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Profit Decomposition: Analyzing the Pathway from Carbon Dioxide Emission Reduction to Revenues and Costs

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ABSTRACT

In 2009, the Indonesian Government has introduced regulation on reducing carbon dioxide (CO_2) emission known as "energy management" to follow up its commitment to reduce CO_2 emission that was ratified in the Kyoto protocol. The regulation mandates companies in Indonesia which consumed more than 6000-tonne of oil equivalent (TOE). The obligation to reduce CO_2 emission has an implication to the companies that the company has to implement strategies incorporating an expensive investment. Through investment, the company's sales are expected to increase and costs are expected to decrease. Several conceptual frameworks have been developed to identify through which pathway CO_2 emission reduction can gain profits for companies but a little study (if any) has been done to analyze the pathways of CO_2 emission reduction that can improve companies' profits. This study aims to examine the pathway of CO_2 emission reductions to the profits generated by revenues and costs. The purposive sampling method was used to obtain data from 384 companies that consumed 6000- TOE from 2016-2017 in Indonesia. The multiple regression analysis with ordinary least square was used to analyze their relationship. The results showed that in the case of Indonesia, the CO_2 emission reduction can generate profits through both pathways namely revenue improvement and cost-efficiency. The increase in revenues and decrease in cost are due to their ability to meet customers' interests, the positive responses of stakeholders in compliance with the regulation to reduce CO_2 emissions, and the investment of environmentally friendly machinery.

Keywords: Carbon Dioxide Emissions, Costs, Decomposition, Profit, Revenues
JEL Classifications: Q48, Q51, G3

1. INTRODUCTION

Carbon dioxide (CO_2) has contributed to global warming which tends to trigger climate change (Tietenberg and Lewis, 2012). According to IPCC (2007), over the past 100 years (1906-2005) the average surface temperature of the earth had risen by around 0.74°C. When the concentration of CO_2 emissions in the atmosphere increases by twice compared to its concentration in pre-industrial periods the average warming temperature rises to 2-4.5°C.

The increasing concentration of CO_2 leads to higher occurrence and severity of natural disasters such as extreme storms, drought, flash floods, a rise in global sea levels and ocean acidification (Solomon et al., 2007). This has also led to a rise in the concern of scholars and policymakers to deal with climate change. Various industrialized countries and developing countries have ratified the Kyoto protocol in accordance with climate change, by committing to reducing CO_2 emissions. In the Paris agreement, the Indonesian Government renewed its commitment to reduce CO_2 emissions by 29% or 41% with/without international support, respectively (Wijaya et al., 2017). This commitment was manifested in the regulation of carbon known as PP. 70 in the year 2009 that was introduced in 2009. It regulates the industrial sector to conduct "energy management," in which, the ultimate objective of this regulation is to mandate companies in Indonesia consuming at least

6000- tonne of oil equivalent (TOE) per year to reduce its CO_2 emissions. This obligation has a consequence on the companies. They must invest in expensive machinery and technology. The investment can improve the company's profits if the benefits higher than the costs, vice versa. Accordingly, companies must be more efficient and more innovative. Although about a decade the regulation has been implemented, there is no study (if any) that examined the effectiveness of the regulation implementation together with through which pathways the CO_2 emission reductions can affect the company's profits, whether from revenue improvement or cost reduction or both.

Several studies have been conducted to scrutinize the effect of corporate environmental performance on finance with lots of spent to ecologically conceptualize a pertinent pathway. For instance, the distinct pathway between market gains and cost savings are presented by Klassen and Mclaughlin (1996), while, Ambec and Lanoie (2008) schematically conceptualize those between opportunities for increasing revenues and reducing costs.

Based on the relevant literature, the theories based on the research framework of the existing studies are grouped into two factions. The first (e.g. Aupperle et al., 1985; Fogler and Nutt, 1975; Levy, 1995) reported that corporate environmental responsibility is generally associated with a decline in competitiveness. This is based on Friedman's (1970) traditional theory which is similar to the neo-classic view. Friedman (1970) stated that the relationship between environmental and corporate financial performance is negative. Friedman assumed that the expenses on meeting the environmental regulations were viewed as costs which need to be minimized by companies, to increase profit. Consequently, the companies need to carry out minimal environmental compliance of the ecological regulation to avoid litigation actions.

