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Stock Market Reactions to Auto Manufacturers' Environmental Failures

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Abstract

The automotive sector must meet strict regulations to increase mobility while reducing emissions to demonstrate environmental stewardship. Trust in the promise of a sustainable *Fahrvergnügen* was broken with recent scandals like Dieselgate denting the confidence of regulators and consumers. Overpromising on sustainable innovative technology resulted in unethical behaviour, deceit, and failure to meet promised standards. We consider to what extent societal disapproval was evident in the stock market reaction to these events.

We sampled 41 announcements (1984 to 2016) and observed a mean stock market reaction of -1.01%. There was no difference in the stock reaction in firms failing governmental vs. voluntary standards and more negative reactions for events following Dieselgate or when compensation was offered. The severity of the reaction to unethical misuse of environmental credentials should encourage maintaining promised environmental performances as a macromarketing strategy.

Keywords: *sustainable marketing, corporate citizenship, environment, environmental fraud, corporate scandal*

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Introduction

Firms are increasingly focusing on the environmental credentials of the products that they produce and sell. Using eco-labels and assurances of environmental standards supports greater margins and the improvement of their business. The use of eco-labels has long been a topic of interest, with research focused on whether eco-labels increase demand for products (Sammer and Wüstenhagen 2006; Testa et al. 2015), whether they generate price premiums (Blomquist, Bartolino, and Waldo 2015; Carlson and Palmer 2016), and their connection to sustainable supply chain management (Darnall, Jolley, and Handfield 2008; Iles 2007). Such labels are “the result of a long interplay between consumers, markets, and public policy” (Kolodinsky 2012, p. 203), representing the interest of many societal groups in the transfer of information to consumers.

Competing pressures mean that reaching the environmental standards that are set for products is not always a simple matter. As an example, consider the increasing requirements in the automotive sector; driven by public interest, many firms have struggled to balance market pricing with technological innovation. The increasing and stringent international environmental limits should have raised early concerns that there was no technological approach available that could feasibly and simultaneously balance regulatory compliance requirements against improved customer expectations (Beene 2015; Smith and Parloff 2016).

Volkswagen (VW) used illegal means to hide the fact that their vehicles did not meet emission levels required by the Clean Air Act; this September 2015 event has been dubbed “Dieselgate” (Nunes and Park 2016). Emissions were 40 times over the allowed EU-limits under non-lab environments, demonstrating the convergence of a failure of governmental regulations, the technological challenge of industry developments to meet standards, and expectations of consumers (Smith and Parloff 2016). There are some arguments that the limits to technology means that meeting the standard is infeasible. However, a test conducted by the

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International Council on Clean Transportation showed that the technology is available and in use in vehicles produced by a VW-competitor (ICCT 2015). For VW's vehicles, the discrepancy between real-time performance and the mandated standard was significant, and the firm opted for an institutional decision to deceive until it was exposed by the EPA (US EPA 2016a). The failure of VW to reach such standards, whether mandated by regulators or voluntarily adopted for promotional or competitive purposes, represents an interesting ethical problem where misleading marketing practices were employed that had an immediate benefit to the firm but a long-term detriment to the environment and society. How should marketers respond to these increasing demands for environmental products and what are the implications of getting it wrong?

For a single firm engaged in deceptive or misleading marketing behaviours, there can be clear consequences. Regulatory requirements may be changed or updated, or there may be penalties levied. The effect of regulatory changes on firms and the study of such consequences for firms are a micromarketing study. In the automotive sector, such consequences may be relatively moderate or light for the firm, leading many firms to breach requirements repeatedly as the immediate cost of doing so may be light while they can ignore the environmental and social costs. For example, it has been recognised that when fuel economy standards (e.g., Corporate Average Fuel Economy (CAFE) standards) become too stringent, automakers willingly violate standards and pass the penalty costs to consumers (Shiau, Michalek, and Hendrickson 2009). Regulation, through the levying of penalties, is a mechanism to provide a voice to other groups in society that are not a party to the transaction (Mittelstaedt, Kilbourne, and Mittelstaedt 2006). What if there were another immediate and inescapable consequence of these behaviours for the firm? This study investigates the consequences of failures to reach environmental standards with the consideration of the wider market turned towards the firm,

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answering the question for macromarketers, “[h]ow do we best measure consequences?”

(Mittelstaedt, Kilbourne, and Mittelstaedt 2006, p. 136).

This study addresses two macromarketing issues. First, environmental standards encourage firms to adhere to requirements, acting as a mechanism to market firms' environmental conduct towards society as a macromarketing concept. Effective use of such environmental standards simultaneously provides economic benefits for firms and environmental benefits to society. Misleading marketing that asserts a product reaches an environmental standard provides a firm an economic benefit while under-delivering on the promised benefits to society.

Second, the study addresses the *measure of consequences* for the firm engaging in misleading marketing practices as they build a *sustainable market orientation* (Mitchell, Wooliscroft, and Higham 2010). Societal disapproval can be fickle with such reactions as boycotts often being ineffective (Diermeier 2012). As a measure of consequence, we take an immediate and broad market evaluation using the *event study method* of evaluating the effects of an announcement of misleading marketing. The measure is the wider stock market reaction, reflective of the requirements and needs of society, examining the future costs and benefits for the firm as a consequence of this event. Our study focuses attention on how society, as shareholders and investors, perceive these events. In this way, our study represents an important feedback loop for firms engaged in such behaviours as they engage with society and develop a stronger sustainability market orientation (Mitchell, Wooliscroft, and Higham 2010). As misleading practices fail to deliver to society and our use of the stock market reaction as a form of feedback to the firm, this study adds to the macromarketing literature.

This study is important as it provides evidence of a systematic stock market reaction to the announcement of misleading marketing practices as applied to environmental standards. In this way, it provides evidence of a strong response and highlights the negativity with which

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such events are perceived and indicates a strong negative market response can be costly for the firms involved. Using an event study methodology, with a sample of 41 negative environmental events in the automotive industry, we find there is a negative abnormal return for firms on the announcement day. As it is a common notion that reductions in stock prices have some deterrence effect on firms (Laplante and Lanoie 1994), this reaction provides a deterrent to firms to avoid failing such standards and an incentive to ensure that they meet or even exceed the environmental standards.

The rest of this report is structured as follows. Next, we provide an overview of eco-labels, explain why environmental standards are attractive to firms, and what happens when standards are failed. Hypotheses are developed, with reference to the automotive sector. Then, we explain the methodology used, including the collection of our sample, the evaluation of themes and the type of analysis used. The calculation of abnormal returns is discussed before the results are presented and explained. We conclude with a discussion and reflection on future research opportunities.

Literature Summary

In this section, we first undertake a literature review of the key concepts relating to environmental performance with a focus on a comparison of government-mandated and voluntary-environmental standards. Second, we examine environmental standards and behaviours in the automotive sector. Third, we develop the key hypotheses we test in subsequent sections.

Product-harm, Safety Recalls, and Government-Mandated Environmental Standards

There is an expansive body of literature on product-harm, and the resulting product recalls to ensure consumer safety; a comprehensive review is provided by Wowak and Boone (2015).

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Recalls can be voluntary or mandated, with the mandated recalls focused on public safety; mandated recalls are more hazardous to firms, suggesting that firms are more likely to confess and be proactive about smaller safety violations (Rupp and Taylor 2002). The issues of product-harm and the management of product safety lie at the heart of the macromarketing focus on the impact of marketing systems on society and the impact of society back on the marketing systems (Hunt 1981). The issue stems from the disruptive event where a gap is identified between firm outcomes regarding product safety and the societal or mandated expectation. Actions required by a firm to close the gap result in operational or financial investments borne by the firm to remain compliant.

