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Business Compliance with Environmental Regulations: Evidence from Vietnam

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1.0 INTRODUCTION	1
2.0 THEORETICAL FRAMEWORK	2
3.0 DATA AND VARIABLES	3
3.1 Data	3
3.2 Variables	4
4.0 EMPIRICAL ANALYSIS	5
4.1 Empirical Strategy	5
4.2 Empirical Results	5
4.3 Discussion	9
5.0 CONCLUDING REMARKS	11
LITERATURE CITED	12

LIST OF TABLES

Table 1.	Business compliance: Overall trend	6
Table 2.	Descriptive statistics	6
Table 3.	Business compliance with least squares estimator	7
Table 4.	Industry fixed effects and reverse causality	8
Table 5.	Attrition bias	9

BUSINESS COMPLIANCE WITH ENVIRONMENTAL REGULATION: EVIDENCE FROM VIETNAM

Hoang-Anh Ho

EXECUTIVE SUMMARY

This study conducts an empirical investigation of the various factors driving business compliance with environmental regulations in Vietnam using data from three rounds of the Small and Medium Enterprises Survey. Results show that knowledge about environmental law has a robust and substantial association with business compliance behaviors. In contrast, the number of inspections is not a significant predictor of compliance. There is evidence that paying bribes has a robust significant association with the probability of getting environmental certificates. Factors related to regulatory responses, public and market pressures, and capacities to comply do not have robust associations with compliance behaviors, especially when unobserved time-invariant characteristics of firms are controlled for.

1.0 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 early as 1993, the first environmental law in the country's history, it was generally incomplete and ineffective (Bryant and Akers 1999; Obbard, Lai, and Briffett 2002). It was only after the substantial amendment of the LEP in 2005 that increasing public efforts have been made to design and enforce various environmental regulations, especially those related to business activities (Clausen, Vu, and Pedronoc 2011).

The LEP requires firms in specific industries (e.g., food, textile, leather) to conduct environmental impact assessment (EIA), and they are only allowed to start or continue their business once their EIA reports are approved. Other firms are only required to prepare a commitment to environmental protection (CEP) statement. Furthermore, firms in some specific industries are required, by Circular 2781/TT-KCM, 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. Besides having an approved EIA (or CEP), firms must have certifications of their actual pollution control performance in order to be granted CMES. If required firms do not conduct and report on their EIA or possess CMES, then they have to face sanctions ranging from monetary penalty to complete shutdown. The maximum monetary penalty has increased from VND 70 million in 2004 (Decree No. 121/2004/ND-CP) to VND 500 million in 2009 (Decree No. 117/2009/ND-CP). Other forms of pollution payments are also defined in (1) Decree No. 67/2003/ND-CP in 2003 on environmental protection charges for waste water, and (2) the Law on Environmental Protection Tax No. 57/2010/QH12, which specifies taxable objects and their corresponding tax rates.

Despite these efforts, available evidence suggests that environmental regulations in Vietnam have had 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) studied 119 firms in the food industry; Dao and Ofori (2010) studied 64 firms in the manufacturing sector, which have already implemented some type of environmental management measure; Nguyen (2011) studied 62 plants in the paper industry; and Le and Dinh (2013) studied 54 firms in the leather industry. The findings, 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 specific industries with only one survey round.

Existing proposed reforms in Vietnam are often in the form of laundry lists (Clausen, Vu, and Pedronoc 2011; Vietnam Central Government 2012); the scarcity of resources, however, always calls for prioritization of policy measures. Without robust empirical body of evidence, these lists cannot be effectively narrowed down. This study attempts to fill in this gap by employing three rounds of the Small and Medium Enterprises (SME) Survey. It provides the first comprehensive empirical evidences on the determinants of business compliance with environmental regulations in Vietnam. Information on the possession of CMES and other environmental activities were used to construct two indicators of compliance. Different regression models are then employed to examine the relationship between potential explanatory variables and these indicators.

