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Global Private Regimes, Domestic Public Law: ISO 14001 and Pollution Reduction

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Abstract

Debates about the efficacy of private environmental regimes have been fueled by disparate research findings, such as when the same regime that has been effective in one setting is found to be ineffective in another. In this article, we show that the efficacy of ISO 14001, the most widely adopted voluntary environmental regime in the world, is conditioned by the stringency of countries' domestic regulations. In doing so, we outline a model of strategic corporate environmentalism wherein firms strategically focus their International Organization for Standardization (ISO) certification to reduce emissions of visible air pollutants as opposed to less visible water pollutants. Our analyses of pollution levels for a panel of 159 countries (73 for water pollution) from 1991 to 2005 indicate that ISO 14001 certifications reduce air (SO_2) emissions in countries with less stringent environmental regulations but have no effect on air emissions in countries with stringent environmental regulations. We also find that ISO membership levels are not associated with reductions in water pollution levels (Biochemical Oxygen Demand BOD), irrespective of stringency of domestic law. Our article suggests that the efficacy of global private environmental regimes is likely to be conditioned by the domestic regulatory context in which firms function,

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and given firm's strategic considerations, this efficacy could vary across pollution types.

Keywords
pollution, voluntary programs, private regulation, clubs, CSR

Introduction

Voluntary private regimes are important instruments of global environmental governance (Coglianese & Nash, 2001; deLeon & Rivera, 2010; Prakash & Potoski, 2006; Vogel, 2005). Firms participating in these regimes, programs, or clubs are expected to adopt environmental stewardship practices that exceed the countries' legal requirements leading to the production of environmental public goods such as a clean environment. In return, program membership allows participants to signal their stewardship commitment to stakeholders who cannot otherwise fully observe or comprehend participants' internal practices. For stakeholders holding salient environmental preferences, this signal provides a low cost mechanism to identify environmental stewards. In theory, voluntary environmental programs make possible a virtuous exchange (Vogel, 2005) of environmental stewardship for stakeholder appreciation.

That being said, there is a vigorous debate about whether firms participating in voluntary programs produce better environmental outcomes in relation to nonparticipants (Koehler, 2007; Morgenstern & Pizer, 2007; Prakash & Potoski, 2011). Given the low entry barriers in sponsoring these programs, some voluntary programs are designed to serve as "greenwashes," that is, not impose real beyond-compliance obligations on their participants while mouthing pious environmental platitudes (Steinzor, 1998). Because strategic considerations play an important role in program sponsorship, some programs might be ruses by firms, or their trade associations, as they look to preempt public regulation (Maxwell, Lyon, & Hackett, 2000). While the theory behind voluntary environmental programs is plausible, it is not clear conditions under which they reduce pollution, and how they complement or undermine public law.

In this article, we examine how the efficacy of ISO 14001, the most widely adopted voluntary environmental program in the world, depends on the opportunities and incentives International Organization for Standardization (ISO) participants have to reduce pollution. We examine the role of two factors in shaping these opportunities and incentives: stringency of public law (government environmental regulations) and the (physical) visibility of pollutants. Stringent regulations influence the portfolio and the quality of firms' environmental policies. Arguably, firms functioning in stringently regulated countries will be likely to have adopted advanced environmental stewardship practices. If so, their marginal costs for undertaking further environmental improvements in response to their membership in a voluntary program such as ISO 14001 will be relatively high. Furthermore, the marginal benefits of differentiating themselves from nonadopters will be low because the average level of environmental stewardship practices is likely to be high. Thus, stringency of public law is likely to influence firms' cost-benefit calculus as they assess their optimal stewardship efforts pursuant to their participation in voluntary programs. Counter intuitively then the efficacy of a global voluntary program is likely to be most pronounced when participating firms function in a context where public law is weak, all else equal.

Environmental stewardship has an opportunity cost for firms, not merely in relation to their pursuit of profits, but also in relation to other types of social stewardship policies firms might pursue. Just as issue visibility influences governmental priorities regarding the supply of public goods (Mani & Mukand, 2007), we suggest that similar incentives shape the behaviors of firms seeking to allocate scarce resources to supply different types of public goods via their participation in voluntary programs. Firms are likely to favor stewardship policies where they can get more appreciation for their efforts; after all a key motivation for joining voluntary programs is the firms' desire to capture reputational gains. If pollutants have different physical visibility, ISO 14001 participants will focus more on reducing visible pollutants in relation to the less visible ones. Given the relatively high physical visibility of air pollution in relation to water pollution (Cao & Prakash, 2012; Dunlap, 1994), we hypothesize that ISO 14001 certified firms will strategically invest more resources to reduce air pollution in relation to water pollution. The observable implication is that all else equal, the effect of national level ISO adoption on reductions in aggregate levels of air pollution should be more pronounced in relation to reductions in water pollution. Importantly, we can expect to observe this effect in countries with lax regulations because the stringency of public regulations influences the benefit and costs of firms' stewardship efforts. Our analyses of a panel of 159 countries (73 for water pollution) over the period 1991-2005 suggest that ISO 14001 adoption levels are associated with reductions in air pollution but not water pollution, and air pollution reductions can be observed only in the context of countries where the stringency of public law is relatively lax.

ISO 14001 is sponsored by the Geneva-based ISO, the world leader in establishing product and process standards. This program outlines standards pertaining to internal management practices rather than the products which the firm produces. Sometimes, well-intentioned firms excessively pollute because they lack well-functioning environmental management systems (EMS). Anticipating such problems, ISO 14001 requires participating firms to adopt high quality EMS which encourage the Plan-Do-Check-Act approach to environmental management.[1] Coglianese and Nash (2001) term this as "regulating from the inside." Since its launch in 1995, ISO 14001 has been widely adopted across the world—By 2005, there were 111,163 ISO 14001 certified facilities across 138 countries.

