Business Compliance with Environmental Regulations: Evidence from Vietnam.[*]

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Abstract

The fact that Vietnam has implemented various environmental regulations over the past 20 years with little success has generated an ongoing debate, and provided a valuable case study for environmental policies in developing countries. Yet very few studies have examined empirically business compliance behaviors with environmental regulations in Vietnam. This study conducts an empirical investigation on business compliance with environmental regulations in Vietnam using two rounds of the Small and Medium Enterprises Survey. The empirical results suggest that knowledge about environmental law, having informal payment, and facing competition have robust and substantial influences on business compliance behaviors; while the role of inspection and public pressures are questionable. These findings are useful for deriving cost-efficient policies to enhance business compliance with environmental regulations in Vietnam, and provide valuable lessons for environmental policies in developing countries.

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1 Introduction

After a period of rapid economic growth, Vietnam has now been confronted with a tremendous challenge of striking a balance between economic development and environmental sustainability (O'Rourke 2004). Although the Law on Environmental Protection (LEP) was established as soon as 1993, the first environmental law in the country history, it was generally incomplete and ineffective (Bryant and Akers 1999; Obbard, Lai, and Briffett 2002). And only after the substantial amendment of the LEP in 2005 that greater public efforts have been made to design and enforce various environmental regulations, especially those related to business activities (Clausen, Vu, and Pedrono 2011).

Despite increasing efforts, available evidences suggest that environmental regulations in Vietnam have been of little success with respect to business compliance. First, many goals specified by the Vietnam government could not be reached and had to be adjusted to more humble levels (Vietnam Central Government 2003, 2012). Second, low levels of compliance have been found in important industries such as food, paper, and leather (Le 2009; Nguyen 2011; Le and Dinh 2013). As a result, many studies have tried to understand the determinants of business compliance with environmental regulations in Vietnam. Le (2009) studies 119 firms in food industry. Dao and Ofori (2010) studies 64 firms in manufacturing services, who *have already implemented* some types of environmental management measures. Nguyen (2011) studies 62 plants in paper industry. Finally, Le and Dinh (2013) studies 54 firms in leather industry. The answers, however, are incomplete and imprecise because these studies only use self-reported information, descriptive statistics, and mean difference testing to study small and unrepresentative samples of firms in some specific industries with only one survey round.

Using two rounds from the Small and Medium Enterprises (SMEs) Survey, the present study provides the first comprehensive empirical evidences on the determinants of business compliance with environmental regulations in Vietnam. The SMEs survey has been conducted regularly since 1991, and has included questions on environmental issues since 2007. Firms are checked if they have the Certificate for Meeting Environmental Standards (CMES), a certificate granted by the government to firms who have completed their actual pollution controls. This certificate as well as other information are exploited to construct different indicators of business compliance. Different regression models are then employed to examine the influences of many potential factors on these compliance indicators.

In general, the empirical investigation reveals that knowledge about environmental law, having informal payment, and facing competition have robust and substantial influences on business compliance behaviors. In contrast, the role of inspection in explaining compliance is questionable, while other factors related to regulatory responses, market and social pressures, and compliance capacities

do not have robustly significant effects, especially when unobserved characteristics of firms are controlled for. Given the absolute majority of SMEs, 98% of total firms (Vietnam General Statistics Office 2010), these empirical evidences are highly valuable for deriving cost-efficient policies to enhance business compliance with environmental regulations in Vietnam.

Outside Vietnam, there have been a host of empirical studies on business compliance with environmental regulations, mainly from developed countries. Some important contributions come from the United States and Canada (Magat and Viscusi 1990; Laplante and Rilstone 1996; Lanoie, Laplante, and Roy 1998; Foulon, Lanoie, and Laplante 2002; Khanna and Anton 2002; Earnhart 2004; Shimshack and Ward 2005, 2008), the United Kingdom (Cole, Elliott, and Shimamoto 2005), and Korea (Kang and Lee 2004; Dasgupta et al. 2006). A few studies from developing countries include Mexico (Dasgupta, Hettige, and Wheeler 2000; Blackman et al. 2010; Blackman 2012; Blackman and Guerrero 2012), Thailand (Tambunlertchai, Kontoleon, and Khanna 2013), China (Dasgupta et al. 2001; Qi et al. 2011), and other countries (Dasgupta, Laplante, and Mamingi 2001). Given the history of environmental regulations in Vietnam, the present study evidently provides useful lessons in environmental policies for other developing countries.

