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Abstract

Voluntary environmental initiatives (VEIs) by firms are often viewed as important for environmental management in developing countries such as India with weak regulatory institutions and poor enforcement of environmental laws. Past research shows that while VEIs may not be able to fully substitute for strong regulation, they could be useful complements to reduce environmental degradation in developing countries. In India, new government initiatives such as "Make in India" are geared towards significantly increasing the manufacturing output in the next few years. In this context, our paper studies the adoption of a widely employed VEI - the ISO 14001 standards certification - among the Indian manufacturing industries. Using the theoretical framework of Earnhart, Khanna, and Lyon (2014) on the drivers of corporate environmental strategies in emerging economies, we hypothesize that the likelihood of adoption of ISO 14001 standards among Indian manufacturing industries is a function of internal firm characteristics, input and output market pressures, and regulatory pressure. We test our hypotheses using a survey of 1000 (large, medium, and small) manufacturing firms across the country, conducted under the aegis of the World Bank in 2016. Results show that internal firm characteristics such as large size and firm innovation have a positive association with the likelihood of adopting ISO 14001 standards. Output market pressures, such as exporting to foreign markets, also positively impact the likelihood of obtaining ISO 14001 certification. In particular, exporting to China, which is ranked first in the number of ISO 14001 adoptions, has a statistically significant impact on probability of adoption. There is no evidence, however, that predominantly consumer-facing firms, another potential indicator of output market pressure, are more likely to adopt ISO 14001 standards. We also find state-fixed effects, potentially capturing the variation in both formal and informal regulatory pressure across states. Thus, consistent with other research in developing countries, we find that pressure to meet the environmental standards of countries to which firms in developing countries export their products acts as a strong incentive to adopt VEIs such as ISO 14001 standards. The lack of evidence that consumer-facing firms are no more likely to adopt ISO 14001 standards potentially indicate that firms in India do not yet find the green consumer markets large enough to adopt VEIs.

***Keywords**:* ISO 14001; manufacturing SMEs; sustainability; green innovations.

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Introduction

Why do firms go beyond legal mandates to voluntarily implement environmental management practices that are costly? Implementation of environmental management systems in general and ISO 14001 standards in particular has been one of the dominant contexts in which this question is studied. While much of the earlier research had been conducted in developed economy settings, more recent focus has been on emerging and developing economies. Early research on understanding motivations for implementing ISO 14001 standards in developing countries was based on cross country comparisons but country specific studies have started to emerge only over the last few years. This paper contributes to this growing literature by testing a set of hypotheses on the drivers for implementing ISO 14001 environmental management standards in India's manufacturing sector.

India has been one of the fastest growing economies in the world in spite of the recent slowdown. On the one hand, with close to a million people joining workforce every month, India has to further accelerate its economic growth to generate employment. The current government has initiated several programs to accelerate employment generation, including a strong emphasis on manufacturing growth. For example, "Make in India," which is a flagship program of the government, aims to make India an attractive destination of investments in manufacturing by creating new infrastructure and facilitating processes that improve the ease of doing business in the country. Under this program, the government is planning to develop large industrial corridors across the country.

On the other hand, the country suffers from numerous environmental problems due to rapid urbanization and industrialization. Many Indian cities rank among the worst polluted cities

in the world (The Lancet Commission on Pollution and Health, 2017[1]), the major rivers such as the Ganges and Yamuna (Pokharel and Rana, 2017) are seriously polluted from urban sewage and industrial waste dumped into them, and industrial hazardous waste and household waste cause severe pollution of ground and surface water in several states. Although India has built a strong environmental regulatory framework on paper, as in many other developing economies, it has so far failed to develop an equally strong regulatory capacity with its enforcement agencies suffering from shortage of manpower and poor resource allocation (OECD, 2006; IIML, 2010). The new initiatives to accelerate industrial production such as Make in India[2] is likely to further worsen the environmental quality, without a concomitant focus on improving regulatory capacity. It is in this context, voluntary initiatives to reduce environmental impacts of industrial operations become important.