In general, the empirical investigation shows that environmental law knowledge has a robust and substantial association with business compliance behaviors. In contrast, the number of inspections is not a significant predictor of compliance. There is also evidence that paying bribes has a robust significant association with the probability of getting environmental certificates. Finally, other factors related to regulatory responses, public and market pressures, and capacities to comply do not have robust association with compliance behaviors, especially when unobserved time-invariant characteristics of firms are controlled for. Given the absolute majority of SMEs at 98% of all firms in 2008 (GSO 2010), these empirical findings are valuable for deriving cost-effective 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 experience of environmental regulations in Vietnam, this study would add to this growing stock of knowledge in environmental policies in developing countries.

The rest of the paper is structured as follows. Section 2 briefly surveys existing theoretical models on business compliance with environmental regulations. Section 3 presents general information about the dataset and the construction of dependent and explanatory variables used in the empirical investigation. Section 4 discusses the empirical strategies and their corresponding results as well as their robustness. Finally, Section 5 ends the paper with some concluding remarks.

2.0 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 owing 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 compliance. 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 performance 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 environment-friendly production processes to increase efficiency in using inputs, hence, reduce profit losses due to regulations. In contrast to conventional economic analysis, Porter and van der Linde (1995) even contend that environmental regulations not only induce firms to adopt green production processes but also increase their profits (i.e., introducing no trade-off at all). The authors further argue 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 environment-friendly production processes depends on their adoption costs and technical knowledge required to implement these technologies.

The second group of theories regards external pressures from consumers, investors, competitors, and society as the main reasons why firms comply with environmental regulations. Arora and Gangopadhyay (1995) found that firms may want to produce more environment-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 profit encourage firms to produce more environment-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 out of 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 environment-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; Dawson and Segerson 2008). In other words, compliance helps firms preempt emerging regulatory threats, influence future course of regulations that cannot be preempted, or 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 law and business stressing the role of internal factors in explaining business compliance with environmental regulations (Howard-Grenville, Nash, and Coglianese 2008; Tyler 2011). These internal factors include managerial incentives, organizational culture, organizational identity, moral concern, among others. The general argument is that these internal factors shape a firm's interpretations of environmental issues that emerge in their daily business, and may ultimately determine a firm's responses.

3.0 DATA AND VARIABLES

3.1 Data

This study employs three rounds (2007, 2009, and 2011) of the Vietnam SME Survey as the basis for the empirical investigation. The survey covers 10 of 54 provinces in Vietnam, and mainly includes non-state manufacturing enterprises. 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 onsite identification strategy. Thus, all surveyed informal firms operated alongside surveyed formal firms, hence were not representative of the whole informal sector.

The number of surveyed enterprises varied through three survey rounds: 2,633 in 2007; 2,655 in 2009; and 2,523 in 2011. The repetition rate between two adjacent rounds is around 80% (i.e., 2,111 out of 2,633 firms in 2007 are repeated in 2009; 2,071 out of 2,655 firms in 2009 are repeated in 2011). Adding three rounds together, there is a balanced panel of 1,646 firms, which serves as the primary sample for the empirical analyses. The attrition rate of around 40% from 2007–2011, however, indicates that the empirical investigation should examine the possibility of sample selection bias.

3.2 Variables

This paper constructs two measures of compliance for the empirical investigation. The first measure defines having CMES as having compliance.¹ However, this definition may be too strict since compliance is a broader concept than CMES. For example, a firm trying to comply should be counted as a case of having 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 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. By this definition, having CMES means having ET, but not vice versa.

Based on the theoretical framework discussed in the previous section and on existing empirical studies in other countries (particularly Dasgupta, Hettige, and Wheeler 2000; Khanna and Anton 2002; Tambunlertchai, Kontoleon, and Khanna 2013), explanatory variables were constructed depending on available information. For the convenience of discussion, these variables are categorized into three groups.

The first group represents regulatory responses and includes

1. the number of times a firm was inspected by government agencies for technical compliance³ in the previous year;
2. a binary variable indicating that the firm's main facility is primarily used for production rather than as residence to capture potential fine;
3. a binary variable for industries in which CMES is compulsory;
4. three binary variables for firms' self-assessment of their knowledge about environmental law ranging from good, average, to poor (compared to no knowledge); and
5. a binary variable for possession of a tax code.