The rest of the paper is structured as follows. Section 2 describes in general the historical evolution of environmental regulations in Vietnam and the institutional context behind the present study. Section 3 briefly surveys existing theoretical models on business compliance with environmental regulations. Section 4 presents general information about the dataset and the construction of dependent and explanatory variables used in the empirical investigation. Section 5 discusses the empirical strategy and the corresponding results as well as their robustness. Finally, section 6 closes the paper with some concluding remarks.

2 Research context

In 1993, Vietnam adopted for the first time the Law on Environmental Protection (LEP). It was the result of a three-year consultation process and was a breakthrough policy of Vietnamese Communist Party and the government to address environmental effects of market renovations (Sinh 2003). After many shortcomings were revealed in practice, the LEP was amended substantially in 2005. The LEP requires firms in some specific industries to conduct environmental impact assessment (EIA), and they only have the right to start or continue their business only when their EIA reports are approved. Other firms are required to prepare a simpler commitment to environmental protection (CEP) statement.

Furthermore, firms in some more specific industries are required, by Circular 2781/TT-KCM in 1996 of Ministry of Natural Resources and Environment, to have

the Certificate for Meeting Environmental Standards (CMES) in order to start or continue their business. Other firms are also encouraged to register for CMES. Thus, CMES is compulsory in some industries and voluntary in others. Besides having an approved EIA (or CEP), firms must have a certificate on their actual pollution control performances in order to be granted CMES. CMES is valid within three years, renewable, and can be withdrawn if firm violates regulations.

If required firms do not conduct EIA reports or possess CMES, they have to face sanctions ranging from monetary penalty to complete shutdown. The maximum monetary penalty has increased from 70 million VND in 2004 (Decree No. 121/2004/ND-CP) to 500 million VND in 2009 (Decree No. 117/2009/ND-CP). Other forms of pollution payments also come from Decree No. 67/2003/ND-CP in 2003 on environmental protection charges for waste water, and the Law on Environmental Protection Tax No. 57/2010/QH12 which specifies many taxable objects and their corresponding tax rates.

3 Theoretical framework

Conventional economic theory suggests that when making decisions with respect to compliance, firms will consider their expected payoffs and choose the most profitable strategies. The extent to which compliance brings about costs and benefits is likely to vary across different firms owning to their heterogeneous characteristics. Many theoretical works have attempted to identify factors that lead to the differences in the costs and benefits of complying with environmental regulations across firms and thereby explain the observed differences in their complying behaviors. These theories can be categorized into three groups concerned with (1) production efficiency, (2) market and social pressures, and (3) regulatory responses.

The first group of theories argues that environmental regulations are win-win solutions because firms can simultaneously cut costs and improve environmental performances by increasing the efficiency of their production processes. Khanna and Zilberman (1997) and Altman (2001) demonstrate that regulations can stimulate profit-seeking firms to adopt environmentally friendly production processes to increase efficiency in using inputs, hence reduce profit losses due to regulations. Porter and Linde (1995) push the argument further by contending that regulations not only induce firms to adopt green production processes, but also increase their profits. The reason is that firms may not always operate on their efficient frontiers because of incomplete information and organizational barriers, and they might not discover profitable green innovations in the absence of regulations. Hence, the extent to which firms adopt such environmentally friendly production processes depends on their capacities such as adoption costs and technical knowledge required to implement those technologies.

The second group of theories regards external pressures from consumers, investors, competitors, and society as the main reasons for firms to comply with environmental regulations. Arora and Gangopadhyay (1995) show that firms may want to produce more environmentally friendly products in order to lessen price competition and gain market share by differentiating themselves from other firms when consumers are willing to pay premiums for these products. This suggests that consumer pressure plus the possibility of making extra profits encourage firms to produce more environmentally friendly products. Barnea, Heinkel, and Kraus (2005) analyze conditions under which firms choose to switch from polluting technologies to clean technologies in order to attract green investors. The authors show that the percentage of green investors in total investors and the cost of switching are important determinants of choosing clean technologies.