Voluntary Environmentalism and Indian Industry

Although the Indian industry has a significant environmental footprint, its response in terms of voluntary initiatives has at best been weak historically. For example, Indian industry's spending on corporate social responsibility (CSR), in spite of growing profits post-liberalization in early 1990s, has been largely ad-hoc with the spending limited to some community development projects (Arora and Puranik, 2004; Sahay, 2004). This eventually led to the Indian government making it mandatory for firms meeting certain threshold revenues and profits to spend 2% of their net profits (averaged over the previous three years) on CSR activities. This mandatory CSR requirement was specified under the Companies Act of 2013 and came into effect from the year 2013-14. The other form of voluntary action practiced globally has been the voluntary disclosure of environmental impacts and practices. In this case, the performance of

[1] http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)32345-0/fulltext, accessed on 26 November 2017

[2] http://www.makeinindia.com/home

Indian firms again has been weak (e.g., Sen et al., 2011). Even as recently as 2011-12, only 37 firms published corporate sustainability reports and disclosed information on environmental, social, and governance indicators (India Responsible Investment Working Group, 2014). This number had increased to 137 in 2014 after the financial regulator, the Securities and Exchange Board of India (SEBI), mandated a "Business Responsibility Report (BRR)" for all the top 100 firms on the Bombay Stock Exchange (BSE). The BRR, which includes indicators on environment, human rights, social responsibility, is expected to be included as part of the mandatory annual reports of the top 100 firms and be made publicly available. While more recent research finds that pressure from supply chains and internal pressure is forcing a few large companies to improve their environmental performance beyond the regulatory requirements (Singh et al., 2014; Sandhu et al., 2012), it appears in general that corporate environmentalism of Indian firms is largely driven by specific regulatory mandates than by any strategic or ethical considerations.

A particular voluntary initiative that appears to be relatively popular among the Indian industry is the adoption of ISO 14001 standards. As Figure 1 shows, the number of firms with ISO 14001 certification has been constantly on the rise with close to 8000 industries obtaining the certification by 2016 from a mere 111 in 1999. India is ranked at 7 in the world in terms of the total number of ISO 14001 certifications. In spite of this rising trend, research that analyses the types of Indian firms obtaining this certification and the motivation for certification is sparse. Our study contributes to this understanding.

Previous Literature

Early empirical literature on cross-country diffusion of ISO 14001 adoption laid the foundations for understanding the adoption behaviour of developing country firms. In one of the

first such studies, Corbett & Kirsch (2001) conducted open-ended interviews with firms that obtained certification and found that developing country (e.g., Brazil, Taiwan, and Uruguay) firms adopted certification so that they can signal their environmental leadership to local stakeholders. Export-orientation was also a significant factor for obtaining certification. Their quantitative analysis of certification counts in a sample of 63 countries confirmed this finding on the link between export orientation and propensity to obtain ISO 14001 certification. Using a much larger sample of 142 developed and developing countries, Nuemayer and Perkins (2004) examined the role of several supply and demand factors on per capita certification of countries. They found that it is not just export orientation but the countries to which goods are exported motivates adoption. In particular, they found that per capita certifications are correlated with exports to Japan and Europe, which at that time had the highest number of ISO 14001 certifications. Stock of foreign direct investment, income per capita, and pressure from civil society also affect per capita certifications positively.

Within the cross country diffusion literature, another stream examines ISO 14001 adoption behavior of developing country firms in the context of debates on globalization and global economic integration (e.g., Prakash and Potoski, 2006; Prakash and Potoski, 2007; Berliner and Prakash, 2013; Berliner and Prakash, 2014). While this literature is not necessarily focused on developing countries explicitly, their findings have significant implications for understanding ISO 14001 adoption behavior among developing country firms. This literature consistently finds that firms in exporting countries (typically developing countries) are more likely to adopt ISO 14001 standards if the adoption rate is high in countries to which they are exporting. This finding, however, is conditional on regulatory stringency in the exporting countries. More specifically, this research finds that firms operating in developing countries use

ISO 14001 adoption as a signal of their environmental credentials only when the regulatory institutions are weak. This finding is grounded theoretically in the argument that when firms operate in countries with weak environmental governance (those branded as "dirty"), they need alternate forms of credible signals to their international customers with strong preference for environment-friendly practices of production. Adoption of ISO 14001 is likely to serve as that credible signal.

ISO 14001 in Developing Countries: Country-specific Studies

Drawing on the cross country diffusion literature, a few country-specific studies, using firm-level data, have been conducted in recent years. Using data on 494 firms in three key industry sectors in Thailand, Tambunlertchai et al., (2013) find that FDI flow from countries in the Organization for Economic Cooperation and Development (OECD) and countries that widely adopt ISO 14001 standards significantly and positively influences firm level adoption in Thailand. Large firms and firms with prior experience with adopting ISO 9000 standards are also more likely to adopt ISO 14001. In a small sample of 40 firms in food industry in Lebanon, Massoud et al., (2010) examine motivations and barriers for the sample firms to adopt ISO 14001 standards, although none of those firms obtained certification. The main motivations are to compete internationally, reduce operational costs, and improve their corporate image. Uncertain benefits from adoption, including poor demand from stakeholders, especially customers, are cited as barriers to adopting the standards.