Our article has important implications for the study of comparative and international environmental policy. In response to the theme of the symposium of *Comparative Political Studies* which focuses on the interactive role of domestic and international factors in shaping environmental policy choices and outcomes, we focus on domestic determinants of the efficacy of a global voluntary, nongovernmental or private authority regime (Buthe & Mattli, 2011; Cutler, Haufler, & Porter, 1998; Prakash & Potoski, 2006; Vogel, 2005). While scholars recognize the role of such new modes of global governance (Avant, Finnermore, & Sell, 2010), there is less systematic work on how these governance modes relate to domestic law, and the conditions under which these governance modes are effective. Our article brings together comparative and international relations literatures to focus on how the efficacy of new forms of global private governance is conditional upon domestic public law. In doing so, we emphasize the important continuity in the role of state institutions, and how private regulation functions in the shadow of, and in conjunction with, public regulation. Instead of retreating or withering away, the state remains an important structural force in influencing the efficacy of new governance modes.

The article proceeds as follows. The "ISO 14001" section describes the ISO 14001 program and its design. The "Theoretical Approach" section discusses our theoretical approach. In the section titled "Empirical Model and Data," we present our model, and identify and discuss our key variables. Statistical methods and empirical results are presented in the "Results" section. In the concluding section, we discuss the implications of our empirical analyses and areas for future work.

ISO 14001

The ISO was founded in 1946. The ISO is a nongovernmental organization whose members are private sector national bodies charged with setting national standards (Mattli & Buthe, 2003). Examples include the American National Standards Institute, the British Standards Institution, and the Deutsche

Institut f ¨ur Normung. The ISO has 162 member bodies, each representing a country.[2] The ISO is the most prominent developer of standards in the world; to date it has developed more than 18,000 standards through its technical committees comprised of representatives from businesses, governments, and other stakeholders. In the 1980s, making a foray into social, political, and managerial issues, the ISO introduced ISO 9001 standards for quality manufacturing practices, inspired in part by British Standard BS 5750. Building on ISO 9001's management system approach, the ISO introduced the ISO 14001 environmental standards in 1996. This was welcomed by businesses, particularly multinational corporations, because variations in government regulations across countries increase their overall regulatory costs. ISO 14001 can be viewed as an instrument for regulatory harmonization in ways that serve business interests.

Joining ISO 14001 requires firms to establish a written environmental policy approved by their senior management. An ISO 14001 caliber EMS must outline quantifiable environmental targets, provide regular review of their progress, and designate a top manager to oversee implementation of the firms' environmental programs. In practice, ISO 14001 typically commits participants not only to comply or exceed domestic laws, but also to adopt the best available environmental technologies, assess the environmental impact of their operations, and establish programs to train personnel in the EMS. For most firms, these management systems are quite extensive, requiring substantial investments in personnel, training, and most critically, in establishing paper trails for their environmental operations to ensure appropriate compliance with applicable law.

Arguably, some program participants might have incentives to shirk on their obligations, while still enjoying the benefits associated with joining the program. Anticipating such shirking problems, ISO 14001 requires external audits by third-party agents who themselves are certified by their domestic national standards body. ISO participants receive an initial certification audit and then annual recertification audits to verify that their EMS are of ISO 14001 caliber. The certification process is also a recognition of the fact that the quality of EMS firms adopt can vary (Anton, Deltas, & Khanna, 2004; Coglianese & Nash, 2001), and some sort of procedure is required that participating facilities' EMS conform to ISO 14001's standards. Establishing EMS and having them audited by a third party can cost from US$25,000 to more than US$100,000 per facility (Darnall & Edwards, 2006; Kolk, 2000). In sum, an ISO certified EMS requires substantial investment beyond the cost of external auditors, including the costs of maintaining paper trails, documenting processes, and perhaps even hiring additional personnel.

Several studies have explored whether ISO 14001 participation leads to pollution reduction. These studies tend to use samples of facilities within a country and focus on a single pollutant or measure of pollution. Some studies do not look at actual outcomes, but at managerial perceptions only. It is fair to say that most studies do not explicitly incorporate the influence of public law on program efficacy. They do not involve a panel research design and focus on changes between two periods of time, before and after certification (exceptions include Henriques, Husted, & Montiel, 2013). In their study of more than 3,000 U.S. facilities regulated under the Clean Air Act, Potoski and Prakash (2005) find that ISO 14001 adoption is associated with pollution reduction. Arimura, Hibiki, and Katayama (2008) provide evidence suggesting that ISO 14001 participation is associated with pollution reduction in Japan. Turk (2009) reports similar findings from Turkey, Link and Naveh (2006) from Israel, and Schylander and Martinuzzi (2007) from Austria.

Our article takes a different approach. Using a panel setting, this is among the first papers to examine the effect of national level ISO 14001 adoption levels, conditional upon domestic law, on national levels of water and air pollution. By explicitly taking into account firms' strategic calculations given the limited resources they can devote to environmental stewardship, we move beyond the debate of whether or not voluntary programs reduce pollution to how program efficacy conditional upon domestic law might vary across pollutants. Below we outline our theoretical approach to study these issues.

Theoretical Approach

International relations and comparative politics scholars tend to emphasize different "images" in their theoretical narratives. We suggest at looking at the interaction of international influences and domestic conditions (Keohane & Milner, 1996) to assess the efficacy of a global private regime. Our claim is that ISO 14001's efficacy depends on the stringency of domestic regulations which program participants face and the nature of the pollution they emit. Domestic public law structures the costs and benefits for firms seeking to invest in environmental stewardship beyond the legal requirements. Because stringent public regulation reduces the opportunities for firms to distinguish themselves as environmental stewards, the marginal benefits of implementing voluntary programs are small. From the cost side, in complying with stringent regulations, firms invest substantial resources, which reduce the levels of "organizational slack" (Cyert & March, 1963) available to undertake other, beyond-compliance stewardship activities.

Indeed, some recent work suggests that firms might be more interested in private regulation in areas of limited statehood where the shadow of hierarchy is weak and the shadow of anarchy looms large (Borzel & Risse, 2010; Potoski & Prakash, 2009). In this case, private regulation serves as a substitute for public regulation. Lee's (2010) work on the impact of Indonesia's information disclosure policies on corporate environmental practices also supports this line of argument. He finds that public disclosures can encourage corporate environmental practices, especially when state monitoring and enforcement capacities are weak.

