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THE DETERMINANTS OF FIRM'S DECISIONS TO PRODUCE GREEN PRODUCTS IN DONG NAI PROVINCE

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ABSTRACT

This study analyzes the determinants of firm's decisions to produce green products in Dong Nai province. We survey 300 firms which are currently doing business in Dong Nai in 2019. A combination of the propensity score matching (PSM) method and the logit regression addresses the problem of heterogeneity between observations in the empirical model. The result implies that a firm that (i) has assigned a leader to take responsibility for green growth; (ii) has an investment in emission treatment equipment; (iii) has procedure guidance for energy saving; and (iv) has an improvement in energy efficiency will have a higher probability to produce at least a green product. Moreover, a penalty for breaching environmental legislation does not encourage firms to produce green products. Several policy implications have emerged on the ground of our empirical findings. First, we propose cooperation and connection between domestic firms and foreign enterprises to inspire the production of green goods and services. Second, some preferential treatments for firms that assign a manager for green development can encourage green production in Dong Nai province. Finally, Dong Nai province shall consider policies supporting firms to mobilize capital to develop technology for green production.

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1. Introduction

In the context of increasing climate change and resource depletion, green growth can be seen as an inevitable development model for countries in the future. The Organization for Economic Cooperation and Development (OECD) defines green growth as stimulating economic growth and development while ensuring that natural assets continue to provide environmental services and resources that are essential to human lives. For this to happen, green growth must be a catalyst for investment and innovation, and a basis for sustainable growth and the creation of new economic opportunities. In addition, World Bank considers green growth as a growth model that ensures efficient, clean use of resources with minimal pollution and environmental impacts.

In Vietnam, the Green Growth Program is implemented through the National Green Growth Strategy 2021-2030, with a vision to 2050 (according to Decision No. 1658/QD-TTg October 1, 2021, Prime Minister Government). Dong Nai is a central province of the southern key economic region of Vietnam, it is one of the six leading provinces/cities in the country in terms of economic development over the years with a growth rate of Gross regional domestic product (GRDP) higher than the national average and is one of the "leaders" of the southern key economic region (Dinh, 2021). Dong Nai province has many comparative advantages in terms of nature and society, with great human resources, and a developed infrastructure system. According to Dong Nai Department of Planning and Investment (2021), Dong Nai is the first province to develop industrial zones and is one of the leading provinces/cities in industrial development in Vietnam. It is recorded as the province with the most industrial zones in the country, including major corporations in the world such as Bosch, Schaeffler, Fujitsu, Changshin, Kenda, Cargill, Ajinomoto and Meggitt (Dinh, 2021).

In the period 2015-2018, industrial production in Dong Nai continued to increase (Figure 1). Industrial production index of the whole industry increased by an average of 8.11% (7.7% in 2015; 7.5% in 2016; 8.6% in 2017; 8.7% in 2018). The industrial growth rate is increasing rapidly, the reason is that the province concentrates on promoting mechanisms and policies that focus on industrial development and effective network industrial parks. At the same time, the number of companies in the province is growing at a very high rate.

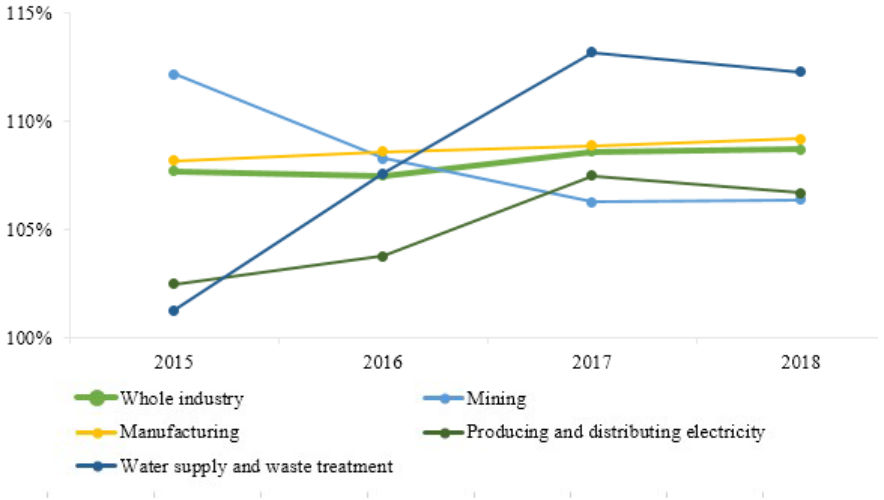

Figure 1. Industrial production index for the period 2016-2018 in Dong Nai province

