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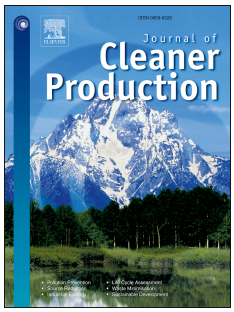

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Industry-Wide Corporate Fraud: The Truth behind the Volkswagen Scandal

Larry Li[a], Adela McMurray[a], Jinjun Xue[b], Zhu Liu[c] and Malick Sy[a]

a: RMIT University, Australia

b: Nagoya University, Japan, and Centre of Hubei Cooperative Innovation for Emissions Trading System, China

c: University of East Anglia, UK and Harvard University, United States

Abstract

Corporate fraud committed under climate mitigation pressures is becoming more frequently observed in line with the ever increasing environmental standards and relevant regulation enforcements. One example is the Volkswagen Emission Gate Scandal. Using firm-level panel data of major automobile manufacturers from 2000 to 2015, this study empirically identifies the motives behind the corporate deception scandal. We develop a conceptual model summarising the factors affecting decision-making, and the firms' **e**nvironmentally responsible investments (ERIs) including the truthfulness of related public communications. Our findings identify legal and regulatory pressures, the firm's existing level of ERIs competency and expertise, pressures from emission regulation, market competitors, consumers, owners, or shareholders as the key factors inducing the scandal. The empirical findings show that firms are more likely to experience corporate fraud if their senior managers are paid with substantial variable components that may lead them to engage in riskier business behaviour and to be more short-term focused, thereby supporting the well-established contract theory. To avoid corporate fraud and engage in legitimate business competitiveness, we suggest that firms should focus on technological innovation as well as improving corporate governance and leverage ratios to effectively control and monitor management. In addition, policy makers should be more realistic about practical and commercial limitations in the policy-setting process, and take on a more supporting role in achieving technological innovations and effective corporate governance. In summary, we argue that cleaner production is not only the result of technologically progress and research, but importantly it also involves issues associated with corporate governance and business ethics.

1. Introduction

The growing concern about the causes and consequences of climate change has impacted on business practices and consumption behaviours world-wide. To maintain long-term sustainable business developments, firms are motivated to invest heavily in research and development, in the effort to improve technological progress, and to minimize their energy consumption and greenhouse gas emissions. Consumers are more willing to buy, and pay a premium for, products whose values are anchored to environmental conservation (Gatersleben et al., 2002; Pickett-Baker and Ozaki, 2008). Thus the green marketing strategy has become a popular approach for firms in their commercial promotions. A green marketing strategy will inevitably lead to a significant positive impact on the firms' sales revenue, profitability and market performance. Consequently, firms are encouraged to conduct their business activities by engaging in cleaner production processes.

The literature shows that technological progress plays a critical role in cleaner production activities (Li and Xue, 2016; Cheng et al. 2017). However, the notion is challenged by the uncovering of corporate fraud in environmental statistics. In 2015, Volkswagen (VW) Auto Group was found to falsify the test records of selected air pollutants by up to 40% (Reuters, 2015). Other automobile manufacturers, including Mitsubishi Motors and Suzuki Motors are also involved in test scandals in which they were found to have manipulated fuel economy data in 2016 (CNBC, 2016). This resulted in worldwide investigations of corporate fraud specifically addressing environmental data within the automotive manufacturing industry.

The originality of this study lies in its investigation of the integrity of the automobile industry in relation to environmental standards, which to date has not been investigated. This study identifies several important and under-researched issues correlated to factors affecting the decision-making, and the firms' environmentally responsible investments (ERIs) in the automobile industry. We review a series of determining factors that affect the decision-making relating to ERIs among automobile makers. Then we extend our investigation to major car makers by empirically identifying the motives behind their deception. The US automobile market, being one of the largest reputable and mature automobile markets, is selected for our study. The research questions underpinning this study are:

- What are the key factors that affect the environmental investment decision of automobile manufacturers?
- What are the factors that underpin a deception scandal in the automobile industry?

- What are the factors that can prevent environmental related corporate deception?

Understanding these questions is important as the climate risk is an increasing concern for everyone on this planet because the effect of climate change could be irreversible and costly (Li and Xue, 2016). Consequently, many countries have introduced a series of environmental policies to transfer the current economic development model to a low carbon economic model with desirable economic growth. In theory, the business sector has no choice but to comply with the environment policies. Realistically, a business corporation needs to balance the potential cost and benefits associated with the compliance to environment policies. However, the literature in this area is scarce thus our study addresses this oversight by developing a conceptual model identifying the factors affecting the investment decision of automobile manufacturers.

