Racing to the Bottom? Trade, Environmental Governance, and ISO 14001

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Globalization critics argue that international trade spurs a race to the bottom among national environmental standards. ISO 14001 is the most widely adopted voluntary environmental regulation which encourages firms to take environmental action beyond what domestic government regulations require. Drawing on a panel study of 108 countries over seven years, we investigate conditions under which trade linkages can encourage ISO 14001 adoption, thereby countering environmental races to the bottom. We find that trade linkages encourage ISO 14001 adoption if countries' major export markets have adopted this voluntary regulation.

Whether international trade hurts or harms the environment is an important question in academic and policy circles. In this article, we employ a panel of 108 countries over seven years to investigate whether international trade encourages firms to adopt ISO 14001, the most widely adopted nongovernmental environmental regime. In doing so, we provide an empirical test for Vogel's (1995) "California effect" where trade serves as a vehicle for transmitting importing countries' regulatory standards to exporting countries. Vogel's (1995) argument applies to product standards as enshrined in governmental regulations. We test his argument for ISO 14001, a nongovernmental regulation that stipulates process standards. Empirically, we find that high levels of adoption of ISO 14001 in the importing countries encourage firms in the exporting countries to adopt this voluntary environmental program. Our article makes theoretical contributions to debates about the race to the bottom and trade versus environment tensions, as well as the private authority literature (Cutler, Haufler, and Porter 1999; Garcia-Johnson 2000; Hall and Biersteker 2002; Haufler 2001; Mattli and Buthe 2003) which examines (among other things) factors that influence the diffusion of private authority or nongovernmental institutions.

ISO 14001 is an interesting case to study because it outlines process or management-based standards that firms need to adopt. Environmentalists criticize the World Trade Organization (WTO) for preventing governments from imposing process standards on imports. These critics argue that the WTO's approach undermines domestic regulations because imports from countries with laws based on lax process standards (and therefore lower production costs) can flood a country with more stringent standards (Daly 1993). Unlike governments, firms themselves can impose process standards such as ISO 14001 on their suppliers, raising important questions about how cross-national trade influences the adoption of a nongovernmental process regulation.

The Geneva-based International Organization of Standardization (ISO) launched ISO 14001 in 1995. Although the costs for firms to become ISO 14001 certified

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are nontrivial, by the end of 2002, there were about 49,462 ISO 14001 certified facilities across 118 countries (ISO 2003). If trade critics are correct, countries that are more integrated into global trading networks should have lower levels of ISO 14001 certifications, ceteris paribus. After all, trade should create disincentives for firms to voluntarily adopt regulations that increase their cost of production and coordination. And if Vogel's argument is correct, trade linkages should serve to support ISO adoption, particularly if ISO 14001 has been widely adopted in the country's key trading partners. Building on the "diffusion of innovation" literature (Rogers 2003) which argues that country-level factors influence the organizational practices their firms adopt (Baron, Jennings, and Dobbin 1988; Cole 1989; Guillen 1994), we hypothesize that a country's ISO 14001 adoption rates will be encouraged *if* ISO 14001 has been widely adopted in its export markets.

While governments may promote ISO 14001 if their economies substantially rely on exports (Roht-Arriaza 1997), firms in some countries actively encourage their foreign suppliers to adopt ISO 14001 (Christmann and Taylor 2001; Christini, Fetski, and Hendrickson 2004; UNCTAD 2000). The U.S. auto industry requires first- and second-tier suppliers, many of which are located abroad, to adopt ISO 14001 (Coglianese and Nash 2001). This is an important development given that most world trade takes place within the value chains of multinational corporations, that is, between companies and their suppliers (UNCTAD 1996). Because most multinational corporations are headquartered in countries with high ISO 14001 adoption rates (and retain strong ties with them as Pauly and Reich 1997 point out), they are more likely to encourage their suppliers to become ISO 14001 certified. If countries with high ISO 14001 adoption rates also absorb the bulk of world exports, then trade could become a vehicle to encourage ISO 14001 adoption.

While voluntary regulatory programs such as ISO 14001 may have virtues, they invite much skepticism. Recent scandals in the accounting industry have undermined public trust in voluntary regulations. Environmentalists tend to be skeptical of voluntary regulations (Steinzor 1998), suggesting they "greenwash" firms' poor environmental performance. While research has indeed shown this to be the case for some voluntary programs (King and Lenox 2000), several studies suggest that adopting ISO 14001 induces firms to take considerable progressive environmental action that translates into pollution reduction and better compliance with government regulations (Anton, Deltas, and Khanna 2004; Dasgupta, Hettige, and Wheeler 2000; Potoski and Prakash 2005a, 2005b; Russo 2001). Importantly, these findings persist even after controlling for facilities' compliance and pollution histories as well as addressing potential endogeneity issues between facilities' environmental and regulatory performance and their decision to join ISO 14001.

The political implication then is that instead of opposing free trade across the board, environmental groups might leverage it to serve their goals. They could establish nongovernmental regimes (as in the forestry sector, Bartley 2003) and work on their widespread adoption in countries that absorb a substantial portion of the world's exports. In sum, by establishing the "right" institutions in critical export markets, environmentalists can strategically harness free trade to create supply chain-based environmental multipliers in developing countries (but see Clapp 1998) and thereby serve their environmental objectives.

ISO 14001

The ISO, also called the International Organization for Standardization or the Organisation Internationale de Normalisation, was founded in 1946. While the ISO is not an "NGO" in the sense of being an activist group, it is a nongovernmental actor whose members are "private sector national bodies" (Mattli and Büthe 2003, 4) such as the American National Standards Institute, the British Standards Institution, and the Deutsche Institut für Normung. For example, "the American National Standards Institute (ANSI) is a private, nonprofit organization (regulated as a "501 (c)3" in the US tax code) that administers and coordinates the U.S. voluntary standardization and conformity assessment system (ANSI)." As a nongovernmental actor, the ISO facilitates international commerce by developing international standards and codes, over 14,000 standards so far, through its technical committees comprised of representatives from businesses, governments, and other stakeholders. To approve a new standard, the ISO requires a two-thirds majority approval in the technical committee and a three-fourths majority among ISO voting members. The ISO reviews and, if necessary, revises each standard at least every five years (ISO 2002).