Firms having more of these characteristics are expected to face higher regulatory pressures; hence, they are more likely to comply. In addition, a binary variable standing for self-reported paying of bribes was also included to capture the influence of corruption. It is noted, though, that corruption may go both ways (i.e., firms may pay to avoid or to have CMES).

The second group stands for market and social pressures and includes (1) percentage of sale for final consumption out of total sales, (2) a binary variable for the firm's self-perception of facing competition from other firms, (3) a binary variable for having direct export, and (4) age of the firm at the time of the survey. 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: (1) firm size measured by the number of employees and (2) a binary variable for locating the firm in production zones (i.e., 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., face lower costs) to comply with environmental regulations.

¹ In contrast with existing studies in Vietnam which use self-reported information, the SMEs Survey required firms to show their CMES.

² Laplante and Rillstone (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."

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 component in itself, this imperfect measure is still of high value for the purpose of the present study.

4.0 EMPIRICAL ANALYSIS

4.1 Empirical Strategy

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

$$y_{it} = x'_{it}\beta + \eta_i + \mu year_t + \varepsilon_{it} \quad \text{Equation (1)}$$

where:

- y = dependent variable (having CMES or having ET),
- x_{it} = vector of all explanatory variables discussed in the previous section including a constant, and
- η_i = firm's fixed effects.

This paper first uses both random-effects and fixed-effects regressions with least squares and maximum likelihood estimators to estimate the model and examine the influence of unobserved time-invariant characteristics. After that, the analysis goes further to investigate the robustness of the estimated results by controlling for high-polluting industries' (food, textile, leather, and paper) fixed effects, checking for reverse causality, and examining attrition bias.

4.2 Empirical Results

4.2.1 Descriptive statistics

Table 1 reports the percentage of firms that have CMES and those that are applying ET in three survey rounds along with the differences from previous rounds. There are significant increases in the percentage of firms that have CMES and those applying ET from 2007–2011. This result indicates that government efforts mentioned above actually have their payoffs. Despite these significant increases, the absolute level of business compliance is still too low compared to the government target. In 2009, only 14% of SMEs had CMES, compared to the government target, which is that 50% of production and business units should have been granted a 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.

Table 2 presents the descriptive statistics of explanatory variables. The average number of inspections in the three rounds of the survey is relatively high (i.e., the annual unconditional probability of being inspected is around 58% on average). This number suggests that a relatively large amount of resources was devoted to inspection activities in Vietnam during the period of 2007–2011.⁴ Around 74% of firms have main production facilities primarily used for production activities, and around 64% of firms operate in industries where CMES are compulsory. The general self-reported knowledge about environmental law is low (i.e., only 20% of total firms have average or good knowledge and 50% have no knowledge at all, on average). The number of firms that do not have a tax code is relatively large (around 38%) on average, and a similar pattern is also seen in self-reported paying of bribes (around 31%). The average age of firms is 15, while the average number of employees is 17. Finally, the proportion of firms having direct export and located in production zones are absolutely low (only 6% and 4% on average, respectively).

⁴ Even a country as developed as Canada possesses a corresponding number of only 18% for one of its largest polluting industries in its largest province (Laplante and Rilstone 1996).

Table 1. Business compliance: Overall trend

	2007	2009	2011
Having CMES	9.15	13.53	16.17
Difference from previous round		4.38	2.64
Having ET	20.66	21.96	52.28
Difference from previous round		1.30	30.32

Table 2. Descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max.	Obs.
No. of inspections	0.58	2.25	0	98	4,938
Potential fine	0.74	0.44	0	1	4,938
Compulsory industries	0.64	0.48	0	1	4,938
Law knowledge					
Good	0.04	0.18	0	1	4,938
Average	0.16	0.36	0	1	4,938
Poor	0.28	0.45	0	1	4,938
No knowledge?					
Having tax code	0.62	0.49	0	1	4,763
Paying bribes	0.31	0.46	0	1	4,938
Final consumption (%)	37.07	40.14	0	100	4,921
Facing competition	0.87	0.34	0	1	4,936
Having export	0.04	0.20	0	1	4,938
Firm age	15.09	10.72	2	77	4,928
Total labor	17.11	49.64	1	2,561	4,938
Production zones	0.05	0.23	0	1	4,938

