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New Dependencies: FDI and the Cross-Country Diffusion of ISO 14001 Management Systems[1]

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Abstract

Dependency scholars contend that multinational enterprises (MNEs) have perverse effects on host country economies, particularly in the developing world. A key manifestation is that MNEs transfer management practices and technologies to their host country subsidiaries that are inferior to what they employ in their home countries. Country-of-origin scholars counter that MNEs promote management practices and technologies in host countries that are similar to the ones employed in home countries. In light of this debate, this paper examines conditions under which MNEs promote via foreign direct investment the cross-country diffusion of ISO 14001, the most widely adopted voluntary environmental program in the world. To investigate this issue, we examine inward FDI stocks and ISO 14001 adoption levels for 98 countries over 6 years (1996-2002). Our empirical model controls for a variety of factors including host countries' domestic institutions and their embeddedness in international economic and sociological networks that might influence ISO 14001 adoption. We find support for the country-of-origin argument: inward FDI stocks are associated with higher levels of ISO 14001 adoption in host countries, but only when FDI originates from home countries that themselves have high levels of ISO 14001 adoption. What matters for ISO 14001 adoption is not how much FDI a country receives but from where.

Introduction

Competition to attract foreign direct investment (FDI) creates opportunities for multinational enterprises (MNEs) to diffuse management practices, technologies, and ideational paradigms from their country-of-origin (home country) to host countries in which their foreign operations are located. The processes by which this diffusion occurs, and its consequences for host countries, have been of interest to scholars for quite some time. This paper examines conditions under which MNEs transfer via FDI progressive environmental practices from home countries to host countries. Our focus is on ISO 14001, the most widely adopted voluntary environmental program in the world. Firms participating in ISO 14001 pledge to take costly progressive environmental actions beyond what governmental regulations require. We show that host country firms are more likely to join ISO 14001 when their country receives FDI from home countries where ISO 14001 has been widely adopted. Broadly, our paper suggests that FDI may serve as conduit for diffusing home country practices to host countries. The policy implication is that developed countries can transfer a range of progressive practices --- from environmental stewardship to labor standards --- to host (developing) countries, a promising development given that developing countries are net recipients of developed countries' FDI.

Our findings are important because globalization critics contend that competition for FDI pressures host governments to weaken domestic regulations, particularly in areas such as environmental protection. For environmentalists, such competition implies that the more FDI a country receives, the more pressure its governments will perceive to race to the bottom, as the "pollution haven" and the "industrial flight" hypotheses contend (Charnovitz, 1993 but see Kahler, 1998). If MNEs believe that host governments do not care about environmental or labor practices, they are unlikely to voluntarily adopt the expensive beyond-compliance practices in

host countries that they tend to employ in their home countries. Our results suggest a different dynamic, however. We find that while overall levels of FDI stocks do not affect ISO 14001 adoption in host countries, FDI can encourage ISO 14001 adoption if this voluntary regulation has been widely adopted in the home countries from which host countries receive FDI. Thus, under some conditions, FDI can help ratchet up environmental practices in host countries rather than instigating a race to the bottom.

Our inquiry bears on two related controversies in the fields of international business and international political economy. The first centers on whether FDI flows are generally benign for host countries. As profit seeking actors, MNEs are likely to channel investments to countries offering competitive advantages such as lower labor, regulatory, and production costs or access to new markets and raw materials (Dunning, 1993; Caves, 1996). Potential host countries may therefore have incentives to lower their regulatory standards to attract FDI. For dependency scholars (Baran, 1957; Frank, 1967), MNEs deploy in host (developing) countries technologies and management practices that are cheaper and inferior to the ones they use in their home countries.[2] If such a pessimistic case were generally true, we would expect host countries receiving more FDI to have fewer ISO 14001 certifications because MNEs would discourage their foreign subsidiaries from voluntarily adopting expensive management practices beyond what host country regulations require.

Conversely, globalization optimists point out that from MNEs' perspectives, standardizing management practices across countries can lower their coordination and

[2] There are different versions of the dependency argument and there are several dependency debates. For an overview of this vast literature, see the special issue of *International Organization*, winter 1978.

management costs. In this vein, the country-of-origin school suggests MNEs have incentives to transfer technologies and management practices, such as those codified in ISO 14001, that are significantly influenced by, if not comparable to, the ones adopted in the home country (Paul and Reich, 1997; Zaheer and Zaheer, 1997; Van Tulder and Kolk, 2001). Not surprisingly then, MNE subsidiaries typically have superior environmental practices in relation to local firms because they have better access to such technologies and practices. In addition advantages regarding the "supply" of superior practices, MNEs may also encounter "demands" from host country stakeholders that they employ such practices. Recent work suggests that given their foreignness, MNE subsidiaries face greater scrutiny from local governments and NGOs and may therefore feel coercive pressures to be greener than their local counterparts (King and Shaver, 2001). As a second order effect, FDI's influence may then spread through host economies as MNE subsidiaries encourage and sometimes even require their suppliers to adopt these standards (Christmann and Taylor, 2001); a phenomenon that has widely occurred in the automobile industry (Coglianese and Nash, 2001).[3]

The second controversy addressed in this paper centers on whether globalization leads to a convergence among organizational structures and management practices across the world. Convergence theorists suggest that rather than tailoring management practices to fit host country idiosyncrasies, MNEs demand that their subsidiaries conform to a uniform and often global standard (Ohmae, 1991). Of course, one might wonder why this standard should conform to the more stringent (i.e., home country) ones. The argument is that because lower environmental or

[3] Given the legal issues about "due diligence" subsequent to the 1984 Bhopal incident, by adopting ISO 14001 world-wide, MNEs could demonstrate "due diligence" in their environmental operations (Monshipouri et al., 2003).

labor standards are unlikely to be acceptable in developed countries, MNEs are likely to adopt the more stringent standards across their subsidiaries.

