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A New Measurement and Its Determinants for Corporate Environmental Management: An Empirical Study in Vietnam

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Abstract

This study examines the environmental performance of firms in Vietnam and its determinants. The contribution of the paper is on both theoretical and empirical aspects. On the theoretical matter, the research proposes a new index measuring environmental management at the firm level, namely the Environmental Management Index with a clear illustration for the case of Vietnam. On the empirical matter, the study points out and estimates determinants of the corporate environmental performance of Vietnamese firms measured by the newly proposed index. Due to data availability and the impossibility of getting more updated data, the empirical analysis covers only the period from 2004–2009. However, findings are still meaningful because, on the one hand, it provides some evidence for Vietnamese policymakers; on the other hand, with the robust methodology proposed, when more recent data are available, researchers can easily replicate the estimation for more insights. Empirical results show that factors having positive impacts on the environmental performance of Vietnamese firms are profit, capital stock, and interestingly public pressure proxied by the population of the province where the firm is located. Firm ownership does also matter in explaining the corporate environmental performance of Vietnam.

Keywords: Environmental Management, Firm Performance, Public Pressure, Manufacturing Firm, FDI Firms

JEL Classification Code: D22, M14, M21, Q01, Q56

1. Introduction

Since the 1990s, Vietnam has been experiencing a relatively high growth rate and integrating into the world economy through trade liberalization. Vietnam's economic structure has been improved with a higher share of industrial and service sectors and a lower share of the agricultural sector in total GDP. Industrial production grew from 20 to 42 percent of GDP between 1990 and 2006. Industrial development also creates many jobs, hence plays an important role in reducing the poverty of the country.

However, Vietnam's rapid industrial development has significantly caused environmental deterioration, mainly in urban areas. Many firms are equipped with obsolete manufacturing technologies, have no environmental protection facilities, are located in densely populated areas, and thus contribute significantly to the pollution intensity in the cities, endangering residents and the environment. Industrial pollution often relates to the release of smoke, bad smell, noise, dust, and harmful and toxic contaminants to the air, soil, surface, and groundwater. As a result, environmental quality in large cities with high industrial concentration has significantly worsened during the last decade. Furthermore, the composition of Vietnamese production seems to change away from the traditional sector and towards pollution-intensive manufacturing (Mani & Jha, 2006). Textile/dyeing, food processing, pulp and paper, electroplating, and rubber industries are usually indicated by governmental agencies and independent researchers as the sectors causing the most serious and severe pollution problems.

Moreover, some of the greatest growth of industrial development coming from state-owned enterprises (SOEs), especially in oil and gas, electricity, cement, and garment industries. Because of their contribution to economic growth,

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starting at the beginning of the 1990s, the SOE sector has undergone important reforms, which have increased autonomy, imposed a hard budget constraint, and established a clear profit motive. In addition, progress in the reform of the regulatory framework for private enterprises and foreign trade has subjected state enterprises to increased domestic and international competition. Yet, these reforms are still incomplete as some state enterprises still benefit from high levels of protection and state subsidies, and the environmental liabilities of the state enterprise sector have yet to be adequately addressed.

The current attitude of firms in Vietnam regarding the environment could be summarized as follows.

(i) Vietnamese firms do not pay enough attention to the impact their activities have on the environment when making a business strategy.

When being formed, firms have to do research on the impacts of their production activities on the environment and to show the appropriate environment certificate to prove that they can deal with those problems during the firm's lifetime. However, for a lot of firms, this work is only the surface. Many of them do not precisely evaluate the roles of environmental protection in the production process. All of what they can do, probably, is to save on input use and waste since it directly affects the costs and profits of the firm. For long-time existing firms, reinvestment on machines and equipment, or improvement of the production process to respond to environmental requirements and regulation at the national and international level are really difficult due to limited finance among other reasons.

In addition, lots of Vietnamese firms, especially SOEs and private SME firms are not familiar with midterm and long-term business strategies, they are only used to short-term plans. That's why they cannot foresee the impacts of external factors on firms' activities, especially those that only reveal after a long operation time like the environmental impacts.

(ii) Lots of Vietnamese firms have not adopted international standards and regulations on the environment.