However, along with the development of industrial parks is the problem of environmental pollution with a large amount of industrial solid waste from industrial and export processing zones in the province. As a result, the quality of the environment is seriously degraded, most of the major rivers in the area are polluted, which negatively affects the quality of life of people in the area. Dong Nai province is one of the regions that actively catch up and quickly deploy solutions to connect and mobilize resources to implement the green growth strategy with the whole country (Giang, 2022). Therefore, we need to study more deeply about the factors affecting the decision to produce green products of enterprises in Dong Nai province, in order to propose appropriate solutions and policies to encourage green products and promote businesses to operate in the "green" direction. Thus, this research topic will focus on clarifying the factors affecting the decision to produce green products of enterprises in Dong Nai province.

2. Literature review

Green production can be considered as a process of technical innovation (Lin & Ho, 2011). Innovation includes any operational change to a business, including equipment, products, processes, policies, and projects (Damanpour, 1991; Kimberly & Evanisko, 1981). Several researchers have proposed a number of factors that influence the innovation of green manufacturing, including factors that come from inside and outside the enterprise.

2.1. Internal factors

Availability of resources

Green production is considered as costly and time-consuming activities that require additional resources (capital equipment, individual employee skills, finance). If companies reduce their environmental impact, they may incur additional production costs. Therefore, more resources are needed for businesses to respond to the pressures of adopting green practice standards (Sarkis et al., 2010). As the number of actual or potential resources increases, the likelihood of green production being implemented increases (Álvarez-Gil et al., 2007; Tang et al., 2015). The lack of resources is expected to prevent companies from making the necessary investments to implement green activities (Branzei et al., 2004).

The ability to change (or organizational inertia)

Sociologists have used the concept of inertia in physics to describe the difficulty of changing organizational structures when businesses are faced with the pressures or opportunities of green production behavior (Huang, 2013). The stronger the force of inertia, the slower organizations change in the face of environmental changes (Huang et al., 2013). Adopting green activities (such as ISO 14000) may require changes to existing technology, processes or practices (Dowell & Muthulingam, 2017; Perron et al., 2006). Organizational inertia is the main obstacle preventing a firm response to environmental change (Huang et al., 2013). Inertia prevents an organization from making the necessary internal changes to adapt to the rapidly changing environment (Huang et al., 2013).

Business leaders in company

It is generally agreed that senior leadership in the business influences employee behavior, thereby promoting product and process related initiatives. Management can influence the success of new company initiatives by promoting employee engagement and empowerment (Daily & Bishop, 2003), as well as by establishing systems for rewards and incentives to guide employee behavior (Pun et al., 2001). Dai et al (2014) argue that leadership's commitment to environmental initiatives directly shapes employees' beliefs, goals and actions. Leadership is responsible for changing the norms, values and culture in the organization, thereby guiding the behavior of each employee (Liang et al., 2007).

2.2. External factors

The government

Many studies have shown that the government plays an important role in orienting enterprises toward green production (El-Baz & Laguir, 2017; Ye et al., 2013; Zhu & Sarkis, 2007). Institutional theory suggests that there are two main types of mechanisms that influence the behavior of organizations: imposition and incentive (Scott, 1987). In view of this, two types of government policy can be distinguished: (i) command/control policy, and (ii) incentive policy. Command/control policy refers to a mandatory compliance approach that forces companies to make similar shares of the pollution control burden, regardless of cost (Jaffe et al., 2002). Incentive policy refers to market-based approaches that encourage businesses to undertake pollution control efforts for their own benefit and to collectively meet policy objectives (Jaffe et al., 2002).