In contrast, divergence theorists, emphasizing the continued importance of host country institutions and cultures, argue that MNEs adapt their technologies and management practices to the requirements of their host countries (Hofstede, 1980). When in China or India, do as the Chinese or Indians do. Because there is considerable diversity in the culture and institutions across host countries, technologies and management practices adopted by MNEs can be expected to vary across subsidiaries. In the light of this important debate (Bartlett and Ghoshal, 1989; Kostova, 1999), this paper examines whether countries' ISO 14001 adoption rates are influenced by domestic host country factors or by factors salient in MNEs' home country.

So far, we have described ISO 14001 and voluntary programs in complimentary terms.[4] It is fair to say that many environmentalists have been quite skeptical of voluntary regulations (Steinzor, 1998), suggesting they 'greenwash' firms' poor environmental performance. Indeed, there is evidence that at least some voluntary programs have been ineffective (King and Lenox, 2000; Welch et al., 2000). As discussed subsequently, recent studies suggest ISO 14001 improves firms' environmental and regulatory performance. While ISO 14001 has its limitations, it is reasonable to assert that ISO 14001 encourages firms to adopt progressive environmental practices.

[4] There is a growing literature on voluntary programs, also described as non-governmental or private authority regimes, examining conditions under which they emerge, how they get legitimized, conditions under which they are effective, and whose interests they serve (Cutler et al., 1999; Haufler, 2001; Hall and Biersteker, 2002; Mattli and Büthe. 2003; Prakash and Potoski, 2006a).

ISO 14001 was launched by the International Standards Organization in 1995, and by 2003 there were about 50,000 ISO 14001 certified facilities around the world. This paper examines ISO 14001 adoption in 98 countries between 1996 and 2002. The empirical analyses suggest that while host countries' overall inward FDI stocks do not influence ISO 14001 adoption levels, host countries are likely to have more ISO 14001 certifications if their FDI stocks originated from home countries where ISO 14001 has been widely adopted. In other words, countries' ISO adoption levels are associated not with *how much* FDI host countries receive but *from whom* they receive it. These empirical results persist even after controlling for the host countries' domestic institutions and their embeddedness in international economic and sociological networks.

While NGOs working to safeguard the environment and improve labor standards are troubled by the rising tide of FDI, our paper suggests that NGOs can leverage MNEs' influence on host country practices for their policy goals. Instead of demanding that FDI inflows be restricted, environmental groups should consider welcoming FDI in order maximize MNEs' potential environmental multipliers in host economies. After all, most MNEs are headquartered in developed countries where environmental NGOs tend to be well established political actors. By strategically 'lobbying the corporation' (Vogel, 1978) in their home turf, NGOs can utilize MNEs' supply-chain networks to diffuse environmental practices in host countries where they may not have the political muscle to lobby the corporation or the government.

The paper is organized as follows. The next section of this paper describes the International Standards Organization and ISO 14001. The third section presents theoretical perspectives and identifies the key hypotheses we examine in this paper. The fourth section

presents the methods and data used in the analyses. The fifth section reports the results and the sixth section concludes the paper.

ISO 14001

The mandate of the International Organization for Standardization (ISO) is to promote international trade by developing international standards, about 15,000 since its inception in 1946. While ISO is not an NGO in the sense of being an activist group, it is a non-governmental actor whose members are private sector national bodies such as the American National Standards Institute and the Deutsche Institut für Normung (Mattli and Buthe, 2003). In its recent *World Trade Report*, the World Trade Organization (2005) discusses the importance of private and public standards, highlighting ISO's role in this regard and explaining the rationale for effective global standards:

> As a network of national standards institutes of 148 countries, ISO is the world's largest developer of standards. Its scope extends to all fields except electrical and electronic engineering, the IEC's domain, and telecommunications, that of the ITU (2005: 119)…. Whether as end consumers or as producing firms acquiring inputs, buyers may be at a significant disadvantage compared to sellers because the latter possess information about the good or service not available to the buyer. This asymmetry can significantly hamper the efficient functioning of markets, and standards can help solve the problem and increase efficiency (2005: xxvi)...
> Among the factors accounting for heightened standardization activity are demands by consumers for safer and higher quality products, technological

> innovations, the expansion of global commerce and increased concern over social issues and the environment (2005: 26).

While ISO 14001 may come across as a technocratic regime, it serves a political purpose, one that MNEs tend to favor. MNEs' generally favor ISO's regulatory harmonization agenda because variations in regulations across countries may increase regulatory compliance costs. By demonstrating that businesses can credibly self-regulate, international standards such as ISO 14001 may preempt or dampen demand for new domestic regulations, a form of regulatory harmonization via a non-governmental regimes, grounded largely on MNEs' terms.[5]

ISO 14001 prescribes the broad principles for firms' environmental management systems; it does not mandate specific environmental standards for firms' products, technologies firms must adopt in their production processes, or even environmental outcomes firms must achieve. The rationale for focusing on management standards instead of products standards or technologies is that if appropriate processes are in place, desired outcomes will follow (ISO, 2005a). Firms that wish to join ISO 14001 must establish a written environmental policy that has been approved by senior management. To comply with ISO 14001 standards, firms must specify 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 technologies, assess the environmental impact of their operations, and establish programs to train their personnel in environmental management

[5] Arguably, the ISO embodies and perpetuates dependency because its rulemaking processes are significantly influenced by industrialized countries (Clapp, 1998)

systems.[6] For most firms, these management systems are quite extensive, requiring substantial investments in personnel, training, and most critically, in establishing paper documentation for their environmental operations (Sayre, 1996).

Unlike some other voluntary environmental programs, ISO 14001 requires participants to receive an initial certification audit, conducted by certified external auditors who themselves are audited and approved by their domestic national standards body. Firms must then receive annual recertification audits to verify that their management systems continue to meet ISO 14001's standards (ISO, 2005b). These audit and certification measures are designed to prevent participants from shirking their program responsibilities as ISO 14001 members. Receiving and maintaining ISO 14001 certification carries non-trivial costs. While Kolk (2000) estimates that ISO 14001 certification can cost from $25,000 to over $100,000 per facility, William Glasser (2004) of the EPA estimates that "large facilities spend on average about $1M in sunk transaction costs to pursue certification."