Failing to meet safety standards spans research on a diverse range of industries (e.g., food safety culture or patient safety culture) where companies commit to stringent standards as errors lead to serious public safety issues. The food industry is very competitive, and food safety and quality is often used as a selling point (Grunert 2005); for example, food companies use nutrition labels (e.g., low-fat product claims) to influence the dietary behaviour of consumer (e.g., overweight and obese) (Pennings, Striano, and Oliverio 2014). Effective use of labels requires the commitment from companies' managers to adhere to standards (Griffith, Livesey, and Clayton 2010; Powell, Jacob, and Chapman 2011). Significant efforts are made in healthcare to reduce medical errors and improve patient safety. McFadden, Henagan, and Gowen (2009) used national data from over 200 hospitals and provided empirical evidence that leadership style is directly related to the patient safety culture. The results provide empirical support that hospitals need to focus on the leadership style to improve patient safety. Similarly, in the automotive industry, corporate leadership in the health, safety, and environmental standards area has shown to be important, where the attitudes of managers and their decisions are vital to product safety (Lutz, Lyon, and Maxwell 2000).

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Several recent issues within the automotive sector stand out as being relevant to the wider implications of safety issues (Suhanyiova, Flin, and Irwin 2016): the Takata airbag inquiry in 2015, the recalls relating to the airbags, and Toyota's high accident rate due to accelerators becoming stuck on incompatible floor mats in 2009.

The faulty airbag manufacturer, Takata, should have been aware as early as 2001 of quality issues that could consequently affect the health and well-being of consumers; the first notifications of accidents were received in 2007, and the first recall occurred in 2008 (Committee on Commerce, Science and Transportation 2015). The sluggish response appears to be a deliberate effort to ignore the issue, as indicated by “internal emails obtained by the Committee suggest that Takata may have prioritized profit over safety by halting global safety audits for financial reasons” (Committee on Commerce, Science and Transportation 2015, p. 1).

In contrast, the quality problems experienced by Toyota resulted in intense public scrutiny. First, there was the minor floor-mat recall (2007), a fatal highway accident (2009), a major Toyota recall (2011) and the release of a U.S. National Highway Traffic Safety Administration (NHTSA) report in 2011; these resulted in non-significant stock market reaction reactions (on the day of the event) of -0.77%, 0.5%, -0.6%, and a significant + 3.74% (Gokhale, Brooks, and Tremblay 2014). The investigation by the NHTSA found that there were “no electronic flaws in Toyota vehicles capable of [creating the] dangerous high-speed unintended acceleration incidents” (NHTSA 2016, para. 3). While there appears to have been no intent to deceive, the Chairman acknowledged his “fear the pace at which we have grown may have been too quick” (Reuters 2010, para. 5), suggesting that culture and employee capability may not have shifted at the same rate as volume growth. Later suggestions were that Toyota had “misled U.S. consumers by concealing and making deceptive statements about two safety issues affecting its vehicles” (Department of Justice 2014, para. 2). In both these cases,

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there appear to be deliberate institutional decisions to deceive. The failures have resulted in costs to the firm to address the issue (e.g., through recalls or compensation) and societal disapproval.

The failure to meet safety standards is similar to failures to meet mandated environmental standards. First, there will be costs to the firm of addressing the issue to ensure products reach the mandated environmental standard. When a mandated safety standard is not met, the firm will suffer direct costs, such as managing the recall, loss of reputation and future sales, reimbursements to customers, or logistics costs associated with product returns, or a penalty to the government (Berman 1999), in particular in the automotive industry (Souiden and Pons 2009). An example of the firm-level impact is the case where Ford Explorers sometimes rolled following a blow out of their Firestone Tyres; the estimated recall cost to Firestone was around \$750 million, not including any liability associated with lawsuits (Bates et al. 2007).

Second, there are the long-term consequences to societal views of such misleading marketing, making this a clear macromarketing issue. In the case of Opel, vehicles were tested to meet government-mandated standards and were found to be *legal* – that is, within the regulations for the laboratory test. The setup of the software for emissions control demonstrated a lack of social responsibility, as they were selected to pass laboratory tests rather than meet customer requirements in actual use (Blanco 2016). The failure to meet these requirements resulted in emissions 40 times greater than the limits (Smith and Parloff 2016), posing health consequences to society and non-users of the vehicles.

There are parallels between the research on product-harm and the failure to reach safety standards and the focus of this research on the failure to reach environmental standards.

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Voluntary Environmental Standards, Competitiveness, and Prices

Eco-labelling and marketing using voluntary environmental standards inform consumers about products' characteristics and environmental attributes (de Boer 2003; Bratt et al. 2011; Delmas and Grant 2014). From a firm's perspective, eco-labels communicate the superior environmental performance of a product compared to non-labelled products, differentiating the product and creating a competitive advantage (de Boer 2003; Bratt et al. 2011; Brécard et al. 2009). Eco-labels enable access to information about a product's environmental pedigree, revealing the more sustainable players in the market (de Boer 2003; Brécard et al. 2009; Delmas and Grant 2014; Harbaugh, Maxwell, and Roussillon 2011). Firms can capitalise on the increased demand for environmentally friendly goods (Brécard et al. 2009; Delmas and Grant 2014). There is evidence that eco-labels influence consumers' green consumption and can guide consumer purchasing decisions (Horne 2009; Sammer and Wüstenhagen 2006; Testa et al. 2015), and steer both consumers and producers in a more sustainable direction (Bratt et al. 2011).

Consumer awareness through more information and education about eco-labels has been cited as a way to improve adoption (Harbaugh, Maxwell, and Roussillon 2011; Madurah, Reiners, and Wood 2016). Behavioural approaches should be used, such as making sustainability issues feel important to consumers (Grolleau et al. 2016). Horne (2009) criticises label simplicity as a solution and found it does not ease inter-product comparisons and undermines label efficacy. These findings are relevant to macromarketing theory, as it has been noted that economists prefer the use of regulations or schemes to remedy the costs or benefits of externalities (Mittelstaedt, Kilbourne, and Mittelstaedt 2006). Such solutions aim to reignite the role of eco-labels and ensure they enable consumers to make informed decisions and firms to reap the benefits of sustainable operations.

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The adoption of stringent standards can promote competitiveness. The voluntary use of a standard stricter than a mandated standard (and advertised using an eco-label) can bring price premiums or market differentiation (Blomquist, Bartolino, and Waldo 2015; Roheim, Asche, and Santos 2011). The adoption of a standard mandated elsewhere in the world that is stricter than that mandated in the current market can also present a competitive advantage in the market; e.g., the adoption of the stricter standards in the U.S. automotive market can influence improved products design in China (Zhu, Sarkis, and Lai 2007). These relationships indicate that as societal expectations increase, there is an increasingly professional and moral responsibility for managers to support organizational activities to meet these expectations (Figure 1).