Climate change research is classified into two categories: the causes and solutions of climate warming, and the effect of environmental policies on corporate performance. In recent years, climate change has attracted researchers' attention from multiple disciplines which produces a significant amount of research outputs. For example, climate change studies can be found in Economics (Kwon, 2005; Lise, 2006; Andreoni and Galmarini, 2012; Meng et al. 2013; Zhang and Tang, 2015), Finance (Daskalakis et al. 2009; Jong et al. 2014; Oestreich and Tsiakas, 2015, Griffin et al. 2015), Science (Allen et al., 2009; Meinshausen et al., 2009; McGlade and Ekins, 2015) and the Management literature (Dowell et al. 2000; Hull and Rothenberg, 2008). Empirical studies employ different methodologies, use a wide variety of samples spanning over a number of time periods. They ask different questions directly and indirectly examining the causes of climate risk, and how climate risk affects the economic and financial performance at country, region, industry and firm level (Li and Xue, 2016). However, the empirical findings of previous studies are inconsistent due to methodological issues associated with varying definitions, the choice of variables and their measurement.

In addition, many studies assume that the corporate sector should actively deal with climate risk and comply with the environment policies and regulations in an honest and truthful way. Unfortunately, it is observed that firms, such as the Volkswagen (VW) group, are strongly motivated to present themselves, or their products, to be more environmental friendly, even if they are not as good as they claim. It is precisely this aspect, which is largely overlooked in the literature. Thus this study empirically investigates the factors that underpin the deception in the automobile industry scandals. Understanding this is important to both regulators and

investors as corporate performance is directly related to investors' interest and the long term economic prosperity of the society in a boarder perspective.

The empirical findings show that corporate fraud is positively related to the variable component of the senior managers' remuneration package, implying that performance based payment design could make managers more short term focused which might deteriorate the long term performance of firms. In addition, the empirical evidence shows that firms with a high corporate governance score and leverage ratio are negatively related to corporate fraud, suggesting that a good corporate governance system and the existence of external creditors do have monitoring power on a managers' behaviour. We find that environmental expenditure is negatively associated with environmental related corporate deception, supporting the notion that technological progress plays a critical roles in carbon emission reduction (Zhang et al. 2014; Liu et al. 2015; Li and Xue, 2016).

To attain long term sustainable communities requires changing current business production modes and consumption behaviours. Consequently, the cleaner production literature mainly focuses on sustainable business models (Bocken et al. 2014), technical progress (Fallde and Eklund, 2015; Cheng et al. 2017), sustainable consumption (Liu et al. 2016; Shao et al. 2017), corporate social responsibility (Barnett and Salomon, 2006; Ghoul et al. 2011; Wang and Sarkis, 2017), and sustainable products and services (Chou et al. 2015; Dyllick and Rost, 2017; Hallstedt and Isaksson, 2017). Based on our study's findings, we assert that corporate governance and business ethicality greatly influence a company's operational decision and play important roles in achieving cleaner production targets. This view is overlooked in the literature. As Volkswagen Chairman Hans-Dieter Pötsch confessed on December 10, 2015 " A group of the company's engineers decided to cheat on emissions tests in 2005 because they couldn't find a technical solution within the company's "time frame and budget" to build diesel engines that would meet U.S. emissions standards". When the engineers did find a solution, he stated, "they chose to keep on cheating, rather than employ it" (Goodman, 2015). Therefore, we argue that policy makers need to re-examine the climate policies to ensure that they are achievable in terms of technological progress, financial budgeting and timing. Furthermore, the accountability, transparency and responsibility in current corporate governance systems need to be further improved.

This study contributes to the literature in four ways. First, a conceptual model is developed that identifies the factors affecting the firms' ERIs decision and the success of the ERIs. The

conceptual model shows that legal and regulatory pressures, the firm's existing level of expertise and competency in ERIs, pressure from competitors, consumers, and owners /shareholders respectively are five key factors determining the a firm's appetite for ERIs. While the success of the ERIs will be heavily influenced by the investment size , marketing timing, technological capacity, managers' ethicality, as well as management's appetite for ERIs. Second, we empirically investigate the fundamental reasons affecting corporate deception in the automobile industry from the corporate governance perspective. The empirical findings show that corporate governance quality and the senior manager's remuneration structure have significant explanatory power on corporate deception. Third, although the cleaner production concept is well established in the literature, the effect of corporate governance and business ethicality on cleaner production has been overlooked. The empirical findings of this study assert that the importance of corporate governance and business ethicality should be taken into consideration and emphasized in the cleaner production process. Fourth and finally, we suggest that policy makers should assist firms in relaxing climate policy pressures by supporting their technological innovation as well as improving corporate governance quality so as to effectively control and monitor management behaviour.

This remainder of the paper is organised as follows. Section II discusses the conceptual model affecting the ERIs decision and the succession of ERIs. Then Section III reports the data and methodology. Section IV presents our empirical results and Section V draws conclusions and areas for future research.

2. Developing an Environmentally Responsible Investments Model

One of the major causes of global warming is rapid economic growth, leading to dramatic increases in energy consumption (Li and Xue, 2016). Fortunately, countries around the world are united in sharing and expressing their deep concern on this issue, including the major greenhouse gas emitters, such as the European Union, China and the US. Due to differences in economic circumstances, the approaches to, and the formulation of environmental policies vary greatly from country to country. Regardless of the differences across the borders, businesses will need to present themselves as being more environmentally friendly, even though it may not always be the case.