Recent research suggests that ISO 14001 certification, in addition to being costly, improves firms' environmental and regulatory performance. In a study of 236 Mexican firms in the food, chemical, nonmetallic minerals and metal industries (which together generate 75 to 95 percent of Mexico's industrial pollution), Dasgupta et al. (2000) find that ISO 14001 adopters show superior compliance with government environmental regulations. This in an important finding given that developing country governments often have difficulties enforcing their own regulations. Instead of undermining public regulation, ISO 14001 may improve firms' compliance with them, even when firms are located in alleged pollution havens. Echoing Dasgupta et al.(2000), in an analysis of over 3000 US facilities, Potoski and Prakash (2005b) find that ISO 14001 certification improves regulatory compliance among US facilities regulated

[6] http://www.iso.org/iso/en/iso9000-14000/index.html; accessed 01/27/2006

under the Clean Air Act. There is also evidence that firms joining ISO 14001 also pollute less. In an analysis of 316 U.S. electronics facilities, Russo (2001) finds that ISO 14001 membership is associated with decreased toxic emissions. Potoski and Prakash (2005a) report that ISO 14001 adopters reduce pollution as recorded in the EPA's Toxics Release Inventory. In sum, while it is true that ISO 14001 alone will not solve all industrial pollution problems, there is some evidence that ISO 14001 adoption leads to lower facility-level pollution and improved facility-level compliance with public law. It achieves this via the requirement that ISO 14001 certified firms adopt management practices that are monitored by outside auditors. The adoption of ISO 14001, a voluntary regulation, therefore poses an interesting puzzle given the belief that firms favor lowering regulatory costs imposed by even by governments.

Theoretical Perspectives

Since the publication of *Wealth of Nations* (Smith, 1776), economic integration proponents (Bhagwati, 2003) and critics (Polanyi, 1944; Daly, 1993) have passionately debated the overall benefits of international economic exchanges. With the end of World War II and the gradual dissolution of colonial empires, policy makers began discussing optimal developmental models to apply in developing countries (Chakravarty, 1997). While some promoted a more laissez faire model (Rostow, 1960), dependency scholars argued that industrial countries' structural advantages favor them in international exchange at the expense of developing countries (Baran, 1957). For dependency scholars, FDI perpetuates, if not exacerbates, the North-South economic divide. They believe that MNEs deploy inferior technologies and practices in the developing world that are no longer useful in their home countries (Hymer, 1960). In this context, MNEs have little incentive to require their overseas subsidiaries to adopt expensive management

practices that are beyond the requirements of host country regulations. The dependency argument thus suggests that countries that receive more FDI will have lower levels of ISO 14001 adoption:

> Hypothesis 1 (Dependency Hypothesis): Countries with higher FDI levels have lower ISO 14001 adoption levels.

As the dependency school won adherents, several developing countries adopted its prescriptions to shun foreign trade and FDI, and to implement instead import-substitution programs. The economic results were unimpressive and the gap between developed and underdeveloped grew. Meanwhile, several East Asian countries that had embraced international economic integration were experiencing spectacular economic growth, thereby suggesting that international economic exchange may have positive payoffs even for "periphery" countries (World Bank, 1992).

Stepping into this debate, analysts have turned to identifying conditions under which FDI and trade can provide the optimal benefits for host economies (Stopford, 1998/1999). The study of when MNEs transfer superior country-of-origin practices versus when they let their subsidiaries respond to host country institutions and cultures (or perhaps even consciously dump inferior practices and technology) has spawned a rich literature. MNEs face potentially conflicting pressures emanating from the home as well as the host country when choosing management practices and technologies. As Rosenzweig and Singh (1991: 345) note, "if subsidiaries of MNEs face pressures to adapt to the institutional demands of host countries, and therefore tend to become isomorphic with other local organizations, they also face pressures for

consistency with other subunits of the MNE." The country-of-origin school (Porter, 1990; Sethi and Elango, 1990; Langlois and Schlegelmilch, 1990; Paul and Reich, 1997; Zaheer and Zaheer,1997; Van Tulder and Kolk, 2001) argues that home country institutions, norms, and management practices shape the activities and decisions of MNEs. The contention is that corporations are not stateless (Ohame, 1990), immune from home country influences. Pauly and Reich note:

> ..(R)ecent evidence shows little blurring or convergence at the cores of multinational corporations based in Germany, Japan, and the United States. They continue to diverge fairly systematically in their internal governance and long-term financing structures, in their approaches to research and development as well as in the location of basic research facilities, and in their overseas investment and intrafirm trading strategies (1997: 1).

If country-of-origin argument holds, then FDI from home countries with high levels of ISO 14001 will tend to be associated with high ISO 14001 adoption in host economies. Furthermore, while MNEs can certainly mold their subsidiaries' environmental programs in the image of their home county operations, the effect of MNEs on host economies may be larger because MNE subsidiaries can create externalities for other host firms. MNEs can diffuse their practices through a host country by mandating them for their local suppliers, by demonstrating their efficacy, and by training workers in mobile labor environments. Indeed, a substantial literature documents the effect of MNEs on host country firms beyond their subsidiaries. For examples, Aitken

and Harrison (1999) suggest that MNEs transfer technology to local firms and Javorcik (2004) finds evidence that FDI increases the productivity of local firms via backward linkages.

ISO 14001 would appear to be a prime case for critics of the country-of-origin school who would argue that host country characteristics dominate MNEs' environmental practices. If host countries have permissive environmental laws, according to this argument, then MNEs may have incentives to adopt environment practices that entail minimal investments, rather than the expensive ones which mimic home country practices. This is particularly relevant given the prominence accorded in popular press to the "pollution haven" and the "industry flight" hypotheses whereby host countries look to entice MNEs by offering lax environmental laws (Daly, 1993; Jaffe et al., 1995; Mani and Wheeler, 1998). Thus, we have two starkly different expectations whether MNEs can be expected to require or encourage their overseas subsidiaries to voluntarily take on new regulatory costs such as the ones embodied in ISO 14001 adoption that reflect home country imperatives. Our discussion leads to the following:

> Hypothesis 2 (Country of origin effect): ISO 14001 adoption rates are higher in host economies that receive FDI from home countries having high levels of ISO 14001 certifications.