More or less, the economic integration in Vietnam leads to increasing environmental awareness among firms. Under improving awareness and especially external pressure, it has been noticed that firms care more and more about the environment over the last few years. However, applications of international standards and regulations on the environment are still very limited. The number of firms that have been granted international certificates about the environment is very modest. Until the end of 2007, 113 firms and organizations in Vietnam obtained ISO 14000 certificate, which corresponds to as low as 1/1000, while in the world, about 120000 ISO certificates have been granted to firms in 138 countries. Moreover, among these certificate holders, 2/3 of them are FDI firms. This fact partly shows the inappropriate behavior about environment liabilities of non-FDI firms in Vietnam. In addition, some firms only use the environment certificate as a marketing tool to polish their image. After making physical and time investments to get an international certificate such as ISO 14000, HACCP, etc. many firms in Vietnam come back to initial status in dealing with environmental impacts of their production activities. Those certificates have been returned since they do not meet all requirements (Boiral, 1998).

Obviously, most firms in Vietnam consider responses to environmental challenges as an additional cost and extra obstacle to their production. Very few enterprises feel that environmentally friendly practices can lead to increased earnings or improved competitiveness, certainly not in the short term.

Although the majority of firms act on environmental improvements only when forced externally, it is already a sign of progress when firms engage in those activities. To make firms more engaged in this mission, to increase their environmental performance, and to reduce their environmental impacts, it is an urgent need to evaluate this performance analytically, to examine dynamics of this performance in recent years, and to find out factors influencing this performance so that environmental policies could be appropriately designed, improved or developed.

This study aims at analyzing the current situation of environmental management of enterprises in Vietnam and its determinants. First, the paper addresses a brief literature review, followed by the clear significance of the study. Then, we briefly show the Environmental Performance Index at the country level of Vietnam reported by the World Economic Forum. The paper proposes a new index that measures environmental management at the firm level: the Environmental Management Index (EMI). Next, the paper calculates that index for Vietnamese enterprises and analyzes firms' environmental performance across firm ownership and firm type. After that, the paper carefully develops and estimates models determining factors that influence firms' EMI. The final part addresses the main findings and conclusion of the paper.

2. Literature Review

A number of empirical studies examined the actions of firms that are concerned with environmental management. These studies have analyzed the determinants that drive firms' environmental actions based on various theories such as stakeholder theory (Roberts, 1992), legitimacy theory (Patten, 1991), regulatory influence theory (Nakamura et al., 2001), economic theory (Cormier & Magnan, 1999; Nakamura et al., 2001) and so on. Although different theories are used for these analyses, the common feature of most previous

studies is the recognition that stakeholders' environmental preferences/pressures and firms' characteristics influence their environmental actions. Thus, firms' environmental actions are considered to be influenced by similar determinants despite various theories, since a firm's voluntary initiative is used to improve its public image. Actually, many of the studies found common determinants that influence firms' environmental actions. Patten (1991, 2002), Adams et al. (1998), Cormier and Magnan (1999, 2003), Welch et al. (2000), Nakamura et al. (2001), Kokubu et al. (2002), and Zhang et al. (2008) found that firm size has a positive effect on the firm's environmental actions. Roberts (1992) and Cormier and Magnan (1999) showed that the more profitable firms tend to undertake more environmental actions. Roberts (1992), Cormier and Magnan (1999, 2003) and Nakamura et al. (2001) indicated that debt ratio influences firms' environmental actions. Nakamura et al. (2001), Bansal and Hunter (2003), and Yiridoe et al. (2003) provided evidence that firms that have more foreign customers are more likely to undertake environmental actions. Cormier and Magnan (1999, 2003) found that stockholders influence such action. And companies should consider environmental factors to improve their financial performance in the long term.

Saraswati et al. (2020) provided evidence that different types of political connections may have different impacts on corporate social responsibility disclosures in Indonesian listed companies. Recently, Indrasari et al. (2021) identified the strategies used in implementing corporate social and environmental reporting (CSER) and investigated the impact of these strategies on organization performance. The results showed that companies use both reactive and proactive strategies in reporting their social and environmental activities. The study also identified the impacts of such reporting on both the financial and non-financial performances of the investigated companies. The empirical results provided insights into the influence of the strategies employed by companies in their corporate social and environmental reporting and the impacts of such strategies on organizational performance.