Environmental stewardship has an opportunity cost. Firms are, therefore, likely to make strategic choices to maximum payoff from their stewardship investments. We suggest that firms are likely to focus their efforts in areas where they can get more visibility and therefore more appreciation for their efforts. After all, the purpose of joining a voluntary program is to signal environmental stewardship. Because stringent regulations leave little organizational slack for environmental improvements, the marginal cost of adopting additional stewardship practices is higher. At the same time, stringent public regulations reduce the marginal benefits for firms to distinguish themselves through voluntary programs because the law probably forces nonparticipating firms to exhibit high levels of environmental stewardship. In sum, when the regulatory bar is high, the marginal reputational payoff for the firm for investing in voluntary program implementation is likely to be lower. However, lax public regulation provides opportunities for participating firms to differentiate themselves as environmental steward compared with nonparticipants. In this way, lax public regulation allows firms to self-select themselves in the category of environmental stewards via the agency of voluntary programs.

Even in the context of lax domestic law, firms need to decide where to focus their stewardship investments. We expect pollutant's physical visibility to be an important factor in this regard. Some literature suggests that air pollution tends to be more visible than water pollution (Cao & Prakash, 2012). Air pollution is physically visible, with smoke plumes jutting out of smokestacks, while water pollution tends to be partially hidden, because citizens often do not observe water pipes discharging waste water into rivers and streams. Social psychologists suggest that routine and visible encounters shape how individuals perceive the importance of an issue. Studies highlight the crucial role of visual experience in this context (Bickerstaff & Walker, 2001; Howell, Moffatt, Bush, Dunn, & Prince, 2003).

There is some evidence to support the notion that air pollution is more visible than water pollution.[3] Dunlap's (1994) report on environmental attitudes across 24 countries reveals that

> in fifteen countries air pollution is the most frequently mentioned problem, and in every country except Portugal it is among the top three. Water quality is mentioned most frequently in four nations, second most in eight, and third most in another seven. (pp. 117-118)

A more recent *Gallup* (2005) survey of China noted,

> More telling is the finding that half of those living in the country's 10 largest cities now say they view air pollution where they live as either very (17%) or somewhat (33%) serious. Chinese express slightly less concern about water quality than air pollution, perhaps because the effects of the latter are more directly evident. Only a fifth of all Chinese see water pollution in their locales as a very (8%) or somewhat (12%) serious problem; this group is outnumbered by those who believe the local water pollution problem is not a serious problem at all (28%). In contrast to the results on air pollution, urban residents are only slightly more likely than their rural counterparts to believe their own communities are facing a water pollution challenge.

New Delhi, the capital city of India, provides an informative example of contrasting regulatory responses to air and water pollution. Prodding from the Supreme Court leads Indian to enforce air pollution laws in the capital city, leading to considerable air pollution reduction. Similar prodding for water pollution has not seemed to be working. Recently, the Supreme Court of India, which for the last two decades has repeatedly asked Delhi government to control water pollution in the capital city, "sought expert help from the Indian Institute of Technology (IIT) after being told by Central Pollution Control Board that despite Rs 5,000 crores (about $1 billion) spent to reduce pollution, the Yamuna was staring at a catastrophe as over 2,400 million litres of untreated sewage flowed into it every day."[4]

Scholars note the important role of issue visibility in influencing political choices. Mani and Mukand (2007) report that issue visibility influences governmental priorities on supplying different public goods: in some cases, prioritizing the supply of more visible public goods (e.g., famine prevention) at the cost of less visible public goods (e.g., preventing malnutrition). Because pollution reduction is a classic public good, we expect that firms interested in gaining recognition as environmental stewards will invest in supplying more visible public goods (air pollution reduction) in relation to less visible public goods (water pollution reduction). These incentives should be more pronounced in the context of implementing voluntary programs because firms employ these programs to signal their environmental stewardship.

Combining issue visibility and the stringency of public regulations, Table 1 summarizes our empirical expectations about ISO 14001's effect on countries' pollution levels. We expect that ISO 14001 has a lesser effect on countries' pollution levels for low visibility pollutants such as Biochemical Oxygen Demand (BOD, water pollution), regardless of the level of regulatory stringency. Conversely, we expect that ISO 14001 uptakes will be associated with more pronounced reductions in countries' pollution levels for

Table 1. Effect of ISO 14001 on Pollution Reduction: Empirical Expectations.

	Lax public law	Stringent public law
More visible pollution	ISO 14001 adoption levels are associated with pronounced reductions in air pollution.	ISO 14001 adoption levels are associated with less pronounced reductions in air pollution.
Less visible pollution	ISO 14001 adoption levels are associated with less pronounced reductions in water pollution.	ISO 14001 adoption levels are associated with less pronounced reductions in water pollution.

ISO = International Organization for Standardization.

more visible air pollutants (SO_2) but only in countries with relatively lax environmental regulations.

So far, we have discussed the impact of the domestic legal stringency and pollutant visibility on ISO 14001 efficacy. An advantage of a country-level study is that it can gauge both the direct effect of the voluntary program on its participants and the spillover effects of the program on the nonparticipants (Borck & Coglianese, 2009). Spillover effects stem from the diffusion of ISO 14001 type EMS from participants to nonparticipants, and sometimes from targeted to nontargeted pollutants (Henriques, Husted, & Montiel, 2013).

What might be spillover drivers? DiMaggio and Powell (1983) identify three diffusion mechanisms: coercive isomorphism (pressures from actors in the external environment on whom the unit is dependent on resources), mimetic isomorphism (normative pressures regarding the appropriate policy to adopt), and normative isomorphism (pressures brought about by professional links such as shared membership in professional associations). ISO 14001's EMS spillovers from participants to nonparticipants occur through two mechanisms. First, an ISO certified firm might suggest, sometimes even require, its suppliers to establish EMS, and in some cases, harmonize them with its own EMS, a form of coercive isomorphism (Vandenbergh, 2007). This is consistent with the fact that firms and their suppliers often harmonize their management systems in other functional areas, such as production and accounting. There is some evidence that such management system harmonization is taking place in the context of environmental issues as well. In a systematic study, Arimura, Darnall, and Katayama (2011) report that ISO 14001 certified facilities require more progressive environmental practices from their suppliers, a diffusion dynamic other scholars have identified as well (Christini, Fetsko, & Hendrickson, 2004; Christmann & Taylor, 2001;

Coglianese & Nash, 2001). Importantly, this EMS spillover influence can occur through both domestic firms and multinational corporations (Albornoz, Cole, Elliott, & Ercolani, 2009). Walmart is an excellent example, as illustrated by its emphasis on suppliers' EMS.[5] A Google search suggests that an industry of consultants has emerged to help Walmart's suppliers establish EMS and, if they want, have their EMS certified under ISO 14001 guidelines.