As a process-based regulation, the theory behind ISO 14001 is that: (1) pollution represents resource waste; (2) rather than exclusively relying on governments' command and control regulations to mitigate pollution, firms can self-regulate; (3) if appropriate management systems are put in place, desired outcomes such as improved environmental performance will follow; and (4) auditing by external accredited auditors will create incentives for firms to adhere to program obligations. ISO 14001 builds on ISO 9000, a quality control standards targeting

manufacturing industry, by prescribing management practices for firms' internal environmental operations. Joining ISO 14001 requires firms to establish a written environmental policy approved by senior management. Firms must lay out quantifiable environmental targets, regularly review their progress, and designate a top manager to oversee implementation of the firms' environmental programs. In practice, ISO 14001 typically commits member firms not only to comply or exceed domestic laws, but also to adopt the best available environmental technology, assess the environmental impact of their operations, and establish programs to train personnel in the environmental management systems. Appendix A provides a list of what an ISO 14001 caliber environmental management system contains. 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.

Unlike some other voluntary environmental programs, ISO 14001 requires participants to receive an initial certification audit and then annual recertification audits to verify that their management systems remain of ISO 14001 caliber. These auditors themselves are approved and certified by their domestic national standards body. The audit and certification measures are designed to prevent participants from shirking their program responsibilities as ISO 14001 members. Participants incur nontrivial costs to receive and maintain ISO 14001 certification. Establishing an EMS and having it audited by a third party can cost from $25,000 to over $100,000 per facility (Kolk 2000). An ISO certified EMS requires substantial investment beyond the cost of external auditors. These include the costs of maintaining paper trails, documenting processes, and increasing headcounts (Prakash 2000). William Glasser of the EPA estimates that "large facilities spend on average about $1M in sunk transaction costs to pursue certification" (2004, e-mail).

According to several recent studies firms that join ISO 14001 pollute less and better comply with governmental law. In their study of 236 Mexican firms in the food, chemical, nonmetallic minerals, and metal industries (which together generate 75% to 95% of Mexico's industrial pollution), Dasgupta, Hettige, and Wheeler (2000) find that ISO 14001 adopters show better compliance with government environmental regulations, an important finding given that many developing countries have difficulties enforcing government regulations. In his analysis of 316 U.S. electronics facilities, Russo (2001) finds that ISO 14001 membership is associated with decreased toxic emissions. In their study of over 3,000 U.S. facilities regulated under the Clean Air Act, Potoski and Prakash (2005a, 2005b) find that ISO 14001 adopters, in comparison to nonadopters, pollute less and show better compliance with the law. Anton et al. (2004) report that more comprehensive EMS (the core requirement imposed by ISO 14001) lead to lower toxic emissions, particularly for firms that have higher pollution intensity. In sum, while adopting ISO 14001 is not the final step in protecting the environment, there is mounting evidence that indicates that ISO-certified facilities adopt environmental programs beyond what is required by domestic governmental regulations.

Because ISO 14001 is not an intergovernmental regime, the typical negotiating strategies (financial aid offers, sanction, or invasion threats) are not likely to be central factors in explaining its adoption across countries. This does not imply that ISO 14001 is a technocratic regime without a political purpose. Because variations in government regulations across countries increase regulatory costs for multinational corporations and often serve as nontariff trade barriers, multinational corporations favor regulatory harmonization. ISO 14001 can serve this political end. If ISO 14001 represents a business-friendly approach to cross-border regulation, albeit of a "beyond compliance" variety, it should be popular with firms across countries. One might then expect to find that ISO 14001 adoption levels are comparable across countries, controlling for the size of the economy. Yet adoption levels vary across countries, particularly after factoring in the relative sizes of the national economies. We examine whether this variation lends support the race to the bottom thesis or whether it supports Vogel's argument in the context of the most widely adopted nongovernmental process standard.

Theoretical Perspectives

There is an established literature examining the precursors and consequences of jurisdictional competition to attract mobile production factors (Tiebout 1956). In recent years, the race to the bottom hypothesis has been examined across issue areas such as welfare spending (Garrett 1998), capital flows (Simmons and Elkins 2004), education (Bailey, Rom, and Taylor 2004), genetically modified organisms (Prakash and Kollman 2003), and public health (Braithwaite and Drahos 2000). There is also a debate about whether regulatory instruments such as tax havens and "flags of convenience" abet regulatory races (Conrad 1973; Palan 2002).

While NGOs typically claim races to the bottom are quite common (Wallach and Sforza 1999), scholars have found little empirical support for them (Drezner 2001; Kahler 1998; Potoski 2001). Arguably, from firms'

perspective, reduced regulatory costs from moving to a jurisdiction with lax regulations may not offset the potential increases in coordination costs, contract enforcement costs, and production costs (Frankel 2003). The race to the bottom literature has, however, ignored the role of nongovernmental regimes in either accentuating or mitigating regulatory races. This article corrects this important omission by examining conditions under which trade influences the cross-country adoption of the world's most established nongovernmental environmental regulation.

The relation between trade and domestic environmental regulations is examined in three literatures. One literature blames the weakening of environmental laws not on domestic pressures but on the obligations that the WTO imposes on national governments (Charnovitz 1993). The WTO, an intergovernmental regime, typically does not allow governments to impose process standards on imports. Environmentalists argue that this makes exports from developing countries (with allegedly lax process-standards) to outcompete firms located in developed countries. As a consequence, governments in developed countries come under political pressure either to establish nontariff barriers (which are frowned upon by the WTO, especially after the Uruguay Round) or to dilute domestic laws.