From the same perspective, Arrow (1962) postulates that competition may also impose pressure on firms to adopt environmentally friendly production technologies to the extent that they represent cost-reducing innovations. He demonstrates that the profit gain is larger for a firm in a competitive industry than for a monopolist because the output price remains fixed in a competitive market. Finally, Tomer (1999) goes further and argues that firms are embedded in a network of social relationships and their legitimacy ultimately depends on public perception. Therefore, firms are expected to assume some social responsibilities in environmental protection in order to obtain intangible benefits in the long run.

The third group of theories argues that firms comply with environmental regulations as a way of responding to stakeholder pressures mediated through regulatory and legal institutions (Segerson and Miceli 1998; Lyon and Maxwell 2004; Dawsoni and Segerson 2008). In other words, compliance helps firms to preempt emerging regulatory threats, to influence future course of regulations that cannot be preempted, or to alter the incentives of regulators in monitoring and enforcing existing regulations. Consequently, firms facing greater threats from potential regulations or having higher expected benefits from shaping future regulations are more likely to comply with present regulations.

Outside economics, there have been an increasing number of studies in laws and business stressing the role of internal factors in explaining business compliance with environmental regulations; see Howard-Grenville, Nash, and Coglianese (2008) and Tyler (2011) for two surveys of the literature. These internal factors include managerial incentives, organizational culture, organizational identity, moral concern, and so on. The general argument is that these internal factors shape firm's interpretations of environmental issues emerged in their daily business, and ultimately determine firm's responses.

4 Data and variables

4.1 Data

The present study uses two rounds (2007 and 2009) of the Vietnam SMEs Survey as the main dataset for the empirical investigation. The survey covers 10 out of 54 provinces in Vietnam and mainly includes non-state manufacturing enterprises, joint venture enterprises are excluded from the sampling population due to high degree of foreign and government involvement (often unclear) in such ownership structures. The sampling procedure is based on the Establishment Census and the Industrial Survey in Vietnam which only contain registered, or formal, enterprises. The survey includes informal firms (firms without business registration licenses or tax codes, and are not registered with government authorities) using on-site identification strategy. Thus all surveyed informal firms operate alongside surveyed formal firms, hence are not representative of the whole informal sector. The number of surveyed enterprises varies through two survey rounds (2633 in 2007 and 2655 in 2009), and 80% of firms in 2007 (2111 out of 2633) are repeated in 2009. The unbalanced structure of this panel data indicates that the empirical investigation have to examine the possibility of sample selection bias.

4.2 Variables

There are two measures of compliance used for the empirical investigation. The first measure defines having CMES as having compliance.[1] This definition may be, however, too strong since compliance is apparently a broader concept than having CMES. For example, a firm trying to comply should be counted as a case of compliance. Yet this firm may not have CMES because its environmental performance has not yet reached the required criteria[2]. Thus using CMES to capture compliance is apparently not sufficient. In order to obtain better information, the second measure extends the definition by counting firms who do not have CMES but have *self-reported* treatment of some environmental factors (ET) as having compliance. Having CMES means having ET, but not vice versa.

Based on the theoretical framework discussed in the previous section and existing empirical studies in other countries (particularly Dasgupta, Hettige, and Wheeler 2000; Khanna and Anton 2002; Tambunlertchai, Kontoleon, and Khanna 2013), explanatory variables are selected and constructed depending on the avail-

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[1]In contrast to existing studies in Vietnam which only use self-reported information, SMEs survey does ask firms to show their CMES.

[2]Laplante and Rilstone (1996) have a similar concern in their study on the impact of inspections on emissions of the pulp and paper industry in Quebec (p. 20): "Indeed, if inspections do not induce a plant to comply with the standard, they may nonetheless induce the plant to reduce the amount of emissions by which it exceeds the standard."

able information. For the convenience of discussion, these variables are categorized into three groups as follows.

The first group represents regulatory responses and includes: the number of times being inspected by governmental agencies for *technical*[3] compliance in the previous year; a binary variable indicating that main production facility is primarily used for production other than residence; a binary variable for industries in which CMES is compulsory; three binary variables for firms' *self-assessment* of their knowledge about environmental law ranging from good, average, to poor (compared to no knowledge); and a binary variable for having tax code. Firms having more of these characteristics are expected to face higher regulatory pressures, hence more likely to comply. In addition, a binary variable standing for informal payment is also included to capture the influence of corruption. Noted that corruption may go both ways, i.e. firms may pay to avoid having CMES, or may pay to have it.