In contrast to the rich international literature analyzing the actions of firms that are concerned with environmental management, studies relating to Vietnam have been limited. Le (2006) developed a suitable environmental policy evaluation methodology to analyze three cases of prominent pollution control measures. Based on those results and experiences drawn from literature, this research aimed to contribute to the improvement of existing environmental policies towards SMEs in HCMC and the development of new feasible, effective, and suitable environmental policies for greening the SME sector. Tran (2020) explored explores firms' motivators to engage in corporate social responsibility (CSR) actions from the middle managers' perspective.

Nguyen & Tu (2020) aimed to measure the relationship between corporate social responsibility (CSR) and affective commitment (ACO), normative commitment (NCO), and organizational performance in food processing enterprises (FPEs) in the Mekong River Delta, Vietnam. The results showed that four aspects of CSR toward employees, customers, environment, and legal are significant factors. In addition, the success of the organizational performance is also affected by the contributions of CSR and NCO. Although ACO does not directly affect performance, it has a positive effect on the NCO. Therefore, it is necessary to enhance the implementation of CSR to promote the implementation of organizational commitments.

Mani and Jha (2006) offered a systematic analysis of the trading and investment patterns to give a broader understanding of the environmental implications of greater openness of the economy during the past decade. The results suggested increasing manufacturing and export activity in water and toxic pollution-intensive sectors compared with the less pollution-intensive sectors. The paper also highlights the need to consider strengthening environmental policies while further trade liberalization is being contemplated through Vietnam's joining of the World Trade Organization. Our study departs from Mani and Jha (2006) in several aspects. First, Mani and Jha (2006) suggest an industry level (22 industries) analysis, hence the authors aggregate firms according to Vietnamese Standards Industrial Classification and rank these industries according to pollution intensity. Our study analyses firm-level actions regarding environmental management. Second, while we endogenize firms' environmental performance, Mani and Jha use pollution intensity as an explanatory variable to explain the change in the composition of output and openness (i.e., exports and FDI). Third, we benefit more from recent enterprise surveys (from 2000 until 2005), while Mani and Jha only exploit information until 2002. Last, our main contribution is that we propose a new measurement of environmental management at the firm level and consistently use it in our analysis, which is missed in Mani and Jha as well as in previous research.

3. Significance of the Study

The Vietnamese government has been raising the profile of environmental sustainability in its national and international dialogue. In the Economic and Social Development Strategy 2000–2010, the Vietnamese Government had highlighted that "…*Growing fast, effective and sustainable…. "Economic growth together with social upgrading and equality and environment protection",* and *"…Economic and social development are associated with environmental protection and improvement, ensuring the harmonization between artificial and natural environments…*". In 2003, the government created the Ministry of Natural Resources and Environment (MONRE), initiated separation of regulation of some natural resources from that of users, and approved the National Strategy for Environmental Protection (NSEP). In 2004, the Environmental Impact Assessment (EIA)

requirements for project approvals were increased and the Strategy for Sustainable Development (Agenda 21) was adopted. The most important policy along this line is the Law on Environmental Protection (1993 and 2005) to enable new policy tools and remedies for pollution prevention and cleanup, and adjustments to cover environmental management in the private sector (for our interest especially, chapter 5 of Law on Environmental Protection 2005 is about the regulation of environmental protection in production, business, and service sectors).

Despite these signs of progress, the standardization capability of Vietnam is still very limited. Environmental regulations in Vietnam are still too general. Vietnam does not have detailed guidelines for firms to follow environmental regulations. This leads to lots of confusion and difficulties for firms to respect international and national regulations and standards about the environment. Furthermore, the economic incentives (fee, fine, penalty, bonus, etc.) are poorly developed. There is an enormous need for substantial improvements in the policy framework for environmental sustainability and institutional arrangements. Progress in achieving results has been slow due to weak commitment by sectoral agencies, low awareness in local departments and officials, and capacity challenges at all levels. There is a fundamental lack of environmental integration at planning and programmatic levels, especially in the public investment planning process and in regional plans for land and resource use. In addition, awareness of the expected, negative environmental impacts on sustained economic growth, and the mechanisms for stakeholders to hold government agencies accountable for their performance is weak. Our work attempts to make a modest contribution along these lines.