Customer pressure

Customer pressure is another institutional force that compels or encourages companies to adopt environmentally friendly practices (Hanim et al., 2012). In today's highly competitive global marketplace, simply competing on price and quality is no longer enough. The environmental demands of buyers are arguably one of the most important factors driving companies towards environmentally friendly products. Lewis and Harvey (2001) argue that customers (including end users and downstream supply chain partners) with strong environmental awareness have developed preferences for green products across society. Developing a more environmentally friendly product helps to create new markets and increase or maintain market share. Numerous studies have confirmed that customer demand for green products is the main driver behind corporate green initiatives (Alvarez-Gil et al., 2007; Zhu & Sarkis, 2007). With increasing green demand from customers, delivery of green products is becoming a standard when ordering (Ye et al., 2013).

3. Methodology and Data

3.1. Research data

The study examines the factors affecting the decision to produce green development-oriented products of enterprises in Dong Nai through a direct survey of enterprises in Dong Nai province in 2019. The survey was built on the basis of the "Information collection form" in the Enterprise Survey of the Vietnamese General Statistics Office. Specifically, the questionnaire is divided into seven parts: (i) General information, (ii) Enterprise overview, (iii) Enterprise's perception of participating in the green manufacturing industry, (iv) Actions of enterprises towards green development in industry, (v) Green innovation activities of enterprises, (vi) Efficient energy consumption, and (vii) green transformation in product mix.

Results from the group of questions on "Transformation of product structure towards green products" are used to determine whether enterprises decide to produce green products or not. Based on the research question of the article and the collected data, we propose to use the dummy variable about whether the company produces at least one green product as a proxy for the green production of the company.

Thornton et al. (2005) suggests that companies that have been fined or that understand the administrative penalties for violating environmental regulations tend to implement better environmental protection measures. Besides, ISO 14,000 certification on environmental management is also a proof that enterprises are well implementing environmental standards in production activities. In addition, companies that assign responsibility to leaders to be in charge of green production also show a serious orientation towards green production development. Therefore, these three factors are used as explanatory variables for the likelihood that the firm will choose to produce at least one green product.

The size of the company is considered as a decisive factor to the company's activities in

each period (Lin & Ho, 2010; and Zhang et al., 2020). Therefore, company size at establishment and company size in 2019 are included in the research model. Company size is formed on the basis of three factors (i) total capital; (ii) total assets; and (iii) total number of employees. Each factor is rated on an ascending scale from 1 to 8. In addition, the number of years of operation of the company also shows the company's experience in its field of production. Production experience is also considered to be one of the factors influencing a firm's decision to adjust production (Ge et al., 2020; and Yasuda, 2005). Therefore, the number of years of operation of the company is included in the model.

The variables of company size, operational policy, technological innovation, efficient energy regulation, and energy saving policy are the variables built on the basis of multiple binary questions ("Yes or no"). In order to avoid multicollinearity and heteroscedasticity caused by including too many variables in the model, we propose to use principal component analysis (PCA) to convert groups of questions on the same topic into one specified variable.

Table 1 presents the statistical results of the surveyed companies on the trend of producing green products in 2019 in Dong Nai. In general, 24.8% of the companies have been producing at least one green product, 35.1% of the companies have assigned a leader responsible for developing green production. All ofcompanies have more than 10 years of experience in the manufacturing sector on average. In addition, 54.9% of businesses have invested in equipment to handle emissions during the production process, 29.4% of the companies achieved ISO 14,000 certification on environmental management, 57.5% of the companies have set regulations and standards on energy saving and efficiency. Only 7.1% of the companies were administratively sanctioned for violating regulations on emissions into the environment. The numbers show positive news when businesses have been interested in developing green production.