The second group stands for market and social pressures and includes: percentage of sale for final consumption in total sales, a binary variable for firm's *self-perception* of facing competition from other firms, a binary variable for having direct export, and firm age at the time being surveyed. Firms having more of these characteristics are expected to face higher market and social pressures, hence more likely to comply. In addition, provincial dummies are also included to capture other community characteristics.

The third group embodies compliance capacities and includes: average age of asset weighted by percentage of asset in different age groups (under 3, 3 to 5, 6 to 10, 11 to 20, and over 20 years), firm size measured by the number of employees, percentage of engineers and technicians in total labor force, and a binary variable for locating in production zones (industrial park zone, high-tech park zone, and export processing zone). Firms having more of these characteristics are expected to have higher capacities (i.e. facing lower costs) to comply.

5 Empirical analysis

5.1 Empirical strategy

The general empirical strategy is to estimate the following regression model with different variations:

$$y_{it} = \mathbf{x}_{it}^{'}\beta + \gamma province_i + \delta time_t + \epsilon_{it}, \tag{1}$$

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[3]This is an imperfect measure since, according to the questionnaire, technical compliance includes "environmental, fire, etc." Environmental and fire protection, however, are the most popular technical regulations in Vietnam. To the extent that fire protection also has an environmental content in itself, this imperfect measure is still of high value for the empirical investigation.

where y is the dependent variable (having CMES or having ET), and $\mathbf{x}_{it}$ is the vector of all explanatory variables discussed in the previous section and a constant. Logarithmic values are applied to firm age, asset age, and total labor.

Although two dependent variables are binary responses, it is safe to estimate regression model (1) with least squares estimator for the convenience of estimation and interpretation since the information of interest is the average marginal effects other than marginal effects at different values of explanatory variables (Angrist and Pischke 2009). With the unbalanced panel data at hands, the empirical investigation makes use of the random and fixed effects estimators to construct the baseline results.

5.2 Empirical results

5.2.1 Descriptive statistics

Table 1 reports percentages of firms that having CMES and having ET in both survey rounds together with their differences from previous round. There is apparently a significant increase in the percentage of firms having CMES from 2007 to 2009, while there is no significant increase in having ET. This result indicates that the increasing public efforts mentioned in the research context section actually have their payoffs. It also points to the necessity of controlling for the time trend in the regression analysis.

Table 1: Business compliance: Overall trend.

	2007	2009	Difference
Having CMES	09.15	13.53	04.38***
Having ET	20.66	21.96	01.30

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

Despite these significant increases, the absolute level of business compliance is still too low compared to government target. In 2009, there were only about 14% of total SMEs having CMES, compared to the government target of 50% of production and business units to be granted the CMES or the ISO 14001 Certificate in 2010 (Vietnam Central Government 2003). It is reasonable to assume that an international certificate such as ISO 14001 is much harder to obtain compared to a domestic one such as CMES.

Figure 1 depicts the percentages of firms that having CMES and ET in each province together with their 95% confidence intervals. Except Long An and Phu Tho, the pattern is relatively clear for the first indicator, i.e. large urban centers[4]

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[4]The highest rank in provincial classification in Vietnam.

(Ha Noi, Hai Phong, and Ho Chi Minh) have significantly higher percentages of firms having CMES compared to other provinces. There is no similar pattern in having ET, i.e. large urban centers do not have higher percentages of having ET compared to other provinces, except Ha Tay. These findings are partly in line with expectation since large urban centers in Vietnam are assumed to have stronger regulatory capacities, better public communication, and so on.
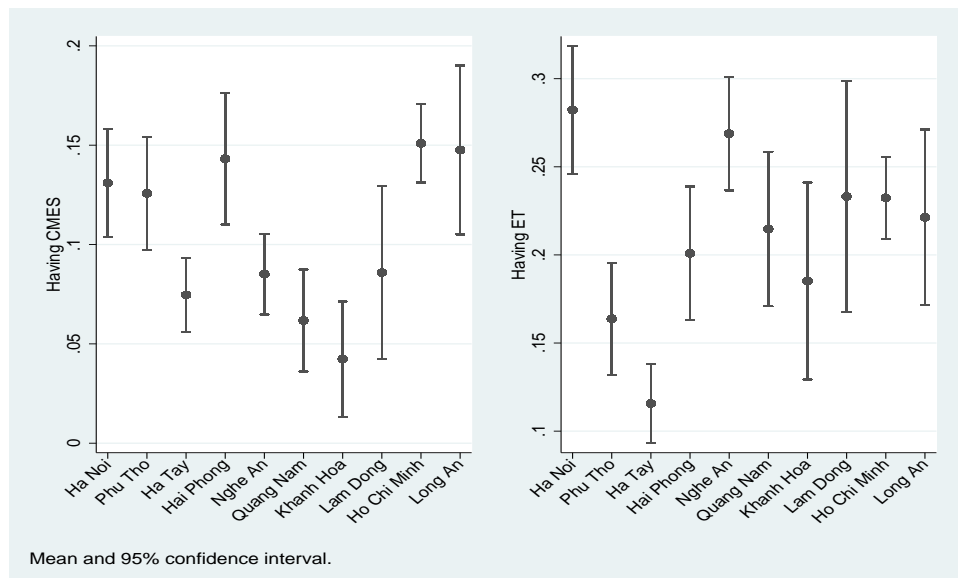