Furthermore, Vietnamese consumers or communities do not pay enough attention to the environmental requirements of the products. This attitude of consumers does not motivate firms to engage in environmental management performance. Our work wishes to ring bells and wake consumers up, remind them to protect themselves against environmental and public health risks caused by industrial production, to make them more demanding about green products. This potential value of our work would be good for both short-term and long-term social development.

To wrap up, increasing pressure being put on firms come from a number of different sources, such as governmental regulation, community participation, and market demand, to engage firms in environmental initiatives. These factors play different roles at various development periods. Government regulation was a major pressure, initially. However, community participation and market demand would become more and more important. Thus, a better understanding of the determinant factors that play a role in engaging firms to take environmental management initiatives may help policymakers develop more effective environmental policies.

For policy and also academic matters, research on determining factors that affect firms' environmental performance using a quantitative measurement for Vietnam is still missing. This research fills in this important gap in the literature of environmental economics by providing evidence in firms' decisions in environmental management. Hopefully, afterward, more evidence-based policies would be made and become more effective.

4. Environmental Performance Indicators of Vietnam

Careful measurement of environmental trends and progress provides a foundation for effective policymaking. The 2020 Environmental Performance Index (EPI) provides a data-driven summary of the state of sustainability around the world. Using 32 performance indicators across 11 issue categories, the EPI ranks 180 countries on environmental health and ecosystem vitality. These categories track performance and progress on two broad policy objectives, environmental health, and ecosystem vitality. These indicators provide a gauge at a national scale of how close countries are to established environmental policy targets. The EPI offers a scorecard that highlights leaders and laggards in environmental performance and provides practical guidance for countries that aspire to move toward a sustainable future.

In general, high scorers exhibit long-standing commitments to protecting public health, preserving natural resources, and decoupling greenhouse gas (GHG) emissions from economic activity.

Low scores on the EPI are indicative of the need for national sustainability efforts on a number of fronts, especially cleaning up air quality, protecting biodiversity, and reducing GHG emissions. Some of the laggards face broader challenges, such as civil unrest, but others seem to be suffering the effects of weak governance. The EPI draws attention to the issues on which policymakers must take further action. While the EPI provides a framework for greater analytic rigor in environmental policymaking, it also reveals a number of severe data gaps. As the EPI project has been highlighted for two decades, better data collection, reporting, and verification across a range of environmental issues are urgently needed. The existing gaps are especially pronounced in the areas of sustainable agriculture, water resources, waste management, and threats to biodiversity. Supporting stronger global data systems thus emerges as essential to better management of sustainable development challenges.

According to a report by the World Economic Forum, Vietnam's EPI index on the port decline, which warned about the quality of environmental management of Vietnam (Table 1).

Table 1: EPI of Viet Nam

Year	Rank	Scor
2006	99/133	54.3
2008	76/149	73.94
2010	85/163	59
2012	79/132	59.54
2014	136/178	38.17
2016	131/180	58.5
2018	132/180	46.96

Source: https://epi.envirocenter.yale.edu/.

5. Environmental Management Index Proposal and EMI of Vietnamese Enterprises

5.1. EMI Calculation Method

To our knowledge, there does not exist an indicator at the firm level that helps quantitatively evaluate the environmental performance of firms. This indicator is expected to play a similar role as EPI at the country level to evaluate and compare the performance of firms in the environmental aspect.

We propose that measurement as the Environmental Management Index (EMI). EMI_i reflects the level of environmental management practices of the firm *i*. Firm *i* is considered to perform environmentally well if (i) they spend more on environmental protection (hence increase its environmental cost), (ii) their total emission is small, (iii) their total emission treated is large. One argues that firms may have to spend more on protecting the environment because they are large. To control that aspect, firm size proxied by their sales is taken into account in the measurement. The final proposal about this index construction is as follows:

$$EMI_i = \frac{\frac{EC_i}{Sales_i}}{\frac{\overline{EC}_i}{Sales_i}} + \sum_j \frac{W_{ji}^T}{\overline{W}_j^T} - \sum_j \frac{W_{ji}}{\overline{W}_j}$$