Table 1. Descriptive statistics of the variables used in the study

Variables	N	Mean	Min	Max
There are few green products	236	0,248	0	1
Assigning responsibility to leaders to be in charge of green production	236	0,351	0	1
Being administratively sanctioned for violating environmental regulations	236	0,071	0	1
Years of operation	236	13,068	0	51
Size of company at establishment	236	0	-2,124	2,693
Size of company in 2019	236	0	-4,47	2,174
Having invested in emission treatment equipment	236	0,549	0	1
Having ISO 14,000 certification on environmental management	236	0,294	0	1
Having green operation polices	236	0	-4,282	1,237
Having green technology innovation	236	0	-1,468	1,454
Having regulations about energy efficiency	236	0,575	0	1
Having policies about energy saving	236	0	-0,19	4,139
Degree of energy efficiency	236	0	-1,13	1,77

According to the survey results of 300 operating companies in Dong Nai in 2019, about 58% of companies are interested in and arrange costs for environmental protection; More than 50% of companies have invested in environmental protection equipments, waste

treatment construction and arranged recurrent expenditures for environmental protection. At the same time, the survey also recorded that about 25% of enterprises have at least 1 green product.

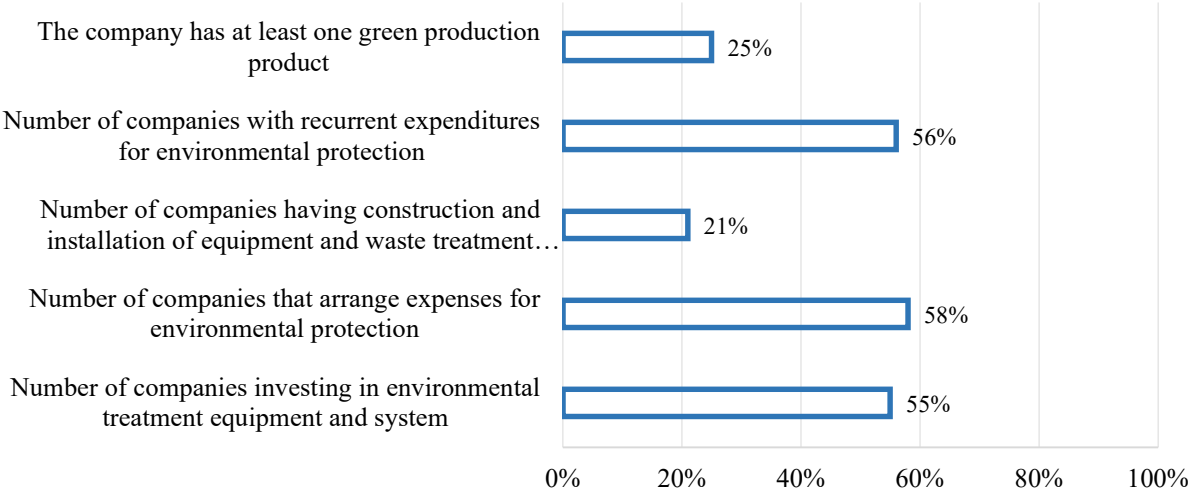

Figure 2. The awareness level of companies in Dong Nai regarding green development

3.2. Empirical research model

The dependent variable is the variable that indicates whether the firm produces at least one green product or not. The main variable of the model is a binary variable and the distribution of the two options is that 24.8% of the companies produce at least one green product and the remaining 75.2% of companies do not produce any green products. Therefore, logit and probit regression models are two appropriate regression methods in this case. Both methods are quite similar when the dependent variable is a binary variable. Therefore, we propose to use the logit regression model as the main regression method in this study. The logit regression method is presented as follows:

$$I_i^* = \beta X_i + u_i \quad (1)$$

Assuming that:

$$Y_i = 1 \text{ if } I_i^* \geq \text{m}$$
$$Y_i = 0 \text{ if } I_i^* < \text{m}$$

Then, the probability that $Y_i = 1$ is calculated as follows:

$$P(Y_i = 1) = P(I_i^* \geq \text{m}) = P(\beta X_i + u_i \geq m)$$
$$= P(u_i \geq m - \beta X_i)$$