Figure 1: Having CMES and having ET by provinces.

The average number of inspections in 2007 and 2009 were relatively high. On average, the annual unconditional probability of being inspected is around 81%, which suggests that a relatively large amount of resources was devoted to enforcement activities in Vietnam in the period 2007-2009.[5] Around 74% of firms have main production facilities primarily used for production activities, and around 61% of firms operate in industries where CMES are compulsory. The general self-reported knowledge about environmental law is absolutely poor, i.e. only around 20% of total firms have average or good knowledge on average. The number of firms do not have tax code is relatively large (around 37%) on average, and a similar pattern also applies to having informal payment (around 31%). The average age is 14, while the average number of employees is 20. Finally, the proportions of firms having direct export and locating in production zones are absolutely low (only 6% and 4% on average).

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[5]Even a country as developed as Canada possesses a corresponding number of only 18% for one of its largest polluting industry in its largest province (Laplante and Rilstone 1996).

5.2.2 Regression results

Owning to space limitation, not all detailed results are presented below. They are, of course, readily available upon request. Table 2 reports the main results from estimating regression model (1) using random and fixed effects estimators for both indicators of compliance. Variables whose estimated parameters are strongly significant with respect to both measures of compliance in both specification are environmental law knowledge, having informal payment, and facing competition. The estimated parameter for environment law knowledge has the expected sign, while the one of having informal payment is positive and the one of facing competition is negative.

In addition, the absolute effects are relatively large for these significant variables. Using the random effects as an example, having good environmental knowledge increases the probability of having CMES by 17% on average (8% for average knowledge and 3% for poor knowledge) compared to no knowledge, holding other variables constant. Similar average marginal effect for having informal payment is 4%, and facing competition 3%. These estimated parameters are even larger in absolute term with respect to having ET suggesting that having CMES is actually a stricter definition of compliance.

In general, the estimated parameters are smaller and less significant in fixed effects models compared to random effects models, which indicates that there are unobserved factors correlating with both explanatory variables and compliance indicators. The existence of unobserved factors are further supported by the fact that the estimated parameters of potential fine, belongs to industries in which CMES is compulsory, firm age, percentage in technical labor, total labor, and locating in production zones are all significant in random effects models, but not in fixed effects models. And most importantly, the Hausman specification test rejects the null hypothesis that the estimated parameters in random and fixed effects models are not systematically different.

The estimated parameters of the number of inspections, percentage of sale for final consumption, having direct export, and asset age index are neither significant with respect to both measures of compliance in both specifications, nor substantial in absolute term. The number of inspections has significant estimated parameter with respect to having ET in random effects model, but even in this case the average marginal effect is only 1%. In case of percentage of sale for final consumption, the absolute size of the estimated parameters are almost zero. The estimated parameter of having direct export is significant with respect to having ET in fixed effects model, and the absolute size of 10% is relatively large. Finally, asset age index does not have significant estimated parameters with respect to both compliance indicators in both specifications.

Table 2: Business compliance explained.

