Does It Pay for SMEs in Developing Countries to Go Green? Evidence from Vietnam

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Recent environmental crises in developing countries indicated the importance of improving businesses' environmental performance. Is it profitable for firms in developing countries to go green? This paper studies the link between the adoption of environmentally friendly practice and the financial performance of small and medium enterprises (SMEs) in developing countries. Specifically, propensity matching is used to evaluate the profitability of sustainability adopters and non-adopters among Vietnamese SMEs between 2011 and 2015. The results suggest a heterogenous impact of sustainability adoption on profitability across industries and firm types, which has important policy implications for the sustainable business development in developing countries.

INTRODUCTION

Since the beginning of economic reform in the 1980s and 1990s, Vietnam has experienced rapid economic growth. At the same time, the level of pollution in Vietnam has also increased and news about environmental crises in the industrial sectors has frequently appeared in the media, with the industrial sector being a major contributor to pollution. This highlights the importance of improving corporate environmental responsibility on improving the Vietnamese environmental quality. Yet, one concern is that the adoption of environmentally-friendly practices will further tighten the constraints faced by many firms, particularly small and medium enterprises (SMEs), thereby negatively affecting their profitability. The goal of this paper is to investigate the relationship between the adoption of environmentally friendly practices (EFP) and the profitability of small and medium firms in Vietnam.

Small and medium enterprises (SMEs) plays an important role on developing countries' living standards (World Bank, 2016). In Vietnam, SMEs comprise the majority (95%) of the Vietnamese private sector and hire the largest share of the Vietnamese labor force (Ho et al., 2014). With the increasing needs for better environmental standards in developing countries, it is expected that SMEs will face a unique set of challenges to adopt sustainability practices, for example, technical and financial constraints may make it difficult for them to be sustainable and profitable at the same time. Yet, recent studies in this area still focuses mostly on large organizations or are conducted in the context of developed countries such as the U.S. or European countries (Hitchens et al., 2005; Rubashkina et al., 2015), while the empirical evidence on the EFP–profitability relationship has been scant for SMEs in developing countries. Moreover, most existing work models the relationship between environmental and financial performance using parametric techniques, which often assumes strict exogeneity in the EFP adoption decisions. Since it is intuitively

reasonable to expect that the financial performance of a firm can influence the decision to adopt sustainability practices, the assumption that EFP adoption decisions are strictly exogenous is non-trivial.

The contribution of this paper is to investigate the effect of sustainability practices on SMEs' profitability in the context of a developing country like Vietnam, using a semi-nonparametric propensity score matching method. Under the propensity score matching (PSM) technique, EFP adopters are matched with non-adopters with similar characteristics, thus PSM limits the reliance on modeling assumptions in estimating the impact of EFP on profitability and can provide a more precise estimate of treatment effects from non-experimental data than standard parametric approaches (List et al., 2003).

Using a firm-level data set of Vietnamese SMEs between 2011 and 2015, several interesting results are obtained. First, there exists a positive relationship between EFP adoption and firm-level profitability, however, this relationship is heterogeneous across different types of firms. Specifically, larger firms are more likely to benefit from environmentally-friendly practices. On the other hand, the impact of EFP on profitability tends to be smaller among firms who are subject to bribery and informal payments. In addition, the positive impact of EFP on profitability is more likely to occur in non-technologically intensive industries, compared to other industries. This suggests that adopting sustainability practices in high-tech industries may involve a larger investment requirements, therefore, firms in those industries are less likely to benefit from EFP adoption. The empirical results also highlight the importance of improving the transparency of the regulatory system and of improving the firm-level knowledge of environmental law on the adoption of EFP among SMEs in Vietnam.

The paper proceeds as follow. Section 2 provides the background information about the business environment in Vietnam, summarizes the recent literature and develops testable hypotheses. Section 3 describes the empirical strategy, data set and variable selection. Section 4 presents the empirical results and finally, section 5 provides some concluding remarks.

BACKGROUND INFORMATION, LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Since its Renovation (*Doi moi* in Vietnamese) in 1986, the Vietnam economy has experienced rapid economic growth. Since 1990, Vietnam has enjoyed an average GDP growth rate of 6.7% per year and the Vietnamese living standards have steadily improved in areas such as life expectancy and primary education enrollment (World Bank, 2017). Yet, rapid development came at a cost. Nowadays, Vietnam faces a number of environmental problems such as air pollution, low water quality, and exhausted natural resources. In the last two decades, efforts have been made by the Vietnam's policymakers to address this problem, particularly the passing of the Environmental Protection Law in 1994 and its amendments in 2005 and 2014. However, improvements in environmental quality have been slow. According to the Environmental Performance Index, Vietnam ranked 131 out of 180 countries in terms of environmental performance (Yale Center for Environmental Law & Policy, 2016) and news about environmental problems in Vietnam has appeared more frequently in the media. Amidst the recent environmental crises, many have advocated the use better environmental standards, however, it is still a common belief that higher environmental standards may not be suitable for the current development of Vietnam (The Economist, 2016; Tuoi Tre News, 2016). One concern is that firms will incur extra costs under higher environmental standards, which leads to lower profitability. The goal of this paper is to test this claim among small and medium enterprises in Vietnam.