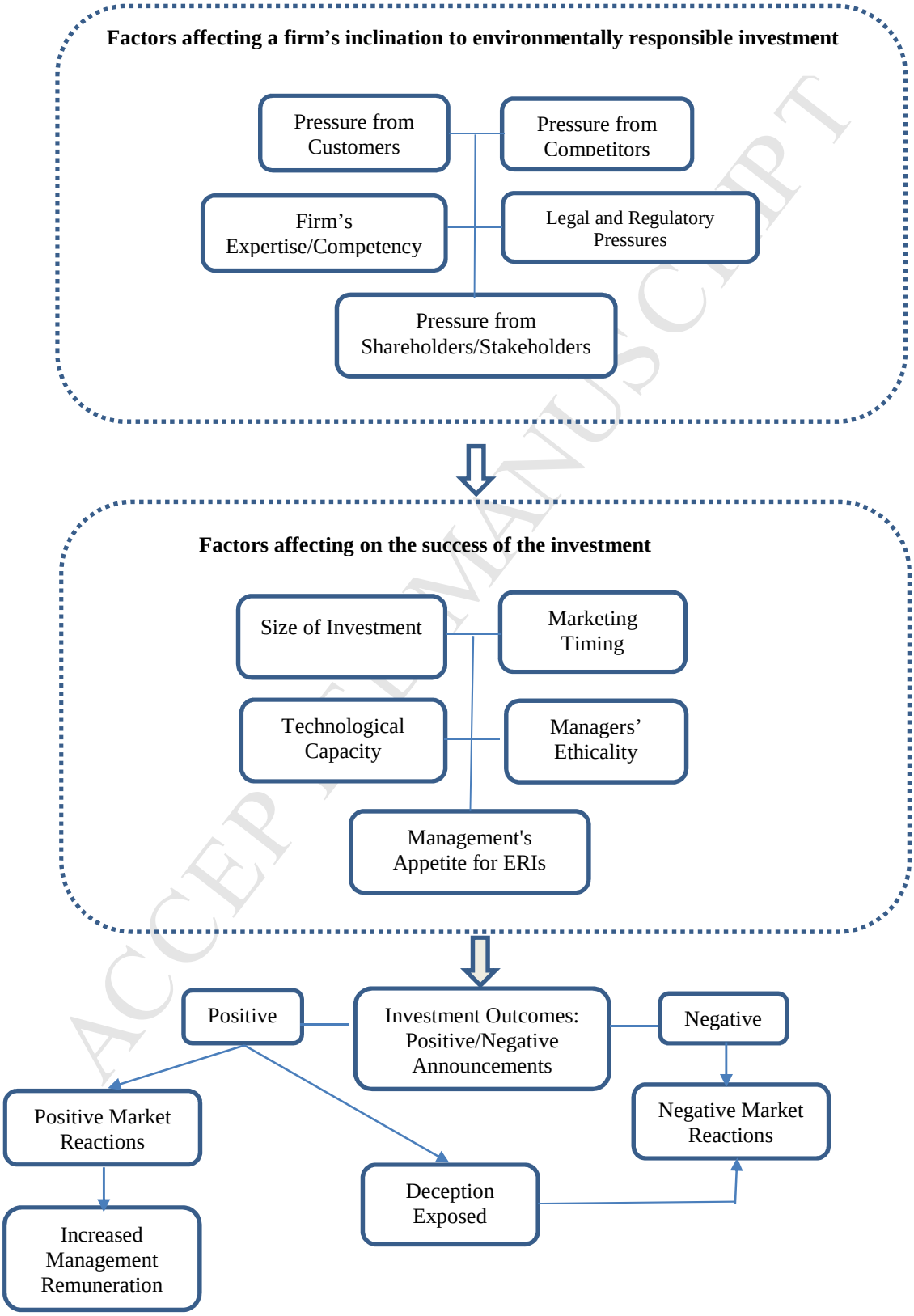
In this study, we present a theoretical model (presented in Figure 1) that summarises the contributing factors impacting on the decision-making of firms' ERIs, the success of firms'

ERIs, the subsequent public announcements relating to the outcome of these projects, and the response to such public communications. We identify the following five key factors that can affect a firm's appetite for ERIs: legal and regulatory pressures, the firm's existing level of expertise and competency in ERIs, pressure from competitors in the market, pressure from consumers, and pressure from owners /shareholders. This model focuses on factors affecting the decision-making and success of ERIs or research, and the communication approaches and results chosen by firms.

The business environment varies depending on the legal and regulatory environment in which a firm operates. In stricter regulatory environments, such as the case in developed countries, there is greater regulatory pressure for a firm to be more environmentally compliant. For example, the automobile industry is heavily regulated in relation to safety features, carbon emissions and fuel economy standards, which forces car makers to find a balance among road performance, fuel consumption and carbon emissions. Zhang et al. (2014) and Liu et al. (2015) conclude that technological progress is the key factor of improving environmental performance as well as carbon emission reduction. Thus, any technological breakthrough is associated with significant economic competitive advantage. Along these lines, greater competency and expertise in environmental technologies will help firms further extend their competitive advantage. At the same time, external pressures such as markets and government regulations force firms to aggressively invest in higher-energy-use technology or projects, even if they have no experience or knowledge in the area. The activities of competitors present another form of pressure swaying a firm's strategic direction. If a firm's main competitors become active in ERIs, the firm will have no choice but to follow suit. A current example of this phenomenon in the global automobile industry is the competition in developing luxury electric cars. Following Tesla's success with Model S sedan, BMW and Mercedes are now in a race to release electric car models (Behrmann and Rauwald, 2016).