where EC_i is the costs of firm i for environmental protection (environmental cost); $\overline{EC}_i$ is the mean of environmental cost; W_{ji} is the total emission of type *j* (liquid waste, air pollutant, solid waste) of firm *i*; $\overline{W}_j = \frac{1}{n}\sum_{i=1}^{n} W_{ji}$ is the average volume of emission of type *j* of all firms, *n* is the total number of firms; and W_{ji}^T $\overline{W}_j^T = \frac{1}{n}\sum_{i=1}^{n} W_{ji}^T$ is the volume of treated emission of type *j* of firm *i* and it is average of all firms; $Sales_i$ is the total revenue of the firm *i*.

Obviously, a firm with a higher EMI reflects better environmental management performance.

Some may also argue that the technology level of the firm also affects their environmental cost. Firms that adopt high technology may have to spend less on the environment than the others that adopt low technology. For the case of Vietnamese firms, we had evidence that there is no correlation between firms' spending on machines/equipment and their environmental costs, hence technology is not taken into consideration (Table 2). For the other countries or other data set, one should consider that dimension if relevant.

Table 2: Correlation Matrix

	1	2	3
1. Environmental costs	1		
2. Revenue	0.475	1	
3. Investment in machinery and equipment	0.042	0.383	1

Source: Authors' Calculation from the Enterprise Survey 2004 to 2009.

5.2. Environmental Performance of Vietnamese Firms

Every year, the General Statistics Office of Vietnam performs a large-scale nationwide, almost comprehensive, survey on enterprises and businesses. Within the survey form, aside from the basic information regarding the activities and status of the respondent businesses, the period 2004 – 2009 survey content also included sections related to environmental costs of enterprises. Specifically, the sample questionnaire of the period has information about the amount of waste that businesses emitted and treated (including solid, liquid, and gaseous wastes), with information about the cost of waste treatment activities and environmental protection. It is unfortunate that data on the environment exists only from 2004–2009. After that, questions regarding the environment no longer exist in the questionnaire. Therefore, our quantitative analysis only performs for the period from 2004–2009. However, the findings are still very meaningful.

According to enterprise survey data, when entering the market, enterprises must ensure necessary conditions related to social responsibility in environmental protection. Therefore, the proportion of enterprises investing in environmental protection in Vietnam is generally large. Table 3 shows the proportion of enterprises investing in environmental protection activities. Accordingly, the

proportion of enterprises investing in environmental protection annually is over 99%.

The information from Table 3 indicates that the company's compliance with environmental regulations is serious. However, to consider whether an enterprise is truly environmentally responsible or not, it is important to take its emissions and waste disposal into account. Meanwhile, to maintain the activities in the long term, businesses would require a revenue sufficient enough to cover the costs. Therefore, the EMI should fully reflect the internal environmental behavior of the business.

Based on the proposed EMI measurement and GSO's enterprise survey data from 2004 to 2009, we calculated EMI for enterprises over the years across firm ownership and industry classification.

By firm ownership, the average EMI of enterprises is shown in Figure 1.

Figure 1 shows the difference in average EMIs of different types of enterprises. This shows that from 2004 to 2009, the environmental action of firms in Vietnam was extremely positive. However, there are differences between the types of enterprises, with the most positive being FDI enterprises. Compared with other countries, the environmental standards in Vietnam are relatively comfortable, thus it is not difficult for this business group to implement social responsibility through compliance with environmental protection regulations. On the other hand, the group of FDI enterprises is heavily influenced by the "parent company" in terms of practicing environmental protection compliance to enlist the support of the community and attract consumers. The second group of enterprises with strong environmental action is the state-owned enterprises, which consider environmental action indispensable and have the advantage in financial resources. The final group is non-state-owned enterprises. As this group of enterprises consists of mostly small and medium enterprises (accounting for over 90%) with financial constraints, the environmental management activities of this group are the lowest. However, compliance with environmental protection regulations of enterprises has shown their positive awareness in taking actions towards sustainable development.