A second ISO 14001 EMS spillover mechanism reflects both mimetic and normative isomorphism. Nonparticipants located in the vicinity of ISO 14001 participants may seek to imitate their EMS. Such mimetic isomorphic responses are motivated by both instrumental and social payoffs. Firms function as a part of the social system, often embedded in what sociologists term as organizational fields: "organizations that, in the aggregate, constitute a recognized area of institutional life" (DiMaggio & Powell, 1983, p. 143). Firms might seek to mimic the appropriate policies of others in their organizational fields. Given the importance of environmental issues, firms may pay close attention to EMS of those that have joined established voluntary programs such as ISO 14001 (Borck & Coglianese, 2009).

A variety of isomorphic pressures can lead to the diffusion of ISO 14001 type EMS from program participants to nonparticipants. Some nonparticipants may eventually decide to receive ISO certification. Others may remain uncertified because they have not adopted the full and comprehensive range of EMS that ISO typically requires. This might be due to cost issues: The firm may not have the personnel to manage the paper trails necessary for a codified EMS, a complaint often heard from small and medium-sized firms (Hillary, 2004; Johannson, 1997). In some cases, while firms might adopt ISO caliber EMS, they decide not to seek the third-party auditing which ISO 14001 certification requires. This is because third-party audits are expensive. Such firms often claim to be "ISO ready" (Prakash, 2000). While "ISO ready" firms do not capture the benefit of affiliating with the ISO 14001 brand, establishing EMS may allow them to tap into opportunities offered by supply chains managed by ISO participants, and signal their normatively appropriate environmental behaviors.

In sum, the literature on the diffusion of EMSs suggests that the national level impact of voluntary program on the pollution level should extend beyond what raw certification counts would suggest. While we are not in a position to estimate the contribution of participants and nonparticipants separately to aggregate pollution reductions, we estimate their combined effect across a range of pollutants.

Empirical Model and Data

We examine cross-sectional time series panel of 159 countries in the SO_2 analysis and 73 countries in the BOD analyses from 1991 through 2005.[6]

While ISO 14001 was launched in 1995, discussions about this program began in earnest even prior to the 1992 Rio summit. Hence, we examine pollution levels from 1991 to improve the level of longitudinal information on pollution levels available for our estimation.[7] The empirical model evaluates whether the effect of countries' ISO 14001 certifications on SO_2 and BOD pollution levels varies across levels of countries' by their level of pollution stringency.[8] In other words, the model examines whether the effect of ISO 14001 certifications is different in countries with lax environmental regulations compared with ISO 14001's effect in countries with more stringent environmental regulations. Following recent literature showing that the *de jure* stringency of countries' environmental regulations is strongly correlated with the number of their environmental treaty commitments, we use treaty commitments as a proxy for the stringency of countries' environmental regulations (Neumayer, 2002). Cao and Prakash (2012) report that the number of treaty commitments is highly correlated (r = .88) with the *de jure* stringency of environmental regulations in 24 countries in 1970, 1980, 1990, and 2000, suggesting that treaty commitments are a strong proxy for the *de jure* stringency of domestic environmental regulations.

We investigate the effects of ISO 14001 certifications on pollution emissions via an empirical strategy that includes extensive controls for political, social, and economic conditions, time series dynamics, and country and year fixed effects. Some statistical issues could complicate empirical estimation of the effect of ISO 14001 on countries' pollution levels. First, some regressors may be endogenous and thus correlated with the error term. Our variable of primary interest, ISO 14001 certifications may be endogenous if for example firms join ISO 14001 in anticipation of later pollution reductions. A lagged dependent variable could likewise be endogenous. Further complicating matters is the fact that our data are wide with many countries but shallow with relatively few time periods (N > T), which means that including fixed effects and a lagged dependent variable may be problematic (Nickell, 1981). A short-term exogenous shock specific to a country would be captured via the country's fixed effect at the time it occurred and thus produce inconsistent estimates for the other regressors (with more time periods the effects of cross-sectional exogenous shocks would be dissipated over time).

To address these issues, we use a linear generalized method of moments (GMM) difference estimator for the panel data (Arellano & Bond, 1991; Roodman, 2006, 2009). The estimator offers a combination of features, with our model having the following characteristics. We introduce a lagged dependent variable (Y_{it-1}) to address dynamics in pollution emissions and then transform equation 1 via first differencing to account for unobserved heterogeneity across countries, allowing us to drop the country-level fixed effects from Equation 1. The result is Equation 1 expressed as

$$\Delta Y_{it} = \beta_0 + \alpha \Delta Y_{it-1} + \beta_1 \Delta \text{ISO14001}_{it-1} + \beta_2 \Delta \text{Stringency}_{it-1} + \beta_3 \Delta \text{ISO14001}_{it-1} \times \Delta \text{Stringency}_{it-1} + \varphi \Delta \mathbf{X}_{it-1} + \boldsymbol{\varphi} \Delta \mathbf{Z}_{it} + T_t + \Delta \epsilon_{it}$$

Equation (1)

In Equation 1, the subscript i indicates country and t indicates year. Y_{it} is the pollution level for country i in year t. ISO14001_{it-1} is the logged number ISO 14001 certifications and Stringency_{it-1} is the logged number of environmental treaty memberships, both for country i at time $t-1$. Δ indicates first differences so that $\Delta Y_{it} = Y_{it} - Y_{it-1}$. In Equation 1, ΔY_{it-1} and $\Delta\text{ISO14001}_{it-1}$ are potentially endogenous variables, which may still be correlated with $\in_{it.}$ To address this, we employ the lagged values of ISO14001_{it} as its instruments making the former predetermined and therefore not correlated with the error term. Furthermore, we also use the past values of the first differenced lagged response variable (Y_{it}) as its instrument.