Customers' preferences are influential on a firm's commercial activities and its strategic decision-making. Consumers are increasingly paying attention to products with environmental conservation tags, due to the growing concern about climate change. Shareholders' views too can weigh heavily on a firm's decision-making. If shareholders strongly favour ERIs, management is tasked to oblige, and to put in place plans to achieve that vision. Along with factors that affect a firm's appetite for ERIs noted above, other

Figure 1: Factors affecting a firm's environmentally responsible investment decisions and their success



helping to solidify the integration of environmental performance targets into a firm's operations (Rodrigue et al. 2013). Once a firm has made its investment decision, the success of the project largely depends on five key factors: market timing, the size of the investment, management's appetite for ERIs, the firm's technological capabilities, and management's level of ethicality. Market timing is critical in shaping the success of commercial endeavours. An ERI is more likely to succeed when the relevant products are available at the right time, in the right place, and supplied to the right customers. The size of investments plays a role in the outcome of any commercial endeavour. A limited budget for investment is a common constraint, hindering a firm's ability to conduct research and develop potential opportunities. Corporate social responsibility (CSR) strategies may generate value in the long run, by lowering a firm's capital constraints through improving transparency, tightening internal control and reducing information asymmetry (Cheng et al. 2014).

An increasing number of firm managers seek to create value for shareholders by being more eco-efficient (Figge and Hahn, 2013). Competition from peers motivates managers to focus on CSR, in fulfilling the desire to be industry leaders with respect to environmental efforts and CSR performance (Rodrigue et al. 2013). However, the technological capabilities of a firm are inevitably limited and predetermined, putting a ceiling on what a firm can achieve through its ERIs. Further investments may boost a firm's capabilities, though this is not guaranteed. Given the recent discovery of emissions scandals across the automobile industry, it would appear that many firms have already reached their technological capacity, but have continued to release positive public announcements based on false information. The discovery of the release of false information exposes the weak corporate governance mechanism and low level of business ethicality in these firms.

The management team's level of ethicality impacts investment outcomes (Parker, 2014). For instance, managers in an ethical management team would be intrinsically motivated to achieve meaningful results from ERIs. On the other hand, if a firm's culture encourages employees to cut corners or "look the other way", there will be a higher likelihood of hidden underlying issues even if there are apparent successes on the surface. Irrespective of the outcomes of ERIs, managers prefer to release positive news to the public and omit the undesirable news. Even worse, some firms manipulate the data to appear positive, and the motivations for data manipulation are primarily driven by either pushing up stock prices or obtaining extra performance bonuses (Wahlen et al. 2011). At the time of writing, in addition

to Volkswagen, Mitsubishi, Suzuki and Nissan have been implicated in scandals involving fuel efficiency testing irregularities.

A negative market reaction is dreaded by all and can itself serve as a deterrent. Once a firm is caught feeding the market false information, the market will question all the information that firm has provided, and any information it may not have provided in order to hide other potential problems in the business. As a result, share prices plummet, at least in the short term. Business associates may distance themselves from future negotiations and collaborations. Banks will start providing less favourable financing terms, and owners /shareholders will demand change and remedial action plans. These reactions add to the pressure from the market and shareholders for better investments and better results from subsequent management decisions. In turn, management will need to be more effective and successful in its future endeavors, thus completing the flow in Figure 1.

3. Data and Method

The sample used in this study consisted of 15 major global automobile makers for the period 2000–2015, and includes 240 firm-year observations. These 15 automobile makers are all publicly listed companies in United States. The list of 15 automobile makers can be observed in Appendix 1. These are the firms that have the required data from Thomson Reuters ASSET4 (for CSR score), DataStream (for firm specific information) and annual report (for execution compensation information and ownership structure) respectively. The Thomson Reuters ASSET4 is a Swiss-based company which specializes in offering a company's environmental, social and governance performance scores. All these data are collected by specially trained research analysts for each firm which can be used for quantitative analysis and the score can be ranged from 0 to 100. The detailed variable definition and measurement can be obtained in Appendix 2.

Table 1 presents the basic summary statistics. The average CGS is 31.302. However, it varies greatly across the sample firms, implying that these firms have a range of views and approaches towards environmental and corporate governance regulations, even though they all operate in the same industry. The percentage of a company's environmental expenses to total sales (EES) also varies greatly across the sample, ranging from 0% to 21.098%, further confirming that the appetite for environmental research and investment varies significantly

across companies. The overall long-term LEV is 19.68% which is maintained at a very healthy level. The average is the variable component of directors' remuneration package (VCR) ratio of our sample firms is 30.299%, ranging from 0% to 84.033%. This suggests that the structure of compensation packages varies greatly across the companies, which may have a significant impact on their operating strategies in relation to environmental research and investment. On average, sample firms have a bank ownership of 6.681%, ranging from 0% to 62.71%. As for the ownership controlled by insurance company and mutual funds, the sample firms have an average value of 1.680% and 1.818% respectively. In addition, on average the top 5 shareholders jointly control 47.633% of total outstanding shares.