If the above probability is symmetric, then:

$$P_i = P(Y_i = 1) = P(u_i \leq \beta X_i - m)$$

The logit model assumes that the error term u_i follows a standard logistic distribution. Thus, the probability that $Y_i = 1$ is as follows:

$$P(u_i \leq \beta X_i - m) = P_i = \frac{1}{1 + e^{-Zi}}$$

In which:

$Z_i = \beta X_i - m$; with $-\infty < Z_i$, then $0 < P_i < 1$

The probability that $Y_i = 0$ will be the complement of $Y_i = 1$, and is calculated as follows:

$$P(Y_i = 0) = 1 - P_i = 1 - \frac{1}{1 + e^{-Zi}}$$

The ratio between $Y_i = 1$ and $Y_i = 0$ is as below:

$$\frac{P_i}{1 - P_i} = \frac{1 + e^{Zi}}{1 + e^{-Zi}} = e^{Zi} \quad (2)$$

Taking the logarithm of both side of the equation (2) we have the following general logit model:

$$L_i = ln(\frac{P_i}{1 - P_i}) = \beta X_i - \mathrm{m} = f(X_i) \quad (3)$$

Empirical model applying logit regression from equation (3) has the form as below:

$$P(Y = 1) = f(X_j) \quad (4)$$

Where Y is the dependent variable with a value equal to 1 if the firm produces at least one green product and 0 otherwise.

The variables X_j in equation (4) include: (i) Being administratively sanctioned for violating environmental regulations; (ii) There is investment in environmental treatment equipment; (iii) Having the ISO 14,000 certification on environmental management; (iv) Size of the company at the time of establishment; (v) Company size in 2019; (vi) Number of years the enterprise has been in operation; (vii) Green operation policy; (viii) Green technological innovation; (ix) There are regulations on efficient use of energy; (x) Having policies on economical use of energy; (xi) Efficiency of energy use; and (xii) The company has assigned responsibility to business leaders in charge of green development in production.

To ensure that the companies included in the logit regression model are highly homogenous, we apply the Propensity Score Matching (PSM) method to create the sample with the highest similarity between the two groups of observations in the sample. The PSM method requires defining a "discriminatory" variable (treatment) to identify two samples. In this study, we propose to use the variable "the company assigns responsibility to business leaders in charge of green development in production" as the treatment variable. We use the "outcome" of this treatment variable as "the business that has converted at least one product in the green direction". Thus, the research results will assess whether assigning responsibility to leaders really makes a difference in deciding to produce at least one green product.

4. Research results

4.1. Regression results

Regression results (Appendix 1) shows the marginal effects of the explanatory variables on the probability that the firm decides to produce at least one green product. Columns (1) and (2) are results across the entire sample. Columns (3) and (4) are the results for the homologous sample using the PSM method, with the treatment being that the enterprise has assigned the leader to be responsible for the green production segment. Columns (5) and (6) are the results of the sample of FDI companies. Finally, columns (7) and (8) are the results of a sample of non-FDI firms.

In Appendix 1, marginal effects are determined in two cases: (i) The company has no investment in emission treatment equipment, and (ii) The company has invested in emission treatment equipment. In general, having a business leader in charge of green development, the enterprise has a higher probability of producing at least one green product. The impact of assigning leaders in charge of green development to the probability of a company producing green products is higher than for companies with investments in emission control systems. For the sample using the PSM method, the impact of having a leader in charge of green development is significantly higher than the results for the entire sample. In addition, the fact that the company assigns a leader in charge of green development has no impact on the probability of green product production, for companies without FDI.

4.2. Results discussions

Technological innovation towards green growth has the effect of increasing the probability of green product production in FDI companies. This result is also similar to the studies of Jun (2019), and Nosheen et al (2021). Besides, for the entire sample, when the company invests in an emission treatment system, the impact of new green technology innovation will increase

the odds of green production by at least 5.2 % at the 10% significance level.