The second group bases itself on logical thinking, such as the stakeholder (Freeman, 1984), instrumental (Jones, 1995) and competitive advantage theories (Porter and Van Der Linde, 1995a; 1995b). The scholars assumed that environmental expenses are viewed as an investment, with the ability to provide sufficient cash flows in the future. Therefore, stakeholders' interests need to be incorporated in making strategic decisions, due to their ability to affect the short and long-run sustainability of company. In addition, consumers have the ability to boycott their products (Rokhmawati et al., 2017), while loan providers and equity investors charge higher due to its inability to meet the interest of stakeholders. Furthermore, scholars stipulated that environmental performance needs to have a positive effect on finance. Therefore, based on the theory of competitive advantage (Porter and Van Der Linde, 1995a), companies reduce their environmental impact without jeopardizing their financial performance by implementing an overall low-cost and differentiation strategy.

Several studies were conducted to differentiate the pathways of ecological and financial performance. For instance, Earnhart and Lizal (2010) conducted an almost similar study by measuring the amount of CO_2 produced by a company with its inability to reduce these emissions. Such measurement may only capture the effect of emissions on financial performance. Earnhart and Lizal (2010) further stated that pollution increases sales. Many prior studies have been conducted to examine the effect of environmental performance on finance based on market measurement by using Tobin's Q (e.g. Busch and Hoffmann, 2011; Capece et al., 2017; Iwata and Okada, 2011; Rokhmawati and Gunardi, 2017; Wang et al., 2014) and based on accounting measurement by using return on assets, return on equity, return on sales, and return on investment (Busch and Lewandowski, 2017; Fujii et al., 2013; Hatakeda et al., 2012; Iwata and Okada, 2011; Rokhmawati and Gunardi, 2017). Iwata and Okada (2011) and Rokhmawati and Gunardi (2017) explained the pathways CO_2 emission effect on financial performance using equity investors, loan provider, customer, and market responses generated by the company. However, the scholars were unable to distinguish pathways that affected their financial performance from revenue/cost streams as explained by the first and second groups. The research is based on the direct influence of CO_2 emissions and financial performance without explaining its ability to increase revenues or reduce costs. This current study, therefore, uses revenues and costs to analyze the CO_2 emissions effect on financial performance. The control variables are also included in this study i.e. increase/decrease of CO_2 emission, exports, and investment amount in machinery, and industrial groups.

These findings are expected to contribute to the literature, practices, and policy of companies. The research result tends to confirm the Friedman's traditional theory by viewing environmental expenses in accordance with Freeman's, Jones', and Porter's theories which viewed ecological expenses as an investment. These are likely to have an implication on revenues and costs in generating cash inflows to cover the costs of ecological handling. In practice, this research provides a way for companies to deal with CO_2 emissions and maintain their profits.

The remaining part of this paper is organized as follows: Section 2 introduces the literature and hypothesis, Section 3 describes the research method, Section 4 contains the results, Section 5 gives the discussions, and Section 6 provides conclusions and recommendations.

2. LITERATURE REVIEW AND HYPOTHESES

2.1. The Relationship between CO_2 Emission Reduction and Revenues

According to the stakeholder theory, companies are entities operate for their interests and benefits of their stakeholders (Freeman, 1984). Furthermore, Jones (1995) reported that stakeholders' interest is an important instrument that needs to be considered when a company wants to gain sustainability, due to their ability to create detrimental attributes assuming their interests are not met. Customers are also willing to pay more prices for green products in accordance with CO_2 ecological emission (Klassen and Mclaughlin, 1996; Rokhmawati et al., 2017). Porter (1985) stated that they exploit such customers by implemented differentiation strategy on niche segments of the ecologically cognizant market (Ambec and Lanoie, 2008). Furthermore, companies have the ability to improve their reputation through their ecologically conscientious conduct (McGuire et al., 1988). According to research, they increase revenues after the successful establishment of standard environmentally friendly, green products (Hart and Ahuja, 1996; Klassen and Mclaughlin, 1996; Porter and Van Der Linde, 1995b). These organizational influences are prolonged and create adequate time for customers to assess the green product before developing their buying intention. Finally, a company may be able to raise its revenue by meeting the ecological standards of customers that require the utilization of efficient green technology. These environmental standards are generally required by customers in developed countries. In addition, they need to possess ISO 14001 and eco-management and audit scheme (EMAS) certificate in order to obtain a liaison, following ecological compliance to enter developed countries (ISO, 2017; Rieckhof et al., 2015; Rokhmawati et al., 2017). When a company implements ecological standards, it possesses great opportunities to enlarge its market shares.

Therefore, a hypothesis is drawn based on the description that CO_2 emission reduction affects firm revenues. The effect is expected to be positive with an increase in CO_2 emission reduction, leading to a rise in revenues.