	CMES (RE)	CMES (FE)	ET (RE)	ET (FE)
Inspection	0.005	0.000	0.008*	0.001
	(0.133)	(0.859)	(0.094)	(0.810)
Potential fine	0.016**	0.006	0.025**	0.007
	(0.040)	(0.544)	(0.048)	(0.726)
Compulsory industry	0.053***	0.004	0.042***	-0.013
	(0.000)	(0.759)	(0.001)	(0.660)
Law knowledge good	0.170***	0.070*	0.258***	0.150***
	(0.000)	(0.061)	(0.000)	(0.001)
Law knowledge average	0.080***	0.038**	0.163***	0.128***
	(0.000)	(0.019)	(0.000)	(0.000)
Law knowledge poor	0.030***	0.022**	0.080***	0.068***
	(0.000)	(0.023)	(0.000)	(0.000)
Having tax code	0.035***	-0.010	0.032**	-0.022
	(0.001)	(0.465)	(0.045)	(0.490)
Informal payment	0.039***	0.026**	0.044***	0.041**
	(0.000)	(0.018)	(0.002)	(0.037)
Final consumption (%)	-0.000**	0.000	-0.001***	-0.001***
	(0.012)	(0.635)	(0.000)	(0.006)
Facing competition	-0.032***	-0.030**	-0.052***	-0.076***
	(0.006)	(0.023)	(0.004)	(0.003)
Having export	0.024	0.014	0.004	0.103*
	(0.414)	(0.714)	(0.918)	(0.087)
Ln firm age	0.017***	-0.009	0.026***	-0.006
	(0.009)	(0.334)	(0.005)	(0.740)
Ln asset age	-0.000	-0.003	0.009	0.023
	(0.960)	(0.800)	(0.452)	(0.218)
Technical labor (%)	0.002	-0.001	0.004**	0.003
	(0.128)	(0.436)	(0.018)	(0.315)
Ln total labor	0.040***	-0.005	0.051***	0.016
	(0.000)	(0.653)	(0.000)	(0.373)
Production zones	0.087***	0.037	0.082***	0.065
	(0.000)	(0.259)	(0.004)	(0.112)
Observations	4842	4842	4842	4842

p-values, using robust standard errors, are in parentheses.

Constant terms, time dummy, and provincial dummies are suppressed.

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

Although not reported, the estimated parameter of time trend is highly significant with respect to having CMES, but not so with respect to having ET, in both specifications. These results are in line with the descriptive analysis in previous section. Its absolute size is around 6%. And in contrast to Figure 1, there are no significant differences in percentage of firms having CMES between Ha Noi and other provinces after controlling for other explanatory variables, except for Khanh Hoa whose difference is already remarkable in the figure. Phu Tho, Nghe An, and Long An even have significantly higher numbers than Ha Noi.

5.2.3 Robustness diagnostics

The discussion so far have implicitly assumed that the empirical results speak for statistical causality. There are, however, three potential threats to the robustness of these results. First, two dependent variables are binary responses, hence the consistent estimator should be maximum likelihood. Second, there may be reverse causality problem in some explanatory variables since all the variables are recorded at the same time firms being surveyed. And finally, entry into and exit from the survey might be correlated with unobserved characteristics of firms in ways that biases the estimated parameters. These problems are examined in details below.

Non-linear specification. In order to know whether a non-linear specification such as maximum likelihood estimator produces different results, the relationship in regression model (1) is re-estimated by simply using random effects probit model. The estimated results are then compared to previous results using random effects model. Although there are some minor differences, the average marginal effects are almost similar between maximum likelihood estimator and least squared estimator. Hence, the empirical results reported above are apparently not driven by linear specification.

Reverse causality. Because the implicit causal interpretation in regression model (1) runs from X to y, a crucial assumption is the values of X must be existed before the values of y. Since both dependent and explanatory variables were recorded at the same time in each survey round, it is apparently not certain that firm's characteristics existed before they decided whether or not to have CMES or ET. In other words, there may be reverse causality in some explanatory variables. For example, firms might already had CMES in 2005 before all inspections happened in 2006, and both variables were recorded in 2007.[6] Similar possibilities might occur to other explanatory variables as well.

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[6]In the case of inspection, many empirical studies have shown that firm's characteristics do influence regulator's inspection decision (Deily and Gray 1991; Dion, Lanoiel, and Laplante 1998; Wang et al. 2003). Magat and Viscusi (1990) reject the hypothesis that current inspections is exogenous with respect to compliance and use lagged inspections instead. See also Laplante and Rilstone (1996) who employ instrumental variable approach.