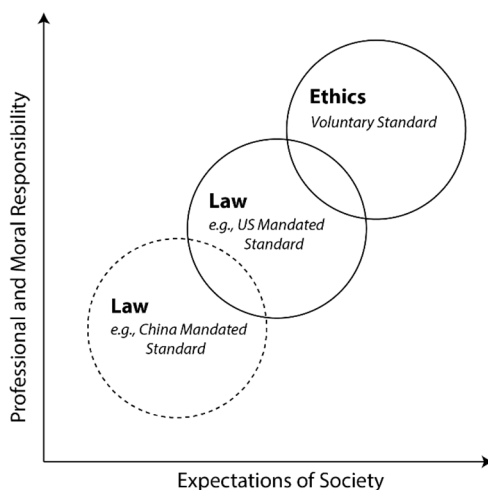


Figure 1. The relationship of voluntary standards to mandated standards and the relationship to higher levels of professional responsibility required to ensure the standards are met. Adapted from Figure 3 in Lacznik and Murphy (2006).

Marketers have considered certifications or eco-labels as marketing gimmicks (Atkinson and Rosenthal 2014) that may be costly to implement and have focused on measuring the benefits to the firm of voluntarily implementing such standards, labels, or certifications (Mittelstaedt, Kilbourne, and Mittelstaedt 2006). While there is some evidence for price premiums (Blomquist, Bartolino, and Waldo 2015; Roheim, Asche, and Santos 2011), others find limited evidence (Carlson and Palmer 2016). There are mixed perspectives on the

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benefits of ISO14001 (environmental standards) certification; while certification improves both long-term financial and operational performance (Treacy 2015), it may decrease the short-term financial performance (Cañón-de-Francia and Garcés-Ayerbe 2009; Paulraj and de Jong 2011). As the financial benefits of certification are uncertain, voluntary adoption of certification can be seen as providing parity rather than an advantage in a competitive marketplace (Paulraj and de Jong 2011). Internationalised firms and those that are more polluting face even greater negative financial performance from certification (Cañón-de-Francia and Garcés-Ayerbe 2009).

The use of voluntarily setting a higher environmental standard for the firm and being found to be non-compliant may have a similar impact to being non-compliant with safety regulations or mandated environmental performance. The firm, wishing to close the gap, may attempt to remedy the situation and resolve the issue, facing operational disruptions and costs of changing products or processes, with the expectation that after incurring these costs their revenue should at least be maintained. When there is public recognition of a gap between voluntarily set standard and actual performance, it can be challenging for a firm to close the gap.

Overall, the marketing use of voluntarily adopted eco-labels and environmental standards can enable a firm to leverage the environmental performance of their product and enhance their competitiveness and financial performance.

Fuel Economy Standards in the Automotive Sector

Little research has examined how firms are affected if they fail to meet the environmental standards that they claim to meet, or that are required by government mandate. Our research has focused on the impact of *avoiding bad* in corporate social responsibility and surrounding

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areas; this contrasts with most research that instead examines the benefits from *doing good* (Lin-Hi and Müller 2013). Downing and Kimball (1982) noted that it was rare for violations of pollution control laws, such as emissions standards, to result in a court action or other punitive measures. Instead, many violations are resolved non-judicially, which is evident in the number of voluntary or forced recalls undertaken when auto manufacturers fail to meet emission standards; as the EPA has the authority to require a manufacturer to issue a recall of vehicles that do not conform to regulations (US EPA 2016a). The negative publicity that occurs from refusing such a request from the EPA is substantial enough to ensure compliance (Jackson and Morgan 1988). Levy and Levenson (1979, as cited in Jackson and Morgan 1988) reported that at least 75% of vehicles repaired under EPA guidance are recalled voluntarily, and only 25% of recalls were EPA-ordered. Barber and Darrough (1996) determined that recalls negatively affect firms' shareholder value; the impact is exacerbated for more reputable firms (Rhee and Haunschild 2006); such studies focused on recalls in general rather than those related to a failure to meet environmental standards.

A deterioration in reputation is not the only challenge facing a firm from failing to fulfil the claims on an eco-label. Some of the firms identified to be performing below certification standards were subsequently de-certified or had their certifications suspended until they improved their performance (Christian et al. 2013; Froese and Proelss 2012; Gutierrez et al. 2012). Loss of certification has further disadvantages and can cause firms to be excluded from vital markets that only trade with certified firms (Lallemand et al. 2016); retaining certification is, therefore, critical for holding the market position. Access to markets is the main motivator for getting certified (Hadjimichael and Hegland 2016) and should provide incentives to firms to avoid failing to meet standards.

A remedy may be provided to consumers when a firm fails to reach a level of performance such as safety standards or environmental credentials as in this study; remedies

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are measures that reflect the firms' strategic choices to meet varying incentives and goals (Liu, Liu, and Luo 2016). Refunds (i.e., monetary compensation), repairs, and extended warranties are the three major remedies for environmental failures adopted by the automotive sector.

First, monetary compensation indicates a cash reimbursement to the misled consumers. For example, Mitsubishi Motors offered compensation of about \$1,000 USD to consumers affected by overstated mileage claims with the value relating to extra gas costs and reduced resale value of the vehicles (Shiraki and Tajitsu 2016). Interestingly, in the case of Dieselgate, Volkswagen claimed the hidden 'defeat devices' (that detect when the vehicle is being tested and improves the results) would not affect the value of the vehicles and refused to compensate European consumers (Hausfeld 2016).

Second, free repairs can also act as a remedy for owners of affected vehicles. Chrysler offered no-cost repairs to consumers when their vehicles were identified as failing to meet U.S. Federal emission standards (US Fed News 2005). Third, extended warranties provide additional value to consumers at no immediate cost to the firm. General Motors supplemented consumers' existing factory warranty with a 48-month/60,000-mile service protection plan as compensation for the overstated fuel economy (Spector 2016). These remedies vary regarding financial obligations for firms and the level of consumer satisfaction they provide.

Hypotheses

We now develop our hypotheses, based on the review of the literature.

The stock market reaction to a failure announcement. The automotive industry has one of the largest impacts on the environment and, therefore, plays an important role in the sustainable development of society and the reducing of emissions (Günther, Kannegiesser, and Autenrieb 2015; Koplin, Seuring, and Mesterharm 2007). Much of the literature on sustainability and the automotive industry looks at the effects of regulations and manufacturers' ability to meet them.

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Government regulations and policies, such as the 1977 Clean Air Act (CAA), can force car manufacturers to conduct sustainable innovation and adopt more sustainable technologies (Gerard and Lave 2005). Technological policies and institutions like the Environmental Protection Agency (EPA) provide pressure that leads to significant technological advances and environmental improvements by firms (Gerard and Lave 2005) and are among those external forces that influence firms' adoption of more sustainable practices (Hall 2000; Seuring and Müller 2008).

As a part of the CAA emissions certification programme, every passenger car or light truck sold in the U.S. has a government fuel economy rating sticker aimed at providing consumers with reliable information they can use to compare vehicles (Greene et al. 2017). These ratings can differ greatly from the estimated amount, and in reality, cars have a much lower fuel economy (Greene et al. 2006, 2017; Mintz, Vyas, and Conley 1993), with automotive fuel economy tests understating fuel use by 15-25% (Schipper and Tax 1994). Greene et al. (2006, 2017) find this estimation gap particularly large for hybrid vehicles, which is concerning considering the advertising for hybrids is built around them being more sustainable and economical. Wernle and Nelson (2014) iterate this in regards to Ford having to lower their fuel economy ratings for a number of their hybrid vehicles and how such actions undercut their advertising, which revolves around fuel economy. Similarly to the way the collective reputation of an eco-label or certification body can be harmed when a single firm fails it (Hamilton and Zilberman 2006), the variation in estimates, “reduces the value of fuel economy information by diminishing confidence in the accuracy of the fuel economy ratings” (Greene et al. 2017, p. 158).