2.2. The Relationship between CO_2 Emission Reduction and Costs

Based on the instrumental stakeholder theory (Jones, 1995), the company needs to pay attention to the stakeholders' interests to avoid detrimental effects, which tends to affect production and managerial costs. The government is one of the stakeholders, with the authority to introduce carbon regulation. When it ignores the regulation it may face litigation action and the government has the authority to impose a penalty, fine or even shut it down (King and Lenox, 2001). In contrast, when it complies with the regulation, the government may offer incentives such as a reduction in tax (Rokhmawati and Gunardi, 2017). Those that comply with the regulation are properly responded by stakeholders due to their reduce litigation risks and vice versa are exposed to lower risk. Conversely, when the company does not comply with the regulation they are exposed to higher risk. For instance, the Indonesian Central Bank introduced Regulation No. 14/15/PBI/2012 on ecological management for commercial banks to consider the environmental regulatory compliance in assessing the eligibility and feasibility of companies to receive loans (Bank_Indonesia, 2012). Therefore, when they do not comply with this regulation, banks have the capability to reject their credit proposal or give loans with higher interest. Furthermore, this condition also has the ability to affect the feasibility of the financed project. However, when they comply with these regulations, banks provide a lower interest rate on loans.

In addition, equity investors may assess companies' risk based on their compliance with the regulation. Those that comply with the regulation are viewed as a lower risk and vice versa. This is in accordance with the risk and returns theory, which stated that the higher the risk, the higher the rate of return required by investors. Furthermore, those with lower risk need funding from equity investors, at a lower cost. This condition tends to affect the feasibility of the financed project, and those with better environmental management have the ability to reduce the cost of ecological monitoring (McGuire et al., 1988). With regards to bordering on regulatory inspection, the local community may impose less pressure such as losing restricted zone and avoiding third-party lawsuits due to the use of superior ecological practices.

In addition, companies need to invest in more efficient machinery to support an efficient production process with the adaptation of an ecologically friendly technology consisting of fewer toxic inputs, less energy, and pollution. Cost reduction occurs when the benefit of saving is higher than the cost of investment.

Therefore, the hypothesis is drawn based on the description that CO_2 emission reduction positively affects firm costs which leads to the efficient enhancement of production processes and minimization of capital costs as well as avoidance of penalties.

3. METHODOLOGY

3.1. Sample and Data

This study used data of type, amount of fossil fuel and electricity consumption, percentage of products exported, classification based on International Standard Industrial Classification (ISIC), cost items, revenues, and profit. Data of type, amount of fossil fuel and electricity consumption is used to compute the CO_2 emissions produced by a company. The data were collected by the Indonesian Statistics through a census conducted in 2016 and 2017. Two-year survey data were needed to calculate the growth of firm CO_2 emissions, growth of costs, and growth of revenues. Samples included in the study were chosen based on the developed criteria. Firstly, it is based on a manufacturing company in accordance with the Indonesian Regulation PP 70/2009. Secondly, those that consumed at least 6000- TOE. Based on the selection criteria, 384 companies were included in this study.

3.2. Measurement

3.2.1. Firm profit

Performance is an illustration of the implementation achievement associated with organizational goals was one of the important objectives of the establishment is to maximize shareholder wealth (Brigham and Gapenski, 2006). Company performance is a formal effort carried out to evaluate the efficiency and effectiveness of its activities that have been carried out over a certain period. According to Rokhmawati (2016), the notion of financial performance is the determination of certain measures that measure the profits generated.

This study uses a financial performance based on three indicators, namely: profit (π), Revenues (R), and cost (C). Profits are derived from the difference between revenue minus company operating costs, which is mathematically stated in the following formula.

$$\pi_{it}=R_{it}-C_{it}\ \pi_{it} \quad (1)$$

Where,

π_{it}: Profits generated by company i over a period t
R_{it}: Revenues generated by company i over a period t
C_{it}: Costs borne by company i over a period t.

3.2.2. Firm revenues

IAI (Ikatan_Akuntansi_Indonesia, 2009), defined revenue as the gross inflow of economic benefits arising from the normal activities of a company, which leads to an increase in equity, not originating from investment contributions. Revenue is the result of all sales which are classified as follows:

1. Operating income: This is defined as the total revenue received which is directly related to its main operational activities
2. Non-operating income: This is the total amount of revenue received outside the main operating results.

This study measures revenue as sales growth to capture the increase/decrease in sales. Due to the introduction of carbon regulation in Indonesia since 2009, therefore, an 8-year lag from the introduction of the regulation to the data used in this study, the years 2016 and 2017 is enough time to adjust their operations. Hence, the effectiveness of the regulation of carbon reduction can be confined. In addition, companies are supposed to implement the ecological standard in their business practices to capture the increase or decrease in sales. The positive/negative growth represents an increase/decrease in firm revenues, which is computed as follows:

$$\text{Sales growth} = \frac{\text{Sales}_{2017} - \text{Sales}_{2016}}{\text{Sales}_{2016}} \quad (2)$$

3.2.3. Firm costs

Cost is defined as an element that exists in a company that needs to be managed and controlled accordingly, in order to achieve its goals and reduce costs. Kieso et al. (2014) defined cost as the sale of goods and services consumed to generate income. In addition, Mulyadi (2014) defined costs as the sacrifice of economic resources measured in units of money, to achieve certain goals.