Table 3: Proportion of Enterprises Investing in the Environmental Protection Activities

Year	FDI Enterprises	State-Owned Enterprises (SOE)	Non-State-Owned Enterprises (Non-SOE)	Total
2004	14.7	11.9	73.2	99.8
2005	14	10	75.7	99.8
2006	15.7	7.5	76.5	99.6
2007	1.9	2.5	95.5	99.99
2008	2	1.5	96.3	99.6
2009	2.04	6.2	73.2	99.8

Source: Authors' Calculation from the Enterprise Survey 2004 to 2009.

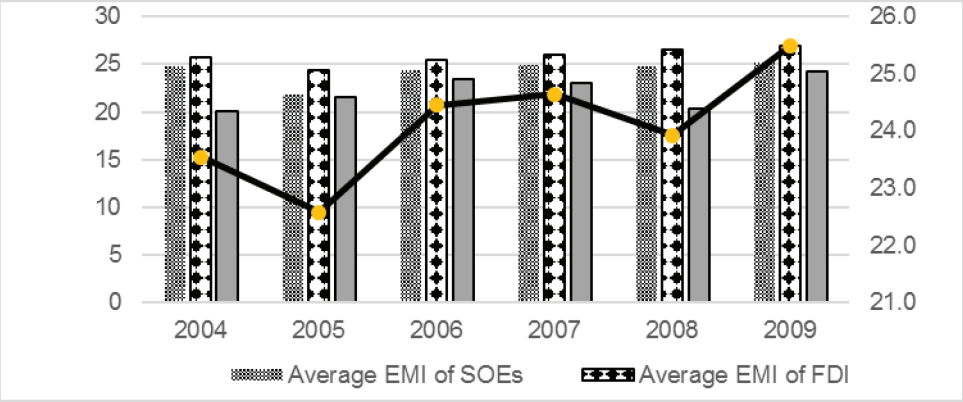

Figure 1: Average EMI Across Firm Ownership in Vietnam, Unit: %

Source: Authors' Calculation from the Enterprise Survey 2004 to 2009.

A comparison of the average EMI between enterprises in manufacturing and non-manufacturing enterprises over the years is shown in Figure 2.

It reveals that over the years, the average EMI of firms in manufacturing is higher than that of non-manufacturing enterprises. As mentioned above, industrial manufacturing is the industry with the highest potential to cause environmental pollution. Therefore, the government's control over environmental issues for enterprises in this industry is the most stringent. To ensure production and business activities, enterprises of this industry are obliged to pay much attention to environmental protection. In addition to complying with the provisions of law, it also aims at enhancing the image of the business in the market, showing firm commitment towards sustainable development.

5.3. The Factors Affecting EMI of Enterprises in Vietnam

In this section, we would like to propose an econometric model to evaluate factors affecting the EMI of Vietnamese firms, then estimate it to find insights.

The Econometric Model

After carefully examining relevant literature as in part 2, we adopt the following econometric model for our analysis of determinants of EMI.

$$\text{EMI} = f(A; E; P)$$

There are 3 groups of determinants of EMI. First, firms' EMI is affected by firms' characteristics (physical capital intensity, human capital intensity, size, sector, the origin of capital, etc.) given by the vector A (ability). In the empirical part, due to data availability, vector A includes physical capital and human capital stock.

Second, firms' EMI is related to firms' economic performance (productivity, profit, debt ratio), since the latter influences the environmental management cost. Economic performance is measured by vector *E*. In this paper, we measure economic performance by firms' profits before tax.

Last, vector *P* represents all external pressures (public pressure, including regulatory pressure, community or regional dimension, and market demand) and in this analysis is measured by the population in the province in which the business operates. This proxy brings a regional aspect into our analysis. This can be the point for an extension for other research along the line.

Data Source

EMI, enterprise characteristics, economic performance are extracted from the enterprise survey by GSO from 2004 to 2009. Data on the population of provinces are obtained from GSO from 2004–2009. These two datasets are combined to obtain the final dataset used in this study.