In the literature, there exists two opposing theories regarding the effect of adopting EFP on corporate financial performance. Some argue that the adoption of EFP incurs additional costs, thereby decreasing corporate profitability (Preston & O'Bannon, 1997; Jensen, 2001). Others argue that there is a positive relationship between corporate environmental and financial performance, since a firm that can effectively control the pollution may also be able to control other costs of production, improve efficiency, and earn a higher rate of returns (Porter & Van der Linde, 1995). The empirical evidence to support either theory is inherently diverse. For example, Konar & Cohen (2001); Wahba (2008); Li et al. (2017) find that good environmental practices have a positive impact on corporate financial performance. In contrast, other

studies find a negative or no significant relationship between environmental performance and financial performance (Link & Naveh, 2006; Gonzalez-Benito & Gonzalez-Benito, 2005; Watson et al., 2004).

While the empirical evidence so far has primarily focused on large corporations or on firms in developed countries, research on the impact of environmental performance on profitability for small and medium firms in developing countries has been sparse. Since small and medium enterprises (SMEs) contribute a significant share to the economic development of developing countries, it is important to understand how these SMEs' profitability is affected by their adoption of more environmentally-friendly practices. Given the lack of consensus on the relationship between environmental and financial performance and the sparse empirical evidence about this relationship for developing countries' SMEs, I suspect there is no clear link between EFP adoption and profitability, therefore, I propose the following hypothesis:

Hypothesis 1: *Holding everything else equal, EFP adoption has no effect on the firm-level profitability.*

The heterogeneous evidence for the EFP-profitability relationship has indicated that the impact of EFP adoption on firm profitability depends on a number of factors, such as the size of the firm or the industry in which they operate (Lefebvre et al., 2003; Molina-Azorin et al., 2009). Thus, in addition to analyzing the overall impact of EFP adoption on profitability, another goal of this paper is to identify the heterogeneity in the EFP-profitability relationship across various firm-level characteristics, such as industries and sizes. The next hypotheses are raised as follows:

Hypothesis 2: *Holding everything else equal, larger firms are more likely to benefit from EFP adoption.*

Hypothesis 3: *Holding everything else equal, firms in more technologically-intensive industries are less likely to benefit from EFP adoption.*

In the next section, I will describe the empirical strategy and data to validate the above hypotheses.

METHODOLOGY AND DATA

Empirical Strategy

This section describes the empirical strategy that I have adopted to study the impact of environmentally friendly practice on the firm-level profitability. The effect of EFP on profitability is defined as "what would have happened to the profitability of EFP adopters if they had not adopt EFP?". A simple comparison between the adopters and non-adopters is not suitable to identify the exact effect of EFP, since there may be some differences in the characteristics of the adopters and non-adopters. Instead, the analysis of the relationship between EFP and firm-level performance requires the construction of a counterfactual. One method of constructing the counterfactual is to create a matched samples of control and treatment groups with similar characteristics, except that the treatment group consists of EFP adopters while the control group consists of non-adopters.

In this paper, I construct the control group by applying the propensity score matching (PSM) method that was first proposed by Rosenbaum & Rubin (1983). To obtain an unbiased estimation of the effect of EFP adoption, the PSM method requires finding a conditioning set of observable characteristics Z, such that

$$(y_0, y_1) \perp T|Z, \quad P(T) = P(T = 1|Z) \in (0,1) \tag{1}$$

where y_0 denotes the profitability when the firm does not adopt EFP; y_1 denotes the profitability when the firm adopts EFP; T is a dummy variable that equals 1 for EFP adopters. $P(T)$ denotes the propensity score, which indicates the probability of EFP adoption given the set of observable variables Z. In this paper, $P(T)$ is estimated using a logit regession.

Upon the estimation of the propensity score, a matching algorithm is employed to estimate the counterfactual, y_{i0}, for each EFP adopter i. In this paper, three alternative matching techniques are

compared: nearest neighbor, radius and kernel matching.[1] Based on the results of the matching, the treatment effect on the treated is given by:

$$ATT_i = E[y_{1i}|T_i = 1, P(Z_i)] - E[y_{0i}|T_i = 0, P(Z_i)] \quad (2)$$

Since the data used in this paper are available for multiple years, I amend the matching method by restricting the pool of potential controls to which a given EFP adopter may be paired. Three alternative matching restrictions are compared: first, restricting matched pairs to be from the same year; second, restricting matched pairs to be from the same year and same industry; and finally restricting matched pairs to be in the same industry from different years. This is the matching method's version of fixed effects (List et al., 2003; Smith & Todd, 2004).

Once the matching estimation has been completed, balancing tests are conducted. Balancing refers to the fact that conditioning on the propensity score, the distribution of the conditioning variables Z should not differ across the treatment and control group of the matched subsample. In this paper, I apply the balancing test described by Dehejia & Wahba (2002). In addition, I also test for differences in the mean of the variables in Z.

Data

The data used in this paper are obtained from the Vietnam Small and Medium Enterprise (SME) survey from 2011 to 2015 (CIEM et al., 2015, 2013, 2011). This biennial survey covers non-state manufacturing firms of micro, small and medium sizes in 10 provinces in Vietnam and consists of information on enterprise characteristics such as production, sales structure, costs, investment, employment, owner characteristics, economic constraints and potentials.[2] The firms are sampled from the Establishment Census of 2002 and the Industrial Survey of 2004-2006 from the General Statistics Office of Vietnam (GSO). Stratified sampling technique was used to ensure an adequate number of enterprises in each province across different ownership forms. Table 0 shows the number of surveyed firms in each round of the survey. In each survey round, approximately 80% of the firms are repeated from the previous survey and new enterprises are added to the sample to replace the firms that have stopped operating, changed owners or relocated to another industry or location. The replaced enterprises are randomly drawn from the list of active enterprises of the local authorities and share similar ownership structure and location with the exiting enterprises.