While fuel economy tests are useful for indicating the relative difference in efficiency of new cars, the tests themselves are a poor measure of actual fuel usage (Schipper and Tax 1994). This is due to factors such as driver behaviour, the testing formulae under-representing

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real-life driving situations, and test values not representing the cars sold, i.e., through optimisation of the tested vehicle (Schipper and Tax 1994). The last point raises a matter of interest; do car manufacturers knowingly manipulate emissions tests to get favourable ratings? Alternatively, are the variations purely down to reasons beyond the manufacturers' control, such as how people drive the car?

The issue of fraudulent emission reporting is evident in the automotive industry with automakers misreporting their emission levels. The most significant example has been dubbed Dieselgate, where VW was publicly vilified when it was discovered their vehicles were not only emitting far more toxic fumes than legally allowed but that they were aware of it and were actively covering it up (Nunes and Park 2016; Siano et al. 2017). Earlier, both Honda and Ford were involved in a similar situation when they were fined by the U.S. government for tampering with emission control devices that caused emissions to increase beyond regulated levels (Mokhiber 1998). Since Dieselgate, U.S. automakers have conducted their own emissions tests, and in Europe automakers hire private companies to conduct them (Hakim and Bradsher 2015). Hakim and Bradsher (2015) also suggested that private testing companies can find ways to obtain the lowest possible emissions levels, and may do so to secure contracts with the carmaker.

Given the economic consequences of this type of event, plus existing studies showing that there is a *spillover* from Dieselgate, we hypothesise that:

HYPOTHESIS 1. *The announcements of failures to meet environmental standards will have a negative stock market reaction.*

Failing to meet environmental standards. Environmental standards may either be mandatory, imposed by governments acting on behalf of their communities, or they may be voluntary, used as a marketing device to promote the superior performance of the product.

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In trying to explain why some firms violated mandated environmental standards when others over-comply, Wu (2009) found that firm's decisions to violate environmental regulations were related to the costs and risks of implementing sustainable practices, along with market forces, facility characteristics, and managerial values. The failure to meet mandated standards results in penalties. For instance, in the U.S. all vehicle and engine emissions are required by the CAA to meet certain pollution standards, and all new vehicles are required by CAFE to meet certain fuel economy standards enforced by either the EPA or the National Highway Traffic Safety Administration (NHTSA) (Shiau, Michalek, and Hendrickson 2009). All new vehicles and engines are also required to have EPA-issued certificates of conformity and emissions labels (US EPA 2017). The EPA may seek civil penalties for violations of the CAA, which can be taken through the courts, and violators can be subject to fines of up to US\$37,500 per noncompliant vehicle or per day for violations in reporting, as well as fines of up to US\$3,750 per tampering event or sale of a defect device (US EPA 2016b). The NHTSA also issues fines for violations of CAFE standards, which have been set at US\$55 per mpg per vehicle (Shiau, Michalek, and Hendrickson 2009). One example in this group is DaimlerChrysler, required to pay a penalty of US\$1m and spend US\$94m improving their emission controls after they were found to be violating the CAA (US EPA 2005), showing there can be an immediate and well-determined financial penalty in the case of failing to meet environmental standards.

Other firms claim to meet a voluntary standard in excess of the mandated standard, using eco-label or branding to tout the environmental superiority of their products relative to the competition. This *voluntary over-compliance* occurs when firms claim to operate at a level above the legal environmental standards (Kirchhoff 2000). Over-compliance and the connotations associated with this attract a subset of customers that highly value this feature and can provide a significant market advantage and increased legitimacy (Guo et al. 2017).

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Strategic use of an environmental orientation leads to improved competitiveness (Leonidou et al. 2017) and improved financial performance (Leonidou, Christodoulides, and Thwaites 2016). The general pattern holds true for manufacturing firms, where superior environmental performance in manufacturing (Koo, Chung, and Ryoo 2014) or logistics (Rao and Holt 2005) leads to improved economic outcomes.

When a firm fails to meet their promoted voluntary standard, it attracts media vilification. The process is sometimes referred to as *greenwashing*, where firms promote themselves as sustainable or green and yet their products' performance fails to meet the promoted levels (Delmas and Burbano 2011). They have claimed that they are operating at a higher environmental standard than regular firms, and as such when their actual operations do not reflect these claims, they are publicly sanctioned. An example was a consumer report that asserted two Ford hybrid vehicles fell short of their claimed fuel economy that was promoted as superior to the competition (Harlin 2012).

Greenwashing is associated with negative abnormal returns; those with poorer environmental performance suffer worse outcomes (Du 2015). When failure to attain the desired standards is revealed, there are adverse implications for the firms affected as “organizations discovered using questionable tactics may suffer dire consequences [such as the] loss of reputation, consumer trust and corresponding market share” and that “the repercussions of greenwashing could be long lasting” (Mitchell and Ramey 2011, p. 43). As the public notification of greenwashing leads to reduced competitiveness and economic returns for the firm, damages their reputation and lowers legitimacy with the passionate market niche, this can have further spill-over effects on the brand itself. The stock market reaction encapsulates an overall judgement of the uncertain impact of greenwashing on the legitimacy of the brand, the reputation, consumer trust, and market share; in contrast to a more certain penalty (for violating a mandated standard), failing to meet a voluntary standard involves

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greater long-term risk. Risk-averse investors are more likely to respond with a stronger negative reaction that reflects the detrimental effect of the failure on the firm.

The failure of a firm to reach a self-imposed standard, higher than the minimum, government mandated level, can cause a loss of competitive advantage in the marketplace. We hypothesise that failure to meet a stringent and self-imposed standard will be treated more negatively by investors than the failure to meet required standards, and, therefore:

HYPOTHESIS 2: The stock market reaction to announcements of failures to meet voluntary fuel standards will be more negative than failure to meet mandated standards.

The impact of a refund as a remedy. Where the environmental failure occurred due to mechanical defect rather than any deliberate intent, firms can protect their reputation with proactive, voluntary recalls to avoid negative publicity (Jackson and Morgan 1988). Thus, it is of interest to determine how firms respond to accusations that they have failed environmental standards, whether deliberate or not. While some firms admit that they have violated regulations and settle any accusations or lawsuits without argument, others deny the allegations but still settle. An example was Nissan, accused of manipulating emission tests by the Korean government and ordered to recall certain vehicles and pay a US\$280,000 fine (Nam 2016). Nissan denied the accusation but in the wake of Dieselgate, agreed to recall the vehicles. Other firms deny accusations and fight any legal action against them until a conclusion, positive or negative, is reached (e.g., SsangYong Motor Company refrained from compensation due to overstating fuel efficiency until after the court verdict (Nam 2014)). Although a firm's reaction to such allegations does not prove their ethical or unethical behaviour, it gives an indication of their defensive nature or sensitivity to such issues (Laczniak and Murphy 2006). The offer of a refund can be perceived as an admission of further or deeper issues and a perceived liability.

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In the case of product recalls, there are greater financial consequences of issuing a refund than other remediation measures (Liu, Liu, and Luo 2016; Ni, Flynn, and Jacobs 2014) and the direct costs to the firm may be higher than using other remedies (Berman 1999). When a firm fails to reach environmental standards, a refund may be preferred by customers if they see the cause of the problem as relatively permanent and unlikely to change (Folkes 1984), while the refund may be seen by investors as the higher cost option.