A second literature examines how trade affects macroenvironmental indicators (directly and indirectly via economic growth) such as pollution levels and deforestation (Grossman and Krueger 1995; but see Antweiler, Copeland, and Taylor 2001). Because trade can have three types of effects on the environment—scale effects (increasing the scale of economic activity and leading to resource over consumption, Princen, Maniates, and Conca 2002), substitution effects (encouraging existing firms to substitute one production technique for another), and composition effects (changing types of firms that populate an economy)—trade's overall impact on the environment depends on the sum of these effects (Esty 2001; Frankel 2003). There is an on-going debate about the empirical salience of the three effects, and the validity of the so-called Environmental Kuzent curve hypothesis.

The third body examines the "pollution haven" and the "industry flight" hypotheses: whether (and if so, why) "environmentally dirty" industries are migrating to the pollution havens in the South. Scholars have examined trends in the salience of "dirty" products in the exports of developing countries to developed countries (Jaffe et al. 1995; Low 1992; Mani and Wheeler 1998). Because businesses tend to portray the alleged problem of industrial flight as a symptom of the broader problem of overregulation (Walley and Whitehead 1994), they demand scaling back of domestic regulations. Blaming free trade for regulatory races (Charnovitz 1993; Daly 1993), environmentalists demand "fair trade" so that domestic firms are not disadvantaged in the world market by stringent domestic regulations. The problem is that "fair trade" requires developed countries to either subject imports from developing countries to process-based standards (which the WTO disallows) or to persuade developing countries to strengthen their alleged lax standards (which is politically difficult).

Vogel (1995) suggests that to understand the environmental consequences of trade, one should examine the specific patterns of trade among countries, rather than the overall volume of global trade. Because trade can be a vehicle for transmitting importing countries' environmental (product) standards to the exporting country, trade can lead to a ratcheting up of environmental standards *if* countries' key export markets have progressive environmental laws. Vogel (1995) terms this as the "California Effect." Building on Vogel's (1995) argument, our article introduces a fourth dimension to the trade-environment debate: how does foreign trade influence the cross-country diffusion of *nongovernmental* environmental regulation?[1] Thus, the key hypotheses we test are:

> H1 (Race to the bottom): ISO 14001 adoption rates will be lower in countries that are more structurally dependent on exports.
>
> H2 (Vogel's California Effect): ISO 14001 adoption rates will be higher in countries whose major trading partners have adopted ISO 14001.

Although trade is the primary variable of interest, our analyses control for several factors that can be expected to influence ISO 14001 adoption. Foreign direct investment (FDI), can be expected to influence ISO 14001 adoption. By the end of 2000, there were about 62,000 multinational corporations operating over 820,000 affiliates (UNCTAD 2002), a dramatic change in the geography of international production over the last five decades. While globalization critics suggest that FDI abets environmental races to the bottom, international business scholars point out that regulatory races to the bottom

[1]This article does not directly examine whether ISO 14001 will improve countries' macroenvironmental performance. The problem is rooted in certification levels. Assume that 10% of a country's facilities receive ISO 14001 certification and that these facilities averaged a 10% improvement in environmental performance. While this would certainly indicate an effective environmental program, it is unlikely to be empirically discernable given the measurement error and other noise in national level data. Until there are more certifications across countries, evidence of ISO 14001's efficacy will need to come from facility level studies, the key ones are cited.

are rare because multinational corporations seldom base their FDI location decisions on environmental costs alone. As Dunning's (1993) Organization-Location-Internalization framework demonstrates, FDI location decisions are complex (Henisz 2000; Jensen 2003). Some scholars predict that despite considerable variation in the stringency of domestic regulations, multinational corporations are likely to adopt stringent practices that are acceptable in both developing and developed countries because of the high costs of adapting different business models to different contexts (Rugman, Soloway, and Kirton 1999). FDI may then serve as a vehicle to transmit environmental practices.

Countries' ISO 14001 adoption rates could also be influenced by normative and ideational pressures. If ISO 14001 represents a normatively appropriate environmental governance approach that fits with prevailing international norms, firms may join it to the extent that they are located in countries embedded in networks that transmit such international norms. Ideas and norms about business responsibility towards the natural environment may flow through networks of international organizations and cultural networks based on shared geography and language.[2] Firms in countries that are more embedded in international intergovernmental organization (IGO) and international nongovernmental organization (INGO) networks (Boli and Thomas 1999) would be more prone to adopt ISO 14001. Ideational diffusion is likely to be more pronounced in culturally similar countries with common languages (Simmons and Elkins 2004) or countries in geographical proximity (Kopstein and Reilly 2000). After all, managers are likely to take cues on appropriate corporate behavior by observing other mangers with whom they have cultural affinities.

While we focus on the role of trade on environmental races to the bottom and ISO 14001, we recognize that domestic institutions can be expected to influence ISO 14001 adoption via firms' perceptions of ISO 14001's instrumental and normative dimensions. Firms view the usefulness of nongovernmental regimes in terms of their fit with domestic institutions. In countries with economic freedom, domestic institutions can encourage ISO 14001 adoption. More competitive market economies can compel firms to differentiate themselves on a variety of counts, including environmental stewardship (Porter and Linde 1995). ISO 14001 adoption rates are likely to be higher in countries that have more open and free economic systems. Another key attribute of the policy environment is countries' affluence. If the demand for environmental amenities has positive income elasticity (Grossman and Kreuger 1995), ISO 14001 adoption rates should be higher in wealthier countries, where ISO 14001 would signal firms' commitments to safeguard the environment. Citizens' perceptions of environmental quality may be reflected in countries' pollution emissions. When pollution levels are high, citizens are likely to demand that governments and firms adopt policies to curb pollution.