Blackman (2012) investigated ISO 14001 certification in Mexico, exploring whether, in addition to export orientation, regulatory pressures, measured as recent fines for environmental violations, encourage firms to obtain certification. Using Cox Proportional hazard models, they find that a fine within the last three years increases the probability of ISO 14001 certification by

a factor of two. This indicates that even in less developed countries regulatory pressures may encourage ISO 14001 certification.

In Indian context, research published on motivations for adoption of ISO 14001 is nearly non-existent. We have come across just two studies. One study interviewed a few certified firms along with consultants, regulatory agencies, non-governmental organizations (NGOs), and representatives of certifying agencies to analyse motivations of Indian firms (Qadir and Gorman, 2008). While this is a really small sample, this study finds that certification is motivated, at least in the first few years, by cost savings due to efficiency improvements in resource and energy use. Market pressures such as competition from peer industries and pressure from foreign customers also play a significant role in motivating firms to adopt certification. A few managers and NGOs also acknowledged the role of the need to build image for the firms as a motivation for ISO 14001 adoption. The second study, which collected data from websites of select industries in Delhi region, employs bivariate analyses with a sample of 60 industries to examine the motivations for ISO 14001 adoptions (Singh et al., 2014). It finds that larger, older, and internationally trading companies are more likely to adopt ISO 14001; manufacturing firms are also more likely than others to adopt.

Two other studies focus not specifically on ISO 14001 but on the implementation of comprehensive environmental management systems (CEMs). One study tests the nature of stakeholder pressures that provide incentives for firms to adopt CEMs and finds that internal pressures from employees and shareholders significantly affect adoption of CEMs but pressure from regulators, household consumers, and societal stakeholders has no influence (Singh et al., 2014). As many other studies find, selling in foreign markets is a significant predictor of CEMs adoption as is business chain pressure. In the second study, the same authors (Singh et al., 2015)

hypothesize that relational (maintaining good relationships with stakeholders), innovational (development of new products and processes), operational (cost savings), and business motivations (competitive pressures) are associated with adoption of CEMs. Their tests of hypotheses reveal that only relational and business motivations matter for the adoption of CEMs.

Overall, there is very little systematic research on ISO 14001 adoption in developing countries in general and India in particular. In the next section, we develop a set of testable hypothesis on motivations for adoption of ISO 14001 standards in Indian manufacturing industry drawing on recent theoretical developments on corporate environmental strategies of firms in emerging economies.

Theoretical Considerations and Hypotheses Development

The costs of adoption of ISO 14001 standards are not trivial (Darnall and Edwards, Jr., 2006), especially for developing country firms, many of which may not even have a well-developed environmental management system. Given this, why would profit maximizing firms adopt ISO 14001 and other such voluntary environmental practices? Theoretical literature on this question, mostly developed in the developed country setting, relies on the predictions of institutional theories of corporate management practices (Delmas and Toffel, 2004). At the core of this literature lies the argument that firms use ISO 14001 certification to signal their environment-friendly credentials to negotiate pressures from a variety of institutions (e.g., Bansal and Bogner, 2002; Darnall, 2006). Institutions in this context are more broadly conceptualized to include government regulators, consumers, international customers, NGOs and local stakeholders. In this perspective, the costs of adoption are justified by potential benefits, some of which are strategic benefits that enhance firms' competitive advantage.

ISO 14001 adoption requires, at a minimum, compliance with environmental regulations which might lead to lower regulatory scrutiny. Since ISO 14001 emphasizes continuous improvement, adoption might help firms closely monitor and evaluate their internal operations thereby leading to efficiency improvements and cost reductions. At a more strategic level, ISO 14001 implementation requires significant employee engagement and help develop new skills that are not easily replicable by competitors (Darnall and Edwards, 2006). Firms also derive strategic benefits from improved relations with local stakeholders, lower risk of future regulations, and enhanced reputation and brand image (Bansal and Bogner, 2002; Darnall 2003; Darnall, 2006).

A second set of variables - internal firm characteristics and capabilities - that drive adoption are derived from resource-based view (RBV) of the firm. RBV is interpreted in this context to suggest that firms possessing capabilities that are complementary for EMS adoption face lower costs (Darnall and Edwards, 2006) and thus are more likely to adopt ISO 14001 standards (Darnall, 2003; Darnall, 2006). Broadly, in this line of argument, such complementary capabilities include existing total quality management systems, pollution prevention strategies, access to capital, and ownership.