This study measured cost as a component of expenditure carried out during a production process. Costs are calculated as the total amount resulting from the production process in Indonesian Rupiah. When growth is positive, there is an increase in costs and a decrease when it is negative. The formula used to calculate cost growth is as follows:

$$\text{Cost growth} = \frac{\text{Costs}_{2017} - \text{Costs}_{2016}}{\text{Costs}_{2016}} \quad (3)$$

3.2.4. CO_2 emissions

The climate change declaration in Copenhagen (Erbach, 2015) legally binds developed countries that ratified the declaration in order to reduce GHG emissions, which are measured by CO_2e intensity. The CO_2 emissions produced by a firm are calculated by following the guidelines provided by the Department for Business, Energy, and Industrial Strategy of the UK (Department-for-Business-Energy, Industrial-Strategy, 2018). However, this study incorporated CO_2 emissions from Scope 1 and 2, excluding Scope 3 due to the company's inevitability to control third party operations. The CO_2e in this context is produced from consuming coal, natural gas, diesel, and electricity for the manufacturing process. The quantification of carbon released is based on the following equation:

$$CO = \sum_{i=1}^{n} CO_i = \sum_{i=1}^{n} H_i \, \delta_i CO \quad (4)$$

Where,

CO: Carbon emissions from an individual firm

COi: Carbon emissions produced from burning coal, natural gas, diesel, and electricity

Hi: Energy consumption of energy i

δi: Coefficient of carbon emissions from energy i

n: Type of fuels or electricity.

In addition, the GHG emissions measured as the growth of CO_2e emissions intensity was calculated using the following equation (Rokhmawati et al., 2018):

$$g_{CO_2} = \frac{\frac{CO_{2_{t+1}}}{\text{Sales}_{t+1}} - \frac{CO_{2_t}}{\text{Sales}_t}}{\frac{CO_{2_t}}{\text{Sales}_t}} g_{CO_2} \quad (5)$$

Where:

g_{CO2}: The growth of CO_2

CO_{2t+1}: Kilogram CO_2 in 2017

CO_{2t}: Kilogram of CO_2 in 2016

Sales_{t+1}: Sales in 2017

Sales_t: Sales in 2016.

Table 1 provides the GHG conversion factors adopted from the Department for Business, Energy, and Industrial Strategy, UK (Department-for-Business-Energy, Industrial-Strategy, 2018).

3.2.5. Control variables

This study includes the increase/decrease in CO_2 emissions, the level of investment in machinery, exportation, and industrial groups as control variables.

Table 1: GHG conversion factors for firms' reporting

No	Type of energy sources	Unit	GHG conversion factor scope 1			kg CO_2e
			kg CO_2	kg CH_4	kg N_2O	
1.	Coal	tons	2427.5	6.73	18.06	2452.29
2.	Natural gas	cubic meters	2.04275	0.0027	0.00107	2.04652
3.	Diesel	liters	2.6502	0.00042	0.03717	3.17799
No	**Type of energy sources**	**Unit**	**GHG conversion factor scope 2**			**kg CO_2e**
			kg CO_2	kg CH_4	kg N_2O	
4.	Electricity	kWh	0.28088	0.00066	0.00153	0.28307

Source: The Department for Business, Energy, and Industrial Strategy of the UK (2018)

3.2.5.1. The firm status of CO_2 emission reduction

The firm's status of CO_2 emission reduction is to determine its ability to reduce its emissions. This is a dummy variable in which score one is provided for companies that have succeeded to reduce CO_2 emissions. Score zero is given to companies that have not been able to reduce their emissions after the increase/decrease status of CO_2. This is calculated with the following equation:

$$\text{The firm status of } CO_2 \text{emissions} = \frac{\frac{CO_2\ \text{emissions}_{2017}}{\text{Sales}_{2017}} - \frac{CO_2\ \text{emissions}_{2016}}{\text{Sales}_{2016}}}{\frac{CO_2\ \text{emissions}_{2016}}{\text{Sales}_{2016}}} \quad (6)$$