Although we are primarily interested in the role of FDI in diffusing ISO 14001 across countries, our analyses control for several international and domestic factors that might influence country-level ISO 14001 adoptions. Previous studies suggest that while countries' overall exports may not significantly influence ISO 14001 adoptions, international trade can encourage

ISO 14001 adoptions if a country's key export markets have widely adopted this voluntary regulation (Prakash and Potoski, 2006b). This trade story is somewhat similar to the one we are outlining in the context of FDI. That is, via international trade, importing countries may influence organizational practices adopted in the exporting countries. We thus control for countries' overall export levels as well as their bilateral exports weighted by the ISO 14001 adoption in recipient countries.

Countries' ISO 14001 adoption rates could also be influenced by normative and ideational pressures emanating from the "world society" (Meyer et al., 1997). If ISO 14001 represents a normatively appropriate environmental governance approach that fits with prevailing international environmental stewardship norms, firms may join the program 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 intergovernmental and nongovernmental organizations, and cultural networks based on shared geography and language. Firms in countries that are more deeply embedded in international intergovernmental organization (IGO) and international nongovernmental organization (INGO) networks (Boli and Thomas, 1999) may be more prone to adopt ISO 14001. Common language (Simmons and Elkins, 2004) and geographical proximity (Kopstein and Reilly, 2000) may also aid across-border normative diffusion. After all, managers are likely to take cues regarding appropriate corporate behavior by observing other mangers with whom they have linguistic and cultural affinities.

Host country institutions could influence ISO 14001 adoption via firms' perceptions of ISO 14001's instrumental and normative dimensions. Host country subsidiaries and other firms are likely to view the usefulness of voluntary regulations in terms of their fit with domestic

institutions. More competitive market economies can create incentives for firms to differentiate themselves on a variety of counts, including environmental stewardship (Porter and Linde, 1995). Thus, ISO 14001 adoption rates are likely to be higher in countries that have competitive economic systems. Another key attribute of the host country environment is the level of 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' demand for environmental protection may be influenced by countries' pollution emissions. When pollution levels are high, citizens are likely to demand that governments and firms adopt policies such as joining ISO 14001 to curb pollution.

Data

To investigate how inward FDI influences country-level ISO 14001 adoption rates, we examine a panel of 98 countries from 1996 through 2002. 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).[7] In 1996 there were an average of about 13.2 ISO

[7] Ideally, our dependent variable would measure the number of ISO 14001 facilities as a proportion of total number of facilities that could potentially subscribe to this voluntary regulation. Because data on the total number of certifiable facilities across a large number of countries are not available, we take GDP adjusted for purchasing power parity (PPP) as a proxy. Because economic systems organize their production processes differently, facilities per dollar of GDP are likely to vary cross-nationally. Assuming variations in purchasing power capture (however, imperfectly) the variations in production systems, we control for PPP adjusted GDP.

14001 certified facilities per country in our sample; by 2002 the number had grown to about 447 with Japan having the most certifications at 10,620. 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 inward FDI stocks on countries' ISO 14001 adoption levels. First, we measure a host country's overall dependence on FDI (*Overall FDI*) based on argument that, irrespective of the FDI's source, higher levels of FDI discourage host countries' ISO 14001 adoption (Hypothesis 1). Unlike trade, FDI accumulates over time. Thus, the potential influence MNEs exercise in host economies depends not only on the FDI inflow in a given year but on MNEs' accumulated inward FDI stock. *Overall FDI* is therefore calculated as a country's total inward FDI stock as a proportion of GDP.

From the country-of-origin school's perspective, host country's ISO 14001 adoption will be influenced not so much by overall FDI but by the ISO 14001 adoption levels in the home countries from which FDI has originated (Hypothesis 2). We measure each country's bilateral FDI context based on its inward FDI stock from various home countries, weighted by home countries' ISO 14001 adoption levels (*Bilateral FDI Weighted by ISO Adoption*). We calculate each country's bilateral FDI context as:

$$\text{Bilateral FDI weighted by ISO adoption}_{it} = \sum_j \text{ISO}_{jt} \times (\text{FDI}_{ij} / \text{FDI}_i)^2$$

In addition, by including country fixed effects, our model captures, among other things, variations in production structures that other covariates do not control.

Where ISO_{jt} is the number of ISO certifications in country j at time t, FDI_{ij} is country i's FDI stock in country j, FDI_{i} is country i's total inward FDI stock. FDI stock data were downloaded from the UNCTAD (www.unctad.org) and OECD (www.sourceoecd.org) databases (see Appendix 1 for the description of these databases).

Akin to the bilateral FDI context, following Prakash and Potoski (2006b), we control for countries' *bilateral exports weighted by ISO 14001 adoption*:

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

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. We also control for exports as a percentage of host GDP (*exports*). Trade data were downloaded from the United Nation Statistics Division's Comtrade database (United Nations, 2004).

Our analyses include several control variables that might influence countries' ISO 14001 registrations. Countries deeply embedded in international networks may have higher levels of ISO 14001 adoption rates. Networks can serve as conduits for ideas, including norms regarding firms' environmental responsibilities. INGO and IGO networks enhance ideational flows across countries. INGO is the total number of non-governmental international organizations a country's citizens have joined and *IGO* is the number of inter-governmental international organizations a country's government has joined, as reported in various years by the *Yearbook of International Organizations* (Union of International Associations, 1997). Linguistic networks can be an important conduit for ideas and norms regarding ISO 14001. The costs of transmitting ideas and norms such as those embedded in ISO 14001 are likely to be low when actors share a common

language. Linguistic brethrens are also likely to take cues from one another regarding the normative appropriateness of management practices. Our model controls for the language effect (*Language*) which we capture in terms of the average number of ISO 14001 certifications per capita in countries that share a common language with a given country. Data on countries' primary language(s) are from the CIA Factbook (CIA 2004).

Geography may also influence ISO adoption levels. Information and norms flow more readily between contiguous entities than between non-contiguous ones simply because neighbors are likely to have more opportunities to exchange information and to observe one another. Our model controls for the neighborhood effect which we capture it in terms of the average number of ISO 14001 certifications per capita in countries that share contiguous borders (*Neighbors)*. Data on geography are from O'Loughlin et al. (1998).