The fact that the company has energy efficiency regulations also contributes to an increase in the probability of production going green when considering the entire sample, the sample of FDI companies, and the sample of non-FDI companies that invest in waste treatment equipment. For the sample using the PSM method, the regulation of energy efficiency has no impact on the decision to produce green products. In addition, the level of efficiency in actual energy use of enterprises also has the effect of increasing the probability of producing products in a green direction, except for FDI companies. Yu-Shan Chen and Ching-Hsun Chang's (2012) research also shows that companies need to develop dynamic capabilities, strengthen transformation leadership, and innovate in green ways to enhance green product development.

In addition, variables related to whether the company was administratively fined for violating environmental protection regulations, the size of the company when it was established, and the size of the company in 2019, owning the ISO 14,000 certificate on environmental management, having a green operating policy, having a policy on economical use of energy have no impact on the decision to produce at least one green product. Bernauer (2006) argues that environmental regulations can encourage innovation by making companies in all sectors aware of their responsibilities and willingness to seize opportunities that may be missed in the development of environmentally friendly products.

5. Conclusion and policy implications

This study assesses the factors affecting the decision to produce green products for enterprises in Dong Nai province. The logit regression results show the marginal effects of the variables including "having leaders in charge of green development", "having investment in emission treatment equipment", "having regulations on efficient energy use", and "having a high level of energy efficiency" increases the probability that enterprises decide to produce at least 1 green product, especially for FDI enterprises. For domestic enterprises, the level of efficiency in energy use has a positive effect on the probability that enterprises decide to produce green products. In addition, when domestic enterprises invest in emission treatment equipment, the adoption of regulations and standards for the economical and efficient use of energy also increases the likelihood of manufacturing green products. The representative variable for institutions is that the administrative sanctions for violations of regulations on environmental protection have no statistically significant impact on the decision to produce green products for enterprises. In addition, the size of the business, operating experience (represented by the number of years of operation), having ISO 14,000 certificate or having a green operating policy also had no impact on production decisions. corporate green products.

From the above research results, we propose some policy implications as follows. *First*, based on the higher green production results of FDI enterprises compared to domestic enterprises, we propose to strengthen the connection between domestic and foreign enterprises and international organizations in order to promote the process of learning and acquiring experiences in implementing green growth and sustainable development. Green growth goals should be placed at the center of the local socio-economic development planning strategy to orient to attract green investment, support and monitor the performance of businesses in the province closely follow the green growth orientation.

Second, the assignment of tasks to the leader responsible for developing the green production field of the enterprise contributes significantly to the decision to produce green products. Thus, on the company's side, in order to develop green production, they need to allocate resources, especially to assign personnel in the

business leadership responsible for developing this production segment. Regarding the role of the government and State management agencies, green production activities, or green production projects of enterprises with specific assignment of departments responsible for development Green production should be the focus of policies to promote green production in Dong Nai Province.

Third, investing in emission treatment equipment, innovating green technologies, and increasing the efficiency of energy use of enterprises contribute to increasing the probability of enterprises to produce green products. Therefore, technology application is considered an effective lever in implementing green transformation. Technology will help businesses optimize performance, productivity, improve system administration quality, and avoid wasting resources. In order for the deployment of technology applications to be feasible, the Government and local authorities need to support businesses in mobilizing investment capital from many different sources such as attracting funding and aid from foreign investors, international organizations, foreign investment, and domestic social capital.

Finally, the administrative sanction not only has no impact on the enterprise's decision to produce green products, but also has a negative sign on the decision to produce green products. Therefore, the policies aim to tighten regulations on waste disposal; regularly organize inspection and monitoring teams in the implementation of environmental regulations of companies; and strict treatment of violations of environmental protection law are necessary, but not the focus in developing policies to promote green exports in the current period of the province.