In this study, I exclude firms in the agriculture sector and firms with foreign or state capital to ensure a more homogeneous sample of domestically owned SMEs. I also use both the unbalanced panel of firms that have participated in at least one round of the survey between 2011 and 2015 and the balanced panel of firms that have participated in all three survey rounds between 2011 and 2015.

Variable Selection

Analyzing the impact of EFP on firms' profitability requires data on the firm-level profits, EFP adoption and other characteristics. In this paper, profitability is measured as the log of real gross profit per employee with the base year being 2010. Two variables are used to measure the firms' EFP adoption. The first measure defines EFP adoption as having a "Certificate for registration of satisfaction of environmental standards" (ESC). While this measure provides an objective indicator of EFP adoption, it is rather restricted, as firms may choose to treat the environment without having an ESC. Thus, a second measure of EFP adoption is used, where EFP adopters are defined as firms who do not have an ESC but have treated some environment factors. These two measures of EFP adoption form two separate treatment groups, which will be compared to the control group of non-adopters using the propensity matching technique.

In addition to the above variables, explanatory variables used for the estimation of the propensity score are also included. To obtain robust and correct estimates of the impact of EFP using propensity score matching, one needs to include a set of observable variables that jointly influence the firm-level profit and the probability of EFP adoption (Caliendo, 2006). Following the literature on corporate

environmental and financial performance (Tybout, 2000; Dasgupta et al., 2000; Khanna & Anton, 2002), in this paper, I use the age of the firm, the number of workers, real assets and three dummy variables that equals 1 if firms self-reported that they have good, average, and poor knowledge of environmental law (as opposed to having no knowledge at all). I also add a set of variables that describe other firm-level characteristics, which include the share of professional workers (to control for the quality of human capital), the share of new machinery and equipment (to control for the quality of physical capital), and dummy variables for ownership status, informal payments, competition, exporting activity, industry sectors and locations. Table 1 summarizes the descriptions of these variables.

TABLE 1
NUMBER OF FIRMS SURVEYED

Survey round	Number of firms surveyed	Number of repeated firms from previous round
2011	2,498	2,047
2013	2,542	2,046
2015	2,648	2,118

TABLE 2
VARIABLE DEFINITIONS

Variable	Definition
Profit	Real gross profit per employee (Base year = 2010)
EFP adoption	=1 if the firm adopts EFP
Law1-3	Dummy variables indicating the firm's self-reported knowledge of environmental law (Law1=Poor, Law2=Average, Law3=Good)
Assets	Log of end-of-year real assets per employee (Base year=2010)
Workers	Number of employees
Asset age	% of machinery and equipment that are ≤ 3 years old
Professional	% of employees who have university or college degree
Firm age	Years from the establishment of the firm
Ownership	=1 if the firm is a household business
Bribe	=1 if the firm has to pay bribe
Competition	=1 if the firm faces competition
Export	=1 if the firm is an exporter
Production zone	=1 if the firm is in an industrial zone, a high-tech zone or an export processing zone
Industry1-8	Dummy variables indicating industry sectors: (1) Industry1: Food, beverages and tobacco; (2) Industry2: Textiles, apparel and leather; (3) Industry3: Wood, paper, publishing and printing; (4) Industry4: Refined petroleum and chemical products; (5) Industry5: Rubber and non-metallic mineral products; (6) Industry6: Metal products; (7) Industry7: Machinery and transport equipment; (8) Industry8: Furniture, jewelry and music equipment
Urban	Dummy variable indicating the whether the firm is in an urban area.

RESULTS

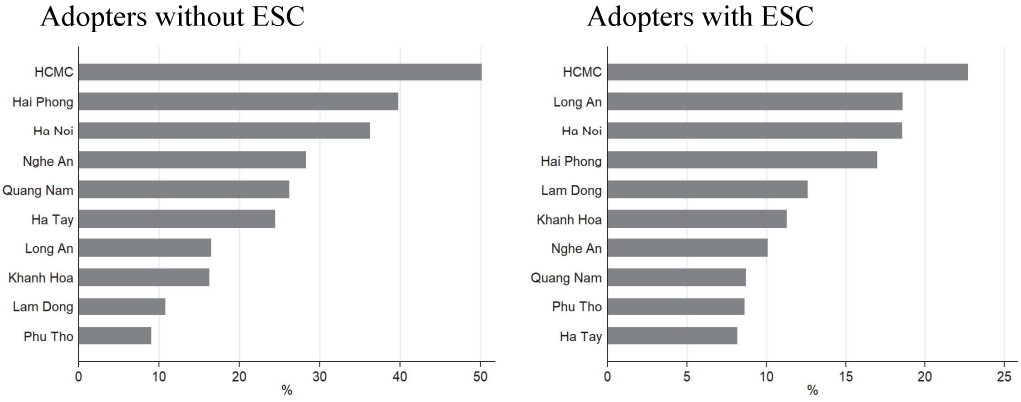
Descriptive Statistics

Table 3 presents the shares of EFP adopters in all survey rounds from 2011 to 2015. On average, 15% of the firms in the sample have an environmental standard certificates (ESC). On the other hand, 40% of the firms in the sample do not have an ESC but have treated some environment factors. Figure 1 shows the percentage of EFP adopters by province. Large urban cities like Ho Chi Minh City (HCMC), Ha Noi and Hai Phong have a higher share of EFP adopters than other provinces.