Note: Figures are calculated based on three-round balanced panel of 1,646 firms

4.2.2 Regression results

Table 3 reports the main results from estimating regression model (1) using random effects and fixed effects regressions for both indicators of compliance. Variables which have estimated parameters that are highly significant with respect to both measures of compliance in both specifications are potential fine, environmental law knowledge, and paying bribes. All these estimated parameters have the expected signs, while the one for paying bribes is positive. In general, their absolute sizes are relatively large. Using the fixed-effects regression as an example, good law knowledge is associated with a 10.4% higher probability of having CMES on average (4% for average knowledge) compared to no knowledge, holding other variables constant. The corresponding value for potential fine is 1.7% and paying bribes is 2.6%.

The estimated parameters for industries for which EIA or CMES is compulsory and those facing competition are only significant in both specifications with respect to having CMES; the ones for final consumption, total labor, and production zones are only so with respect to having ET. The estimated parameter of final consumption, however, only has a negligibly absolute size (0.1%). The variables which have estimated parameters that are not significant include number of inspections, having direct export, and firm age, while having tax code is only significant in random effects regressions. The estimated parameters of 2009 and 2011 dummies are significantly positive (results not shown), which are in agreement with the descriptive analysis in the previous section. In addition, in compliance of firms in the capital Ha Noi (which is expected to have better regulatory capacities) is not significantly associated with higher percentage of firms having CMES or ET compared to other provinces, except Khanh Hoa.

Table 3. Business compliance with least squares estimator

Attribute	CMES				ET			
	(1)		(2)		(3)		(4)	
	RE	p-value	FE	p-value	RE	p-value	FE	p-value
No. of inspections	0.001	0.446	−0.000	0.734	0.002	0.347	−0.001	0.750
Potential fine	0.017**	0.026	0.017**	0.048	0.036**	0.012	0.041**	0.022
Compulsory industries	0.062***	0.000	0.027**	0.046	0.043***	0.002	0.009	0.777
Knowledge								
Good	0.161***	0.000	0.104***	0.003	0.199***	0.000	0.121***	0.008
Average	0.071***	0.000	0.041***	0.003	0.116***	0.000	0.068***	0.004
Poor	0.027***	0.002	0.013	0.155	0.079***	0.000	0.064***	0.000
Having tax code	0.031***	0.006	−0.012	0.338	0.084***	0.000	0.020	0.537
Paying bribes	0.035***	0.000	0.026***	0.004	0.048***	0.001	0.029*	0.083
Final consumption (%)	−0.000*	0.071	0.000	0.529	−0.001***	0.000	−0.001**	0.037
Facing competition	−0.033***	0.001	−0.036***	0.000	−0.001	0.951	−0.007	0.748
Having export	0.001	0.977	−0.033	0.384	−0.036	0.376	−0.037	0.517
<i>ln</i> firm age	−0.005	0.475	−0.010	0.254	−0.002	0.883	−0.022	0.182
<i>ln</i> total labor	0.050***	0.000	0.010	0.296	0.060***	0.000	0.029*	0.058
Production zones	0.065**	0.013	0.016	0.571	0.113***	0.000	0.079**	0.036
Observations	4,735		4,735		4,735		4,735	

Notes: (1) Robust standard errors. (2) Constant terms, time dummies, and provincial dummies are suppressed to save space.

(3) RE = random effects, FE = fixed effects. (4) Significance level: * p < 0.1, ** p < 0.05, *** p < 0.01.

In most of the cases, the estimated parameters are larger in absolute term with respect to having ET, which suggests that having CMES is actually a stricter definition of compliance. The estimated parameters are generally less significant in fixed-effects models compared to random-effects models owing to smaller absolute sizes. This fact indicates that there are unobserved time-invariant factors correlating with both explanatory variables and compliance indicators. In addition, the Hausman specification test rejects the null hypothesis that the estimated parameters in random- and fixed-effects models are not systematically different. Hence, estimated results from fixed-effects regressions should serve as the baseline results. Finally, similar estimated results in terms of statistical significance are obtained with random-effects probit and fixed-effects logit regressions in general (results not shown). The average marginal effects in probit random effects regression are slightly different, while the ones in fixed effects regression cannot be estimated in the case of dummy variables. Since the primary information of interest in this study is average marginal effects, it uses least squares estimator as a reasonable approximation for the convenience of estimation.