3.2.5.2. Investment

Investment is the monetary value of assets provided by organizations to acquire long term assets, while return refers to the increased cash flows in the future attributes acquired. Revenues and costs depend on the level of investment in the machine. In addition, an increase in investment results is also expected to affect the profits caused by the rise in production levels. This investment is measured by the nominal value of the Indonesian Rupiah invested by the company. This is computed as follows:

$$\text{Investment} = \text{Ln (Investment)} \quad (7)$$

3.2.5.3. Export

Companies that carry out export activities are predicted to possess a significant influence on company revenues which ultimately affect profits. Export is computed as follows:

$$\text{Export} = \text{The proportion of firm production sold to abroad} \quad (8)$$

3.2.5.4. Industrial group

In this study, the industrial group referred to heavy and non-heavy industries, with their classification based on the ISIC. This is a dummy variable where the heavy and non-heavy industry groups have the numbers 1 and 0, respectively. The following are grouped into heavy industries: pulp and paper, coal product and petroleum milling, chemical industry and chemical products, basic metal, machinery and equipment. Other kinds are grouped into the non-heavy industry.

3.2.5.5. Analysis method

To analyze the data, this study developed two models of multiple regressions that are seen as follows:

Regression equation model 1

$$R_{it} = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + e_i \quad (10)$$

Regression equation model 2

$$C_{it} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon_i \quad (11)$$

Where,
R: Revenues
C: Costs
X_1: CO_2 emission growth
X_2: Firm status of CO_2 emissions
X_3: Investment
X_4: Export level
X_5: Industrial group
a: The constant of regression model 1
α: The constant of regression model 2
b_1–b_5: Regression coefficient of X_1–X_5 of model 1
β_1–β_5: Regression coefficient of X_1–X_5 of model 2
e_i and ε_i: Error terms.

Before conducting the regression analysis, classical assumption tests were carried out for the two models. These tests include normality, multicollinearity, and heteroskedasticity. However, the autocorrelation test was not conducted because it is not a time series of data. This was followed by the regression analyses which were used to examine the pathway from CO_2 emissions flows to either revenues or costs or in order to determine the significance and sign of b_1 and b_2 as well as β_1 and β_2. The results of these tests are provided in the appendix.

4. RESULTS

4.1. Descriptive Statistics Analysis

Descriptive statistics provide a description of CO_2 emission growth to revenues, costs and control variables as well as the maximum, minimum, mean, and standard deviation figures (Table 2).

4.2. The Goodness of Fit Test

The result of classical assumption tests is provided in the appendix, while the following Tables show the result of the determination coefficient (R^2) and F test.

4.2.1. The determination coefficient (R^2)

Based on the results of Table 3, the coefficient of determination (R square) is 0.258. This means that 25.8% of revenue variation is explained by CO_2 emissions, emission reduction status, Ln (investment), exports, and industry groups, while the remaining

Table 2: Descriptive statistics test results

	n	Minimum	Maximum	Mean	Std. Dev.
Revenues	384	2.2205	2.4027	2.300751	0.0313124
Costs	384	2.2128	2.4608	2.307370	0.0392112
CO_2 emission growth (%)	384	–0.2923	0.3096	0.003387	0.0503052
Status of CO_2 emission reduction	384	0	1	0.49	0.500
Ln (investment)	384	2.3000	28.9500	9.968177	7.5223687
Export level	384	0	100	22.85	35.932
Industry groups	384	0	1	0.27	0.446
Valid N (listwise)	384				

Source: Processed data

74.2% is explained by other variables not included in the model. Table 4 shows that the coefficient of determination (R square) is numbered 0.153. This means that 15.3% of cost variations are explained by CO_2 emissions, Ln (investment), exports, and industry groups, while the remaining 84.7% is explained by other variables not included in the model.

4.2.2. F tests

From Tables 5 and 6, it is concluded that the model is fit for further analysis to be carried out.

4.3. Results

The statistical result of the developed hypothesis is seen in Table 7 as follows:

From Table 7, the multiple linear regression equation is shown as follows:

Table 3: The result of determination coefficient regression model 1

Model	R	R square	Adjusted R square	Std. Error of the estimate
1	0.508[a]	0.258	0.248	0.0271557

Source: Processed data. [a]Dependent variable: Revenues

Table 4: The result of determination coefficient regression model 2

Model	R	R square	Adjusted R square	Std. Error of the estimate
1	0.391[a]	0.153	0.142	0.0363293

Source: Processed data. [a]Dependent variable: Costs

Table 5: The result of F test regression model 1

Model		Sum of squares	Df	Mean square	F	Sig.
1	Regression	0.097	5	0.019	26.245	0.000[b]
	Residual	0.279	378	0.001		
	Total	0.376	383			

Source: Processed data. [a]Dependent variable: Revenues

Table 6: The result of F test regression model 2

Model		Sum of squares	Df	Mean square	F	Sig.
1	Regression	0.090	5	0.018	13.635	0.000[a]
	Residual	0.499	378	0.001		
	Total	0.589	383			

Source: Processed data. [a]Dependent variable: Costs

Revenues=2.29825–0.19696 CO_2 emission growth+0.01664 status of CO_2 emissions+0.00034 Ln (investment)+0.00013 Export level+0.00601 industrial group.