Data

To investigate how trade influences country-level ISO 14001 adoption rates, we examine a panel of 108 countries over seven years. Our dependent variable is the number of ISO 14001 certified facilities in each country, from 1996 through 2002, as reported in the 12th cycle of the ISO 9000/14000 census (ISO 2003).[3] In 1996 there were an average of 13.2 ISO 14001 certified facilities per country in our sample; by 2002 the number had grown to 446.5, with Japan having the most certifications at 10,620 in 2002. As to be expected with a "count" variable such as this, the data are not normally distributed: in 1996 about half the countries in the sample did not yet have an ISO 14001 certified facility; by 2002 only two countries had no ISO 14001 certified facilities.

We employ two measures to examine the effect of international trade on countries' ISO 14001 adoption rates. First, we measure a country's structural dependence on exports (*Export Dependence*) based on the argument that, irrespective of the exports' destination and the policies of the importing countries, greater export dependence leads to lower ISO 14001 adoption rates. *Export Dependence* is calculated as a country's total exports divided by its GDP. Second, if the export destinations matter, the practices

[2] One could employ proxies such as the circulation of foreign magazines and market penetration of foreign films and TV shows, etc. Unfortunately, data for such ideational flows is available only for a small sample of countries. We also investigated telecom traffic (number of phone calls) as a proxy for ideational flows. Because we did not find this to be significant and its exclusion did not affect our substantive findings, we have not included it in our model.

[3] Ideally, our dependent variable would measure the number of certified facilities as a proportion of total number of certifiable facilities. Because data on the total number of certifiable facilities are not available, we take GDP adjusted for purchasing power parity (PPP) as a proxy. Because the production structures are dissimilar, facilities per dollar of GDP are likely to vary cross nationally. We handle this in two ways. First, we take PPP adjusted GDP, and not GDP per se, as a control variable. We assume that variations in purchasing power capture the variations in how production systems are organized across countries. Second, we include country fixed effects to capture unit specific variation including variations in production structures that are not captured by other covariates. While we do not foresee it as a problem, we recognize that production scales at the facility level may vary in ways not captured by our covariates, including fixed effects.

and norms of the importing countries can be transmitted back to the exporting country through trading channels. We measure each country's bilateral trading context based on its exports to other countries, weighted by those countries' ISO 14001 adoption levels (*Bilateral Trade Weighted by ISO Adoption*). Countries whose major export partners have higher ISO 14001 adoption levels should have higher certification levels as well. Following Guler, Guillen, and MacPherson (2002), we calculate each country's bilateral trade context as:

$$\text{Bilateral trade weighted by ISO adoption}_{it} = \sum_{j} \text{ISO}_{jt} \times (\text{Exports}_{ij}/\text{Exports}_{i})^2,$$

where ISO_{jt} is the number of ISO certifications in *country j* at time *t*, Exports_{ij} is *country i's* exports to *country j*, Exports_{i} is *country i's* total exports. This measure gauges each country's exports to other countries, weighted by the number of ISO 14001 certifications in the destination countries. Trade data were downloaded from the United Nation Statistics Division's Comtrade database (United Nations 2004).

Our model includes several control variables. We control for levels of foreign direct investment inflows as a percentage of GDP in the country (*FDI*). Our expectation is that countries with higher FDI inflows have higher ISO 14001 adoption rates.[4] FDI data were downloaded from the World Development Indicators (WDI) (World Bank 2004). Networks can serve as conduits for ideas on firms' environmental responsibilities. INGO and IGO networks enhance ideational flows across countries. *INGO* is the total number of nongovernmental international organizations a country's citizens have joined and *IGO* is the number of intergovernmental international organizations a country's government has joined, as reported in various years of the *Yearbook of International Organizations* (Union of International Associations 1997).[5]

A common language reduces costs of transmitting and acquiring ideas and norms. We expect managers to take cues about ISO 14001's instrumental value and normative appropriateness from other managers that speak in the same language. We calculate the language variable as the average number of ISO 14001 certifications per capita in all other countries that share a common language with each country (*Language*).[6] Data on each country's primary language are from the CIA Factbook (CIA 2004). Information is likely to flow more easily between contiguous countries than between noncontiguous countries. Neighbors are likely to have several opportunities to exchange information and to observe one another. We calculate the neighborhood variable as the average number of ISO 14001 certifications per capita in countries that share contiguous borders (*Neighbors*). Data on geography is from O'Loughlin et al. (1998).

We also control for several domestic variables that may affect ISO 14001 adoption rates. We take GDP adjusted for purchasing power parity (*GDP*) as a proxy for the total number of certifiable facilities in a country. Because ISO 14001 may have more appeal to firms in the manufacturing sector, we control for the manufacturing sector's share in GDP (*Manufacturing*). While ISO 14001 certification is open to both public and private sector organizations, private companies may have stronger incentives to certify. Therefore, our analyses include the public sector's share of each country's economy to measure the size of government (*Government Consumption*). The data are from World Development Indicators (World Bank 2004).

Citizens in wealthier countries may demand that firms adopt policies such as ISO 14001. Our measure of national wealth, GDP per capita (adjusted for purchasing power parity), is drawn from the World Development Indicators (*per capita GDP*). Prior research suggests that wealth and environmental protection have a nonlinear relationship (Grossman and Krueger 1995). Hence, we also include per capita GDP squared (*per capita GDP*^{2}) as a covariate. High pollution levels may also drive citizens' demands for environmental quality. We measure this by SO_2 emissions (in tons) per GDP dollar (SO_2), as reported in Stern (2005).