In order to examine the influence of reverse causality, regression model (1) is estimated again using the values of two compliance indicators in 2009 and lagged values of explanatory variables in 2007. Since unobserved factors cannot be controlled for in these regressions, the estimated results are then compared with previous results in random effects models. With the exception of some minor differences, the estimated results with lagged values can be said to be similar to those in the random effects models.

Non-random attrition. The final and most serious threat to previous empirical results relates to the possibility of selection bias, i.e. firms existing through survey rounds are systematically different from firms exiting with respect to compliance behaviors. This problem is even more likely to occur with SMEs who are often in and out of business owning to economic fluctuations (Rand and Torm 2012). Two testing strategies proposed by Verbeek and Nijman (1992) are employed to examine the influence of selection bias on the reported results.

The first test is based on the simple idea that if selection bias is not significant, the estimated results based on the unbalanced panel and sub-balanced panel should not be systematically different. Hence, all columns in Table 1 are re-estimated using their sub-balanced panel counterpart. The traditional Hausman test is then used to examine if the differences in estimated results between the two samples are statistically significant. The test results reject this hypothesis, and suggests that selection bias is real. A closer examination into the magnitude of the problem, however, suggests that the absolute differences in estimated parameters are not substantial. In other words, all the findings based on unbalanced panel hold when using sub-balanced panel in general.

The second test allows us to examine in more details the problem by analyzing if repeated and non-repeated firms are statistically different regarding to their compliance behaviors.[7] First, a binary variable is constructed for firms surveyed in both 2007 and 2009 rounds. Then using 2007 round, regression model (1) is then estimated with the inclusion of this dummy variable and its interactions with other explanatory variables. The results shows that the estimated parameter of the dummy variable for repeated firms is insignificant. In addition, only the estimated parameter of its interaction with the number of inspections is significant in both measures of compliance. The estimated parameter for this interaction term is negative and has an absolute size of around 4% in case of having CMES, and 6% in case of having ET. Furthermore, the estimated parameter of the number of inspections is now significantly positive with respect to both compliance indicators. The absolute size of the estimated parameter for inspection is around 5% in case of having CMES and 7% in case of having ET. These results may explain why the estimated parameter of the number of inspections is fatalistically insignificant as

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[7]This procedure is also used before by Becketti et al. (1988) to study income dynamics.

reported in Table 1. Hence, the previous empirical results might underestimate the influence of inspection. Finally for other explanatory variables, the effects of selection bias are negligible.

In general, it should be concluded that selection bias is real. But the magnitude of the problem is not substantial, except for the case of inspection. Even in this case, the present study is ignorant of the data generating process behind the scene, i.e. whether firms went bankrupt, changed location, or anything else happened. Therefore, the study abstains from arbitrarily construct the traditional Heckman selection model. Future research should try to collect better data to understand the selection mechanism and overcome this problem.

Table 3: Sample selection bias: Inspection.

	CMES	ET
Inspection	0.045***	0.073***
	(0.002)	(0.000)
Repeated firm	0.035	0.073
	(0.687)	(0.573)
Repeated firm*Inspection	-0.039**	-0.064***
	(0.013)	(0.000)
Observations	2378	2378

p-values, using robust standard errors, are in parentheses.
Other variables are suppressed.
* p<0.1, ** p<0.05, *** p<0.01

5.3 Discussion

The present study so far has empirically investigated the determinants of business compliance with environmental regulations in Vietnam. In general, the results are comparable to what have been found in other developed and developing countries to the extent that they all lend support to the theoretical framework discussed above. In other words, factors related to regulatory responses, market and social pressures, and compliance capacities are the main drivers of business compliance with environmental regulations. A closer scrutiny, however, reveals a different story in Vietnam.

First and foremost, the empirical results suggest that knowledge about environmental law seems to make firms feel the regulatory heats much stronger than other factors, hence more likely to comply with environmental regulations, at least in the short and medium run. To be exact, what really matters here is *self-assessed*

knowledge, and in order to say which policy is more cost-efficient, one must also take into account the cost of upgrading firm's self-assessed knowledge about environmental law from nothing to poor/average/good, relative to the cost of, for example, making one extra inspection. Although more detailed calculation must be carried out, it seems promising from this result to allocate more public resources on environmental law communication.