Estimation results of determinants of EMI of all firms

The estimation results of the effect of profit (before tax) – the only economic performance that can be observed from the dataset - on EMI of enterprises are shown in Table 4. In this model, Lagrange test results to choose between random effect model and pooled regression model give low p-value results, so the model used for analysis is not a combined regression model. In addition, the Hausman test results give high *p*-value results, so the random effect model is more effective than the fixed effect model. The final model used for analysis is the random effect model with Robust standard error (Robust RE model). Results show the regression coefficient of the profit before tax variable is statistically significant at 1% and bears a positive sign. This implies that the profit before tax of businesses has a positive effect on the EMI of enterprises in Vietnam. With good economic performance, the enterprise

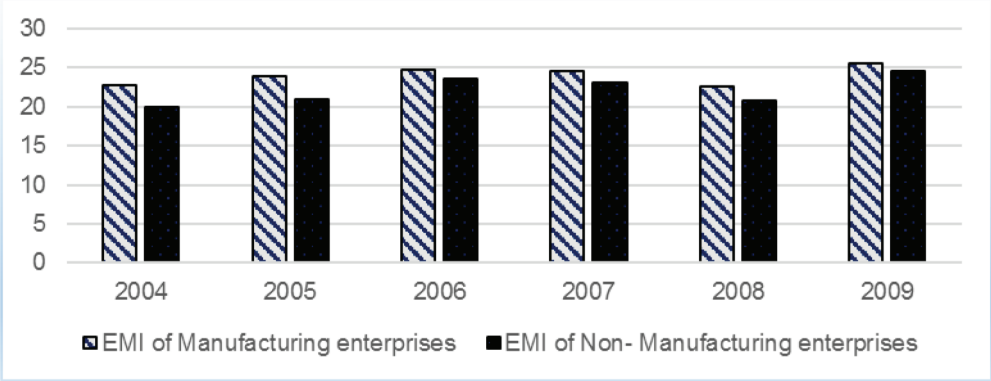

Figure 2: Comparison of the Average EMI Between Manufacturing and Non-Manufacturing Enterprises, Unit: %

Source: Authors' Calculation from the Enterprise Survey 2004 to 2009.

Table 4: Effect of Profit on the Environmental Management Index of Enterprises

Variables	RE Model	FE Model	Robust RE Model
Profit	0.000** (0.000)	0.000 (0.000)	0.000*** (0.000)
LnL	0.213* (0.123)	2.080* (1.069)	0.213* (0.118)
LnK	0.147* (0.082)	0.305 (0.644)	0.147* (0.083)
Lnpop	0.200 (0.117)	2.970 (7.896)	0.200* (0.117)
Non-state Enterprise	−0.813** (0.343)		−0.813** (0.376)
SOE	−0.691** (0.307)		−0.691** (0.361)
Industry	0.813** (0.380)		0.813** (0.388)
Intercept	22.309*** (1.177)	−12.258 (58.731)	22.309*** (1.168)
No. of observations	1138	1138	1138
Coefficient of determination	0.574	0.817	0.574
Lagrange test	χ^2 = 31.41		
	P-value = 0.00		
Haussmann test	χ^2 = 10.76		
	P-value = 0.3763		

Note: Values in parentheses are standard errors, *; **, *** coefficients are significant at 10%, 5% and 1%.

has strong economic resources to implement environmental costs, thus favorably affect the environmental management index. At the same time, the enterprises applying environmental protection measures will increase costs. The enterprises with strong resources will actively commit to environmental responsibility.

Results from the POLS model with a robust standard error show that the regression coefficient of the population variable is positive and statistically significant (Table 4). The direct implication of the estimation result is that the regional dimension matters in explaining corporate environmental performance. Large provinces and cities with a high population may have an important voice in reflecting/affecting the environmental behavior of businesses. Estimation result also shows that the government/community plays an important role, significantly affecting the environmental behavior of businesses.

Regarding effects of firm ownership, the regression coefficient of the 'type of enterprises' dummy variable is positive and statistically significant at 5%, which shows that the environmental management index of FDI enterprises is better than that of SOEs and non-state enterprises. It can be seen these environmental activities of FDI enterprises are paid more attention than domestic ones. On the other hand, as FDI enterprises consider that environmental activities bring about economic benefits such as building a good image in the eyes of consumers, it has become the most important motivation for them to invest in environmental protection, followed by building a good corporate image with authorities, protecting workers' health and other initiatives. Alternatively, as the cost of environmental activities is often large, it is an obstacle for domestic enterprises, especially non-state enterprises.