Drawing on these theoretical insights, more recent work has proposed frameworks to explain corporate environmental strategy in developing country setting (Fikru, 2014a; Fikru, 2014b; Earnhart et al., 2014). Fikru (2014b) modeled international certification decision of firms in Ethiopia as a function of firm capabilities and coercive, mimetic, and normative pressures that firms face both from stakeholders outside and inside the country.

Earnhart et al., (2014) framework integrates several theoretical insights discussed so far in the context of developing countries. They model corporate environmental strategy of firms in

emerging economies as a function of firms' internal resources and capabilities (e.g., size, technology,, input market (e.g., investors, employees, energy and other input resource markets) and output market (e.g., customers, both domestic and foreign) pressures, government pressure, and civil society pressure. We use this framework in the context of adoption of ISO 14001 in India to develop our hypotheses.

Output Market Pressures

Firms in emerging and developing economies such as India, when exporting to developed markets need to differentiate their products to gain competitive advantage. Given that importing firms in developed markets face stronger customer demand for green products, developing country firms need credible mechanisms to signal their environment-friendly credentials. To the extent that ISO 14001 adoption can serve as a credible signal, especially in exporting countries with weak regulatory institutions, one would expect that firms that export to other countries are more likely to adopt ISO 14001 standards. Empirical literature in developing countries consistently provides support for this hypothesis. In addition, there is evidence that not only export-orientation but also the country to which firms predominantly export may also determine the ISO 14001 adoption decision (e.g., Berliner and Prakash, 2013). In particular, past studies argue that countries that widely adopt ISO 14001 are more likely to mandate those standards for exporting firms. As per the most recent survey of International Standards Organization (ISO, 2016), China has the highest number of ISO 14001 certifications, followed by Japan and several European countries. Based on these arguments, we hypothesize:

H1a: Indian firms that export are more likely to adopt ISO 14001 certification.

H1b: Indian firms that export to China are more likely to adopt ISO 14001 certification.

H1c: Indian firms that export to developed country markets (US, Europe, and Canada) are more likely to adopt ISO 14001 certification.

To the extent that Indian consumers demand environment-friendly practices and products, firms with direct interface with consumers are more likely to adopt ISO 14001. There is little research to evaluate, one way or the other, the willingness of Indian consumers to pay price premium for green products or demand for environment-friendly practices. We explore this question by hypothesizing that:

> H2: Indian firms with direct consumer-facing products are more likely to adopt ISO 14001 than others.

Firm Internal Resources and Capabilities

Size of the firm has been consistently found to be correlated with decision to adopt ISO 14001 certification. Large firms have greater access to capital and greater resources and thus can better afford the costs of ISO 14001 adoption, relative to small firms. Thus:

> H3: Large and medium firms are more likely to adopt ISO 14001 certification than small firms.

Another set of firm capabilities that we argue are relevant are the ability of firms to innovate. The ISO 14001 requires that the certified firms not only meet the relevant regulatory standards but also improve continuously. Innovative firms are more likely to achieve continuous improvements in environmental performance by lowering costs. Thus, we hypothesize:

> H4: More innovative the firms, more likely that they will adopt ISO 14001 certification.

We do not have a good measure of pressures from civil society and regulators. However, we use industry sector fixed effects and state fixed effects to proxy for these pressures. In India, there are both state level and sector level variations in regulatory activity. For example, the Ministry of Environment and Climate Change in India categorizes industry sectors into red, orange, green based on the level of pollution inherent in such sectors (red being most polluting and green being least polluting) (CPCB, 2016). This categorization also drives the frequency of

inspections with red category industries being subject to more frequent inspections. Similarly, the erstwhile Indian Planning Commission developed an index of state of the environment to rank Indian states on their performance (Chandrasekharan et al., 2013). This suggests that there is a variation in regulatory scrutiny across states as well.