Firms in competitive economies are more likely to use ISO 14001 to differentiate their environmental policies. We draw upon the Heritage Foundation's Survey of countries' internal economic policies. The index has 10 components pertaining to trade policy, fiscal burden of government, government intervention in the economy, monetary policy, capital flows and foreign investment, banking and finance, wages and prices, property rights, regulation, and black market activity. Because we look to assess institutional bases for economic policies, we include

[4] We also examined whether short-term capital flows influence ISO 14001 adoption. Given that this variable was not significant and its exclusion did not affect the main conclusions, we have not included it in our analysis.

[5] The number of environmental treaties that a country has signed could capture a country's embeddedness in intergovernmental environmental networks and serve as a proxy for embeddedness in the transnational epistemic community. Because this is highly correlated with IGO membership but not with the variables of substantive interest, we have not used it in our model.

[6] Following Simmons and Elkins (2004), we tested for other forms of sociological networks, specifically colonial networks and religion-based networks. We also tested for tourism flows and internet connections (Sandholtz and Gray 2003). Because we did not find them to be significant and their exclusion did not affect our substantive findings, we have not included them in our model.

the scores only for property rights and regulation components (*Regulations*) of the Index of Economic Freedom (Heritage Foundation 2003).[7] ISO 14001 was modeled on the ISO 9000 quality control regime; both programs have the same sponsoring organization and share the same management system-based approach. Hence, we control for ISO 9000 (*ISO 9000*). Data are from the 12th cycles of ISO 9000/1400 census (ISO 2002).

Our data were not complete for all variables for all countries in our sample. King et al. (2001) suggest that dropping such countries from the sample induces biases and recommend that researchers impute missing data values. We applied the Amelia program for missing data to input missing values in our data (Honaker et al. 2001). The results presented below are the adjusted averages from analyses of seven data sets with missing values imputed via Amelia. The data were on the whole 90.1% complete. The variables with the most missing data were the NGO and IGNO measures each at 71.0% complete, followed by the SO_2 emissions variable at 75% complete. All other variables were at least 85% complete.

Empirical Model

To model the effects of trade on countries' ISO 14001 adoption, we estimate an equation of the following form:

$$h(\mu_{it}) = x'_{it}\beta \quad \text{and} \quad \text{var}(y_{it}) = g(\mu_{it}) \cdot \alpha \qquad (1)$$

where μ_{it} is the marginal expectation of $y[\text{E}(y_{it})]$, and x'_{it} are the covariates of ISO 14001 certifications (y) for each country (i) over each year (t). The variables in x'_{it} are the measures of trade plus control variables, including fixed effects. All independent variables other than the scale parameter GDP are lagged by one year to account for response time in the variables' effects.[8] The form of h, g, and α are the standard (or "canonical") structure for negative binomial event-count models (Cameron and Trivedi 1998). Thus g represents the negative binomial distribution (or "family), h is a natural log "link" function for transforming the expectation of y, and α is the dispersion parameter.

We choose this specification due to the distribution of the dependent variable. National counts of ISO 14001 certifications have an obvious lower bound of zero. In our sample countries and years, there are a large number of zeros and the standard deviation greater than the mean.[9] Given the overdispersion in our data, we employ a negative binomial specification instead of a Poisson specification. The median number of facility certification in our sample is quite low (only nine in 1998 and 38 in 2002), indicating that a large number of countries had small numbers of certified facilities, even by the end of our study period. The distribution of our ISO 14001 certifications across countries suggest that while large, wealthy countries such as Germany and Japan have many certified facilities, ISO 14001 still has an important presence in smaller developing countries such as those in Sub-Saharan Africa and Central America. Such a distribution suggests that the analyses must have thorough controls for size of the economy and levels of economic development.

Within each country, our observations over time are not independent: a realization of the dependent variable is conditional on the past value of the dependent variable. To address serial correlation, the analyses include with an AR (1) within-observation correlation matrix such that the correlation between y_{it} and y_{is} (where $t > s$) is $\rho^{|t-s|}$ (Zorn 2001, 480). We tested for serial correlation by regressing the residuals from our analysis on all the independent variables, plus the lagged dependent variables and lagged residuals (Cameron and Trivedi 1998; Wooldridge 2003). Given that we are working with a count model and not OLS, we first normalized the residuals to have a mean of zero and a standard deviation of one (Cameron and Trivedi 1998, 293–97). The coefficient for the lagged residual was not significant, suggesting the absence of serial correlation.[10]

Because observations within countries are not independent, though we assume they are independent across countries, we use robust standard errors adjusted for clustering within countries (Williams 2000). Also, because countries may differ in ways not fully captured by the independent variables in x, we include a series of "fixed effects" dummy variables for each country. Finally, observations of our dependent variable may be "spatially"

[7] Prior research suggests that firms in litigious legal contexts should be less likely to join ISO 14001 (Kollman and Prakash 2001). We employed a proxy for the legal context: the number of environmental law firms in each country. This variable was not significant in our analyses. For simplicity, we have not included it in our model.

[8] Calculating the bilateral trade measure takes a one year lag in ISO 14001 certifications into account, although the export measures used as scales are not lagged.

[9] The number of zero values in 1996 was 64 but two in 2002. A "zero-inflated" model may be appropriate for count dependent variables with large numbers of zero values. Zero inflated models are often used in cases where an occurrence of the first event is driven by different factors than the occurrence of later events, perhaps because the first event serves as a trigger for subsequent event occurrences.

[10] The use of lagged dependent variables in panel analyses has received some critique in recent years (Achen 2000, though see Beck and Katz 2004 for a response). As reported below in the specification test section, we also estimated models with a lagged dependent variable. The results were not substantively different from those reported in our primary analysis.

correlated if countries exert influence on each other through geographical proximity and common cultural connections. We model this influence with the independent variables *Neighbor* and *Language* included in *x*, as discussed above.