As a refund may indicate other, deeper problems and that there may be more to the issue than is admitted, coupled with the greater financial costs of offering a refund, we hypothesise:

HYPOTHESIS 3: The stock market reaction to offers of refunds will be more negative than for other remedies.

The changing perception of the importance of meeting standards. Firms have demanded that suppliers adopt more environmentally friendly practices, pushing environmental concern up the supply chain in both the automotive sector (González, Sarkis, and Adenso-Díaz 2008; Vanalle, Lucato, and Santos 2011) and other sectors (Rogers 2016; Wang, Petkova, and Wood 2014; Wang and Wood 2016). There has been increasing dissemination of ISO 14001 standards through globalized supply chains (Castka and Corbett 2015; Heras-Saizarbitoria and Boiral 2013; Heras-Saizarbitoria, Boiral, and Allur 2018).

Sukitsch et al. (2015) note that the automotive industry is aware of the significance of corporate sustainability activities, yet the majority of implementation appears to be defensive rather than proactive. Firms like Ford have successfully overcome allegations of greenwashing and become celebrated for their green practices (Mitchell and Harrison 2012).

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As a result of the significant growth in firms' awareness, they have increasingly worked to capitalise on the trend towards improved environmental performance (Brécard et al. 2009; Delmas and Grant 2014). As this occurs, firms and supply chains improve their performance levels to meet requirements. When a problem or failure occurs, investors are likely to perceive it as a failure of the firm's marketing strategy rather than the firm's inability, which generates less societal damage. Given recent improvements in environmental performance (through the use of technology), failure to reach the environmental standard is regarded by investors as a failure of the macromarketing strategy as firms aspire to economic gains using eco-labels but are wary of the costs of achieving the promised environmental performance. Therefore, the overall damage to their reputation is smaller compared with that in earlier years when performance was lower. This means that the stock market reaction to such infractions will be increasingly smaller over time. Therefore, we hypothesise that:

HYPOTHESIS 4: *The stock market reaction to recent announcements of failures to meet environmental standards will be less negative than for older announcements.*

The change in reaction following Dieselgate. While, in general, the impact of announced failures to meet environmental standards will reduce over time, following Dieselgate, the stock market reaction to such news is likely to be more negative. The influence of a large and recognised event, such as Dieselgate, can have wider ramifications on the business community. Mansouri (2016) identified the reasons behind Dieselgate, examined the impact on VW stakeholders and how such an event should be dealt with, and how it can be prevented from happening again. Dieselgate illustrated the trade-off between controlling vehicle emissions under regulation and improving vehicle performance to meet consumer demand (Klier and

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Linn 2016). Cârstea (2016) faults consumers for wanting high-performance cars despite the environmental impact these types of vehicles have through excessive pollutants.

One of the largest consequences of the scandal was the loss of consumer confidence in car manufacturers that affected not only VW but the entire automotive industry (Cârstea 2016). Lack of consumer faith in VW caused loyal customers to switch brands, and VW sales fell dramatically (Mansouri 2016). Shareholders also lost confidence, and VW's shares plunged, wiping billions of dollars in value from the company (Mansouri 2016). Dieselgate provoked discussions on how to reduce the gap between emissions testing and real-world observations, and both the U.S. and the E.U. regulators adjusted their evaluation of fuel economy measures (Klier and Linn 2016). Investors are risk-averse and volatility increases following an event, with a contagion effect on related firms (Brown, Harlow, and Tinic 1988). Due to the risk-averse nature of investors and the way they treat related firms, in this case the competitors of VW, we expect systematic changes following a watershed event like Dieselgate where investors may take a more punitive approach to offenders that fail to meet environmental standards.

Given the change in consumption patterns and increasing regulatory attention, it is clear that investors, regulators, and society react to the highly publicised circumstances of the offending firm and their competitors after a watershed event. With the close attention and the risk-averse nature of investors, there will be an increased stock market reaction to failures to meet standards following Dieselgate. Therefore, we hypothesise that:

HYPOTHESIS 5: The stock market reaction to announcements of failures to meet environmental standards after Dieselgate will be more negative than other announcements.

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Methodology

Sample Selection and Description

The sample in this study consists of announcements made about firms in the automotive industry which have failed to meet their environmental commitments. Often these announcements are made when the government, or some other party such as the EPA in the U.S., discovers certain vehicles violate environmental standards (i.e., with excess emissions), when a recall is announced due to emissions flaws, or when a firm has been found to have overstated the efficiency/economy claims of their vehicles.

To generate our sample, we first undertook an initial search with preliminary keywords following guidelines in Wood and Wang (2018). As we identified announcements, we developed a more comprehensive set of keywords. Through the standard iterative process of identifying, evaluating, and adding commonly used keywords in such announcements, a final set of keywords was created. The search terms used related to a sequence of synonyms of *certification* for automotive firms (e.g., *ecolabel** or *certif** or *Clean Air Act*) within five words of a synonym for misrepresentation (e.g., *fals** or *mislead** or *greenwash** or *fraud** or *unsustainab** or *misrepresent**) were used to identify relevant events, along with verbs located near the keywords to ensure the events were of interest to the study; the broad set of keywords limits the possibility of missing any important announcements. These keywords were used to search for and download the full text of announcements from the *Dow Jones Institutional News*, *Global Newswire (U.S.)* and *The Wall Street Journal (All sources)* for the period 1980-01-01 to 2016-12-15.

This search resulted in over 17,000 articles. The articles were scanned for relevance to the failure of environmental standards. Of those deemed relevant, the full text was scanned. All articles not concerning the environmental performance of automotive manufacturers were

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excluded, along with multi-event announcements. For example, a firm announcing two separate recalls, one due to an environmental failure and the other a safety issue, would be excluded as the effect of the environmental failure could not be isolated. To ensure that the first announcement was identified, more targeted searches were undertaken on each event, and only the earliest announcement was retained (Park, Park, and Zhang 2003).

The final event sample of 53 was gathered. Any subsequent developments relating to the main event were recorded as sub-events, as often the ramifications and coverage of these events extended. While these were not included in the research, the event and sub-event sample were 136 from 25 different automotive firms (although some belong to the same parent group).

Two additional checks determined whether there were other confounding events and to ensure there were sufficient stock returns data, enabling the event to be considered in further analysis. First, a confounding event check on the event sample of 53 cases was used to determine whether other financially relevant events also occurred during the event window (McWilliams and Siegel 1997; Wood and Wang 2018). Thus, a three-day event window (the date before and after the initial announcement) was analysed for each firm, and confounding events, if any, were recorded and the event was excluded. Second, we collected the stock returns using *Datastream*. In some instances, a firm was not publicly listed (at the time of the event) and was excluded. After checking for and removing cases where there were confounding events or no stock returns data, the final sample size was 41 events.

Estimating Abnormal Returns

We used the event study methodology to calculate abnormal returns to determine the stock market reaction to the failure of firms to meet environmental standards. This is a process for evaluating the difference between the return on a given stock (related to the events in our sample) relative to an appropriate benchmark. Careful selection of the benchmark enables

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control for several other factors that might explain changes in the stock returns. After controlling for these factors, the remaining unexplained variation is considered to be the abnormal return that is connected to other influences – in this case, the influence of the events under study. Event study methodology has been used to investigate many significant events that are of interest to the stock market and consumers, such as recalls of food (Salin and Hooker 2001) or toys (Wood et al. 2017), delays in product introductions (Hendricks and Singhal 2008), and supply chain disruptions (Papadakis 2006).