Method

We used data collected under the 2016 India Manufacturing Innovation Capability Survey (the 2016 India ICS), conducted in collaboration between the Tilburg University and the Enterprise Analysis Unit (DECEA) of the Development Economics Group of the World Bank. This is part of a wider project undertaken by the Tilburg University to study the innovative capability of manufacturing firms in ten countries selected from three regions - Ghana, Tanzania, Uganda, Kenya, South Africa, and Ethiopia from Africa, Bangladesh, and India from South Asia and, Vietnam and Indonesia from East Asia and Pacific. The project, which is funded by the British Department for International Development (DFID), is carried out in ten developing countries by Radboud University and Tilburg University in cooperation with local partners. The 2016 India ICS aims at studying the innovative activities and innovative capabilities of manufacturing firms in India, by collecting firm-level data using a suitably designed questionnaire and following the DECEA's global methodology of survey design. This survey is a follow-up to and complements the 2014 India Innovation Follow-up Survey undertaken by the World Bank Group.

We linked the 2016 India ICS data with the 2014 India Enterprise Survey (ES) of the World Bank. The sampling strategy follows the standard ES global methodology of stratified random sampling. The random sample of 1000 manufacturing firms is stratified based on firm size and location, unlike the standard ES sampling methodology which includes sector as one of

the three stratifying variables. The survey covers 17 Indian states and distributed across small (5 to 19 employees), medium (20 to 99 employees) and large (100+ employees) firms. Table 1 below provides distribution of the realized sample by region and firm size. Overall, the survey response rate is good, with over 62% of the contacted interviews turned into completed interviews. Table 1 provides some characteristics of the sample firms.

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Insert Table 1 about here
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Table 2 shows the measurement of variables for our analysis as well as the descriptive statistics. We use classification based on number of employees for measuring firm size. Innovative capabilities of firms are measured using annual internal and external R&D expenditures. In our regression analysis, we use logarithm of R&D expenditures. Export orientation is measured as a binary variable - whether the firm exported in 2012. For measuring export to developed countries and export to China, we use percentage of firms' direct exports to these regions. Finally, the extent to which a firm is consumer-facing is measured by percentage of firm's sales to individual consumers.

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Insert Table 2 about here
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Results

Figures 2-4 shows the distribution of ISO 14001 certified firms by size, industrial sector, and state. Overall, 14% of all firms have ISO 14001 certification and it varies by size with a larger proportion of large firms certified than medium and small firms. Only 7% of small firms in our sample are certified as opposed to 25% of large firms. Sector-wise, almost a quarter of transport machinery firms are certified. This sector includes automobile manufacturing and is likely driving the certification. State-wise distribution shows approximately half of the sample firms

certified in Haryana; this is not meaningful because it is likely the effect of sector-wise distribution of firms across states.

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Insert Figures 2, 3, and 4 about here
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Table 3 shows our logistic regression results in which whether a firm has an ISO 14001 certification is the dependent variable. The first model (Model 1) had only internal firm characteristics and capabilities as the explanatory variables. Large firms were more likely to be certified than small firms and external R&D expenditures also positively affect the probability of ISO 14001 certification. We also included state and firm fixed effects in this model. In the second model, we included output market pressures. Consistent with research in other developing countries, we find evidence that firms that export are more likely to adopt ISO 14001 standards. It also matters the location to which they are exporting - exporting to China has a statistically significant impact on likelihood of adoption. Exporting to developed countries (US, Canada and EU) has a weak impact on adoption likelihood. It is important to note that firm size (being large) and innovation (external R&D expenditures) continue to be significant even after introducing market pressure variables.

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Insert Table 3 about here
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In Model 3, we replaced R&D expenditures with a binary variable on whether the firms filed a patent in the last three years. Filing a patent is a more credible signal of the firm's capability to innovate. We find similar results as Model 2, except that exporting to advanced countries such as USA, Canada, and Europe had no statistical significance. The patents variable

was positive and strongly significant, as expected. Large industries were more likely than industries to adopt ISO 14001 as in the case of other models.

In Model 4, we introduced interaction between firm size and export-orientation. We tested whether being export-oriented has a differential impact on the likelihood of adoption for large and small firms. Neither of the interaction terms was statistically significant and export orientation also became insignificant. This means that exporting small firms are no more likely than non-exporting small firms to adopt certification, all other variables being equal. Thus, while exporting firms are more likely, overall, to adopt, small exporting firms do not face the same market (dis)incentives as large firms to induce them to adopt ISO 14001 certification standards. Patents and exports to China continued to be positive and statistically significant. Being a large industry was weakly significant in this Model, suggesting that even among non-exporting firms, the difference in adoption likelihood between large and small firms is (marginally) significant.