As indicated above, MNEs' policies in host countries are likely to be responsive to local institutions and culture. Accordingly, our model controls for theoretically important domestic variables that are likely to affect ISO 14001 adoption levels. We take GDP adjusted for purchasing power parity (*GDP*) as a proxy for the total number of certifiable facilities in a country. Citizens may demand more environmental protection if they are located in countries with high pollution levels. We capture the pollution effect in terms of a country's total SO_2 emissions (in tons), as reported in Stern (2005). ISO 14001 adoption levels may also respond to citizens' demand that firms adopt environmentally progressive policies. Such demands may be higher in wealthy countries. We control for this wealth effect by including *per capita GDP* (adjusted for purchasing power parity) as a covariate. Data on *per capita GDP* are from the World Development Indicators. The effect of wealth on macro level environmental indicators may be non-linear as the debate on the so-called environmental Kuznet curve suggests

(Grossman and Krueger, 1995). To model such potential non-linearities, our model includes per capita GDP squared (*per capita GDP*^{2}) as a covariate.

ISO 14001 can serve as branding mechanism that signals a firms' commitment to environmental policies and likely to appeal more to firms operating in competitive markets. We capture the competition effect on ISO 14001 adoption by controlling for the regulatory context as reflected in countries' property rights and regulatory policies (*regulations).* To do so, we draw on the Heritage Foundation's Index of Economic Freedom (Heritage Foundation, 2003). Finally, we recognize that ISO 14001 management system approach is modeled around the ISO 9000. To control for such dependencies, our model includes previous ISO 9000 (*ISO 9000*) adoption levels. Data are from the 12th cycles of ISO 9000/14000 census (ISO, 2003).[8]

Our data were not complete for all variables for all countries in our sample. While *IGO* and *INGO* measures were only 71.0% complete and SO_2 emissions variable was 75% complete, other variables were at least 80% complete. Instead of list-wise deletion via dropping countries with missing data, we imputed the missing data (King et al., 2001) and generated seven data sets using the Amelia program (Honaker et al., 2001). The results presented below are the adjusted averages from analyses of seven data sets with missing values imputed via Amelia.

[8] We also experimented with several variables that could bear upon ISO 14001 adoption levels in the host country. These include the litigious context, the share of manufacturing in the GDP, and government's share of GDP, portfolio inflows, embeddedness in colonial and religion-based networks, tourism inflows and internet connections. Because these variables were not significant and their exclusion did not affect our substantive results, we did not include them in the final model

Empirical Model

This paper seeks to model the effects of inward FDI stock and other covariates on host countries' ISO 14001 adoption. To do so, we estimate the following equation:

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

where μ_{it} is the marginal expectation of y [$E(y_{it})$], 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 FDI 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.[9] The form of *h, g* and α are the canonical structure for negative binomial event count models (Cameron and Trivedi, 1998) where *g* represents the negative binomial distribution, *h* is a natural log link function for transforming the expectation of *y,* and α is the dispersion parameter.

We chose a binomial event count model due to the distribution of the dependent variable.[10] Clearly, zero is the lower bound for any country's ISO 14001 adoption. Indeed, in our

[9] Our calculations of the bilateral FDI and bilateral exports measures take a one year lag in ISO 14001 certifications into account, although the export measures used as scales are not lagged.

[10] One could specify the dependent variable as the number of facilities per dollar of GDP and employ an OLS type model based on assumption of normally distributed dependent variable. The issue is that even in its transformed form, the dependent variable persists with a non-normal distribution. Further, because such a dependent variable would still be skewed and have a large

sample countries and years, we find a large number of zeros and the standard deviation greater than the mean. Because there is no reason to suggest that different factors drive any country's first ISO 14001 in relation to its subsequent ones, we decided not to employ zero-inflated models. Further, the dispersion in our data suggests a negative binomial specification should be preferred over a Poisson specification.

Our dependent variable, ISO 14001 certifications, is likely to be serially correlated within countries. To address this issue, our model includes 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). To check whether this correction is adequate, following Woolridge (2003), we regressed the residuals from our analysis on all covariates, the lagged dependent variables, and the lagged residuals. Because we are working with a count model, we first normalized the residuals to have a mean of zero and a standard deviation of one (Cameron and Trivedi 1998). The coefficient for the lagged residual was not significant, suggesting the absence of serial correlation.

Finally, we should address three other statistical issues. First, while we have assumed that observations across countries are independent, we recognize that observations within countries are not independent. To deal with this issue, our model employs robust standard errors adjusted for clustering within countries (Williams, 2000). Second, because countries may differ in ways not fully captured by the covariates (Green et al., 2001), we include "country fixed effects" to better specify our model and take care of the omitted variable bias. While this strategy has been criticized (Beck and Katz, 2004), not having sticky institutional covariates in our model gives us

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number of zeros and a long "tail" of positive values, models based on normality assumptions will yield inefficient and biased results.

additional confidence about employing country fix effects. Third, we recognize that ISO 14001 adoption may be subject to spatial correlation if countries exert influence on each others' ISO 14001 adoption levels through their geographical proximity and common cultural connections. The *Neighbor* and *Language* variables seek to control for such influences.

Results

The results of our analyses of the number of certified facilities in 98 countries between 1996 and 2002 are presented in Table 1. We also report the discrete changes in our key explanatory variable. By discrete change we mean a change in the ISO 14001 adoption associated with a change in an independent variable from one standard deviation below its mean to one deviation above its mean, holding all other variables at their means (Long 1997). We interpret the effects size of negative binomial event count models relative to the median value of the dependent variable. For reference, the median number of certified facilities is 4 across the entire sample of years and countries, and 24 in 2002.