Table 7 shows that CO_2 emission growth has a negative and significant effect on revenues. This means that an increase in growth is followed by a reduction in revenues. Furthermore, companies that are able to reduce their CO_2 emissions have higher revenues compared to those unable to reduce their emission which is significant to improve revenues. At the confidant level of 90%, investment has a positive and significant effect on revenues. Export level also significantly improves companies' revenues contrary to other variables. Additionally, heavy companies have higher revenues than non-heavy industry. From Table 8, the multiple linear regression equation is as follows:

Costs=2.31278+0.20477 CO_2 emission growth–0.01605 status of CO_2 emissions+0.00032 Ln (investment)+0.00003 export level–0.00761 industrial group.

The table shows that CO_2 emission growth has a positive and significant effect on costs. Furthermore, when we check the status of CO_2 emission reduction, the CO_2 emission reduction has a negative and significant effect on costs. It implies that companies that are able to reduce CO_2 emissions have lower costs and vice versa, while other variables do not have significant effects on costs.

5. DISCUSSIONS

5.1. Effects of GHG Emission Reduction on Revenues

The results showed that CO_2 emission growth has a negative and significant effect on revenues, in accordance with the hypothesis that a decrease in CO_2 emission growth increases revenues and vice versa. This finding is also confirmed by the positive and significant impact of CO_2 emission reduction status and those that are able to reduce it have higher revenues. Furthermore, the investment made by the companies is able to improve their profits through the pathway of revenue improvement. Due to the investment, the companies are able to improve their international markets in which this finding is confirmed by the positive and significant impact of export on revenues. These results are consistent with the theory of competitive advantage, particularly in the differentiation strategy (Porter, 1985). Eco-branding strategies may be implemented (Orsato, 2006), with the use of the Instrument stakeholder theory (Jones, 1995). Exported products are generally required to meet a high ecological standard. Therefore, those with high environmental control increase their opportunities to obtain higher revenues

Table 7: Results of multiple regression analysis model 1

Model		Unstandardized coefficients B	Unstandardized coefficients Std. Error	Standardized coefficients Beta	t	Sig.
1	Constant	2.29795	0.00296		775.418	0.000
	CO_2 emission growth	–0.19696	0.02870	–0.31643	–6.864	0.000
	Status of CO_2 emission reduction	0.01664	0.00287	0.26601	5.792	0.000
	Ln (investment)	0.00034	0.00019	0.08141	1.814	0.070
	Export level	0.00013	0.00004	0.14571	3.216	0.001
	Industrial group	0.00601	0.00319	0.08567	1.887	0.060

Source: Processed data. [a]Dependent variable: Revenues

Table 8: Results of multiple regression analysis model 2

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta		
1	Constant	2.31278	0.00396		583.358	0.000
	CO_2 emission growth	0.20477	0.03839	0.26270	5.334	0.000
	Status of CO_2 emission reduction	–0.01605	0.00384	–0.20489	–4.176	0.000
	Ln (investment)	0.00032	0.00025	0.06070	1.266	0.206
	Export level	0.00003	0.00005	0.02552	0.527	0.598
	Industrial group	–0.00761	0.00426	–0.08661	–1.785	0.075

Source: Processed data. [a]Dependent variable: Costs

through easier access to certain markets. When they are able to meet the interest of their abroad customers, they acquire benefit from expanding their market. Boiral et al. (2011) stated that the company's efforts to reduce CO_2 emissions help improve their competitiveness. In addition, a firm's responsible behavior towards the environment enhances their reputation (McGuire et al., 1988). When the firm reputation is excellent, the customer becomes loyal to the products, which increases their revenues. Xie et al. (2016), Jackson and Singh (2015) also stated that value or financial performance improves when the company implements adequate environmental strategies.

The samples of this study are all manufacturing companies that consume fossil fuels and energy greater than 6000 TOE. Porter and Van Der Linde, (1995a) argued that environmental issues, need to be able to motivate them to be more creative and innovative in exploring and developing their potential. Therefore, they are expected to improve their competitiveness. Under the Indonesian regulation PP No. 70/2009, companies are required to make efforts to reduce their CO_2 emissions. Therefore, in conclusion, the regulation has been successfully implemented since the reduction of CO_2 emissions has a positive effect on companies' revenues.