TABLE 3
PERCENTAGE OF EFP ADOPTERS BY YEAR

Year	2011	2013	2015
Share of adopters without ESC	36.4%	42.2%	38.2%
Share of adopters with ESC	15.8%	16.3%	13.2%
Total share of adopters	52.2%	58.5%	51.4%
Sample size	2441	2487	2593

FIGURE 1
PERCENTAGE OF EFP ADOPTERS BY PROVINCE, 2011-2015



There exist a number of differences between non-adopters and adopters in the sample, as table 4 indicates.[3] For example, on average, adopters of EFP are more knowledgeable about environmental laws, have a larger amount of assets and number of workers. The majority (82%) of non-adopters are household businesses, while the share of household businesses among adopters is only 25%. In addition, non-adopters are less likely to export or locate in production zones and are less exposed to bribery and informal payments.

TABLE 4
SUMMARY STATISTICS OF NON-ADOPTERS VERSUS ADOPTERS, 2011-2015

	Non-adopters		Adopters without ESC			Adopters with ESC		
	Mean	SD	Mean	SD	t-test	Mean	SD	t-test
Ln(Profit)	3.185	0.764	3.351	0.898	**	3.457	1.074	**
Law1	0.229	0.421	0.333	0.471	***	0.348	0.477	***
Law2	0.105	0.307	0.179	0.383	***	0.313	0.464	***
Law3	0.008	0.090	0.024	0.154	***	0.085	0.279	***
Ln(Assets)	4.871	1.235	5.342	1.171	***	5.544	1.170	***
Ln(Workers)	1.382	0.849	1.984	1.032	***	2.904	1.183	***
Professionals (%)	1.480	4.917	3.905	7.277	***	6.901	8.119	***
Asset age (%)	16.685	29.210	14.637	26.385	***	14.828	25.819	*
Ln(Firm age)	2.596	0.666	2.426	0.649	***	2.463	0.569	***
Ownership	0.818	0.386	0.566	0.496	***	0.258	0.438	***
Bribe	0.290	0.454	0.512	0.500	***	0.629	0.483	***
Competition	0.848	0.359	0.914	0.280	***	0.912	0.283	***
Export	0.026	0.160	0.063	0.243	***	0.175	0.381	***
Production zone	0.014	0.118	0.053	0.223	***	0.139	0.346	***
Observations	3,095		2,733			1,083		

***, **, and * indicate the 1%, 5% and 10% level of significance.
The t-test is to test the difference between non-adopters and adopters.

The Estimation of the Propensity Score

In this section, I present the estimation results of the propensity score, which measures the probability of adopting environmentally friendly practices (EFP) given a set of firm-specific characteristics. The estimation of the propensity score is calculated using a logit regression, where the dummy for EFP adoption is regressed on the baseline characteristics listed in section 3.3. Since there are two definitions for the EFP adoption dummy variable, I estimate two logit models: one that uses non-adopters and adopters without an ESC as the control and treatment groups, and another that uses non-adopters and adopters with an ESC as the control and treatment groups.

The logit estimation of the propensity score is presented in tables 5.[4] Specifically, columns (1) and (2) reports the estimation results for adopters without an ESC using the unbalanced and balanced panel data. Columns (3) and (4) presents the estimation results for adopters with an ESC. The estimation results show that the adoption of EFP is more likely with increasing understanding of environmental law, where the impact of environmental law knowledge on EFP adoption is the strongest among firms with an ESC. In addition, larger firms with better physical and human capital are more likely to adopt sustainability practice. This is indicated by the positive and significant signs of the coefficients on the firms' assets, the number of workers, the share of professional workers and the share of machinery that are less than 3 years old. The parameters for the firm's age is positive and significant but the parameter for the squared firm's age shows negative sign, which implies that the youngest firms and the oldest firms are less likely to adopt EFP, perhaps because they are less able to manage the costs and risks from EFP investment. The coefficient on bribery is positive and significant among all EFP adopters, which suggests that firms may make informal payments to receive the support needed for sustainability adoption. Finally, being in an urban area or in a production zone also increases the likelihood of sustainability adoption.