4.2.3 Robustness diagnostics

The investigation so far has shown that the obtained results are robust to unobserved time-invariant factors. There are, however, three potential threats to the robustness of these results. First, it is well-known that some industries such as food, textile, leather, and paper are more pollutive than others.⁵ Hence, being in these industries may correlate both with many explanatory variables and two indicators of compliance. Second, there may be a reverse causality problem in some explanatory variables since all the variables are recorded at the same time that firms are being surveyed. 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 detail in the following section.

Polluting industries' fixed effects. Four industrial dummies (food, textile, leather, and paper) are added to the fixed-effects regressions in Table 3. Although few firms switch from one industry to another over time, this exercise is still useful to examine the robustness of the above results. Columns (1) and (2) of Table 4 reports the estimated results. As can be seen, the results are almost similar to the ones obtained before, in

⁵ Previous studies in Vietnam reviewed above have also focused on these industries.

terms of statistical significance, even though the absolute sizes of the estimated parameters are slightly different. Furthermore, the estimated results (not shown here but available upon request) also change negligibly even if the regression model controls for the interaction terms among four industrial dummies and provincial dummies. Hence, the empirical results obtained so far are robust to polluting industries' fixed effects.

Reverse causality. Because the assumed causal interpretation in regression model (1) runs from x to y , a crucial assumption is that the values of x must exist before the values of y . Since both dependent and explanatory variables were recorded at the same time in each survey round, it is not certain whether a firm's characteristics had 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 have already had CMES in the beginning of 2006 before all inspections were conducted in 2006—both variables were recorded in 2007.⁶ Similar possibilities might occur with other explanatory variables as well.

In order to examine the influence of reverse causality, regression model (1) was re-estimated using the values of two compliance indicators and one-period lagged values of explanatory variables. Because the aim is to examine the influence of the reverse causality problem, the analysis employs random-effects regression to separate the influence of time-invariant unobserved factors. Columns (3) and (4) in Table 4 report the estimated results of this exercise. The most remarkable change is the insignificant estimated parameters of potential fine, which suggests that firms may use their main facilities primarily for production because they have CMES or ET, not the other way around. The estimated parameter of paying bribes is still significant with respect to having CMES but not ET, while facing competition is not significant with respect to having CMES.

Table 4. Industry fixed effects and reverse causality

Attributes	Industry Fixed Effects				Reverse Causality			
	(1)		(2)		(3)		(4)	
	CMES	p-value	ET	p-value	CMES _{t+1}	p-value	ET _{t+1}	p-value
No. of inspections	-0.000	0.734	-0.001	0.727	0.002	0.325	0.004*	0.067
Potential fine	0.017**	0.048	0.041**	0.022	0.009	0.344	-0.014	0.429
Compulsory industries	0.028**	0.028	-0.024	0.492	0.087***	0.000	0.076***	0.000
Knowledge								
Good	0.105***	0.003	0.118***	0.009	0.121***	0.006	0.108**	0.016
Average	0.041***	0.003	0.069***	0.003	0.049***	0.005	0.099***	0.000
Poor	0.013	0.148	0.065***	0.000	0.006	0.604	0.045**	0.010
Having tax code	-0.012	0.323	0.019	0.558	0.071***	0.000	0.125***	0.000
Paying bribes	0.026***	0.005	0.028*	0.092	0.026*	0.076	0.020	0.303
Final consumption (%)	0.000	0.555	-0.001**	0.044	-0.000*	0.090	-0.000**	0.050
Facing competition	-0.036***	0.000	-0.007	0.757	-0.009	0.455	-0.029	0.190
Having export	-0.033	0.374	-0.039	0.492	-0.007	0.832	0.005	0.904
Ln firm age	-0.010	0.255	-0.022	0.179	-0.008	0.393	-0.003	0.791
Ln total labor	0.010	0.305	0.028*	0.069	0.070***	0.000	0.090***	0.000
Production zones	0.016	0.574	0.077**	0.041	0.044	0.104	0.074**	0.018
Observations	4,735		4,735		3,282		3,282	