Investment has a positive and significant effect on companies' revenues. The investment is made to replace the old machinery and increase production capacity and efficiency. The same result is also provided for the industrial group, at the confidence level of 90%, heavy industries have higher revenues than non-heavy industries. The heavy industry is carbon-intensive companies. When they implement efficient machinery and technology to replace their old machinery, these kinds of companies will gain more benefits than the non-heavy industry in terms of reputation because the companies become considerably cleaner and more environmentally friendly. Although non-heavy companies may also be able to reduce their CO_2 emissions the reduction intensity may not be such considerable as heavy companies. The enhanced reputation may be responded positively by the stakeholders due to their lowered risk. Therefore, grouping them based on the heavy and non-heavy ISIC is able to capture their revenue growth. These classifications give perspectives that carbon-intensive companies may gain higher benefits from reducing CO_2 emission than non-heavy companies. This finding implies that not only heavy companies firms consuming more than 6,000 TOE but also should these companies consuming <6000 TOE get benefits from reducing their CO_2 emissions through investment in efficient and clean machinery and technology. Accordingly, the government should motivate such companies to do the same with what the companies consuming more than 6,000 TOE have done.

5.2. Effects of GHG Emission Reduction on Costs

The statistical result shows that CO_2 emission growth has a positive and significant effect on costs. This means that an increase in emissions leads to a rise in costs and vice versa. This result is strengthened by the statistical result of CO_2 emission reduction status which has a negative and significant effect on costs. Companies that reduce CO_2 emissions have lower costs than firms that do not reduce their emissions. According to instrumental stakeholder theory (Jones, 1995) and the least cost strategy of Porter (1980), the reduction in CO_2 emissions decreases costs, which accordingly increases profits. From the perspective of instrumental stakeholder theory, this may be because of the company's compliance with the regulation. Regulatory compliance will lower the company's risk. The statistical result developed a hypothesis, which stated that the reduction of CO_2 emissions is through the pathways of costs. Therefore, companies have the ability to minimize their costs by improving the ecological standard required by the stakeholders, thereby, reducing the risk level.

The finding implies that the carbon regulation of PP 70/2009 has been effective to impose ecological conduct and lower the environmental costs from an operation. The cost reduction can be explained as follows. From the enforcement of the regulation, companies are required to invest in efficient and environmentally friendly machinery. The investment seems to provide more benefits than its costs to reduce the company's operating costs by utilizing efficient and ecologically friendly machinery and technology. The benefits may arise from that the Indonesian government provides tax reductions for capital expenses that support the government program to reduce CO_2 emissions. Furthermore, they may also obtain better access to loan and equity financing with a lower cost of capital. The social costs may also be minimized through the implementation of high ecological standards. The results of this study are also consistent with the research conducted by Stern (2007) which stated that efficient energy decreases energy through costs and also reduces CO_2 emissions. Therefore, the results of this study support the theory of competitive advantage particularly the least-cost strategy (Porter, 1985) and the instrumental stakeholder theory (Jones, 1995).

In addition, investment affects costs positively but insignificant. The positive sign of the effect is used to predict the meaning, increase the amount of investment, will increase the cost growth. The insignificant effect from this research failed to capture that investment made by the companies will reduce costs. This may be because an 8-year lag from the beginning of regulation introduced to the year 2016 and 2017 is too long because the companies have been firmed in adjusting their strategy to make an investment in efficient and clean machinery and technology. So, the considerable effect has been already taken place in the early years of investment. Now the effect has been steady. Hence, future studies may use time-series panel data to capture the trend of cost reduction resulted from investment.

The export level does not have a significant effect on cost growth. Ecological standards to be met by the exporting company need costs to improve the processing and practical ecological standards using ISO 14001 or EMAS, however, these costs cannot be captured in the 1-year data. This may be because the companies have made expenses to meet the ecological standard in past years.

Finally, at the confidence level of 90%, the heavy industrial groups have a negative and significant effect on cost growth. This means that companies with carbon-intensive have a lower cost growth than non-heavy companies. Companies with carbon-intensive may gain higher cost reduction than those which non-heavy ones.

6. CONCLUSIONS AND SUGGESTIONS

6.1. Conclusions

The results of this study indicate that the growth of CO_2 emissions has a negative impact on revenues and vice versa. It means that CO_2 reduction tends to improve revenues through market share from domestic and abroad exportation, and by increasing sales from environmentally friendly conscious customers.

This study also shows that the growth of CO_2 emissions has a positive impact on costs. A decrease in its growth is followed by a reduction in costs. This result showed that the reduction of CO_2 emissions has the ability to lower costs. This is realized through their compliance with the ecological standard compared to their regulation in Indonesia. The compliance of the regulation provides fiscal incentives from the Indonesian Government and tends to minimize the risk level perceived by stakeholders, with easier access to loan and equity funding with a lower cost of capital.