TABLE 5
ESTIMATION OF THE PROPENSITY SCORE

Dependent variable: Adoption of environmentally friendly practices (EFP)				
	Adopters without ESC		Adopters with ESC	
Variable	Unbalanced	Balanced	Unbalanced	Balanced
	(1)	(2)	(3)	(4)
Law1	0.2065***	0.2403***	0.5898***	0.6489***
	(0.0711)	(0.0876)	(0.1130)	(0.1349)
Law2	0.0623	0.0814	0.6881***	0.6908***
	(0.0942)	(0.1177)	(0.1297)	(0.1562)
Law3	0.2441	0.4492	1.3881***	1.4012***
	(0.2614)	(0.3500)	(0.2905)	(0.3873)
Ln(Assets)	0.1354***	0.1325***	0.3559***	0.3435***
	(0.0269)	(0.0338)	(0.0440)	(0.0540)
Ln(Workers)	0.3604***	0.3135***	0.9694***	0.9482***
	(0.0442)	(0.0552)	(0.0653)	(0.0792)
Professionals (%)	0.4899	0.4965	0.6007	0.5089
	(0.5868)	(0.7574)	(0.7475)	(0.9293)
Asset age (%)	0.0022*	0.0034**	0.0034*	0.0030
	(0.0011)	(0.0014)	(0.0019)	(0.0023)
Ln(Firm age)	0.5119**	0.6576*	2.0002***	2.3191***
	(0.2397)	(0.3521)	(0.4240)	(0.6196)
Ln(Firm age) ^{2}	-0.1233**	-0.1445**	-0.3626***	-0.4343***
	(0.0493)	(0.0688)	(0.0850)	(0.1194)
Household	-0.0744	-0.0842	-0.6792***	-0.9019***
	(0.0926)	(0.1177)	(0.1310)	(0.1575)
Bribe	0.3314***	0.3250***	0.4008***	0.2184*
	(0.0653)	(0.0817)	(0.0990)	(0.1207)
Competition	0.3466***	0.2688**	-0.0029	-0.0454
	(0.0975)	(0.1193)	(0.1569)	(0.1891)
Export	-0.0057	0.1725	-0.2580	-0.4229*
	(0.1604)	(0.2032)	(0.1882)	(0.2406)
Production zone	0.6056***	0.9715***	0.6491***	1.1450***
	(0.1975)	(0.2838)	(0.2218)	(0.3166)
Urban	1.5213***	1.5183***	1.1625***	1.2124***
	(0.0693)	(0.0880)	(0.0998)	(0.1211)
Constant	-2.7058***	-2.8056***	-7.8736***	-7.7615***
	(0.3509)	(0.5147)	(0.6276)	(0.9027)
Time effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Number of obs.	5930	3896	4243	2889
Log-likelihood	-3312.5245	-2174.8422	-1428.5320	-983.3490
Pseudo-R ^{2}	0.1923	0.1914	0.4137	0.4208
χ^2	1577.0793	1029.4128	2015.9518	1428.8776
Prob $> \chi^2$	0.0000	0.0000	0.0000	0.0000

***, **, and * indicate the 1%, 5% and 10% level of significance.
Standard errors are in parentheses.

The Impact of EFP Adoption on Profitability

From the estimation of the propensity score, sustainability adopters are matched with non-adopters with the closest propensity score. The significant differences between non-adopters and adopters presented in table 4 require a careful matching of adopters with non-adopters to ensure that EFP adopters are matched with non-adopters of similar characteristics. In this paper, three alternative matching techniques are compared: nearest neighbor, radius and kernel matching.[5] Since the results from these alternative matching methods are robust and have the same implications, this section focuses on the results based on the kernel matching method, which has been shown to perform well in cases of large differences in the number of observations in the treatment and control groups (Frolich, 2004).[6] To check the appropriateness of the matching, I apply the balancing test described in Dehejua & Wahba (2002) after each matching estimation, where the null hypothesis is that the matched samples of adopters and non-adopters have similar distributions of baseline characteristics, independent of their adoption decisions. In all estimations, the balancing test fails to reject the null hypothesis at a 5% significant level and in almost all cases, the means of the conditioning variables Z in the control and treatment groups are equal at a 5% significant level (1% for few dummy variables).

Columns (1) and (2) of table 6 presents the impact of EFP on the firm-level profitability under three matching algorithms: within sector; within year; and within year and sector. On average, adopting environmentally friendly practices improve the firm-level profit, since the estimated treatment effects are positive and significant across the matching algorithms. The estimated "benefit" of being sustainable is larger among firms with an environmental standard certificate, compared to voluntary adopters who did not obtain an ESC.

TABLE 6
THE IMPACT OF EFP ADOPTION ON PROFITABILITY

	Adopters without ESC		Adopters with ESC	
ATT	Unbalanced	Balanced	Unbalanced	Balanced
	(1)	(2)	(3)	(4)
Matching algorithm: Within sector	0.1138***	0.0941**	0.1811**	0.1578**
	(0.0319)	(0.0403)	(0.0714)	(0.0780)
Matching algorithm: Within year	0.0843***	0.0804*	0.1130	0.0787
	(0.0321)	(0.0417)	(0.0762)	(0.0688)
Matching algorithm: Within year & sector	0.0960***	0.0986**	0.1796***	0.1534**
	(0.0314)	(0.0388)	(0.0620)	(0.0689)

***, **, and * indicate the 1%, 5% and 10% level of significance.

Table 7 summarizes the average treatment effects for different sub-samples under the within-year, within-sector matching algorithm.[7] It can be seen from the table that the benefit of adopting sustainability practices is larger among firms with more than 10 employees, compared to firms of smaller size. Furthermore, the results from table 7 suggests that the gain in profit from EFP adoption is larger among firms who do not engage in informal payments. Thus, while many firms may pay bribes in order to adopt sustainability practices, doing this does not necessarily improve their profitability. In addition, firms in industries with low technological intensities are more likely to benefit from EFP adoption than firms in medium or high technological-intensive industries.[8] One explanation is that adopting sustainability practices in high-tech industries involves a larger investment requirements, therefore, firms in those industries are less likely to benefit from EFP adoption.