The interaction term $\text{ISO14001}_{it-1} \times \text{Stringency}_{it-1}$ captures the conditional relationship between ISO 14001 certifications and environmental treaty memberships. β_1 and β_2 are coefficients measuring the baseline effects of ISO 14001 certifications and regulatory stringency and β_3 is the conditioning coefficient between ISO 14001 certifications and stringency. One way to interpret these coefficients is to see β_1 as the coefficient for ISO 14001 when the value of stringency is zero, with β_3 showing the change in β_1 across stringency levels. The interaction term complicates model interpretation (Brambor, Clark, & Golder, 2006) because whether the coefficient β_1 is significantly different from zero can depend on the value of stringency and it can be of substantive interest whether β_1 varies significantly across stringency values. As we are interested in both issues, and to ease interpretation, we present the results graphically by plotting β_1 across the range of Stringency values (from 0 to 5.5), following the guidelines and the Stata code provided by Brambor, Clark, and Golder (2011).

The remainder of Equation 1 follows conventional panel data analysis procedures. **X** and **Z** are vectors of country-specific and time varying control variables, listed below, with the variables in **X** lagged by 1 year to take into account delays in their effects on pollution and guard against reverse causality. Variables in **Z** are presumed to have contemporaneous effects on pollution. φ is a vector of coefficients for the variables in **X** and $\boldsymbol{\varphi}$ is a vector of coefficients for **Z**. T_t are year fixed effects.

Models were estimated in Stata v. 12 using the xtabond2 command. We report the Hansen tests of the instruments' validity; an insignificant Hansen test suggests valid instruments. Increasing the number of instruments improves estimation by adding information about the instrumented variable. But adding too many instruments can likewise compromise inference by over fitting the instrumented variables and failing to expunge their endogeneity with the dependent variable. Some suggest as a rule of thumb that the number of instruments should be less than the number of units (countries in our case), though Roodman (2009) suggests that this may be too high. Without hard rules, we adopt the convention of including fewer instruments than countries and look for Hansen tests with *p* values that are "safely" above standard significance levels (e.g., $p > .20$), but not so high to as to approach the implausible ($p > .90$). We start with two periods of lag lengths and experiment with longer lags. Our aim is to have sufficient number of instruments for valid estimation of the endogenous variables, but not so many instruments that risk over identification. Finally, we use the "two-step" standard error estimation to account potential heteroskedasticity, as recommended by Roodman (2009), including the "robust" option (Windmeijer, 2005) to account for potential downward bias in two-step standard error estimates.

Variables

The dependent variables (*Y*) are measures of countries' emissions of a regulated air pollutant, Sulfur dioxide (SO_2) and a common indicator of water pollution, BOD. For SO_2, the variable is the logged of SO_2 emissions in giga grams. For BOD, the variable is the logged kilograms of BOD per day. Table 2 presents the descriptive statistics of the independent and dependent variables in the analyses. Table 3 lists the sources for the data.

The independent variable of interest is the number of ISO 14001 certifications in the country in a given year, as reported on the ISO website (ISO, 2006). While there are no measures of the de jure stringency of countries' environmental policies with sufficiently broad and long coverage for our purposes, fortunately there is a proven proxy: countries' environmental treaty commitments. *Regulatory Stringency* is the log of the number of a country's environmental treaty commitments for each year, as reported in Mitchell (2002-2011).[9]

To isolate the effect of ISO 14001 certifications on pollution reduction across levels of regulatory stringency, our analyses include controls for domestic and international factors that can be expected to influence countries' pollution levels. Beginning with domestic factors, economic conditions in a country can have major consequences for pollution levels. The analyses include economic control variables, starting with (logged) gross domestic product (*GDP*). Wealth is measured with *GDP per capita* (in constant 2005 dollars at purchasing power parity) along with its squared term to control for the nonlinear relationship between wealth and pollution, as suggested by the Environmental Kuznets Curve hypothesis. The model controls for the share of industrial production in GDP (*Industry*) because industrial production tends to have higher pollution levels relative to other economic sectors like

Table 2. Descriptive Statistics.

Variable	*M*	SD	Minimum	Maximum	Logged	Data source
SO_2	4.13	2.65	−8.51	10.50	Yes	EDGAR
PM10	3.78	0.69	1.89	5.66	Yes	WDI
BOD	11.10	1.69	4.95	15.94	Yes	WDI
ISO 14001	1.75	2.55	0.00	10.06	Yes	ISO
GDP	24.33	2.24	19.54	30.21	Yes	WDI
GDP per capita	10907.57	12283.94	241.81	74421.63	No	WDI
GDP per capita2	2.70E + 08	5.31E + 08	58470.03	5.54E + 09	No	WDI
Population	15.76	1.91	10.60	20.99	Yes	WDI
Industry	3.34	0.36	2.10	4.56	Yes	WDI
Urban	3.87	0.54	2.02	4.62	Yes	WDI
Regulatory stringency	3.78	0.73	0.69	5.45	Yes	IEA
ISO 9000	3.24	3.35	0.00	11.23	Yes	ISO
Democracy	3.60	6.36	−10.00	10.00	No	Polity IV
Ideology	0.076	0.42	−0.89	1.00	No	WBDPI
Exports-treaties	2.77	0.68	0.00	4.53	Yes	[a]
Exports	4.30	0.54	2.52	6.05	Yes	WDI
FDI stocks	7.87	2.59	0.80	15.10	Yes	UNCTAD
FDI flows	5.68	2.57	−1.31	12.67	Yes	UNCTAD
IGOs	3.83	0.34	1.39	4.52	Yes	YIO
INGOs	6.41	0.99	0.693	8.27	Yes	YIO

SO_2 = Sulfur dioxide; EDGAR = Emissions Database for Global Atmospheric Research v4.0; WDI = Word Development Indicators; BOD = Biochemical Oxygen Demand; IEA = International Environmental Agreements Database Project; ISO = International Organization for Standardization; GDP = gross domestic product; UNCTAD = UNCAD Stat; IGO = International government organizations; YIO = Yearbook of International Organizations; INGO = International nongovernmental organizations.
a. Authors' calculations.

agriculture and services. Furthermore, as firms' pollution reduction may be due to the adoption of ISO 9001 quality standards, our model controls for (logged) ISO 9001 certifications in a country.