Therefore, it is concluded that the reduction of CO_2 emissions to improve profits flows from the pathway of increasing revenues and reducing costs.

6.2. Suggestions

This study has implications for practices; therefore companies that need to make profits are required to consider their stakeholders. For example, those that need to meet a certain interest of the targeted countries, which require higher ecological standards, also need to reduce costs by complying with the regulation.

It is recommended for the government to assist those that are not able to reduce their CO_2 emissions through the introduction of the regulation that is able to encourage creativity and innovation. The government may apply punishment for companies that consuming more than 6000 TOE that are not able to reduce their CO_2 emissions. Companies, which produce CO_2 emission above the regulated standard, need to be punished by paying extra money for their extra produced emissions. In terms of investment, this research has not been able to prove the significant evidence that they need to invest in reducing costs. Therefore, further research needs to be conducted to use time-series panel data to capture the trend of the effect of investment on costs.

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APPENDIX CLASSICAL ASSUMPTION TEST

a. Residual normality test result

From Table 9, the Kolmogrov-Smirnov test statistic values indicate the Asymp value. Sig (2-tailed) are both above 0.05 which is 0.30322 for revenues and 0.917 for costs. So it can be concluded that the data is normally distributed

b. Multicollinearity test

From Tables 10 and 11, it can be concluded that there is no multicollinearity among independent variables for regression model 1 and model 2 because the tolerance value of each variable is >0.1 and the VIF value is smaller than 10.

c. Heteroscedasticity test

Tables 12 and 13 show that there was no heteroscedasticity for regression model 1 and model 2 because the significance value was more than 5%. Excepting industrial group in Model 2 was less than 0.05. This number should be no problem because this variable was a dummy variable.

Table 9: Normality test

	Unstandardized residual model 1	Unstandardized residual model 2
n	384	384
Normal parameters[a,b]		
Mean	0.0000000	0.0000000
Std. Deviation	0.03609134	0.02674384
Most extreme differences		
Absolute	0.028	0.043
Positive	0.028	0.035
Negative	–0.024	–0.043
Test statistic	1.44724	0.556
Asymp. Sig. (2-tailed)	0.30322	0.917

[a]Test distribution is normal, [b]Calculated from data

Table 10: Result of regression multicollinearity test model 1 Coefficients[a]

Model		Collinearity statistics	
		Tolerance	VIF
1	CO_2 emission growth	0.924	1.082
	Status of CO_2 emission reduction	0.931	1.074
	Ln (investment)	0.975	1.025
	Export level	0.957	1.045
	Industrial group	0.952	1.050

Source: Processed data. [a]Dependent variable: Revenues

Table 11: Result of regression multicollinearity test model 2 Coefficients[a]

Model		Collinearity statistics	
		Tolerance	VIF
1	CO_2 emission growth	0.924	1.082
	Status of CO_2 emission reduction	0.931	1.074
	Ln (investment)	0.975	1.025
	Export level	0.957	1.045
	Industrial group	0.952	1.050

Source: Processed data. [a]Dependent variable: Costs

Table 12: Result of regression heteroscedasticity test model 1

Model		Unstandardized coefficients[a]		Standardized coefficients[a]	t	Sig.
		B	Std. Error	Beta		
1	Constant	0.01879	0.00191		9.823	0.000
	CO_2 emission growth	–0.00825	0.01853	–0.02377	–0.445	0.656
	Status of CO_2 emissions	0.00159	0.00186	0.04557	0.857	0.392
	Ln (investment)	0.00009	0.00012	0.03961	0.763	0.446
	Export level	0.00001	0.00003	0.01153	0.220	0.826
	Industrial group	0.00018	0.00206	0.00460	0.088	0.930

Source: Processed data. [a]Dependent variable: AbsRes1

Table 13: Result of regression heteroscedasticity model test 2

Model		Unstandardized coefficients[a]		Standardized coefficients[a]	t	Sig.
		B	Std. Error	Beta		
1	Constant	0.02945	0.00235		12.523	0.000
	CO_2 emission growth	0.04272	0.02277	0.09968	1.876	0.061
	Status of CO_2 emissions	–0.00163	0.00228	–0.03788	–0.716	0.475
	Ln (investment)	0.00003	0.00015	0.01141	0.221	0.825
	Export level	–0.00001	0.00003	–0.02322	–0.445	0.657
	Industrial group	0.02945	0.00235		12.523	0.000

Source: Processed data. [a]Dependent variable: AbsRes2