Table 10 in Appendix A.2 estimates the average treatment effect where data from 2011 are used to estimate the propensity of adopting sustainability practices in 2013 and 2015. Overall, the results lead to similar conclusions about the impact of EFP adoption on firm-level profitability across different firm size and sectors, however, the estimated coefficients are slightly smaller than the main estimation results in tables 6 and 7.

TABLE 7
THE IMPACT OF EFP ADOPTION ON PROFITABILITY BY SECTOR

	Adopters without ESC		Adopters with ESC	
ATT	Unbalanced	Balanced	Unbalanced	Balanced
	(1)	(2)	(3)	(4)
Matching algorithm: Within year and sector				
Overall	0.0960***	0.0986**	0.1796***	0.1534**
	(0.0314)	(0.0388)	(0.0620)	(0.0689)
<= 10 employees	0.0820***	0.0631	0.1569**	0.0258
	(0.0301)	(0.0390)	(0.0625)	(0.0770)
> 10 employees	0.1829**	0.0448	0.2225**	0.2282
	(0.0874)	(0.1090)	(0.1120)	(0.1477)
Informal payment	0.0669	0.0623	0.0978	0.0371
	(0.0523)	(0.0646)	(0.0906)	(0.1039)
No informal payment	0.1080***	0.0780*	0.1044	0.1518*
	(0.0362)	(0.0449)	(0.0830)	(0.0824)
Low tech intensive industries	0.1280***	0.1229**	0.1442**	0.2995***
	(0.0412)	(0.0596)	(0.0645)	(0.0898)
Medium tech intensive industries	0.0875	0.0584	0.0569	0.0199
	(0.0626)	(0.0656)	(0.1451)	(0.1183)
High tech intensive industries	0.0936	0.0184	-0.0076	0.0285
	(0.0878)	(0.1109)	(0.2053)	(0.3283)

***, **, and * indicate the 1%, 5% and 10% level of significance.

SUMMARY AND DISCUSSION OF RESULTS

The deterioration of environmental quality in many developing countries has urged the design of new policies to encourage sustainability practices. But, does the adoption of environmentally friendly practices negatively affect firms' profitability? In other words, does it pay for firms, particularly SMEs in developing countries, to go green? This study is among the first to examines how the adoption of environmentally friendly practices affects the profitability of SMEs in the context of a developing countries like Vietnam. Given the similar characteristics of Vietnam with other developing countries, particularly Southeast Asian countries, the paper provides useful implications for environmental policies in other developing countries.

The study also contributes to the current literature by using a seminonparametric method based on propensity score matching, which has been shown to estimate treatment effects from non-experimental data more precisely than standard parametric estimators. Under the matching techniques and utilizing the panel nature of the data, I am able to control for time- and industry- specific unobserved factors. The main findings of the paper are that: (i) EFP adoption has a positive impact on profitability, however, larger firms and firms in non-technologically intensive industries are more likely to benefit from EFP; (ii) the propensity to adopt EFP depends on the firm-level knowledge of environmental law, the number of workers, the size of the capital stock, the firm's engagement in informal payments and its location.

These findings suggest that policies that encourage sustainability practices can also improve the financial performance of the firms, even among firms that do not have an environmental standard certificate. For example, directing more resources towards the education and communication of environmental law potentially increases the probability of EFP adoption. Moreover, improving the transparency of the regulatory system can boost the benefits of EFP adoption, as the treatment effects of sustainability practices on profitability are larger among firms who are not exposed to informal payments.

Finally, EFP adoption can be boosted through increasing support for small businesses and for firms in technology-intensive industries.

Future work can extend this study in the following areas. First, it would be interesting to explore the relationship between EFP and profitability in the long term as more data become available. Second, it is also interesting to explore the relationship between alternative measures of firm-level environmental and financial performance using a single-country or cross-country analysis. Finally, the scant evidence on the firm-level EFP-profitability relationship in developing countries is partly due to the limited availability of firm-level data for developing countries, therefore, efforts at improving the quality and quantity of these data will benefit further explorations in this area.

ENDNOTES

1. Caliendo & Kopeinig (2008) provides a summary of the different matching techniques. In this study, nearest neighbor matching is calculated using different number of nearest neighbors and radius matching is conducted with different choices of radius. Finally, kernel matching is conducted using the Gaussian kernel function with the bandwidth 0.01. The results are robust to other choices of bandwidth.
2. Micro firms consist of up to 10 employees; small firms consist of up to 50 employees while medium-sized firms consist of up to 300 employees.
3. Table 8 shows the summary statistics of adopters and non-adopters by year.
4. The goodness-of-fit test is insignificant at a 5% significant level, which indicates the logit model presents an appropriate fit for the data.
5. Caliendo & Kopeinig (2008) provides a summary of the different matching techniques. In this study, nearest neighbor matching is calculated using different number of nearest neighbors and radius matching is conducted with different choices of radius.
6. The results from the other matching methods are available upon request. Kernel matching is conducted using the Gaussian kernel function with the bandwidth 0.01. The results are also robust to other choices of bandwidth.
7. Table 9 in the Appendix reports the average treatment effects of the sub-samples under the within-year and the within-sector matching algorithms.
8. Low-technology industries are: Food, beverages and tobacco; Textiles, apparel and leather; Wood, paper, publishing and printing. Medium-technology industries are: Refined petroleum and chemical products; Rubber and non-metallic mineral products; Furniture, jewelry and music equipment; Metal products. High-technology industries include Electronic machinery, transport equipment and motor vehicles.