Domestic social and political factors can also influence countries' pollution levels, including population size (logged), which we measure with the variable *Population.* As urban areas tend to generate more pollution, we include the variable *urban* population which measures the share of total population living in urban areas. Political pressure can influence pollution levels as well. Some believe that leftwing parties favor environmental protection (Neumayer, 2003). Hence, we control for the legislative *ideology* of a country's legislature. The variable is an index that takes the proportion of legislative seats held by the three largest parties multiplied by −1 for parties of the right, 1 for parties of the left, and 0 for the centrist and nonideological parties. The three variables are then summed into an index ranging from −1 (right) to

Table 3. Data Sources.

Source	Name	Citation
EDGAR	Emissions Database for Global Atmospheric Research v4.0.	European Commission, Joint Research Centre, and Netherlands Environmental Assessment Agency (2009)
WDI	Word Development Indicators	The World Bank (2011)
ISO	ISO Survey of Certification	International Organization for Standardization (2006)
UNCTAD	UNCAD Stat	United Nations Conference on Trade and Development (2011)
WPDPI	Database of Political Institutions	Beck, Clarke, Groff, Keefer, and Walsh (2001)
POLITYIV	Polity IV Project	Marshall, Jaggers, and Gurr (2004)
IEA	International Environmental Agreements Database Project	Mitchell (2002-2011)
YIO	Yearbook of International Organizations	Union of International Associations (1990-2005)

1 (left). Governments in democratic countries may be more responsive to public pressure for protecting the environment. Hence, we control for levels of *democracy* as reported in the Polity IV database.

International factors can influence pollution levels through economic and sociological networks. Prior research suggests that countries receive pressures for environmental protection from other countries via their trade and investment relations, and membership in international institutions. *FDI Stocks* (logged) measures the yearly stock of the foreign direct investment in a country, while *FDI Inflows* (logged) measures the yearly inflow of foreign direct investment a country receives. *Exports* variable measures a country's exports as a proportion of GDP. Vogel (1995) suggests that a country that exports to destinations where citizens demand environmental protection may themselves experience pressure to reduce their own pollution. We, therefore, control for *Export treaties* which measures country *i*'s exports to country j as a proportion of country *i*'s GDP, weighted by the number of environmental treaties in the receiving country *j* (Greenhill, Mosley, & Prakash, 2009). International government organizations (*IGO*) measures the (logged) number of governmental organizations to which a country belongs and International nongovernmental organizations (*INGO*) measures a country's (logged) nongovernmental organization memberships.

Results

Table 4 presents the results of the analyses of the effects of ISO 14001 certifications on countries' SO_2 and BOD pollution levels using equation 1. Because we are interested in the ISO 14001 coefficient and how it varies across levels of regulatory stringency, we focus on the interaction between the ISO 14001 and Stringency coefficients. In the SO_2 analysis, the interaction term coefficient is statistically significant and positive. For the BOD analyses, the interaction term coefficients are not statistically different from zero. Our hypotheses are that effect of ISO 14001 certifications on SO_2 pollution (as a visible pollutant) will be more pronounced as the stringency of countries' environmental regulations diminishes. However, across all levels of stringency, ISO 14001 will have no statistically effect on countries pollution levels for less visible pollutants (BOD). To evaluate the coefficients in light of these hypotheses, Figures 1 and 2 plot, respectively, the coefficient for ISO 14001 on SO_2 and BOD pollution levels across levels of stringency, holding constant the effects of other factors in the model. In the figures, the solid line shows the coefficient for ISO 14001 across levels of stringency and the dotted lines represent 95% confidence intervals. Given that both ISO and pollution measures are logged, the solid line represents pollution elasticities: changes in countries' pollution levels with a 1% increase in ISO 14001 certifications across the levels of regulatory stringency.

In the SO_2 analysis shown in Figure 1, the ISO 14001 coefficient is statistically significant and negative at stringency values lower than about 2 (logged). This means that for countries with stringency levels below these levels, 1% increase in ISO 14001 certifications reduces national level SO_2 pollution levels by between 0.05% and 0.01%, holding constant other factors in the model. Note that while the magnitude of these coefficients may appear to be small, they must be interpreted in the context of ISO 14001's exponential growth. The average number of certifications in a country in 1995 was 1.2 and by 2005 the average was 522. For some countries, the certification growth rate was above 100% per year. Japan saw its certifications increase from 4 in 1995 to 23,466 in 2005.

When stringency is greater than these levels, the coefficient for ISO 14001 is statistically indiscernible from zero, which means that ISO 14001 certifications are not associated with lower pollution levels in countries with more stringent environmental regulations. These results are consistent with our theoretical expectations. ISO 14001 reduces pollution emissions, but only in countries with less stringent environmental regulations, as indicated by fewer international environmental treaty commitments.

Table 4. GMM Results for Countries' Pollution Emissions and ISO 14001 Certifications.

Variables	SO_2	PM10	BOD
$ISO14001_{it-1}$	−0.076* (0.030)	−0.024* (0.010)	0.018 (0.027)
Regulatory stringency	−0.333** (0.096)	−0.062 (0.038)	−0.092 (0.123)
Regulatory stringency × ISO 14001	0.025* (0.010)	0.008 (0.004)	−0.005 (0.008)
Lagged DV	0.182 (0.108)	0.430** (0.119)	0.219 (0.172)
GDP per capita	0.000 (0.000)	−2.17E – 06 (0.000)	−0.000* (0.000)
GDP per capita2	−1.50E – 09 (8.68E - 10)	2.05E – 10 (3.49E - 10)	−8.54E – 10 (4.14E - 10)
GDP	0.118 (0.229)	−0.241** (0.072)	−0.307 (0.269)
Industry	0.083 (0.098)	0.046 (0.046)	−0.063 (0.144)
ISO 9000	−0.003 (0.005)	0.001 (0.002)	0.004 (0.004)
Population	0.960* (0.390)	−0.091 (0.171)	0.391 (0.405)
Urban	−0.021 (0.425)	−0.012 (0.239)	−0.176 (0.957)
Democracy	−0.012 (0.007)	0.004 (0.003)	−0.001 (0.003)
Ideology	−0.023 (0.028)	0.025 (0.014)	0.004 (0.011)
FDI inflows	0.007 (0.008)	0.000 (0.003)	0.007 (0.004)
FDI stock	−0.074* (0.033)	−0.012 (0.010)	−0.013 (0.032)
Exports	0.033 (0.066)	−0.021 (0.025)	0.056 (0.035)
Exports-treaties	0.022 (0.028)	0.009 (0.015)	0.022 (0.027)
IGOs	−0.093 (0.073)	0.002 (0.026)	−0.045* (0.022)
INGOs	−0.05 (0.052)	−0.017 (0.023)	0.04 (0.077)
Year dummies	Yes	Yes	Yes
n (countries)	134	133	66
n (total)	1,272	1,198	445
Wald χ^2	135.78**	530.84**	84.18**
Arellano–Bond Test for AR(1) in first differences	−2.74*	−3.66**	−0.80
Arellano–Bond Test for AR(2) in first differences	−1.09	0.56	−0.81
Hansen test (χ^2, *df*)	98.04 (88)	84.71 (79)	10.95 (11)