Table 1 about here

As shown in table 1, FDI influences ISO 14001 adoption through *bilateral FDI weighted by ISO 14001 adoption* (Hypothesis 2) but not via *overall FDI* (Hypothesis 1). Host countries whose inward FDI stock originates from home countries that have high levels of ISO 14001 certifications tend to have higher levels of ISO 14001 adoptions (Hypothesis 2). An increase in the *bilateral FDI* context from one standard deviations below its mean to one standard deviations above increases the number of ISO 14001 certified facilities by about five holding the effects of

other variables constant at their means. Note that holding all other variables, reduces the apparent size of the predicted effect for the *bilateral FDI weighted by ISO 14001 adoption* variable, particularly the per capita GDP measure because the bulk of ISO 14001 registrations occur among wealthy nations. Indeed, the predicted effect of *bilateral FDI weighted by ISO 14001 adoption* is much higher when the GDP measure is set at its 95th percentile and the other variables are set at their means.

The coefficient for *overall FDI*, -1.248e-11, is not statistically significant. Our analysis, therefore, suggests that levels of FDI a host economy receives overtime do not have a statistically significant influence on host country firms' decisions regarding ISO 14001 (Hypothesis 1). This implies that the dependency argument that high levels of FDI stocks will be associated with low ISO 14001 adoption levels is not operating in our case. Instead, the country-of-origin argument holds because the levels of ISO 14001 adoption in home countries from which FDI stock has originated influence its adoption in host economies (Hypothesis 2).

Exports are not significant either, an issue we further investigate in the next section. However, we find that *bilateral exports weighted ISO 1400 adoption* have statistically discernable effects on host countries' ISO 14001 adoptions – a result that coheres with Prakash and Potoski (2006b). This suggests that two key commercial networks in which host countries are embedded, foreign direct investment and international trade, can serve to encourage the adoption of environmental management practices. FDI transmits norms and practices of home countries to host countries while foreign trade transmits the norms and practices of the export destinations to the exporting countries. What matters for ISO 14001 adoptions is: (1) the home countries from which the host country receives its FDI overtime and (2) the destinations to which the host country exports. In sum, contrary to the dependency argument, international economic

integration via FDI and trade may create incentives for host country firms to mimic environmental practices of home countries (and export destinations) and adopt policies that often exceed the requirements of host country regulations.

Our analyses suggest that *Neighbors* and *Language* are neither individually nor jointly significant ($p>.10$), suggesting that geography and common cultural values do not influence the diffusion of environmental managerial practices that are embodied in ISO 14001. Regarding the international sociological network variables, again *IGOs and INGOs* are not individually or jointly significant ($p>.2$). Our model therefore does not lend support to the World Society perspective (Boli and Thomas, 1999) that sociological networks serve as conduits of ideas and norms that lead to adoption of common organizational practices across countries. Arguably, in our case, FDI networks and trading networks (which World Society models do not privilege, perhaps even ignore, as conduits for ideas) may serve to diffuse ideas about environmental policies as enshrined in ISO 14001**.** It is possible that in addition to creating instrumental incentives for local firms to join ISO 14001, FDI and trading networks may also transmit normative pressures and raise the expectations that citizens have of their firms, both local and foreign. We believe that scholars interested in studying the role of ideas and norms in international political economy will need to examine the role of both commercial and non-commercial networks as conduits for the international diffusion of ideas.

Our model controls for several domestic variables. We find that *Regulation* is statistically significant and its directionality is in the expected direction. Thus, competitive markets encourage firms to differentiate themselves and ISO 14001 becomes an instrument firms could employ in this regard. *GDP,* a proxy for total number of facilities, and SO_2 are not statistically significant. We do find that countries with more *ISO 9000* registrants tend to have higher levels

of ISO 14001 adoption. We speculate that the management system approach prescribed by both ISO 9000 and ISO 14001 reduces the costs for local firms to understand the pros and costs of ISO 14001 and given the reported success of ISO 9000 in improving quality control practices (Rao et al., 1997), has persuaded them to join ISO 14001. We also find support for the argument that the relationship between wealth (*per capita GDP*^{2}) and ISO 14001 certifications is non-linear. ISO 14001 certifications increase slowly at the low percentiles of per capita income (the expected number of registration is 2.5 at the 10th percentile and only 8.7 at the 50th), increase sharply for countries that fall up to the 90th (81.2) percentiles, and then declines for countries at the top percentiles of per capita income.

Alternative Specifications

We examined different specifications of our model and find that our key findings hold across specifications. That is, *Bilateral FDI Weighted by ISO Adoption*, retains statistical and substantive significance across specifications. The other key independent variable, *Overall FDI*, is not significant in any specification but for the specification where we drop country fixed effects (Appendix 2, Column 4). Even in this specification, its directionality is opposite to that predicted in Hypothesis 1; that is, higher levels of overall FDI are positively, not negatively, associated with ISO adoption.

Dependency scholars allege that FDI has pernicious effects on developing countries. Given that developed countries are both the providers and recipients of bulk of the FDI, do our results hold for developing country alone? As reported in Appendix 2, Column 1, we find that our argument holds for developing countries; FDI supports the diffusion of ISO 14001 as long as it originates from home countries that have widely adopted this voluntary program.

The European Union (EU) countries have been in forefront of several environmental issues. Germany and United Kingdom also exhibit high levels of ISO 14001 certifications. Given the high levels of FDI flows within EU countries, it is plausible our results are driven by an "EU effect." To check for the "EU effect," we simply dropped the EU countries from our model and re-ran the analysis. As shown in Appendix 2, Column 2, the results are consistent with the full model, thereby suggesting that our conclusions that an "EU effect" is not driving our results regarding the effect of FDI on ISO 14001 adoption. We tested for a similar argument for Japan which has the highest levels of ISO 14001 adoption and is a major source of outward FDI to the rest of the world. We dropped Japan from the model and re-ran the analysis. As reported in Appendix 2, Column 3, we find that our results are consistent with the full (including Japan) analysis, suggesting that our conclusions are not driven by a "Japan effect".

Our model has included fixed effects to control for unit heterogeneity (Green et al., 2001). While the fixed effects are statistically significant in our main analyses reported in Table 1, given the criticism of this approach (Beck and Katz, 2004), we ran our model without fixed effects. As reported in Appendix 2, column 4, in this specification as well, *Bilateral FDI Weighted by ISO Adoption* is statistically significant and positive. While *Overall FDI* is also significant, its coefficient is positive and contrary to the dependency claim. In fact, the positive directionality of this variable reinforces the broader claim that inward FDI support ISO 14001 adoption in host countries.