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APPENDIX

A.1. Summary Statistics

This section presents the summary statistics by year for all firms, adopters and non-adopters of EFP between 2011 and 2015.

TABLE 8
SUMMARY STATISTICS OF NON-ADOPTERS AND ADOPTERS BY YEAR

	2011			2013			2015		
	Non-adopters	Adopters without ESC	Adopters with ESC	Non-adopters	Adopters without ESC	Adopters with ESC	Non-adopters	Adopters without ESC	Adopters with ESC
Ln(Profit)	3.249	3.439	3.580	3.140	3.295	3.343	3.162	3.331	3.449
	(0.765)	(0.910)	(1.042)	(0.732)	(0.811)	(1.084)	(0.785)	(0.966)	(1.087)
Law1	0.223	0.331	0.301	0.218	0.349	0.344	0.245	0.317	0.408
	(0.416)	(0.471)	(0.459)	(0.413)	(0.477)	(0.476)	(0.430)	(0.466)	(0.492)
Law2	0.148	0.174	0.314	0.0947	0.178	0.312	0.0740	0.184	0.313
	(0.355)	(0.379)	(0.465)	(0.293)	(0.383)	(0.464)	(0.262)	(0.388)	(0.464)
Law3	0.0152	0.0306	0.0957	0.00544	0.0226	0.0735	0.00357	0.0202	0.0859
	(0.122)	(0.172)	(0.295)	(0.0736)	(0.149)	(0.261)	(0.0597)	(0.141)	(0.281)
Ln(Assets)	5.213	5.569	5.721	4.798	5.265	5.510	4.609	5.225	5.381
	(1.296)	(1.184)	(1.248)	(1.170)	(1.152)	(1.091)	(1.152)	(1.154)	(1.143)
Ln(Workers)	1.498	2.112	2.731	1.389	1.885	2.877	1.268	1.976	3.134
	(0.899)	(1.037)	(1.211)	(0.812)	(1.044)	(1.137)	(0.814)	(1.004)	(1.169)
Professionals	1.717	4.381	6.419	1.710	3.844	7.230	0.819	3.479	7.053
(%)	(4.971)	(7.391)	(7.648)	(5.277)	(7.443)	(8.295)	(4.024)	(6.981)	(9.181)
Asset age (%)	16.59	18.31	17.88	16.90	13.96	12.71	16.60	12.15	13.78
	(29.81)	(29.63)	(29.74)	(28.22)	(25.12)	(22.40)	(29.47)	(24.26)	(24.38)
Ln(Age)	2.421	2.284	2.376	2.659	2.472	2.439	2.710	2.502	2.591
	(0.686)	(0.662)	(0.607)	(0.617)	(0.633)	(0.583)	(0.653)	(0.635)	(0.479)
Ownership	0.787	0.564	0.372	0.826	0.602	0.244	0.840	0.532	0.141
	(0.410)	(0.496)	(0.484)	(0.379)	(0.490)	(0.430)	(0.366)	(0.499)	(0.349)
Bribe	0.313	0.427	0.540	0.330	0.519	0.612	0.236	0.579	0.752
	(0.464)	(0.495)	(0.499)	(0.470)	(0.500)	(0.488)	(0.425)	(0.494)	(0.433)
Competition	0.839	0.917	0.878	0.857	0.894	0.934	0.849	0.932	0.926
	(0.368)	(0.276)	(0.328)	(0.350)	(0.308)	(0.248)	(0.358)	(0.252)	(0.262)
Export	0.0265	0.0636	0.138	0.0283	0.0595	0.155	0.0241	0.0660	0.242
	(0.161)	(0.244)	(0.346)	(0.166)	(0.237)	(0.362)	(0.153)	(0.248)	(0.429)
Production	0.0114	0.0623	0.133	0.0218	0.0513	0.152	0.0107	0.0457	0.129
zone	(0.106)	(0.242)	(0.340)	(0.146)	(0.221)	(0.360)	(0.103)	(0.209)	(0.336)
Observations	1,055	818	376	919	975	381	1,121	940	326

Standard deviations in parentheses.

A.2. Estimations of Treatment Effects by Types of Firms

This section presents the treatment effects for firms of different sizes and industries. Specifically, table 9 shows the treatment effects using the within-sector and within-year matching algorithms. Table 10 provides the treatment effects of EFP adoption where data from 2011 are used to estimate the propensity of adopting sustainability practices in 2013 and 2015.