Notes: (1) Robust standard errors. (2) Constant terms, time dummies, provincial dummies, industrial dummies are suppressed to save space. (3) Industrial dummies are food, textile, leather, and paper. (4) Fixed effects in columns (1) and (2), random effects in columns (3) and (4) Significance level: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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

Attrition bias. The final threat to the results obtained so far relates to the possibility of selection bias (i.e., firms existing through survey rounds are systematically different from firms existing with respect to compliance behaviors). This problem is even more likely to occur with SMEs who are often in and out of business due to economic fluctuations (Rand and Torm 2012). The author used a strategy suggested by Verbeek and Nijman (1992) to examine if firms that were surveyed repeatedly are systematically different from ones surveyed only once as regards their compliance behaviors.⁷ First, a binary variable is constructed for firms surveyed in all three survey rounds. Then using 2007 and 2009 survey rounds, regression model (1) is then estimated, using ordinary least squares, with the inclusion of this dummy variable and its interactions with other explanatory variables. Table 5 summarizes relevant results obtained from this exercise.

Results show that being repeated firms is associated with higher probability of having CMES or ET. In addition, the estimated parameters of the interaction terms between the dummy for repeated firms and the number of inspections, paying bribes, and firm age are significant with respect to both indicators of compliance. In case of the number of inspections, the estimated parameters of the interaction term are negative and have an absolute size of around 4%. Furthermore, the estimated parameters of the number of inspections are now significantly positive with absolute sizes slightly larger the ones of the interaction term. These results may explain why the estimated parameters of the number of inspections in Table 3 are fatalistically insignificant.

With the inclusion of the interaction term, the estimated parameters of paying bribes are now insignificant. Furthermore, the estimated parameter of the interaction term is significantly positive, which suggests that the positive association between paying bribes and two compliance indicators are stronger for repeated firms than non-repeated ones. Finally, the estimated parameters of firm age are significantly positive with the inclusion of the interaction term which indicates that, among non-repeated firms, older firms are associated with higher probability of having CMES or ET.

Table 5. Attrition bias

Attribute	1		2	
	CMES	p-value	ET	p-value
No. of inspections	0.041***	0.000	0.052***	0.000
Repeated firms x No. of inspections	-0.037***	0.000	-0.046***	0.000
Paying bribes	0.019	0.269	0.006	0.781
Repeated firms x Paying bribes	0.037*	0.092	0.058**	0.036
Ln firm age	0.037***	0.000	0.040***	0.001
Repeated firms x Ln firm age	-0.032**	0.011	-0.033**	0.039
Repeated firms	0.095**	0.030	0.130**	0.027
Other variables	YES		YES	
Observations	5,274		5,274	

Note: (1) Robust standard errors. (2) Constant terms, time dummies, provincial dummies, and other variables are suppressed to save space. (3) Other variables include all variables as in Table 3 and their interactions with repeated firms dummy. (4) Significance level: * p < 0.1, ** p < 0.05, *** p < 0.01.

4.3 Discussion

So far, the present study 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 predictors of business compliance with environmental regulations in Vietnam. Furthermore, exploring each specific factor also provides us more interesting stories.

First and foremost, the empirical results have shown a robust positive association between environmental law knowledge and the probability of having CMES or ET. Although the investigation cannot

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

rule out omitted time-variant factors which may correlate to both variables, this finding supports hypothesis that law knowledge makes firms feel the regulatory heats much stronger and more likely to comply with environmental regulations. In addition, the finding is in line with answers to the question on why firms choose to have CMES or ET. Around 65% of firms surveyed in 2011 report that they have CMES because it is required by law, and another 21% is to improve working conditions for labor. The corresponding numbers for having ET are 38% and 49%. To be more precise, what 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 average/good, relative to the cost of, for example, making one extra inspection.