Table 1 Summary statistics for sample firms

Variables	Mean	Std. deviation	Min	Max
Scandal	0.2	0.4	0	1
CGS	31.302	28.294	2.12	93.51
LEV (%)	19.68	8.953	1.488	45.928
ROE (%)	7.448	36.833	-252.84	281.62
VCR (%)	30.299	29.017	0	84.033
EES (%)	1.119	1.652	0.000	14.347
Bank(%)	6.681	10.258	0	62.71
Insurance(%)	1.680	4.963	0	35.62
Mutual Fund(%)	1.818	3.712	0	16.76
Top 5 shareholding(%)	47.633	23.076	0	100

Notes: Scandal: dummy variable representing whether a sample company is involved in a deception scandal, 1 = yes, 0 = no; CGS: corporate, social and responsibility score; LEV: long-term leverage ratio; ROE: return on equity; VCR: variable component of directors' remuneration package, measured by the percentage of variable component divided by the total remuneration package; EES: percentage of company's environmental expenses to total sales. Bank: percentage of equity controlled by banks. Insurance: percentage of equity controlled by insurance companies. Mutual Fund: percentage of equity controlled by mutual funds. Top 5 shareholding: percentage of equity controlled by top 5 shareholders.

We ran a firm-level probit regression with a scandal dummy variable as the dependent variable and firm-specific factors as explanatory variables for each sample firm in our data set, as follows:

$$\Pr(Scandal=1 \mid x)=e^{(x^{'}\beta)}/(1+e^{(x^{'}\beta)})=\Lambda(x^{'}\beta)$$

$$\text{Where } x'\beta=\{\beta_0+\beta_1 CGS_{it}+\beta_2 LEV_{it}+\beta_3 VCR_{it}+\beta_4 EES_{it}\} \quad (1)$$

Our basic empirical model in Equation (1) is a panel data regression. It is expected that firms with a high CGS, high LEV and higher EES are less likely to be associated with a deception scandal. In contrast, we expect that firms will be more likely to release misleading information to the public if their executives receive a significant proportion of variable compensation.

4. Empirical Findings

Our empirical analyses involved t-tests of mean difference, and a probit regression. The univariate test was conducted to test the significance of differences between firms who are facing a scandal and those who are not. Table 2 shows that firms experiencing scandals have significantly higher VCR, lower LEV and lower CGS.

Table 2: Univariate test of key independent variables

Variable	Mean (scandal firms)	Mean (non-scandal firms)	T-test value
CGS	11.691	37.089	-5.095
LEV	12.584	21.551	-6.7827
VCR	38.56	28.13	1.866

The regression results of model (1) are presented in Table 3. In Table 3, we found that VCR is positively related to the scandal dummy, which is statistically significant across all models except model 5. This finding suggests that firms are more likely to be associated with scandals when executive remuneration is closely related to firm performance. Chhaochharia and Grinstein (2009) and Conyon (2014) argue that the variable component of executive compensation package, such as bonus and stock options, is basically performance related. Cable and Vermeulen (2016) argue that performance-based pay can hurt companies in the long term because variable components of payment are more focused on the firm's current and short-term performance. Large bonuses and stock option plans change the behavior of many senior managers in that they become driven to focus on short-term gains and to take more risks, confirming that in many cases much higher reward levels have a detrimental effect on performance including creativity (Ariely et al. 2009). Of course, the duties of senior managers rarely involve routine tasks, and managers must be innovative and creative. Indeed, they must make hard decisions based on careful consideration of the directions and challenges facing their firm, in the context of a highly volatile business environment. Yet this type of job is particularly unsuited to substantial variable pay (Cable and Vermeulen, 2016).

Table 3: Regression results

	Expected sign	Models				
		1	**2**	**3**	**4**	**5**
C		2.186***	2.41***	1.048***	2.419**	2.277**
		(2.52)	(3.11)	(4.81)	(3.08)	(2.14)
		[0.868]	[0.772]	[1.084]	[0.786]	[1.177]
CGS	(-)	-0.083**				
		(-1.97)				
		[0.0421]				
Bank			-0.068**			
			(-2.04)			
			[0.033]			
Insurance				-0.168		
				(-1.63)		
				[0.103]		
Mutual funds					0.370	
					(0.78)	
					[0.473]	
Top 5 shareholding						0.007
						(0.58)
						[0.012]
LEV	(-)	-0.108**	-0.158***	-0.243***	-0.172***	-0.153***
		(-2.06)	(-3.14)	(-3.35)	(-3.41)	(-3.20)
		[0.052]	[0.050]	[0.072]	[0.050]	[0.047]
VCR	(+)	0.047***	0.311**	0.038**	0.023*	0.019
		(2.62)	(2.23)	(2.04)	(1.94)	(1.50)
		[0.018]	[0.014]	[0.018]	[0.012]	[0.012]
EES	(-)	-0.895*	-0.01	-0.001***	-0.007*	-0.001
		(-1.94)	(-1.53)	(-2.50)	(-1.81)	(-1.62)
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Pseudo R^2		0.4945	0.4852	0.5974	0.4484	0.3692