In Model 5, we introduced additional interactions that involved interaction between patents (binary) and size. In this model, we tested whether the ability to innovate has differential impacts for large and small firms. Do small firms with demonstrated ability to innovate more likely to obtain ISO certification than other small industries? The interaction variables were not significant but patents variable continued to be significant even after introducing interactions with size. This means that small firms that file patents are more likely than other small firms to adopt ISO 14001 standards.[3] The coefficient on *large* was weakly significant at 10% meaning that even among firms with no exports and no patents, large firms are more likely than small firms to adopt ISO 14001. Another significant result was that there was no evidence that direct consumer-facing firms are any more likely than others to adopt ISO 14001 standards. This result

[3] It is important to note though that this comparison is based on a very small sample of small firms that have patents - here are only 9 small firms that filed patents of which 2 have ISO 14001 certification.

held across all our models. Thus, it appears that Indian firms do not find enough pressure from domestic customers to undertake proactive environmental practices.

Discussion and Implications

Using theoretical insights from management and policy literature, we hypothesized that pressures from international markets predominantly drive ISO 14001 adoption among Indian manufacturing firms. Our results are largely consistent with this hypothesis. We find that exporting firms are more likely to adopt ISO 14001 standards than others. Based on the idea that importing countries that widely adopt ISO 14001 are more likely to pressurize the exporting country firms to require ISO 14001, we also find that Indian firms exporting to China are more likely to adopt - a result that holds consistently across all our models. This result is less robust with regards to export with developed economies (US, Canada, and Europe).

We also find that while exporting firms are more likely to adopt overall, there are differences based on size with small exporting firms no more likely to adopt ISO 14001 standards than their non-exporting counterparts. Because of their ability to generate employment, policy in India has generally favoured small firms; these firms, however, contribute a large share of pollution (Kathuria and Turaga, 2013; D'Souza, 2001). Small firms are also subject to less regulatory scrutiny because of their sheer numbers as well as the perception that they may not have the resources to undertake pollution control activities. In such a regulatory environment, voluntary initiatives such as ISO 14001 are expected to partly substitute for weak regulations. Even in Indian context, there is evidence for example that implementation of ISO 14001 standards may lead to lower pollution (e.g., Singh et al., 2015; Prasad and Mishra, 2017). Similarly, voluntary participation in Green Ratings Program led to pollution reductions, especially among dirtier firms (Powers et al., 2011). Our results show that small firms may not

have enough incentives to adopt such voluntary measures even when they are exporting to international markets.

Thus one implication is that market pressures are unlikely to work as well with small firms as they might with larger firms and one can argue that there is a case for policy interventions. Indian governments (federal and state) already provide subsidies to small scale industries to set up common pollution control facilities in order to achieve economies of scale (Kathuria and Turaga, 2013). Our results show that there may be a case for extending such subsidies to encourage small and medium firms to adopt ISO 14001 certification.

Theoretically, innovative capabilities make it less costly for firms to undertake voluntary measures that are costly. Another result with regards to firm size with potential policy implications is the finding that small firms with ability to innovate (proxied by patents) are more likely than other small firms to adopt ISO 14001. This should of course be interpreted with caution given the really small sample of patented small-scale firms in our sample. Nevertheless, this finding may suggest that in addition to (or instead of) direct subsidies to adopt ISO 14001 standards, government may want to implement policies that improve the innovation capabilities of small firms. In addition, providing technical assistance may also facilitate improve the innovation capabilities of small firms. The improved innovation capabilities will have additional benefits in terms of more generally improving competitiveness of small firms.

Conclusions

In spite of being ranked seventh in terms of number ISO 14001 certified firms, little is known regarding motivations of Indian firms to adopt ISO 14001 standards. Our study is aimed at contributing to this understanding and more generally extend the literature on voluntary environmental initiatives by firms in developing and emerging economies. We tested a set of

hypotheses, grounded in theoretical insights from management and policy literature, regarding adoption behaviour of Indian firms using a survey of 1000 manufacturing industries spread over 17 states in India. Broadly, our results indicate market pressures may not induce small firms, which contribute significantly to industrial pollution in India, to undertake voluntary initiatives. This suggests need for policy action to facilitate implementation of more formal environmental management systems in small firms through technical assistance and subsidies.

Because of the lack of good measures, our study could not test several other hypotheses that involve other firm characteristics (e.g., ownership structure), other input market pressures, and institutional pressures in the form of regulatory scrutiny and pressure from civil society groups. Future research should focus on testing a more comprehensive set of hypotheses that improve our understanding of firm adoption behaviour in India. It is also important, often more difficult because of data unavailability, to better understand the extent to which voluntary initiatives lead to better environmental performance among Indian firms and more generally developing country firms.