One might argue that FDI would influence ISO 14001 adoption directly and indirectly via its effect on countries' per capita income. Given the possibility endogeneity issue between FDI stock, ISO 14001 adoption and wealth, we employed a two-stage instrumental variable approach. The first stage equation contains per capita income as the dependent variable and FDI and other

control variables as the independent variables. In the second stage equation, we replaced the actual values of per capita income by the predicted values for per capita income. As reported in Appendix 2, Column 5, in this specification as well, our key results are consistent with those reported in Table 1.

We also checked our results by employing a lagged dependent variable instead of an AR1 correction for serial correlation. As Cameron and Trivedi (1998) recommend, the lagged dependent variable was logged, the zeros were replaced with .05, and a dummy variable was include which was scored one for the zeros, and scored zero for all other values. As shown in Appendix 2, Column 6, our substantive results were consistent with those presented in Table 1.

Finally, given that more than half of world trade is intra-firm (that is, it takes place within the value chains of MNEs), our model may not have correctly estimated the total effect of FDI on country level ISO 14001 adoption. We, therefore, estimated a model that allowed us to examine the full impact of FDI (Hypothesis 1; the dependency argument) () while allowing the correlated variance between trade and FDI to be discounted. To do so, we first regressed FDI on trade, saved the residual trade, and then employed residual trade and FDI as covariates in our model to predict ISO 14001 adoption. In this specification also *Overall FDI* is not significant while *Bilateral FDI Weighted by ISO Adoption* is significant (Appendix 2, Column 7). In sum, across all specification we examined *Bilateral FDI Weighted by ISO Adoption* retains a positive and statistically significant relationship with the dependent variable, *ISO Adoption*, while *Overall FDI* remains statistically insignificant but for the specification without fixed effects.

Conclusion

Dependency theory alleges that international economic exchanges favor developed countries and to the detriment of developing countries. Because MNEs enjoy structural advantages in relation to host governments, they can exploit economic exchanges to their own benefit. If so, one would expect MNEs to dump inferior technology on host economies and adopt out-of-date management systems and practices in their subsidiaries. While a parent company may adopt progressive environmental policies in its home operations, its overseas subsidiaries especially in developing countries are unlikely to voluntarily take up new regulations that impose non-trivial costs. In the context of this paper, a dependency perspective would suggest that inward FDI stocks are likely to be negatively associated with ISO 14001 adoptions in host economies.

Several scholars question dependency theory's bleak assertions. In their view, FDI is associated with the transfer of technologies and practices to host countries which mimic MNEs' home country operations. This starts a virtuous cycle in which supply chains, labor mobility and institutional mimicry diffuse the technologies and practices beyond MNEs' subsidiaries to other host country firms. If this occurs, inward FDI stocks would be positively associated with ISO 14001 certifications in host economies if it emanates from home countries that have enthusiastically adopted ISO 14001.

From a policy perspective, it is important to know not only how much FDI a country receives but importantly from where. If public policy can influence FDI's sources, policy makers can indirectly influence the technologies and practices that are likely to be diffused to their country. If free trade and investment agreements such as NAFTA privilege FDI from signatory countries, then policy makers should carefully choose countries they wish to partner with. The

effect of inward FDI needs to be appreciated beyond its usual role of alleviating resource scarcity and creating jobs in host countries (Rugman et al., 1999). FDI is a conveyor of norms, technologies, and management practices and its impact on the local economy is likely to extend well beyond the activities of its subsidiaries.

FDI's critical role can also create new opportunities for non-governmental organization to influence environmental, labor, and social practices in the developing world. If non-governmental organizations can target key MNEs that have operations in far flung countries, they can leverage MNE networks to spread their preferred norms. If non-governmental organizations can persuade MNEs to adopt progressive environmental policies as represented in ISO 14001, then they can leverage FDI to diffuse this voluntary regulation to parts of the world where they themselves may not have much political leverage. Thus, instead of blanket opposition to "globalization," "multinationals," "or foreign investment," non-governmental actors need to think strategically and use globalization to their own advantage.

Table 1
Country-Wide ISO 14001 Adoption Levels, 1996-2002

Independent Variables	*Coefficient*	*Standard Error*
Overall FDI	-1.284e-11	4.644e-11
Bilateral FDI weighted by ISO Adoption	.302**	.075
International Controls		
Exports	-..046	.598
Bilateral Exports weighted by ISO Adoption	.143*	.081
Language	.018	.016
Neighbor	-.010	.027
IGO (intergovernmental organizations)	-.321	.341
INGO (nongovernmental organizations)	.175	.188
Domestic Controls		
GDP	.771	.593
Per Capita GDP	1.986 e-4*	8.677 e-5
Per Capita GDP^2	-3.144e-9**	1.248e-9
Pollution	-.016	.015
Regulations	.167*	.087
ISO 9000	.354**	.141
Fixed effects (yes)		
Constant	-22.139	14.832
N (98 countries, 6 years)		
Chi^2	1007	

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

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Appendix 1
Databases for Bilateral FDI Flows

OECD (http://titania.sourceoecd.org/vl=1609981/cl=61/nw=1/rpsv/ij/oecdstats/16081080/v45n1/s5/p1)

Database coverage extends (in theory at least) back to 1980. Flows are reported in US dollars. Covers flows from OECD members to other OECD members and about 30 non-OECD countries (Includes China, India, Brazil, Malaysia). Since data on inflows in OECD countries are available, it would be possible to get data on flows from these countries to OECD (China to Australia for example), but not possible to get developing-developing country flows. Data coverage varies among OECD countries (for example, there were only 3 partner countries listed for Canada).

UNCTAD (http://www.unctad.org/Templates/Page.asp?intItemID=3198&lang=1)
Data coverage rarely extends back before 1990. Flows from OECD countries and a handful of other countries are reported in national currencies; developing country flows in US dollars. There are country reports for (an estimate) around 120 countries; some of these do not provide the relevant FDI data however. There are not country reports for all of the industrialized countries (France and US, for example, are not listed), so getting data on flows from these countries requires looking at inflows in the other country reports. Partner countries covered in the country reports vary: the longest lists may include as many as 70 countries (with OECD countries well represented), while only two or three partners might be listed for some developing countries. Currency conversion is necessary for the industrialized country data, and in a few cases a double conversion is required (for a few eurozone countries, pre-1999 data was listed in euros, so it was necessary to convert from euro to national currency then national currency to US dollars).