Note: t-statistics are given in parentheses. Standard errors are given in square brackets. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

In contrast, environmental research and investment are more focused on the long term, and rarely create competitive advantage or promote firm performance in the short term. Therefore, when variable pay is substantial, managers are not highly motivated to support environmental research or environmentally friendly projects. For example, VW's bonus system is unusually generous, and it impacts all employees, from the assembly line up to the executive management team. The more senior the position, the more bonus there is available as part of one's remuneration package. And the bonus system at VW rewards consensus. Bonuses are rewarded at three levels: the individual bonus, the company performance bonus, and a reward

for team performance. Because a substantial proportion of bonuses are tied to people around each employee, there is financial incentive for individuals not to criticise the company's wrongdoing. We believe that the heart of the deception issue at VW is linked to the executive compensation scheme, and this is why none of the firm's employees have dared to speak up.

In addition, people are more likely to engage in misconduct or dishonest behavior when a large proportion of their pay is based on variable financial incentives, because they must balance their personal financial benefits with the company's needs. This will lead senior managers to make unethical decisions – in academic terms, "extrinsic motivation causes people to distort the truth regarding goal attainment" (Cable and Vermeulen 2016). Many studies (Harris and Bromiley, 2007; Peng and Roell, 2008) have shown that a performance-related payment system significantly increases the likelihood of earnings manipulations, shareholder lawsuits and product safety problems. Wowak et al. (2015) argue that option-based compensation is implemented to align the interests of executives and shareholders. However, this performance payment design could lead to undesirable outcomes. These authors find that firms with CEOs on option-based compensation are more likely to have product safety issues.

Our results show that, as expected, CGS and LEV are negatively associated with the scandal dummy, and are statistically significant across all the models. The literature shows that a good corporate governance system can not only protect shareholder investment, but also motivate professional managers or entrepreneurs to maximize the wealth of investors. Furthermore, it can provide investors with sufficient incentive and power to monitor and control management in order to achieve profit maximization (Shleifer and Vishny, 1997; La Porta et al., 2000; Bebchuk and Weisback, 2010). Therefore, firms with a high CGS are more likely to effectively control and monitor their managers, and thereby better avoid corporate fraud.

Besides shareholders, creditors also have the power to monitor companies' operational behavior (Shleifer and Vishny, 1997). In this regard, it is not surprising that banks are highly involved in and exercise a significant degree of influence and control over companies with which they are associated, even if they do not hold share ownership in the company. For example, Pinkowitz and Williamson (2001) report that the cash balance of Japanese firms is affected by the monopoly power of banks in Japan, and is gradually reduced when the role of banks is weakened. Furthermore, bank-influenced firms have a better chance of obtaining

external capital. Therefore, it is believed that firms tend to behave more reasonably when they have fewer creditors (Agarwal and Elston, 2001). Thus, it is understandable that firms will be less likely to be associated with scandal or corporate fraud when their LEV is relatively high. As expected, a negative relationship between EES and the scandal dummy is observed, for which the explanation appears straightforward: the more environmental research or projects a firm invests in, the lower will be the likelihood of that firm being involved in an environmental scandal, supporting the notion that technology improvement is the most important component to environmental performance (Zhang et al. 2012). Similar conclusions are drawn by Qi et al. (2016).

Besides the CGS obtained directly from the database, we also use ownership controlled by banks, insurance companies, mutual funds and ownership concentration ratio (ownership percentage held by the top 5 shareholders) to capture the monitoring power of shareholders. The literature shows that block holders and concentrated ownership can monitor management effectively to protect shareholders' interests (Shleifer and Vishny, 1997). The regression results in Table 3 (Models 2–5) show that only bank ownership exerts a significant and negative influence on the scandal dummy variable, implying that firms are less likely to commit misconduct or dishonest behaviour when one or several banks control a significant proportion of the firm's ownership.

4.1 Robustness Tests

We employed alternative ownership variables to examine the robustness of the results presented in Table 4. The three new ownership employed variables are: 1) bank ownership to top 5 shareholdings if banks are on the list of top 5 shareholders, 2) insurance company ownership to top 5 shareholdings if insurance companies are on the list of top 5 shareholders, and 3) mutual fund ownership to top 5 shareholding if mutual funds are on the list of top 5 shareholders. As presented in Table 4, banks to top five shareholdings and insurance company to top 5 shareholdings are negatively related to the dependent variable. Conversely, mutual funds do not exert a significant influence on the sample firms' behaviour due to the relatively limited size of the investment.