Results

Table 1 presents the results of the event-count analyses of the number of certified facilities in 108 countries between 1996 and 2002 (also see Appendix C). Our results discussion reports the discrete changes of our important explanatory variables. A discrete change is the change in the ISO 14001 associated with a change in an independent variable from two standards deviation below its mean to two deviations above its mean, holding all other variables at their means (Long 1997). The effects size of negative binomial event-count models are best interpreted relative to the median value of the dependent variable. The median number of certified facilities is only four across the entire sample of years and countries and 38 in 2002.

TABLE 1 ISO 14001 Certification Rates, 1996–2002

Independent Variables	Coefficient	*Standard Error*
Export Dependence	.045	.124
Bilateral Trade weighted by ISO Adoption	.132**	.029
International Controls		
FDI	−.017	.073
Language	.118*	.047
Neighbor	.053	.041
IGO (intergovernmental organizations)	−.396	.282
INGO (nongovernmental organizations)	.503*	.248
Domestic Controls		
GDP	.807	.521
Manufacturing	−.012	.018
Per Capita GDP	1.475e−04**	5.732e−05
Per Capita GDP^2	−2.3114e−09*	7.512e−10
SO_2	−.018	.016
Regulations	.137	.086
Government Consumption	.016	.028
ISO 9000	.440**	.128
Fixed Effects (yes)		
Constant	−22.206*	10.992
N (108 countries, 7 years)	756	
χ^2	953	

**p < .01, *p < .05.

Table 1 shows that international trade influences ISO 14001 adoption through bilateral trade but not through structural trade. Countries, whose export destinations have higher levels of ISO 14001 certifications, have higher certification levels themselves (H2). Increase bilateral trade from two standard deviations below its mean to two standard deviations above increases the number of ISO 14001 certified facilities by about 25.1 holding the effects of other variables constant at their means. The coefficient for structural trade, .045, is not statistically significant. Thus, it is not structural dependence on trade per se that creates incentives for firms to adopt ISO 14001 (H1). Instead, specific characteristics of trade linkages support the adoption of this nongovernmental regulation. Our empirical analysis strongly suggests that Vogel's (1995) "California Effect" is operating in the case of ISO 14001: if export destinations support ISO 14001, then firms in exporting countries are more likely to join this regime.

This finding has important policy implications. Trade critics fear that developed countries are likely to dilute their environmental laws to remain competitive with developing country exports. Given that the bulk of developing countries' exports are absorbed by developed countries that have relatively stringent environmental laws, our analysis suggests that trade creates at least some incentive for firms in developing countries to adopt "beyond compliance" environment policies, if the trade occurs with countries whose firms have adopted a progressive environmental program. Thus, trade can be an instrument for ratcheting up the environmental practices of firms in developing countries, specifically the ones that export to developed countries whose domestic industry has adopted progressive environmental policies.

Foreign direct investment does not have statistically discernable effects on countries' ISO 14001 certifications. In part, this may be due to the high correlation between trade and FDI flows at 0.75. Importantly, FDI and exports were not jointly significant in our analyses. While there is no evidence that FDI serves as a vehicle to transmit environmental practices (as in the case of bilateral trade) our results suggest that it does not discourage adoption of ISO 14001.

While the *Neighbors* variable is not significant, *Language* is significant. This suggests that managers take cues about the instrumental and normative value of joining ISO 14001 from their linguistic brethren. Because language-based networks have a strong influence

on country-level ISO 14001 adoption, this points to the importance of shared culture in the diffusion of governance models. The statistical significance of the international sociological network variables (*IGOs* and *INGOs*) is mixed. While the *INGO* variable is significant and its directionality is in the expected direction (it is positively associated with ISO 14001 adoption), the *IGO* variable is not significant. Thus, our model lends support to the argument that international nongovernmental networks are important conduits of ideas and norms. Perhaps, because ISO 14001 is a nongovernmental regime, nongovernmental networks can be expected to be more important in relation to intergovernmental networks as carriers of norms.

Turning to the domestic control variables, our analysis suggests that ISO 14001 adoption rates respond to some aspects of countries' domestic contexts. Neither *GDP* nor *Manufacturing* are statistically significant. Countries with more ISO 9000 registrants have more ISO 14001 certifications, most likely because these programs share a common approach based on management system standards. We also find that the relationship between wealth (per capita GDP^2) and ISO 14001 certifications is nonlinear. ISO 14001 certifications increase slowly until the 65^{th} percentile of per capita income, increase sharply for countries that fall between the 65^{th} and the 95^{th} percentiles, and then fall sharply for the top five percentile. Thus, while ISO 14001's attractiveness increases with a country's wealth, its appeal declines for the wealthiest countries, such as the United States and France, ceteris paribus. We also find that other domestic variables specifically, government consumption, regulation, and pollution levels, are not significant.

Alternative Specifications

We examined five different specifications of our model and find that our key independent variable, *Bilateral Trade Weighted by ISO Adoption*, retains statistical and substantive significance across specifications while the other key independent variable, *Export Dependence*, is not significant in any specification. While our model has included fixed effects to control for unit heterogeneity, we recognize that scholars have debated for some time the pros and cons of employing fixed effects for panel analysis; Green, Kim, and Yoon's "Dirty Pool" article (2001) has reinvigorated this discussion. Fixed effects look to control for the influence of unit (country in our case) specific variables not addressed by the other covariates in the model. While acknowledging the usefulness of fixed effects in certain situations, critics highlight the "costs" of using this approach (Beck and Katz 2004). The costs are substantial if key covariates that are expected to influence cross-sectional variations in the dependent variable do not vary sufficiently over time, a common occurrence in comparative political economy where institutional variables are often sticky and vary little over time. The second criticism is that fixed effects chew up substantial degrees of freedom, making estimates of standard errors and other coefficients less precise. While we believe that fixed effects are appropriate in our case for both theoretical and empirical reasons (the fixed effects are statistically significant), we experimented with analyses omitting fixed effects, reported in Appendix B, column 1. In this specification, *Bilateral Trade Weighted by ISO Adoption* is statistically significant and positive while *Export Dependence* is not significant. We should point out that, not surprisingly though, in the absence of fixed effects, the statistical significance of some control variables changes: *international nongovernmental organizations* (*INGO*) and *Language* are no longer significant while GDP has become significant.