TABLE 9
THE IMPACT OF EFP ADOPTION ON PROFITABILITY

	Adopters without ESC		Adopters with ESC	
ATT	Unbalanced	Balanced	Unbalanced	Balanced
	(1)	(2)	(3)	(4)
Matching algorithm: Within sector				
Overall	0.1138***	0.0941**	0.1811**	0.1578**
	(0.0319)	(0.0403)	(0.0714)	(0.0780)
<= 10 employees	0.0805***	0.0654*	0.0882	0.1420**
	(0.0298)	(0.0374)	(0.0599)	(0.0670)
> 10 employees	0.1228	0.1172	0.1873*	0.1357
	(0.0878)	(0.1062)	(0.0998)	(0.1246)
Informal payment	0.0870	0.0570	0.1134	0.0633
	(0.0553)	(0.0648)	(0.0840)	(0.1101)
No informal payment	0.1241***	0.0955**	0.1461**	0.0978
	(0.0360)	(0.0440)	(0.0730)	(0.0795)
Low tech intensive industries	0.1229***	0.1433***	0.2357***	0.2912***
	(0.0399)	(0.0550)	(0.0796)	(0.0931)
Medium tech intensive industries	0.0458	0.1222*	0.1116	-0.1386
	(0.0711)	(0.0623)	(0.1620)	(0.1343)
High-tech intensive industries	0.0931	-0.0248	-0.1444	0.1837
	(0.0923)	(0.1243)	(0.1963)	(0.2027)
Matching algorithm: Within year				
Overall	0.0843***	0.0804*	0.1130	0.0787
	(0.0321)	(0.0417)	(0.0762)	(0.0688)
<= 10 employees	0.0763**	0.0395	0.1104*	0.0575
	(0.0308)	(0.0385)	(0.0602)	(0.0725)
> 10 employees	0.0679	0.0398	0.1607	0.1264
	(0.0904)	(0.1179)	(0.1163)	(0.1357)
Informal payment	0.0148	0.0045	0.0123	0.0694
	(0.0578)	(0.0721)	(0.0990)	(0.1198)
No informal payment	0.1198***	0.0571	0.1443*	0.1518*
	(0.0352)	(0.0489)	(0.0745)	(0.0788)
Low tech intensive industries	0.1280***	0.1229**	0.1442**	0.2995***
	(0.0412)	(0.0596)	(0.0645)	(0.0898)
Medium tech intensive industries	0.0876	0.0584	0.0569	0.0200
	(0.0626)	(0.0656)	(0.1451)	(0.1183)
High-tech intensive industries	0.0932	0.0185	-0.0078	0.0286
	(0.0877)	(0.1109)	(0.2053)	(0.3283)

***, **, and * indicate the 1%, 5% and 10% level of significance.

TABLE 10
THE IMPACT OF EFP ADOPTION ON PROFITABILITY

	Adopters without ESC		Adopters with ESC	
ATT	Unbalanced	Balanced	Unbalanced	Balanced
	(1)	(2)	(3)	(4)
Matching algorithm: Within sector				
Overall	0.1098***(.0310)	0.0888**(.0383)	0.1985***(.0597)	0.1715**(.0660)
<= 10 employees	0.0615*(.0323)	0.0707**(.0357)	0.0985*(.0593)	0.1131 (.0699)
> 10 employees	0.1254 (.0838)	0.1440 (.0879)	0.2076**(.1050)	0.1236 (.1086)
Informal payment	0.0529 (.0637)	0.0412 (.0635)	0.1967**(.0813)	0.1638*(.0950)
No informal payment	0.1016***(.0387)	0.0799*(.0437)	0.2506***(.0749)	0.1509*(.0869)
Low tech industries	0.1162***(.0406)	0.1605***(.0570)	0.2640***(.0643)	0.2248**(.0961)
Medium tech industries	0.0856 (.0552)	0.0017 (.0601)	0.1113 (.1319)	0.1473 (.1098)
High-tech industries	0.0479 (.1089)	-0.1488 (.1029)	-0.1859 (.1943)	-0.2949 (.2690)
Matching algorithm: Within year				
Overall	0.0917***(.0325)	0.1100***(.0402)	0.1468**(.0608)	0.1264*(.0675)
<= 10 employees	0.0690**(.0302)	0.0980***(.0355)	0.1524**(.0608)	0.1005 (.0677)
> 10 employees	0.1048 (.0808)	0.0939 (.0918)	0.1018 (.0971)	0.1243 (.1108)
Informal payment	0.0194 (.0568)	0.0107 (.0683)	0.1378 (.0870)	0.1573*(.0944)
No informal payment	0.1032***(.0380)	0.0762*(.0461)	0.2551***(.0692)	0.1444*(.0817)
Low tech industries	0.1393***(.0424)	0.1678***(.0484)	0.2769***(.0623)	0.1731**(.0826)
Medium tech industries	0.1387**(.0556)	0.0290 (.0611)	0.0527 (.1208)	0.0780 (.1056)
High-tech industries	-0.0073 (.1018)	-0.0380 (.1328)	-0.3139 (.1995)	-0.4276 (.2796)
Matching algorithm: Within year and sector				
Overall	0.1045***(.0310)	0.1232***(.0397)	0.1977***(.0526)	0.1319**(.0652)
<= 10 employees	0.0704**(.0312)	0.0881**(.0360)	0.1374**(.0643)	0.1130 (.0712)
> 10 employees	0.1408*(.0829)	0.1352 (.0962)	0.0904 (.0968)	0.1029 (.1177)
Informal payment	0.0443 (.0555)	0.0795 (.0619)	0.1536*(.0807)	0.1410 (.0984)
No informal payment	0.0870**(.0384)	0.0401 (.0462)	0.1883**(.0737)	0.2181**(.0891)
Low tech industries	0.1393***(.0424)	0.1678***(.0484)	0.2769***(.0623)	0.1731**(.0826)
Medium tech industries	0.1386**(.0556)	0.0290 (.0611)	0.0526 (.1208)	0.0781 (.1056)
High tech industries	-0.0064 (.1019)	-0.0381 (.1328)	-0.3150 (.1999)	-0.4278 (.2796)

***, **, and * indicate the 1%, 5% and 10% level of significance. Numbers in parentheses are standard errors.