In contrast, the investigation has found no significant association between the number of inspections and two compliance indicators. This result, however, may be subjected to attrition bias. But given the already-high level of inspection activities in Vietnam, it is reasonable altogether to question why the number of inspections has not shown up as a strong predictor of compliance indicators. It is possible that inspection gives firms more law knowledge and induces them paying more bribes which are true by descriptive statistics. In order to see if these are the cases, the author replicates the regressions in Table 3, excluding law knowledge and paying bribes. The author finds that the estimated parameters of the number of inspections are still insignificant in all specifications (results not shown). This insignificant association of inspection is in 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 empirical results have shown that paying bribes has a robust positive association with the probability of having CMES. Furthermore, this association is only significant in the subsample of firms operating in compulsory industries (results not shown) and firms who repeated through three survey rounds. Unfortunately, the question on why firms pay bribes does not mention environmental regulation directly. On average of three survey rounds, around 21% of firms pay bribes to get connected to public services, 27% to deal with taxes and tax collection, and 30% for other reasons. In the context of Vietnam, registering for CMES can be regarded as getting connected to public services. This finding, together with the one of inspection, is in line with the conventional view that Vietnam has a weak regulatory system (e.g., Clausen, Vu, and Pedronoc 2011).

Second, the empirical results have found no robust significant association between indicators of public and market pressures and two compliance indicators. Producing mainly for final consumption has a significantly negative association with the probability of having ET, but its absolute size is almost zero. Facing competition has a significantly negative association with the probability of having CMES, which may suggest that green technologies do not represent cost-reducing innovations for SMEs in Vietnam; but the association does not pass the test of reverse causality. Finally, both having direct export (even export to OECD countries, results not shown) and firm age have insignificant estimated parameters, though the result of firm age may subject to attrition bias. This finding in line with the conventional wisdom that Vietnamese public has a low awareness of environmental issues (e.g. Clausen, Vu, and Pedronoc 2011). Only 3.7% of firms surveyed in 2011 answered that they have CMES to attract or to satisfy requirements of customers, the corresponding number for having ET is 0.7%. The finding, however, are contrary to many empirical studies in developed countries (Khanna and Anton 2002; Earnhart 2004) and developing countries (Dasgupta et al. 2001).

Third, the investigation has found that indicators of compliance capacities have a robust association with the probabilities of having ET, but not CMES. Bigger firms and firms locating in production zones are more likely to treat some environmental factors. The result on having ET is line with empirical studies in developed countries (e.g. Khanna and Anton 2002), but the result on having CMES is in contrast to empirical studies in developing countries on ISO 14001 Certificate (e.g. Tambunlertchai, Kontoleon, and Khanna 2013). Most of the firms surveyed in 2011, around 83%, consider air quality, fire, heat, and noise are the most difficult requirements for CMES. Only around 2% of firms have CMES or ET because it is cost reducing (in the longer run). This finding is in line with conventional wisdom in economics that environmental regulations are generally not win-win options (Palmer, Oates, and Portney 1995). The finding may also suggest that firms in Vietnam are generally far below the required capacities to have CMES, hence more government support may be needed.

Last but not least is the curious result that most of the estimated parameters are less significant, owing to smaller absolute sizes, when unobserved time-invariant factors are controlled for in the fixed-effects regressions. These results support the hypotheses from laws and business theories that unobserved internal factors such as managerial incentives, organizational culture, organizational identity, moral concern, and so on may influence business compliance behaviors (Howard-Grenville, Nash, and Coglianese 2008; Tyler 2011). For example, firms with environment-friendly organizational culture may be more likely to base their production in production zones, and at the same time they may also be more likely to comply with environmental regulations. Similar interpretations can also be applied to other variables as well.

5.0 CONCLUDING REMARKS

The fact that Vietnam has implemented various environmental regulations over the past 20 years with little success, especially regarding to business compliance, has generated an ongoing debate on its environmental policies, as well as provided an interesting case study for environmental policies in developing countries. The empirical results found in this study have many important policy implications for enhancing business compliance in Vietnam. First, it is worth exploring the possibility of increasing law communication and government support with more detailed cost-effectiveness analyses. Second, Vietnam should reconsider the cost-effectiveness of putting more resources into inspection and public education, at least in the short and medium run. Finally, 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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