The European Union (EU) has been a leader in environmental policies. Given that the EU countries have been in forefront of ISO 14001 adoption, and these countries are also highly integrated via trade, our results could be driven by an "EU effect." In Appendix B, Column 2, we check for the EU effect by simply dropping the EU countries from the analyses and rerunning the analysis. The results are essentially the same as the full (EU included) analysis, suggesting that our conclusions regarding the effect of trade on ISO 14001 are not driven by a dominant "EU effect." Similarly, we adopted the same logic to check for a "Japan effect" given that Japan leads in ISO 14001 adoption and is highly integrated in the world economy (Appendix B, Column 3). The results are essentially the same as the full (including Japan) analysis, suggesting that our conclusions are not driven by a "Japan effect."

Our study examines the role of trade in supporting ISO 14001 adoption. Arguably, trade affects ISO 14001 adoption directly, as well as indirectly via its effect on countries' per capita income. In other words, there may be a potential endogeneity issue between trade, ISO 14001 adoption and wealth. To investigate this issue, we employed a two-stage instrumental variable approach in which the first-stage equation contains per capita income as the dependent variable and trade and other control variables as the independent variables. The second-stage equation used the predicted values for per capita income in place of per capita income and otherwise replicated the

model in Table 1. Again, none of the important results differed from those reported in Table 1 under this alternative specification (Appendix B, Column 4).[11]

Finally, we check our results using a lagged dependent variable in place of the AR1 correction for serial correlation, reported in Appendix B, Column 5. For this specification, the lagged dependent variable was logged, and as Cameron and Trivedi (1998) recommend, we arbitrarily replaced zeros with .05 and included a dummy variable scored one for the zeros, and scored zero for all other values. The substantive results did not change from those presented in Table 1. In sum, while the relative strength of the coefficients varied somewhat under these alternative specifications, *Bilateral Trade Weighted by ISO Adoption*, retains a positive and statistically significant relationship with the dependent variable, *ISO Adoption*, across different specifications while *Export Dependence* remains statistically insignificant.

Conclusion

Environmental groups argue that international trade creates structural conditions leading to regulatory races as developing countries' exporters exploit their allegedly less stringent environmental standards to capture markets in developed countries. They believe that governments in developed countries are likely to come under pressure from their constituents to level the playing field by diluting domestic environmental laws. As a result, free trade abets races to the bottom in governments' environmental regulations. Our results suggest while high levels of trade per se may not significantly affect firms' decisions to adopt ISO 14001, trade can be a vehicle to disseminate ISO 14001 if the key export markets have widely adopted this nongovernmental regulation. Thus, importing countries are influencing organizational practices in the exporting countries, not vice-versa.

From this perspective, international trade has significant political implications beyond the obvious distributive ones. Market access can serve as an important instrument to encourage the diffusion of preferred governance models and organizational practices. And this works not only for product standards as in Vogel's "California Effect" but also for process standards as in ISO 14001. In some ways, the WTO is not an enemy of the environment. Given that developed countries with stringent environmental standards absorb the bulk of developing country exports, free trade can lead to ratcheting up of environmental product and process standards in developing countries. From this perspective, environmental NGOs should not always oppose intergovernmental regimes that lower trade barriers. In addition to campaigning for stringent domestic regulations, environmental groups may be well served to craft nongovernmental regimes and to pressure home firms to join them and require their suppliers to do so as well. There are several examples such as the forestry sector and the apparel industry where northern NGOs have used market power at home to encourage suppliers in developing countries to adopt progressive policies (Gereffi, Garcia-Johnson, and Sasser 2001).

Our study suggests an important new research direction. This article has studied a specific case of a nongovernmental regime, albeit the most widely adopted one in the environmental governance arena. The research program on nongovernmental governance is still in its infancy, at least in international relations and comparative politics. Nongovernmental regimes can vary on several characteristics such as sponsorship, membership eligibility, membership requirements, and sanctioning mechanisms for noncompliance (Cutler, Haufler, and Porter 1999). Comparative research can assess how these characteristics influence nongovernmental regimes' diffusion and efficacy. By embarking on this route, scholars would be better able to connect the private authority literature with the broader literature on policy diffusion and innovation.

The policy impact of nongovernmental regulation depends on the types of regulations imposed by intergovernmental regimes. Had the WTO allowed governments to impose process-based standards on imports, nongovernmental actors would have fewer incentives to establish process-based regimes. Thus, the WTO has created the political space for the emergence of process-based voluntary regulation. While environmentalist often view voluntary regulation as undermining governmental regulation, future research needs to pay careful attention to how nongovernmental regulation may also complement governmental regulation.

[11] An alternative specification of the dependent variable might be to use number of certificates per dollar of GDP coupled with an OLS type model based on the assumption of a normally distributed dependent variable, perhaps with panel corrected standard errors (Beck and Katz 1995) to correct for heteroskedasticity and contemporaneous correlation of errors across countries that are common to panel data. We should note that the transformation of the dependent variable (ISO 14001 certificates per unit of GDP) does not really eliminate the problems of the nonnormal distribution that compelled us to use an event count model in the first place. The variable is highly skewed, with a large number of zeros and a long "tail" of positive values, suggesting that models based on normality assumptions will yield inefficient and biased results.

Appendix 1

A Check List for Implementing ISO 14001 Management Systems

Policy
- Does the company have a documented environmental policy?
- Has the policy been approved by the top management? Is there a designated top manager in-charge of overseeing its implementation?
- Is the success in meeting policy objectives periodically reviewed?
- Does the policy require employees to adopt best available technology and commit to continual improvement?
- Does the policy meet or exceed legal requirements?