Estimation Windows and Time Period When Measuring Abnormal Returns

The normal return parameters were estimated through an ordinary least squares approach with an estimation window of 200 trading days, separated from the event day by a 10-day isolation period, resulting in an estimation window of (-211, -11), and this is similar to previous event study research (Hendricks, Singhal, and Zhang 2009).

Model for Estimating Abnormal Returns

While there are many methods of calculating the abnormal returns, we opted to use the commonly used market model as this provides an effective estimate of abnormal returns by relating the normal returns to the returns of market portfolio (Brown and Warner 1985; MacKinlay 1997). Using the market model, the abnormal return AR_{it} for firm i on day t was estimated as:

$$AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt}), \quad (1)$$

where R_{it} is the return on the stock of firm i on day t . R_{mt} is the normal return calculated with reference to the market portfolio of stocks on day t . $\hat{\alpha}_i$ and $\hat{\beta}_i$ are market model parameters, estimated using ordinary least squares.

Since the final sample firms are listed in different indices from six countries, local indices are applied to estimate market movement for individual stocks, as suggested for multi-

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country event studies (Campbell, Cowan, and Salotti 2010; Corrado and Truong 2008; Meric, Ratner, and Meric 2008; Samitas, Kenourgios, and Zounis 2008). The selected local indices are presented in Table 1.

Table 1. Local Market Index and proportion of each sample coming from each country.

Country	Local Index	Sample	% of sample
Germany	CDAX_GERMANY	6	14.63%
France	SBF_120_FRANCE	1	2.44%
Japan	NIKKEI_225_JAPAN	9	21.95%
U. S.	S&P_500	19	46.34%
Korea	KOREA_SE	5	12.20%
U. K.	FTSE_UK	1	2.44%

Hypothesis Testing and Cross-Sectional Analysis

We used cross-sectional regression to determine how the impact of the announcement was related to the firm and characteristics of the failures in question (Kothari and Warner 2007).

We used the following regression model:

$$AbRet_{i,j} = \beta_0 + \beta_1 Firm_i + \beta_2 Recall_{i,j} + \beta_3 FirmSize_{i,j} + \beta_4 Voluntary_{i,j} + \beta_5 Compensation_{i,j} + \beta_6 Recency_{i,j} + \beta_7 PostDieselgate_{i,j} + \varepsilon_{i,j}, \quad (2)$$

where $AbRet_{i,j}$ is the abnormal return for firm i for event j and the control variable $Firm_i$ controls for the firm-fixed effects of each firm in the sample.

Variables to represent hypotheses. Whether the failure related to voluntarily high levels of performance was addressed with the variable **Voluntary**. The voluntary status was evaluated by examining the announcements to determine how the event was described. The predicted sign of the coefficient was negative.

What compensation method, if any, was used by the firm (**Compensation**) was evaluated by classifying the announced remedy. The primary focus was a classification of compensation offered vs. other remedies. The predicted sign of the coefficient was negative.

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Whether the effects of more recent events were milder than older events (*Recency*) was evaluated by calculating the number of years from the start of the sample (1984) to the year of the current event. Therefore, recent events have a higher value. The predicted sign of the coefficient was positive.

The variable for events occurring following Dieselgate (*PostDieselgate*) was calculated by taking the date for Dieselgate and classifying whether the event occurred before or after the date. The predicted sign of the coefficient was negative.

Control variables. We used three control variables. First, we controlled for the firm-fixed effects in the model for each firm (*Firm*). Some firm-specific factors may influence reactions similarly to recalls announced by a single firm.

Second, we controlled for the size of the firm (*FirmSize*). We used the logarithm transformation of the net sales or revenues of the firms involved for the year before the announcement. The revenue determines whether the size of the firm has any effect on the abnormal returns. Larger firms have a greater ability to cover costs associated with an adverse event (Jones and Rubin 2001), and thus the abnormal returns may be influenced by the firm size.

Third, we controlled for whether a recall was simultaneously announced (*Recall*), which tests if the involvement of a recall in an announcement affects the observed returns as there is strong evidence that recalls have a negative impact on abnormal returns.

Model Diagnostics for Influential Observations and Homoscedasticity

An analysis of the influence of each observation indicated that no observation was greater than three times the average hat-value, which is the point in a smaller sample where there would be a concern that the observation was unduly influential (Fox 2002). We also tested for skewness

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in the data; the departure from a normal distribution has minimal impact on results when using the market model to estimate daily stock returns (Brown and Warner 1985). Due to the small sample size, we used the studentised Breusch-Pagan test (Breusch and Pagan 1979) which indicated a level of heteroscedasticity (13.093, $df = 7$, $p\text{-value} = 0.06987$). Therefore, we used robust standard errors in our analysis (White 1982); specifically, the Heteroscedasticity Consistent (HC3) estimator as it provides robust performance with small samples and influential observations (Kleiber 2008).

Results and Discussion

We found that on the day of an announcement about a failure to meet environmental standards (Day 0), there is a mean negative abnormal return of -1.01%, which is statistically different from zero at the 5% level with a two-tailed test using the Boehmer et al. adjusted test statistic of t-BMP (Boehmer, Masumeci, and Poulsen 1991), the Corrado Rank test (Corrado and Zivney 1992), and the Patell Z test (Patell 1976). Table 2 shows the results using two commonly used models to calculate the abnormal returns; both models provide consistent results indicating no sensitivity to the selection of the model used to calculate abnormal returns. The following analysis used the more conservative abnormal returns calculated using the market model. Sixty one percent of the firms experienced a negative return.

Table 2. Abnormal returns for the event day (0) using two common models.

<i>n</i>	Mean CAR	Positive: Negative	Cross- sectional <i>t</i>	Patell Z	t-BMP	Corrado Rank
<i>Multi-country Market model</i>						
41	-1.01%	16:25	-2.0131**	-4.7246***	-2.5791***	-2.1625**
<i>Mean adjusted model</i>						
41	-1.16%	18:23	-2.0617**	-3.9114***	-2.6757***	-1.8657*

Significant levels (two-tailed tests): * 10% level, ** 5% level, *** 1% level

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These results indicate that an announcement of an environmental failure has a negative financial impact on the firm, and firms that fail to meet advertised or assumed environmental performance have adverse stock market reactions. To further understand what contributes to the abnormal returns found, explanatory variables were regressed against the abnormal returns as the dependent variable (Table 3).

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Table 3. Results of hierarchical regression analysis (n=40; 1 case was excluded due to missing data).

Independent Variable	Model 1		Model 2		VIF
	Coefficient	Robust std Error	Coefficient	Robust std Error	
Intercept	0.0649*	0.0404	0.0229	0.0464	
Firm	-0.0005	0.0015	-0.0007	0.0016	2.31
Recall	0.0044	0.0144	0.004	0.0129	2.76
FirmSize	-0.0037**	0.0021	-0.0018	0.002	1.51
Voluntary			-0.0241	0.0232	3.14
Refund			-0.0558***	0.0214	1.37
Recency			0.0016*	0.0011	5.07
PostDieselgate			-0.0568**	0.0314	2.22
F	1.739		7.97		
Significance	.1763		.000		
R ²	.1266		.6355		

Significant levels (one-tailed tests): * 10% level, ** 5% level, *** 1% level

The variance inflation factors (VIF) are all below 10.0, providing evidence of low multicollinearity (Hair et al. 2014). Model 1 includes the three control variables (firm-fixed effects, the presence of a recall, and the firm size). The variables used to test the hypotheses of interest were added to generate Model 2, which can be used to investigate whether they added significantly to the abnormal returns. With an R² of 17.63% in Model 1, on their own, recalls and firm size (revenues) were unable to explain any variance in the abnormal returns. By adding further explanatory variables in Model 2, the R² increased substantially to 63.55%, indicating this model is accurate in explaining the variation in the abnormal returns observed on Day 0 of an environmental failure announcement.