SO_2 = Sulfur dioxide; BOD = Biochemical Oxygen Demand; ISO = International Organization for Standardization; GDP = gross domestic product; IGO = International government organizations; INGO = International nongovernmental organizations.
*$p < .05$. **$p < .01$.

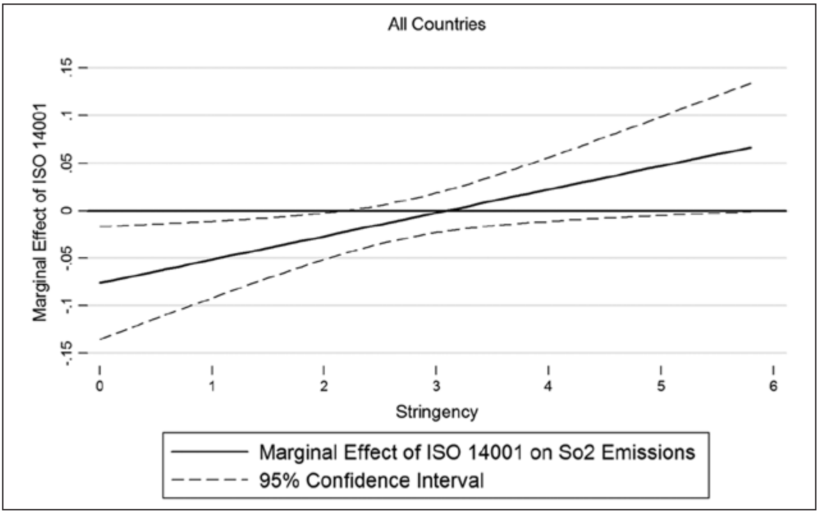

Figure 1. Effect of ISO 14001 on SO_2 emissions across stringency.
ISO = International Organization for Standardization; SO_2 = Sulfur dioxide.

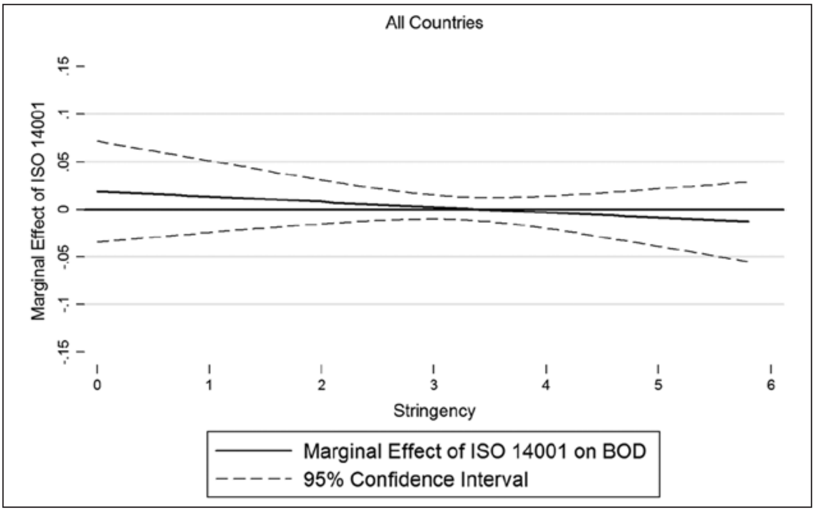

Figure 2. Effect of ISO 14001 on BOD emissions across stringency.
ISO = International Organization for Standardization; BOD = Biochemical Oxygen Demand.

Figure 2 presents the effects of ISO 14001 certifications on countries' BOD pollution levels across levels of regulatory stringency. Unlike the results in Figure 1, Figure 2 shows that the coefficient for ISO 14001 is not statistically different from zero at any level of regulatory stringency. This can be seen graphically as the dotted lines in the figures straddle the *x*-axis at zero across all values of stringency. These results are also consistent with our theoretical expectations that ISO 14001 has a smaller, even negligible, effect on countries' levels of less visible pollutants.

The control variables in Table 4 generally behave as expected, though we note that the lack of significance among some variables is likely due to the extensive controls for country and year fixed effects, time series dynamics, and time varying factors. The results show that SO_2 and BOD levels are significantly higher among countries with larger and wealthier populations. Pollution levels follow the Kuznets curve relationship between wealth and pollution levels and are higher in countries with larger populations and where trade is a larger share of the economy.

Robustness Check

So far, we have found that ISO 14001 adoption levels are associated with reductions in visible air pollution (SO_2), but only where the stringency of public law is low. We also found that ISO 14001 does not have statistically significant effects on less visible water pollution irrespective of the stringency of public law. Particulate matter is another important type of air pollution. This is often expressed as PM10: the concentration of fine suspended particulates less than 10 microns in diameter. Does ISO 14001 reduce PM10 pollution levels in countries where public law is less stringent? We hypothesize that the effect of ISO 14001 on PM10 conditional upon domestic law will be less strong in relation to SO_2 because this pollution is often a result of vehicular emission or other activities over which firms have less direct control. Consequently, in the context of countries with lax laws, firms' stewardship focus to reduce their visible air pollution will translate into reductions in PM10's aggregate pollution levels which are more modest in relation to reduction in aggregate SO_2 pollution levels.