Environmental Impact
- Has the company assessed the environmental impact of its operations and products in terms of their likelihood and severity?
- Does the location of any facility require specific environmental consideration?
- Has the facility assessed the environmental impact if the production processes were to malfunction?

Environmental Objectives
- Have specific and measurable environmental targets been established?
- Is there a system for documenting relevant EMS and the targets they intend to achieve?
- Is progress towards various targets periodically tracked? Is there a system to take corrective action in the event targets are not being met?
- Is there a process to assess resources required to meet these targets?
- Does the facility identify specific personnel at various levels and make them responsible for achieving environmental targets?
- Do they have adequate resources to fulfill their responsibilities?
- Are employees directly and indirectly involved in the EMS implementation?

Environmental Plan
- Does the environmental planning involve stakeholders within and outside the firm?
- Is the plan periodically reviewed?
- Are there identified personnel who maintain the list of all applicable laws and regulations that pertain to facility operations?
- Is there a system of tracking compliance with these laws?

Organizational Alignment
- Is the EMS integrated with the organization's strategic plan and business plan?
- Is there a process to resolve conflicts between environmental and non-environmental objective?
- Does the top management regularly communicate to organizational personnel about environmental issues?
- Does the organization recognize and reward contribution to establishing and implementing EMS?

Source: Sayre (1996).

Appendix 2

Alternative Models of ISO 14001 Certification Rates, 1996–2002

Independent Variables	*Event Count without Fixed Effects*	*Model without EU*	*Model without Japan*	*Two-Stage Instrumental Variable Model*	*Event Count with Lagged Dependent Variable instead of AR1*
Export Dependence	.0325 (.054)	.055 (.130)	.045 (.124)	.046 (.102)	.0517 (.096)
Bilateral Trade weighted by ISO adoption	.199 (.022)**	.134 (.032)**	.132 (.030)**	.197 (.042)**	.0644 (.022)**
International Controls					
FDI	8.738e−11 (3.620e−11)	−.028 (.081)	−.018 (.073)	4.062e−11 (4.333e−11)	−5.17e−11 (2.93e−11)
Language	.006 (.022)	.114 (.053)*	.116 (.047)*	.03 (.017)	.023 (.011)**
Neighbor	.036 (.047)	.062 (.044)	.054 (.041)	−.014 (.035)	−.005 (.019)
IGO (intergovernmental organizations)	−.246 (.194)	−.448 (.321)	−.400 (.281)	−.238 (.261)	−.329 (.189)*
INGO (nongovernmental organizations)	.241 (.187)	.571 (.269)*	.500 (.251)*	.482 (.242)*	.252 (.144)*

(continued on next page)

Appendix 2 (*Continued*)

Independent Variables	*Event Count without Fixed Effects*	*Model without EU*	*Model without Japan*	*Two-Stage Instrumental Variable Model*	*Event Count with Lagged Dependent Variable instead of AR1*
Domestic Controls					
GDP	.631 (.128)**	.197 (.182)	.810 (.523)	.791 (.511)	.701 (.508)
Manufacturing	.015 (.011)	−.018 (.019)	−.012 (.018)	−.011 (.019)	−.011 (.013)
Government	7.873e−4 (.015)	.030 (.027)	.016 (.028)	.015 (.026)	.010 (.020)
Consumption	1.034e−4	2.538e−04	1.488e−04	1.542e−04	0.0001
Per Capita GDP^2	(3.654e−05)**	(1.062e−04)*	(5.765e−05)*	(7.071e−5)*	(.000004)**
Per Capita GDP^2	−2.036e−9	−5.55e−09	−2.326e−09	−2.471e−09	−1.605e−09
	(7.160e−10)**	(2.553e−09)*	(7.551e−10)**	(9.911e−10)*	(6.146e−10)**
SO_2	−.008 (.011)	−.021 (.016)	−.017 (.016)	−.017 (.017)	−.012 (.009)
Regulations	−.016 (.049)	.138 (.088)	.142 (.087)	.092 (.085)	.145 (.062)**
ISO9000	.226 (.093)*	.437 (.131)**	.441 (.129)**	.521 (.148)**	.368 (.069)**
$ISO14001_{t-1}$					.281 (.040)
$ISO14001(dummy)_{t-1}$					.245 (.157)**
Fixed effects	No	Yes	Yes	Yes	Yes
Constant	−16.649 (2.777)**	−9.200 (4.338)*	−22.317(11.035)*	−23.197 (10.969)*	−18.54 (10.96)*
N	756	651	749	756	756
χ^2	1609	1290	924	690	2407

Standard errors in parentheses.
**p < .01, *p < .05.

Appendix 3
Descriptive Statistics

Variable	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
ISO14000	175.71	669.24	0.00	10620.00
Key Independent Variables				
Export Dependence	.399	.95	.01	27.92
Bilateral Trade weighted by ISO Adoption	4.72	3.84	.158	61.93
International Controls				
FDI	.029	.60	−20.73	10.72
Common Language	−3.12	3.38	−6.91	3.84
Neighborhood	−3.45	3.34	−11.21	4.04
Intergovernmental organizations	3.86	0.34	2.30	5.01
Nongovernmental organizations	6.74	0.81	4.17	8.73
Domestic Controls				
GDP	24.42	1.96	20.16	29.85
Manufacturing	17.61	6.61	3.99	52.13
Government Consumption	16.14	5.87	3.71	33.14
Per Capita GDP	10,482.74	9058.50	341.29	56022.03
Per Capita GDP^2	1.93e+08	3.11e+08	116,477.7	3.14e+09
SO_2	1.05	1.66	−4.38	5.67
Regulations	5.63	1.82	1.27	10.54
ISO 9000	4.54	3.49	−3.00	11.11

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