Model 2 provides some support for our hypothesised relationships. The hypothesis relating to the voluntary standards is not significant. The remaining hypotheses are significant with compensation statistically significant at the 1% level, the recency of the events is significant at the 10% level, and the occurrence following Dieselgate is statistically significant at the 5% level.

While we had predicted that failure to reach a voluntary standard would be more negative, there is no evidence to support this. As predicted, the estimated coefficient relating to the breach of a voluntary standards is negative but the robust standard error is large and,

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therefore, we cannot say conclusively whether a difference existed when the standard breached has been voluntarily set.

The estimated coefficient for the indicator variable that a refund was used as a remedy is negative and statistically significant at the 1% level in a one-tailed test. The result indicates that there is an additional penalty on the firm if they elect to compensate customers with a refund. A key implication of our results is that firms pay a higher price if they use refunds. The negative economic impact should encourage firms to examine other options that may rectify the situation without the adverse impacts.

While we predicted that the coefficient relating to the recency of the event would be positive, the estimated coefficient was only marginally positive and significantly different from zero at the 10% level in a one-tailed test. This result indicates a very weak pattern whereby more recently occurring events are less economically damaging to the firms. The coefficient is also of a smaller magnitude than the others, indicating a weak and small effect.

In contrast, the estimated coefficient relating to events occurring post-Dieselgate was negative, as predicted, and significantly different to zero at the 5% level in a one-tailed test. This result indicates that the added scrutiny on firms, their behaviours, and failures in the post-Dieselgate economy has led to a sharper stock market reaction to failures for the eight events in our sample following Dieselgate. A key implication is that managers should increasingly pay attention to the implications of failing to meet the environmental standards in the contemporary era.

In the case of the control variables, the coefficients for firm size and the presence of recalls are insignificantly different to zero. While the coefficient relating to recalls is insignificantly different from zero, it is positive. This result may indicate that a recall in conjunction with the announced environmental failures is perceived as being marginally

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positive, perhaps indicating that the firm is prepared to take more substantive action to remedy the problem.

Table 4. Results of the hypothesis testing.

Hypothesis	Predicted direction	Result
HYPOTHESIS 1: The announcements of failures to meet environmental standards will have a negative stock market reaction.	-	-1.01% ^a
HYPOTHESIS 2: The stock market reaction to announcements of failures to meet voluntary fuel standards will be more negative than failure to meet mandated standards	-	Not significant
HYPOTHESIS 3: The stock market reaction to offers of refunds will be more negative than for other remedies.	-	-0.0558***
HYPOTHESIS 4: The stock market reaction to recent announcements of failures to meet environmental standards will be less negative than for older announcements.	+	0.0016*
HYPOTHESIS 5: The stock market reaction to announcements of failures to meet environmental standards after Dieselgate will be more negative than other announcements.	-	-0.0568**

Significant levels (one-tailed tests): * 10% level, ** 5% level, *** 1% level

Significant levels (two-tailed test for the abnormal return): a 1% level

The results (Table 4) indicate that while Dieselgate has *grabbed headlines*, this category of failure is consistently considered *negative* by the stock market. Therefore, while Dieselgate resulted in a loss of stockholder wealth for VW (Mansouri 2016), this category of event is also negative for other automotive firms. Our results are broadly consistent with the findings of Nunes and Park (2016), which documented that the impact of the Dieselgate was contagious to other U.S. automotive sector firms (the competitors). Similarly, we find a temporal effect, insofar as while Dieselgate increased immediate suspicion of the other firms, the negative abnormal returns post-Dieselgate also increased in magnitude.

Our finding relating to the fuel standards is that identified breaches of fuel standards lead to more negative abnormal returns. In some ways, this contrasts with the theoretical perspective where we might expect substantive efforts made by the firms to reach voluntary targets to be more significant. When we consider the operational performance of the firms and *fuel standards* as an *order qualifier* instead, the failure to attain this standard is clearly

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strategically problematic for the companies involved as it may lead to direct penalties or *removal from the market*; in contrast, failure to hit a voluntary target leaves them *in the market*.

Implications

The finding of a negative stock market reaction to failing to meet environmental standards matches the hypothesised direction. The strength of the reaction is also worth noting – Table 5 indicates that it is greater than the stock market reaction to several types of recalls or even labour abuse announcements, a social issue rather than environmental (Daly, Pouder, and McNeil 2017). This research highlights the significant costs of disruption caused by the announced failure to meet standards.

Table 5. Event study results of this study relative to similar studies.

Study	Disruption and sector	Event window	Stock market reaction
This research	Environmental standards in the automotive sector	Event day	-1.01% ***
Rupp (2001)	Safety recalls in the automotive sector	(-1, 0)	-0.28% **
Thirumalai and Sinha (2011)	Safety recalls in the medical devices sector	(-1,0)	-0.26% ns
Chen et al. (2009)	Product recalls (proactive strategy), consumer products	Event day	-0.59% **
Thomsen and McKenzie (2001)	Safety recalls, meat and poultry sector	Event day	-0.4% *
Zhao et al. (2013)	Product recalls in China (pharmaceuticals, automobile, food, electronics)	Event day	-0.31% ns
Daly et al. (2017)	Labour standards	Event day	-0.24% **

Significance levels: ns not significant, * 10% level, ** 5% level, *** 1% level

Notes: These may not reflect the main results reported in each article – we have used data provided in the articles to isolate values closest to the event-day window that we used in the present article.

Our first finding is that when the firm is told to compensate consumers for the failure in the announcement, the abnormal returns are more negative. This finding suggests that when compensation is involved, investors perceive that the costs of the failure will be greater to the firm. This finding is important for businesses to note, as it highlights the fact that providing compensation may not be the best way to remedy an environmental failure (financially, in any case). We recommend that other forms of compensation such as extended warranties or free

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repairs may be a more viable option. If monetary compensation is most practical, another suggestion could be to avoid mention of compensation in the initial failure announcement, and instead notify consumers privately to not concern shareholders. This finding relates to the observation of Chen et al. (2009), who stated that when firms proactively manage product recalls, investors infer that the crisis is severe and the firm has to reduce potential financial loss. This suggests that firms should communicate effectively to investors about the rationale for the action.

Secondly, the significance of abnormal returns being more negative after the VW scandal suggests that public scrutiny of automotive firms failing environmental standards has largely increased after this event. Due to the large losses VW faced in the wake of cheating their emissions tests (Mansouri 2016), subsequent environmental violations saw shareholders react with increased alarm at potentially similar disastrous losses. In a post-Dieselgate world, automotive firms should, therefore, be increasingly concerned with maintaining their environmental standards, and ensuring that they are meeting the required environmental regulations.

According to marketing theory, consumers are not always capable of selecting good products for themselves (Abela and Murphy 2008). They make their decisions based on advertisements. In a post-Dieselgate world, they are more sensitive about the failure to meet environmental standards. This increasingly negative impact of adverse events occurring post-Dieselgate could be transferable to other industries, and the negative impact on abnormal returns could exist for other types of failures. Thus, after an industry experiences a major shock event, like Dieselgate, investors could become increasingly sensitive to any similar reoccurrences, even if they are not on the same scale. Further research would be required to ascertain the existence of this phenomenon.