In addition, our research also has some unavoidable limitations in the implementation process. First, firm size should be the real variable instead of the nominal variable. However, the fact that the survey sample shows that company size information provided by respondents is often misleading and limited. Therefore, the research team decided to use the identifier variable to measure company size. Second, information about the board of directors and corporate governance was not included in the survey. Because the study sampled companies in Dong Nai province without classifying the type of business, the structure and organization of the board of directors or corporate governance differs. As part of this study, the research team was unable to sample companies by company type. Thus, the informational nature of management will not be consistent across observations. Therefore, the research team did not include questions about information from company directors in the survey.

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Appendix 1. Factors affecting the probability that a company decides to produce at least one green product

Explanatory variables	Whole sample		PSM sample		FDI companies		Non-FDI companies	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Having business leaders in charge of green development	0,089**	0,115**	0,121*	0,150**	0,114**	0,151**	0,012	0,013
	(0,045)	(0,057)	(0,062)	(0,076)	(0,054)	(0,073)	(0,108)	(0,112)
Being administratively sanctioned for violating environmental regulations	-0,066	-0,085	-0,096	-0,119	-0,031	-0,041	-0,144	-0,152
	(0,084)	(0,110)	(0,119)	(0,150)	(0,105)	(0,141)	(0,213)	(0,241)
Years in operation	-0,001	-0,001	0,001	0,001	-0,001	-0,002	0,006	0,006
	(0,003)	(0,004)	(0,005)	(0,006)	(0,004)	(0,005)	(0,006)	(0,006)
Company size at establishment	-0,012	-0,015	-0,004	-0,005	0,008	0,011	-0,080	-0,084
	(0,032)	(0,041)	(0,050)	(0,062)	(0,036)	(0,048)	(0,084)	(0,090)
Company size in 2019	0,005	0,007	0,004	0,006	-0,006	-0,008	0,036	0,038
	(0,028)	(0,035)	(0,043)	(0,054)	(0,030)	(0,040)	(0,065)	(0,069)
Having invested in emission treatment equipment	0,092**	0,118*	0,130**	0,162*	0,108***	0,144*	0,027	0,028
	(0,038)	(0,067)	(0,055)	(0,090)	(0,039)	(0,075)	(0,132)	(0,149)
Having ISO 14,000 certification on environmental management	-0,028	-0,036	-0,053	-0,066	-0,037	-0,050	-0,080	-0,085
	(0,051)	(0,066)	(0,074)	(0,092)	(0,058)	(0,076)	(0,110)	(0,114)
Having green operation polices	0,011	0,015	0,037	0,046	0,026	0,034	-0,017	-0,018
	(0,029)	(0,036)	(0,041)	(0,050)	(0,037)	(0,048)	(0,037)	(0,039)
Having green technology innovation	0,040	0,051*	0,061	0,076	0,054*	0,071**	-0,004	-0,004
	(0,026)	(0,030)	(0,041)	(0,046)	(0,030)	(0,036)	(0,050)	(0,053)
Having regulations about energy efficiency	0,149**	0,192***	0,141	0,175	0,136**	0,182**	0,288	0,305**
	(0,064)	(0,074)	(0,094)	(0,110)	(0,065)	(0,082)	(0,193)	(0,134)
Having policies about energy saving	0,007	0,009	0,066	0,082	0,022	0,029	-0,027	-0,029
	(0,041)	(0,052)	(0,074)	(0,091)	(0,046)	(0,061)	(0,061)	(0,065)
Level of energy efficiency	0,048**	0,062*	0,062*	0,077*	0,016	0,021	0,121***	0,128**
	(0,023)	(0,032)	(0,034)	(0,044)	(0,029)	(0,038)	(0,045)	(0,054)
R-square	0,259		0,298		0,330		0,156	
Number of observations	236	236	146	146	174	174	62	62
Having invested in emission treatment equipment	No	Yes	No	Yes	No	Yes	No	Yes

Note: The dependent variable is the variable that indicates whether the firm produces at least one green product or not; The above results are the marginal effects from the logit regression model of the variables in the two cases (i) the company ***has*** invested in emisssion treatment equipment, and (ii) the company ***has not*** invested in emisssion treatment equipment; standard deviation in parentheses; ***, ** , and * are statistically significant at the 1%, 5%, and 10% level.