Since 1970, manufacturing firms are always considered to be the main reason for environmental pollution. Our regression results seem to support this fact. The coefficient of the industry dummy variable is statistically significant, and this shows that there is a difference in the environmental management of enterprises between industries and other sectors. We, therefore, are going to take a close look at this subset of firms to find more insights.

Determinants of EMI of Manufacturing Firms

The estimation results of factors influencing the EMI of enterprises in the manufacturing industry are shown in Table 5. Accordingly, the most effective model that is used to analyze is a Robust combined regression model (Robust POLS Model) as the Lagrange test results show a large *P*-value.

According to the results of this estimation, profit has a positive effect on the environmental performance of enterprises operating in industrial manufacturing. This result is similar to the estimation for the whole sample. On the other hand, for industrial production, the environmental management index of FDI enterprises is greater than that of non-state enterprises but less than that of state-owned enterprises. State-owned enterprises play a key and pivotal

Table 5: Effect of Profit to the EMI of Manufacturing Firms

Variables	RE Model	Robust POLS Model
Profit	0.000*** (0.000)	0.000*** (0.000)
lnL	−0.156** (0.078)	−0.156** (0.077)
lnK	−0.006* (0.035)	−0.006* (0.035)
lnpop	0.036* (0.019)	0.036* (0.019)
Non-state Enterprise	−0.543* (0.302)	−0.543* (0.284)
SOE	0.085* (0.048)	0.085* (0.049)
Intercept	0.000*** (0.000)	25.049*** (1.255)
No. of observations	337	337
Coefficient of determination	0.708	0.708
Lagrange test	$\chi^2 = 0.00$	
	P-value = 1	

Note: Values in parentheses are standard errors, *; **, ***Coefficients are significant at 10%, 5% and 1%.

position in a number of industries, especially in industrial production. With an important role and financial resources of SOEs in large manufacturing industries, the environmental costs of these businesses are implemented according to the Government's procurement program, with the orientation to high technology and environmentally friendly green technology. Therefore, the environmental management index of this type of enterprise may be better than that of FDI enterprises.

Similar to the dataset of all firms, results from the POLS model with robust standard error for manufacturing firms only show that the regression coefficient of the population variable is positive and statistically significant. Again, the region does play important role in explaining corporate environmental performance. It provides evidence that central or local government policy can affect the environmental behavior of businesses.

6. Conclusion

Quantitative research results have reached a number of conclusions as follows:

First, the economic performance of firms affects their environmental performance no matter whether it is the whole sample or the subsample of manufacturing firms only. A wealthier firm is more likely to be more responsible for the environment than the less wealthy ones. Thus, to improve the corporate environmental performance, financial and technical support are effective policies.

Second, we find evidence that FDI enterprises environmentally perform better than domestic firms. Meanwhile, if we take manufacturing firms only, SOEs performs the best environmentally, followed by FDI firms. Non-state enterprises always poorly perform environmentally for all firms or the subset of manufacturing firms. This finding shows that it is necessary to provide more resources, especially to small and medium enterprises to improve their environmental performance.

Third, the analysis supports the difference in environmental management between manufacturing and non-manufacturing firms. This is the reason why the manufacturing sector always plays a central role in pollution debates. In fact, Vietnamese firms now are making a great effort towards the environment, e.g., obtaining ISO 14000 certification. This is increasingly important as all firms want to create a good image in their business environment.

Fourth, the paper shows how the regional dimension matters in influencing corporate environmental performance. The regional community should be an active agent in this complex setting toward sustainable development. It also shed light on the impacts of public and market pressure on firms, which would lead to strong suggestions for actions of both government and consumers towards firms in improving the environmental responsibility.

Finally, this paper uses data mostly from the Enterprise Survey of Vietnam. It is unfortunate that data on the environment exists only from 2004–2009. After that, questions regarding the environment no longer exist in the questionnaire. Therefore, our quantitative analysis only performs for the period from 2004–2009. However, the findings are still very meaningful. On the one hand, it provides some evidence for policymakers. On the other hand, due to a robust methodology, when more recent data are available, researchers can easily re-estimate the model for updating purposes.

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