.08****	0.004	**0.17*****	0.07	0.18	0.01	0.08	0.001	-0.05	-0.004	**0.05****
	(2.42)	(1.52)	**(2.71)**	(0.55)	(1.56)	(0.11)	(0.80)	(0.61)	(0.86)	(1.17)	**(2.50)**
Obs	95	95	95	101	97	101	97	95	95	95	104
Tiers Dummy	2.05	-0.41	-3.81	1.02	-7.44	-13.46	**-18.62***	0.04	7.76	0.19	-2.21
	(0.54)	(1.41)	(0.57)	(0.08)	(0.59)	(1.26)	**(1.70)**	(0.14)	(1.29)	(0.57)	(1.12)
Interaction	-0.07	**0.01****	0.15	0.11	0.04	0.27	**0.30***	**0.001***	**-0.22****	**-0.01****	**0.08*****
	(1.14)	**(2.49)**	(1.49)	(0.50)	(0.21)	(1.56)	**(1.78)**	**(1.85)**	**(2.38)**	**(2.41)**	**(2.67)**
PolCentral	**0.13*****	0.002	**0.20****	0.05	0.09	-0.04	-0.03	0.003	0.03	-0.002	0.03
	(2.95)	(0.67)	**(2.48)**	(0.30)	(0.62)	(0.32)	(0.21)	(0.82)	(0.39)	(0.68)	(1.45)
Obs	81	81	81	84	84	84	84	81	81	81	87
Tiers	-0.17	-0.14	-2.32	0.49	-2.13	-1.60	-1.45	0.05	3.01	**0.25***	**-1.13***
	(0.14)	(1.51)	(1.12)	(0.11)	(0.54)	(0.46)	(0.42)	(0.58)	(1.60)	**(2.48)**	**(1.69)**
Interaction	-3.44	0.07	-2.98	-0.96	-6.14	5.11	2.63	0.06	**-6.37***	-0.21	0.60
	(1.62)	(0.42)	(0.80)	(0.14)	(0.96)	(0.91)	(0.47)	(0.41)	**(1.89)**	(1.15)	(0.57)
PolCentral Dummy	**14.06***	-0.26	17.95	3.95	20.02	-25.51	-15.75	-0.05	**25.66***	0.91	-2.61
	(1.69)	(0.41)	(1.23)	(0.15)	(0.80)	(1.17)	(0.71)	(0.10)	**(1.93)**	(1.27)	(0.62)
Obs	81	81	81	84	84	84	84	81	81	81	87
SubEmploy	0.84	-0.01	0.04	-0.80	-1.44	-2.27	**-3.31***	0.01	0.13	-0.009	-0.03
	(1.40)	(0.23)	(0.04)	(0.37)	(0.65)	(1.37)	**(1.87)**	(0.34)	(0.12)	(0.19)	(0.10)
Interaction	0.31	**0.25*****	**6.14*****	**6.59***	**7.09****	**9.00*****	**11.27*****	**0.18*****	-0.70	-0.12	**0.94****
	(0.30)	**(3.53)**	**(3.64)**	**(1.81)**	**(2.02)**	**(3.22)**	**(4.03)**	**(3.68)**	(0.39)	(1.48)	**(2.02)**
PolCentral Dummy	-1.21	**-0.73*****	**-12.47****	-15.97	**-21.09***	**-26.19*****	**-33.17*****	**-0.64*****	-0.30	0.36	-1.44
	(0.36)	**(3.09)**	**(2.23)**	(1.26)	**(1.77)**	**(2.71)**	**(3.48)**	**(3.91)**	(0.05)	(1.32)	(0.91)
Obs	58	58	58	62	60	62	60	58	58	58	65

Notes: t-statistics within parenthesis. The first stage regression includes squared terms for the size variables (*Land, Population, GDP/Capita*) but not the political or religious variables, as the low number of observations makes this infeasible.