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Our findings overall suggest that firms are punished by the market when they publicly announce a failure to achieve certain environmental standards. We hope that these findings serve as a deterrent to those firms who try to get away with minimal compliance, those which benefit from inflated environmental performance claims that differ from reality, and those which try to evade the legal environmental requirements completely, as in the case of VW.

While these results are derived from the automotive sector, this is merely a context for the study. Similar early studies in product-harm literature also focused on automotive recalls (Haunschild and Rhee 2004; Rupp 2001), and yet the results have been broadly similar to other product recalls. As a result, we assume that the results would be generalisable to other sectors as well. Some of the key results indicate that managers should take care following major events and monitor to ensure that their firms will not *fall foul*; our results indicate that investors have become increasingly risk-averse following the Dieseltgate scandal, with following cases experiencing a more severe stock market reaction. Similarly, if there is a major event in another sector, competitors should monitor their performance following the event as the further failures will be treated more severely afterward.

Asserting environmental performance will continue to be important as marketers focus on the rise of sustainable consumption, which is defined as consuming for present needs in a way that does not compromise future needs (Cherrier, Szuba, and Özçağlar-Toulouse 2012). In promoting sustainable consumption, marketers encourage the development and use of technological innovation and offer green products to consumers (McDonagh and Prothero 2014). Following this critical perspective, researchers have studied the effects of the ecosystem. For example, Cherrier et al. (2012) explored the constraining forces to reduce greenhouse-gas emissions via sustainable consumption. The results show that there is an awareness of gas emissions and social pressure is important for reducing gas emissions. Konar and Cohen (2001) reported that a 10% reduction in emissions of toxic chemicals increased the market value of

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studied firms by US \$34m. These studies highlight the relationship between emissions and firm performance and infer that marketers should pay attention to sustainability, environmental performance, or emissions as mechanisms that can propel firm performance upwards.

Nkamnebe (2011) highlighted the importance of sustainability marketing in fostering sustainable consumption, which increases customer value, social value, and ecological value, and identified challenges in its adoption. In this context, marketing ethics is an important consideration for marketers. Marketers should communicate ethically about the environmentally harmful products to consumers (Nill and Schibrowsky 2007), and be responsible for the marketing of products that advance well-being (Ferrell and Ferrell 2008).

Our results show that failing to reach environmental standards has a similar outcome for the firms involved as failing to reach a safety standard. Strong negative stock market reactions to the announcements show feedback at a societal level and the macromarketing consequences of the failure; from a macromarketing perspective, the problem of deception and ethics is an important one. The stock market reaction to the failures that we have reported on is significantly greater than, say, a regulatory penalty of US\$1m as levied against DaimlerChrysler (US EPA 2005). This strong stock market reaction demonstrates the severity of the long-term consequences to society of such behaviours, as perceived by stock market investors.

Conclusions

Based on our analysis of 41 announcements made by publicly traded automotive firms from 1984-2016, we have documented that the announcements are associated with a statistically significant negative stock market reaction. Using a single-day event window, the mean stock market reaction is -1.02% and the percent of cases experiencing a negative reaction is 61%. We find that more recent announcements resulted in a less negative stock market reaction than

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early announcements; however, a failure to meet fuel standards, the announcement occurring after Dieselgate, and the offering of compensation as a remedy, are all associated with a more negative stock market reaction.

These findings are important as they indicate that announcements about firms failing to meet environmental standards in the automotive industry do have a negative impact on stock returns on the day of the announcements. This finding is of interest to macromarketers as it shows the consequences to firms of misleading marketing practices where there are claims of environmental performance that are not met. Investors appear to have an adverse reaction to such announcements, possibly in the expectation that firms will subsequently incur large costs in remedying the publicised failure. These results provide evidence that these failures are monitored closely and can be more significant following a bellwether event, such as VW's Dieselgate scandal. Our results also indicate that while the Dieselgate episode was a major event, this category of event is also important and can result in a meaningful adverse stock market reaction.

The findings document that the stock market reactions to environmental failures can be large. Surprisingly, the Dieselgate scandal revealed an organisational behaviour of firms using marketing systems to take advantage of self-imposed or controlled regulations to not only deceive customers but that they willingly choose their course of action while knowing of the possible negative implications. Such deceptive organisational behaviours are common, as we demonstrate in this research; however, we also demonstrate that the stock market reaction reflects a strong belief that there are severe long-term consequences of such behaviours. This outcome may influence future marketing behaviour. The behaviours of managers can have a much wider impact and change the overall marketing system that they operate within. The German government, despite their involvement in the Dieselgate scandal, worked to protect the market, the German brand, and attempted to restore the civic trust that government

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decisions are made to benefit society. They used the failure and deception of the automotive industry for two ends. First, they updated the government-regulated quality assurance process. Second, they also reminded the industry about their social responsibility, enforced research, and innovation by outlawing their products within city limits.

Laczniak and Murphy (2006) stated that the quality of the ethical analysis is influenced by the moral thinking of managers and ethical standards. As more stakeholder groups are evaluated, the higher the likelihood of perceiving possible negative outcomes that require further investigation by a firm. In the case of VW, recognise any potential negative outcome for all stakeholders would be challenging due to the many stakeholders involved in the evaluation process, and, therefore, a greater challenge to discover unethical issues. As suggested by the comments made by the Toyota President (Reuters 2010), employee capability may be difficult to maintain in periods of rapid growth. Firms should carefully consider ethical behaviours that may impact society, as Laczniak and Murphy (2006) suggested that marketers should take responsibility for the end of a marketing campaign. In the case of VW, while marketers may not know of the institutional decision to deceive, they should, however, take responsibility for the outcomes and focus on both the methods and outcomes of the marketing campaigns, even where the negative outcomes were the result of an institutional intention to deceive. These outcomes suggest that, given the magnitude of the stock market reaction, there is a strong onus on marketing managers to be aware of activities within the firm that may lead to negative societal outcomes and, from this, a negative stock market reaction when the public is informed of the outcomes.

The research results are of interest to macromarketers as they show the stock market reaction to misleading marketing and failing environmental standards can be severe, addressing the question of how consequences of this lapse in marketing ethics can be measured (Mittelstaedt, Kilbourne, and Mittelstaedt 2006). The stock market reaction to the

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environmental standard failures studied is similar to the negative reaction to safety standard failures and provides an important feedback loop for firms as they work to develop a stronger sustainable market orientation (Mitchell, Wooliscroft, and Higham 2010). The immediate stock market reaction may prove to be a stronger feedback mechanism than regulatory penalties; therefore, such a negative stock market reaction may help firms to develop an orientation that provides improved societal outcomes with products that deliver the environmental performance promised. These results suggest that marketing system behaviours should adapt to develop and market products that meet the promised environment standards.

We have identified three directions for future research. First, it could be valuable to examine in more detail whether there are different drivers for the failures and examine whether the abnormal return varies by these different drivers. Second, the interaction between recalls and failures may require additional exploration as our estimated coefficient for the use of recalls was positive although not significantly different to zero. Third, our research examined the financial performance of the firm in response to failures to reach standards and leaves aside the question of whether a firm striving to reach more stringent voluntary standards will gain operational performance benefits and whether these failures to reach voluntarily standards have operational performance consequences.

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