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Table 1. Description of Sample Firms (Sample Size = 1000)

Firm Characteristic	Description
Size	• Small (25%), Medium (47%), and Large (28%) • No. of full-time employees: Mean - 122, Median - 40, Maximum - 3700
Location	17 states represented; distribution across states is generally proportionate to the size of the state
Industry sector	19 manufacturing sectors represented; 10 sectors account for 85% of sample firms
Age	Mean age of 23 years, median of 20 years, newest firm is 3 year old, and the oldest firm was established in 1863
Ownership	• 28% of the sample firms are part of a larger firm • 98.7% of the firms are owned by domestic individuals, companies, or organizations; only 2 firms have some government stake and only 2 firms are 100% foreign-owned • About 15% of the firms in the sample have some level of female ownership; about 45% of these firms have 50% or more of female ownership.
Export Orientation	• 28% of sample have some levels of exports in 2012, exporting to more than 45 different countries • The mean value of exports in 2012 was ₹150 million (Standard Deviation = ₹500 million)
Annual Sales	• Mean annual sales (all sample firms) = ₹504 million, S.D. = ₹2.46 billion; • Mean annual sales: ₹1.55 billion (large), ₹125 million (medium), and ₹27 million (small)

Table 2: Measurement of study variables and descriptive statistics

Construct	Measurement	Mean (S.D.)
ISO 14001	Do you have ISO 14001 certification? (Yes/No)	0.14 (0.35)
R&D Expenditures	Self-reported annual internal R&D expenditure (₹)	1.2 million (14 million)
	Self-reported annual external R&D expenditure (₹)	0.091 million (0.85 million)
Patents	Whether the establishment applied for at least one patent between fiscal year 2010/2011 and fiscal year 2012/2013? (Yes = 1, No = 0)	0.11 (0.31)
Size	Categorization based on number of employees: Large >= 100 employees Medium >=20 and <=99 Small >=5 and <=19 *large* = 1 if Large else 0 *medium* = 1 if Medium else 0 *small* is the reference category in all the analyses	Large = 0.28 (0.45) Medium = 0.47 (0.5)
Exporting Firm	Whether the firm exported in 2012	0.28 (0.45)
Age	Years since the establishment of the enterprise	23 (14)
Export to Developed Countries	In fiscal year 2012/2013, what percent of this establishment's direct export revenue were from Europe and America and Canada?	14.5 (35)
Export to China	In fiscal year 2012/2013, what percent of this establishment's direct export revenue were from China and Hong Kong?	2.6 (16)
Consumer-facing	In the fiscal year 2012, what percentage of this establishment's sales went to individual consumers?	15.3 (27.5)

Table 3: Logistic Regression Results: ISO Certification (Yes/No) as Dependent Variable

Variable	Coefficient				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Firm Capabilities					
Large	1.41***	0.98***	0.76**	0.71*	0.86*
Medium	0.59*	0.46	0.43	0.47	0.47
Ln (Internal R&D expenditures)	-0.01	-0.028			
Ln (External R&D expenditures)	0.069***	0.063***			
Patents (Yes/No)			2.08***	2.1***	2.54***
Large*export				0.04	0.001
Medium*export				-0.16	-0.17
Large*patents					-0.73
Medium*patents					0.18
Market Pressures					
Export (Yes/No)		0.77***	0.93***	0.98	0.99
Export to US, EU, and Canada		0.56*	0.40	0.39	0.38
Export to China		1.57***	1.44**	1.44**	1.47***
Consumer-facing		-0.005	-0.008	-0.008	-0.008
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	-4.2***	-3.76***	-3.9***	-3.9***	-3.9***
N	929	929	957	957	957
Log Likelihood	-286.58	-274.98	-277.8	-277.77	-277.26
LR Chi-square	200.51***	223.71***	251.46***	251.61***	252.62***
Pseudo R^2	0.26	0.29	0.31	0.31	0.31