Appendix 2
Alternative Models of ISO 14001 certification rates, 1996-2002

Independent Variables	*Model Without OECD countries*	*Model without EU*	*Model without Japan*
Overall FDI	-9.061 e-12 (5.096 e-11)	2.561e-11 (8.310e-11)	1.615 e-12 (6.443 e-11)
Bilateral FDI weighted by ISO Adoption	.200** (.066)	. 297 ** (.072)	.301** (.073)
International Controls			
Exports	-.275 (1.002)	-.205 (.703)	-.050 (.622)
Bilateral Exports weighted by ISO Adoption	.191* (.091)	.168* (.087)	.141* (.084)
Language	.015 (.015)	-.004 (.031)	.020 (.017)
Neighbor	-.013 (.027)	.013 (.032)	-.011 (.027)
IGO (intergovernmental organizations)	-.346 (.433)	-.491 (.433)	-.332 (.381)
INGO nongovernmental organizations)	.279 (.267)	.196 (.252)	.174 (.207)
Domestic Controls			
GDP	.860 (1.157)	.055 (.279)	.771 (.594)
Per Capita GDP	1.942 e-4* (1.135 e-4)	5.918 e-4** (1.784 e-4)	2.002 e-4* (8.749e-4)
Per Capita GDP^2	-2.863 e-9 * (1.299 e-9)	-1.206 e-8** (4.759 e-9)	-3.155 e-9* (1.260 e-9)
SO_2	-.017 (.022)	-.018 (.014)	-.016 (.017)
Regulations	.147 (.116)	.169* (.090)	.176* (.094)
ISO 9000	.532 ** (.106)	.324* (.139)	.355** (.135)
ISO 14001 (t-1)			
Fixed effects	yes	yes	yes
Constant	-25.643 (29.567)	-5.065 (6.706)	-22.174 (14.884)
N	74 countries 6 years	83 countries 6 years	97 countries 6 years
Chi^2	570	1072	952

Standard Errors in Parenthesis
** p < .01, * p < .05

Appendix 2 (Contd)
Alternative Models of ISO 14001 certification rates, 1996-2002

Independent Variables	*Event Count without Fixed Effects*	*Two-Stage Instrumental Variable Model*	*Event Count with Lagged Dependent Variable instead of AR1*	*FDI plus residual trade*
Overall FDI	4.393 e-11* (3.929 e-11)	1.248 e-11 (4.644 e-11)	2.370 e-11 (2.719 e-11)	-1.011e-11(8.907e-11)
Bilateral FDI weighted by ISO Adoption	.206** (.055)	.302 ** (.075)	.093* (.025)	.328** (.070)
International Controls				
Residual Exports				-7.727 (4.142)*
Exports	.271(.409)	-.046 (.597)	.293 (.392)	
Bilateral Exports weighted by ISO Adoption	.020 (.025)	.143* (.081)	.091** (.041)	2.584 e-4 (2.447e-4)
Language	.014(.019)	.018 (.016)	.016* (.009)	.025 (.020)
Neighbor	.073 *(.036)	-.010 (.027)	-.013 (.017)	.002 (.027)
IGO (intergovernmental organizations)	-.564* (.282)	-.321 (.341)	-.398* (.199)	-.290 (.318)
INGO (nongovernmental organizations)	.321*(.161)	.175 (.188)	.094 (.121)	.078 (.174)
Domestic Controls				
GDP	.624** (.127)	.771 (.593)	.569* (.245)	1.461* (.799)
Per Capita GDP	9.384 e-5 * (4.116e-5)	1.986 e-4* (8.677 e-5)	9.970 e-5* (3.967 e-4)	1.207e-3 (2.068)
Per Capita GDP^2	-1.892 e-9 * (8.190e-10)	-3.144 e-9**(1.242 e-9)	-1.496 e-9** (5.518 e-0)	-2.411e-9 (2.666e-9)
SO_2	-.004 (.010)	-.016 (.014)	-.009 (.009)	-.023 (.018)
Regulations	.014 (.057)	.167* (.087)	.089* (.049)	.196* (.098)
ISO 9000	.194* (.112)	.354** (.141)	.256** (.040)	.393** (.152)
ISO 14001(t-1)			.335 **(.033)	
ISO 14001(dummy) (t-1)			.229 (.158)	
Fixed effects	no	Yes	Yes	Yes
Constant	-15.206** (2.766)	-22.139 (14.832)	-13.258* (5.763)	-36.401** (18.732)
N	98 countries, 6 years	98 countries, 6 years	98 countries,6 years	98 countries, 6 years
Chi^2	831	1007	2091	1426

Standard Errors in Parenthesis
** p < .01, * p < .05

Appendix 3
Descriptive Statistics

Variable	*Mean*	*SD*	*Min*	*Max*
ISO 14001	222.31	752.11	0	10620
Overall FDI	2.82e8	8.67e8	-1.83e9	1.03e10
Bilateral FDI weighted by ISO Adoption	3.93	3.00	-2.99	8.23
International Controls				
Exports	.306	.232	.021	8.229
Bilateral Exports weighted by ISO Adoption	1.879	4.483	-2.995	7.983
Language	1.311	3.421	.001	46.549
Neighbor	1.189	3.073	.000	103.316
IGO (intergovernmental organizations)	3.897	.291	3.089	4.742
INGO (nongovernmental organizations)	6.838	.800	4.431	8.848
Domestic Controls				
GDP	24.628	1.916	20.254	29.852
Per Capita GDP	11142.22	9301.203	547.999	56022.03
Per Capita GDP^2	2.11e08	3.35e08	300303.7	3.14e09
SO_2	10.009	9.165	.621	117.161
Regulations	5.620	1.836	2	10.828
ISO 9000	5.052	3.311	-2.996	11.108