Table 4 Robustness tests

	Expected sign	Models		
		1	**2**	**3**
C		2.385***	4.054***	2.422***
		(3.71)	(3.76)	(3.07)
		[0.751]	[1.079]	[0.787]
Bank_to top 5 shareholdings		-0.0312**		
		(-2.03)		
		[0.015]		
Insurance_to top 5 shareholdings			-0.11**	
			(-2.48)	
			[0.044]	
Mutual funds to top 5 shareholdings				0.242
				(1.16)
				[0.208]
LEV	(-)	-0.152***	-0.243***	-0.172***
		(-3.28)	(-3.34)	(-3.40)
		[0.046]	[0.072]	[0.051]
VCR	(+)	0.026**	0.036**	0.024**
		(2.11)	(2.00)	(1.97)
		[0.012]	[0.018]	[0.012]
EES	(-)	-0.001*	-0.01**	-0.007*
		(-1.28)	(-2.33)	(-1.88)
		[0.000]	[0.000]	[0.000]
Pseudo R^2		0.4589	0.5763	0.4479

Note: t-statistics are given in parentheses. Standard errors are given in square brackets. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

4.2 Marginal Effects

Marginal effects tests are conducted to further measure how a change in the independent variable is related to the dependent variable. Again, the empirical results of the test confirm that CGS, LEV, VCR and EES do have a significant impact on whether a particular firm is more or less likely to be associated with a scandal related to environmental standards.

A one unit increase in CGS will produce a 1.5% decrease in the probability of scandal involvement for the sample firms. Similarly, a 1% increase in the long-term LEV will generate a 2% decrease in the probability of involvement in an environmental scandal for the sample firms, while a 1% increase in the EES ratio will generate a 16.31% decrease in the

probability of such involvement. In contrast, a 1% increase in the VCR ratio will generate a 0.8% increase in the probability of involvement in an environmental scandal among these firms. Based on the empirical findings, it is fair to say that the management teams of the sample firms seek to find a balance between honesty and dishonesty. Figure 2 shows that the decisions made by the management teams eventually depend on whether they can run the business according to certain corporate governance and ethical standards (CGS, LEV and EES) or they put their personal interest ahead of such concerns (VCR). In other words, these decisions revolve around whether the financial incentive for senior managers is strong enough to persuade them to distort the truth. Based on the coefficients, we can safely conclude that the effective approach to preventing environmental scandals in the future would be to invest aggressively in environmental research or ERIs, which is consistent with the international literature (Meng et al., 2013; Liu et al., 2015; Li and Xue, 2016).

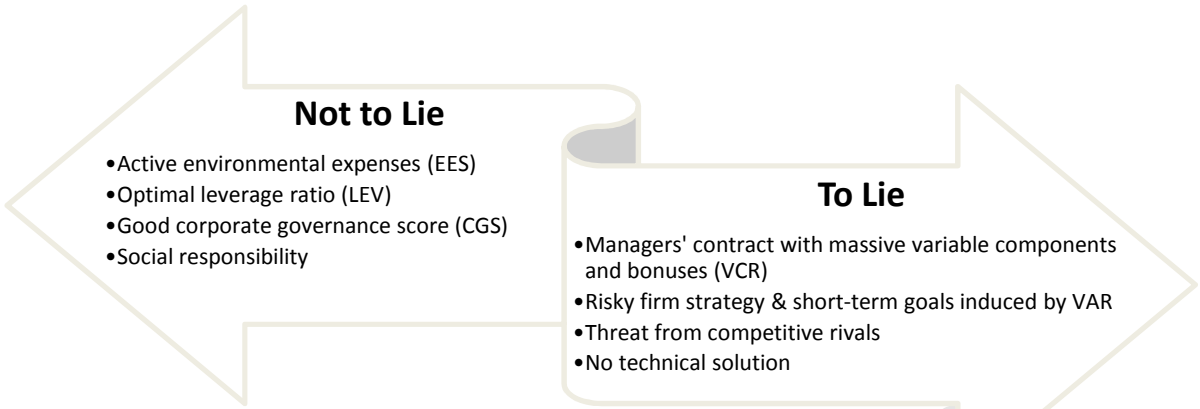
Table 5 Marginal effects results

	Models			
	1	**2**	**3**	**4**
CGS	-0.015**			
	(-2.37)			
Bank_to top 5 shareholdings		-0.0062**		
		(-2.42)		
Insurance_to top 5 shareholdings			-0.017***	
			(-3.31)	
Mutual funds to Top 5 shareholdings				0.05
				(1.21)
LEV	-0.02**	-0.03***	-0.04***	-0.03***
	(-2.54)	(-5.60)	(-6.62)	(-6.23)
VCR	0.008***	0.005***	0.006**	0.005**
	(3.97)	(2.63)	(2.47)	(2.32)
EES	-0.163**	-0.0001	-0.0001**	-0.0001**
	(-2.30)	(-1.31)	(-2.79)	(-2.10)

Note: Z-statistics are given in parentheses.

To return to the VW scandal, this deception lasted for more than 10 years, and not one VW employee publicly questioned the firm's cheating behavior over that time. It is hard to believe that this "mistake" was entirely the fault of a group of engineers, and that the senior managers and other employees knew nothing about it. We argue that all VW employees – senior managers, in particular – chose to keep these deceptions secret from the public because of the pecuniary benefits of doing so.

Figure 2: To Lie or not to Lie



5. Conclusion

This study provides a theoretical model of the many relevant factors that can have an impact on the dynamics of a firm's ERIs decision-making, and answered the following research questions addressing: 'What are the factors that can impact on the ERI decisions?', 'What are the factors that cultivate a deception scandal in the automobile industry?', and 'How can firms prevent environmental related corporate frauds in the future?'.