In the PM10 analysis shown in Figure 3, the statistical results are weaker in relation to SO_2: the ISO 14001 coefficient borders being statistically significant and negative at regulatory stringency values lower than about 2.0 (logged). This means that 1% increase in ISO 14001 certifications reduces national level PM10 pollution levels by between about 0.025% and 0.01%, holding constant other factors in the model. When stringency is greater than these levels, the coefficient for ISO 14001 is statistically indiscernible from zero, which means that ISO 14001 certifications are not associated with lower PM10 pollution levels in countries with more stringent environmental

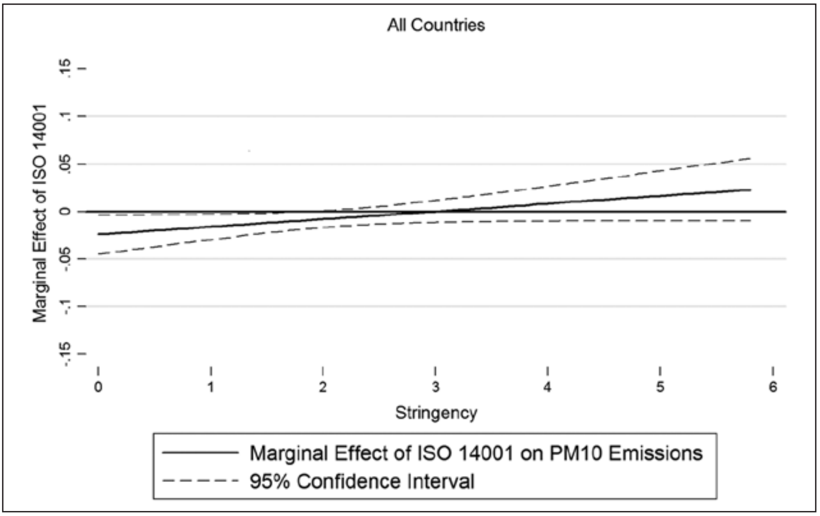

Figure 3. Effect of ISO 14001 on PM10 emissions across stringency.
ISO = International Organization for Standardization.

regulations. These results are consistent with our theoretical expectations about the visibility of PM10 pollutant but firms having less control over their concentration levels.

Conclusions and Future Research

This article examines how the efficacy of the most widely adopted global private environmental regime is contingent on the stringency of domestic environmental law. More broadly, we suggest that regime scholars need to play more attention to domestic institutions and politics in trying to understand the efficacy of global regimes.

Does ISO 14001 work as promised? The answer is yes and no. We find that the efficacy of ISO 14001 is uneven both across pollutants based on their physical visibility and across countries based on their levels of regulatory stringency. For countries with less stringent environmental regulations (as indicated by their environmental treaty commitments), a 1% increase in ISO 14001 certifications is associated with as much as a 0.05% reductions in SO_2 pollution levels. In countries with more stringent environmental regulations, ISO 14001 uptake levels do not have a statistically discernible effect on SO_2 pollution levels. For less visible water pollution (BOD), ISO 14001 does not have a statistically discernible effect at any level of regulatory stringency.

Our article raises several questions for future research. Future research should consider the extent to which findings from ISO 14001 can be generalized across voluntary programs. Voluntary environmental programs vary along several program design dimensions, which can influence program efficacy and the level and quality of spillover effects the program creates for nonparticipants. Research comparing efficacy across programs can shed light on how program design might influence program efficacy.

Our measure of *de jure* regulatory stringency may not capture the more subtle differences in countries' regulatory effectiveness. How regulatory context affects the availability of organizational slack within an organization needs to be probed further. While we have employed country fixed effects to control for country-specific idiosyncrasies, especially when they are sticky or time invariant, more nuanced measures of regulatory stringency, *de jure* as well as *de facto*, may uncover subtle differences in how regulatory stringency influences firms' response to voluntary environmental programs such as ISO 14001.

Finally, we believe that more work is needed to understand how pollutant characteristics, shape firms' stewardship priorities. Visibility has many dimensions and our article has focused on one dimension only. The policy salience of a pollutant for a firm which is evaluating its stewardship investments might be influenced by other factors such as pressures from environmental groups working on specific pollution problem, life cycle of pollutants, exogenous shocks such as oil spills and media coverage (Iyengar, 1991). Our article is an initial step to examine how pollutant characteristics influence firms' stewardship calculus, and therefore program efficacy. We hope that future work will explore other pollutant characteristics and relate the issue of visibility to broader environmental policy debates.

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Notes

1. http://www.iso.org/iso/theiso14000family_2009.pdf
2. http://www.iso.org/iso/about/iso_members.htm
3. Even within the category of water pollution, there seems to be more media coverage on oil (visible) pollution as opposed to chemical pollution. If so, public

policy responses as well as firm-level responses should be biased toward the former, an issue future research should investigate. We owe this point to Ron Mitchell.

4. http://www.samachar.com/Yamuna-faces-catastrophe-apex-court-told-mmfcLFfecei.html
5. http://walmartstores.com/Sustainability/9292.aspx
6. Pollution data on Sulfur dioxide (SO_2) beyond 2005 are not available. As we are using a panel design, we focus on SO_2 and Biochemical Oxygen Demand (BOD) for which data are available for a relatively long time series for a large number of countries. Consequently, we do not test the impact of ISO 14001 adoption on say NO_x emissions. In the robustness check, we check for ISO 14001's impact on particulate emission.
7. Starting the panels in 1991 actually strengthens our research design by incorporating more information about countries' pollution when the program was not available, akin to a pre-test post-test design. A research design that first observes all countries without the program and then observes how their pollution changes with the introduction (and growth) in the program is superior to one that just observes time periods where the program exists for at least some countries. For example, the expanded time period is less vulnerable to the problematic situation where long-term trends influence (in ways not captured by the model) both ISO 14001 certifications and pollution levels.
8. Because we are interested in the interaction of ISO adoption with public law, we do not study CO_2 which is an unregulated pollutant during the time period of our study.
9. This measure is strongly correlated (0.75) with the measure Perkins and Neumayer (2012) have developed to measure the stringency of auto-emissions regulations. This provides additional confidence about the robustness of our measure.

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