***p<0.01, **p<0.05, *p<0.1

Figure 1: Trends ISO 14001 certifications in India

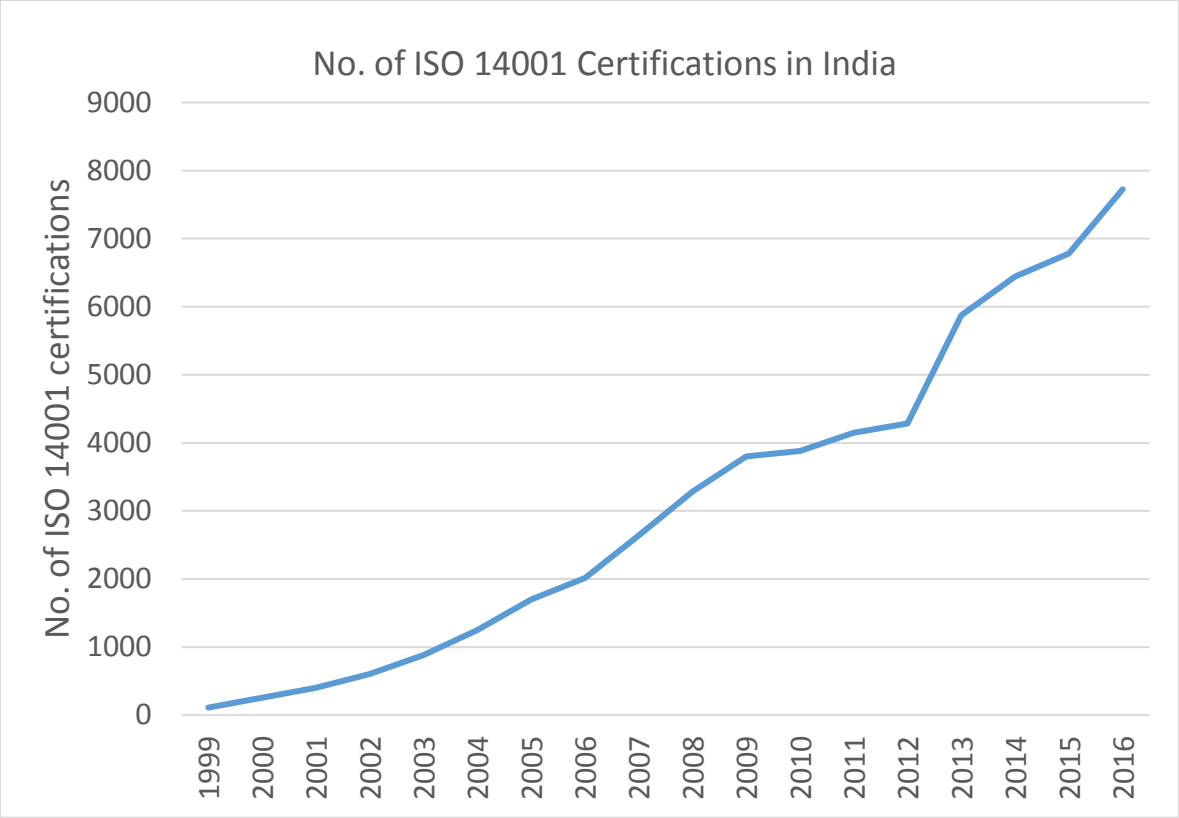

Figure 2: Size-wise distribution of ISO 14001 certified firms in the sample

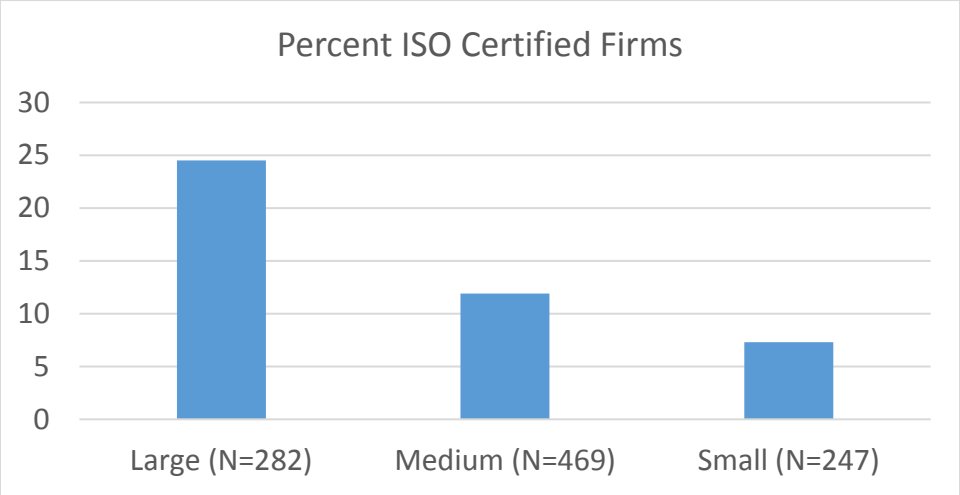

Figure 3: Industry Sector-wise distribution of ISO 14001 certified firms in the sample

Figure 4: State-wise distribution of ISO 14001 certified firms in the sample