Through the conceptual model, we have identified five key factors that significantly impact on a firm's appetite for ERIs:

(1) legal and regulatory pressure;
(2) the firm's existing level of expertise and competency in ERIs;
(3) pressure from competitors in the market;
(4) pressure from consumers;
(5) pressure from owners /shareholders.

We conclude that in terms of public communications, firms may choose to truthfully report their ERIs outcome to the public, or to deliberately hide undesirable news, even to manipulate data to falsely present positive ERIs results. To avoid corporate fraud and have a fair play in business competitiveness, we argue that in order to achieve a more environmentally responsible production process, we need more than technological progress and research, but also improved corporate governance and business ethics. Consequently, the setting and the implementation of environmental policies needs to be further considered and reformed. It is expected that technological progress will continue to play a critical role in achieving cleaner

industrial production. In additional, business corporations are required to greatly improve the accountability and transparency of their internal corporate governance mechanisms. Furthermore, leadership is identified as a key driver of governance, change and innovation, and it is imperative to accommodate for the workers who are involved in the production process.

Furthermore, we note that this is the first study to empirically investigate the factors underpinning the exposed deception scandals in the automobile industry over the past decade. Our empirical analysis is based on the ERIs model and the firm-level panel data of major automobile manufacturers from 2000 to 2015. The study findings provide new insights into how firms handle the ever-growing environmental pressure in their business operations. Our results indicate that the remuneration structure of the sample firms – for senior managers, in particular – do have a significant impact on these firms' decisions to deceive. This relationship in turn influences the design of remuneration packages, including key performance indicators, organizational design and governance. Conversely, corporate governance, the leverage ratio and investment in environmental research have a significantly negative relationship with the likelihood of involvements in a scandal. Future studies may consider testing the model and its elements in the settings of other large manufacturing industries, as well as various service sectors. Whilst the model has integrity in the US market, it would be worthwhile testing it in other countries.

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Appendix 1: List of the 15 Automobile Makers

Number	Name
1	Bayerische Motoren Werke (BMW) Auto Group
2	Daimler-Benz Auto Group
3	Fiat Automobiles
4	Ford Motor Company
5	General Motors Company
6	Honda Motor Company
7	Hyundai Motor Company
8	Kia Motor Corporation
9	Mazda Motor Corporation
10	Mitsubishi Motors corporation
11	Nissan Motor Company Ltd
12	Groupe Renault
13	Suzuki Motor Corporation
14	Toyota Motor Corporation
15	Volkswagen Auto Group

Appendix 2: Variables Description

Variables	Definition	Sources
Scandal	dummy variable representing whether a sample company is involved in a deception scandal, 1 = yes, 0 = no	Media (Reuters, CNBC)
CGS	A sample firm's corporate, social and responsibility score.	Thomson Reuters ASSET4.
LEV (%)	Long term leverage ratio, measured by the percentage of long term liability divided by the total assets	DataStream
ROE (%)	Return on equity, measured by the percentage of net income divided by the total shareholders' equity	DataStream
VCR (%)	Variable component of directors' remuneration package, measured by the percentage of variable component to the total remuneration package	DataStream
EES (%)	A company's innovation score, measured by the percentage of company's environmental expenses to total sales.	DataStream
Bank	Bank ownership variable, measured by the fraction of equity controlled by banks	Annual Report
Insurance	Insurance company ownership variable, measured by the fraction of equity controlled by insurance companies	Annual Report
Mutual Fund	Mutual fund ownership variable, measured by the fraction of equity controlled by mutual funds	Annual Report
Top 5 shareholding	Ownership concentration variable, measured by the fraction of equity controlled by the top 5	Annual Report

	shareholders	
Bank to Top 5 shareholdings	bank ownership to top 5 shareholdings if banks are on the list of top 5 shareholders	Annual Report
Insurance to top 5 shareholdings	insurance company ownership to top 5 shareholdings if insurance companies are on the list of top 5 shareholders	Annual Report
Mutual Fund to Top 5 shareholdings	mutual fund ownership to top 5 shareholding if mutual funds are on the list of of top 5 shareholders	Annual Report

Highlights:

- Using firm-level panel data of major automobile manufacturers from 2000 to 2015, this paper studies the Volkswagen emissions scandal and explore why firms lie on emission report.
- We first time provide a theoretical model to analysis the factors affecting firms' environmental responsible investments (ERIs) decision-making and corporate governance.
- We find that legal and regulatory pressures, the firm's existing level of expertise and competency in ERIs, pressure from competitors in the market, pressure from consumers, and pressure from owners /shareholders are five key factors have an impact on a firm's appetite for ERIs.
- We argue that cleaner production is not only the result of technologically progress and research, but also an issue of corporate governance and business ethics factors.
- We suggest avoid the fraud and raise firms' competitiveness by promoting technology progress, improving corporate governance and ensuring business ethicality. We also suggest the governments reform environmental policies to reduce pressures from the ever-growing environmental pressure in their business operations.