In contrast, the empirical results actually raise question about the role of inspection activities in enhancing business compliance. The effect of inspection is not robustly significant in the baseline regressions. And even when taking into account the selection bias problem, an extra time of inspection still has a relatively small effect on compliance compared to environmental knowledge. This inferior role of inspection is somewhat contrast to many empirical studies in developed countries (Magat and Viscusi 1990; Laplante and Rilstone 1996; Earnhart 2004; Kang and Lee 2004; Shimshack and Ward 2005) and other developing countries (Dasgupta et al. 2001).

In addition, the result on having informal payment suggests that firms who pay bribes are in general more likely to have CMES and ET. Firms in Vietnam seem to be more inclined to making informal payment to have CMES than not to have it. Given the relatively large amount of resources has been put into inspection activities, these results confirm the conventional view that Vietnam has a weak regulatory system, but they question the traditional suggestions of putting more resources into enforcement activities (Clausen, Vu, and Pedrono 2011; Vietnam Central Government 2012). What matters for environmental enforcement in Vietnam seems to be quality rather than quantity.

Second, the empirical results indicate that promoting public awareness to enhance business compliance does not seem to be a cost-effective solution as conventionally believed in Vietnam (Socialist Republic of Vietnam, 2012). Producing for final consumption and firm age all have either insignificant or negligible influences on compliance which suggest that facing more public pressures do not matter much in Vietnam. These results are contrary to many empirical studies in developed countries (Khanna and Anton 2002; Earnhart 2004) and developing countries (Dasgupta et al. 2001). Nevertheless, one may argue that the Vietnamese public do not get enough information on business pollution. Hence, the question if the public disclosure policy often used in developed countries, e.g. Foulon, Lanoie, and Laplante (2002), would be effective in Vietnam is still inconclusive.

In contrast to the theoretical proposition, firms which feel that they are facing competition are less likely to comply with environmental regulations. This result suggests that green technologies do not represent cost-reducing innovations for firms in Vietnam. With a broad definition of compliance, having direct export can be said to have substantial influence on compliance as found in other empirical

studies in developing countries (Blackman and Guerrero 2012). Either encouraging firms to export their products or focusing environmental enforcement on non-export firms seem to be more promising in enhancing business compliance than educating the public, at least in short and medium run.

Third, the empirical results suggest that compliance capacities do not matter much for business compliance behaviors in Vietnam. Weighted average age of assets, percentage of technical labor, firm size measured by total labor, and locating in production zones do not have robustly significant influences on compliance. These results are contrast to other empirical studies in developed countries (Khanna and Anton 2002) and developing countries (Tambunlertchai, Kontoleon, and Khanna 2013). If green technologies are actually cost-increasing innovations for firms in Vietnam, these results may suggest that firms in Vietnam are generally far below the required capacities to comply with environmental regulations. And, this reasoning clearly calls for more supports from the government.

Last but not least is the curious results that many estimated parameters lose significance when unobserved factors are controlled for in the fixed effects models, i.e. having potential fine, belonging to compulsory industries, having tax code, firm age, percentage of technical labor, total labor, and locating in production zones. These results provide support for the hypotheses from laws and business theories that internal factors such as managerial incentives, organizational culture, organizational identity, moral concern, and so on do influence compliance behaviors (Howard-Grenville, Nash, and Coglianese 2008; Tyler 2011). For example, firms with environmentally friendly organizational culture are more likely to base their production in production zones, and at the same time they are also more likely to comply with environmental regulations. Similar interpretations can also be applied to other variables as well.

6   Concluding remarks

The fact that Vietnam has implemented various environmental regulations over the past 20 years with little success has generated an ongoing debate on its environmental policies, as well as provided an interesting case study for environmental policies in developing countries. Existing proposed reforms in Vietnam are often in the form of laundry lists (Clausen, Vu, and Pedrono 2011; Vietnam Central Government 2012), yet resources scarcity always calls for prioritization of policy measures. Without robust empirical evidences, however, the list cannot be effectively narrowed down. The present study has attempted to fill in this gap.

Although limitations remain, the empirical results suggest that increasing law communication and government support are promising venues for environmental policy to boost business compliance, at least in the short and medium run. In addi-

tion, environmental enforcement should also be directed more towards non-export firms. And finally, the cost-efficiency of putting more resources into inspection and public education are questionable, at least in the short and medium run. Future research should focus on understanding the impact of more public disclosure on business compliance behaviors, especially with more precise information about actual environmental performances. Another important research question is the long term compliance behaviors of firms, especially after being granted CMES.

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