Journal of Cleaner Production 229 (2019) 974–988

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Does firm size matter? Evidence on the impact of the green innovation strategy on corporate financial performance in the automotive sector

Woon-Leong Lin [a], Jun-Hwa Cheah [a, *], Mohamed Azali [a], Jo Ann Ho [a], Nick Yip [b]

[a] Faculty of Economics and Management, Universiti Putra Malaysia, Serdang, Selangor, Malaysia
[b] Norwich Business School, University of East Anglia, Norwich, UK

ARTICLE INFO

Article history:
Received 27 January 2019
Received in revised form
2 April 2019
Accepted 18 April 2019
Available online 7 May 2019

Keywords:
Green innovation strategy
Corporate financial performance
Automotive industry
GMM
Firm size

ABSTRACT

In the past few years, there has been increasing awareness regarding the significance of the Green Innovation Strategy (GIS) in the academic and practical fields. Hence, it becomes important to determine the correlation between the GIS and the Corporate Financial Performance (CFP). This study attempted to determine the dynamic correlation between the GIS and the CFP, with regards to the firm size. For this purpose, this study has collected data for 163 international automotive firms, from the CSRHub database, for the period ranging between 2011 and 2017. Furthermore, we also used the dynamic panel data system, i.e., the Generalised Method of Moment (GMM) method, for estimating this relationship. The empirical results indicated that the GIS positively affected the CFP. Interestingly, we also uncovered that the firm size moderated the negative correlation between the GIS and the CFP. The small-sized firms showed higher green innovation investments return than the larger-sized firms, which indicated that these smaller firms were more prone to seek variation and visibility, for accessing better resources. Furthermore, due to the extensive scrutiny of the stakeholders, these small firms could generate higher profits. The implications for managers and the theories in this regard are then discussed.

1. Introduction

Currently, the automotive industry faces many obstacles. This sector generally relies on the technological paradigm of volume production, which has gradually become more unprofitable due to the increase in the segmented niche markets. Furthermore, this sector has to undergo many social and regulatory pressures, which can improve the sustainability of all its products and production methods. Research conducted in this field showed that the automotive sector is facing these challenges and have to establish techniques for developing a profitable and sustainable sector for future generations (Smith and Crotty, 2008) After the publication of KPMG's report (2012) on environmental regulations in the automotive sector, various governments started imposing strict environmental regulations on the OEMs (Original Equipment Manufacturers) for controlling the CO_2 emissions. For example, the European Commission implemented legislation for testing fuel quality, reducing emissions, and fuel consumption as follows:

By 2021 the cars, which emit >95 g of CO_2/km, would be disallowed in the market.
By 2020, the greenhouse gas intensity of all automobile fuels must be reduced by 10%, for improving the fuel quality.
By 2021, the automobile manufacturers should produce light-duty vehicles that consume <3.6 l/100 km of diesel or <4.1l/100 km of petrol.

In the past, the transportation sector was seen to be responsible for 27% of the total global energy consumption and 33.7% of all greenhouse gas emissions (Tie and Tan, 2013). These trends would change in the future, due to the scarcity of fossil fuels and increasing environmental pressure (Nilsson et al., 2012). Because of the increasing concern with regards to the environmental issues, by the public, consumers, suppliers and the administration, a majority of the firms have begun the development of environmentally-friendly green products (Green et al., 2012; Tseng et al., 2013). Hence, the techniques which save energy, or reduce CO_2 emissions and air pollution, in the automotive sector, are important challenges and issues affecting the governments (Hui, 2010). In their

* Corresponding author.
E-mail addresses: linwoonleong@gmail.com (W.-L. Lin), jackycheahjh@gmail.com (J.-H. Cheah), azali@upm.edu.my (M. Azali), ann_hj@upm.edu.my (J.A. Ho), n.yip@uea.ac.uk (N. Yip).

https://doi.org/10.1016/j.jclepro.2019.04.214
0959-6526/

study, Shrivastava (1995) stated that firms must differentiate their products, lower production costs, improve product quality and develop more innovation processes. Therefore, continuous innovation was seen to be an important strategy which could help in overcoming the pressures implemented by the competitors, customers and the regulators (Porter and Van der Linde, 1995a,b).

Due to the strict international rules, increasing consumer environmentalism, and the conventions regarding green innovation, the competition and the business-related tactics have undergone a significant alternation in all global industries. These factors have also affected the business in the automotive industries. Hence, the Green Innovation Strategies (GIS) have played a vital role (Russo and Fouts, 1997). GIS is described as the development of green process and green products-related innovation strategies and decisions, that associated with the application of green activities and environmental management systems (Eiadat et al., 2008; Tomomi, 2010; Dong et al., 2014). On the other hand, very few researchers have investigated the effect of the GIS on the Corporate Financial Performance (CFP). CFP is defined as measuring the results pertaining to a firm's operations and policies in monetary aspects. The company's return on investment, value added and return on assets as depicted with these results. In this research study, CFP has been employed as an instrument to measure economic performance as well as integrating accounting-based measures, which includes asset utilisation, firm's profitability, return on equity, the return of investment and return on asset (Wu et al., 2006). An organisation's internal efficiency is represented by the accounting-based measures, which is impacted by the social performance of the organisation (Van Beurden and Gössling, 2008). So, it is important to develop policies that can effectively implement GIS in the industries (Petts, 1998). In this study, we have attempted to bridge this gap and described many novel green innovation-related concepts.

In the past few years, GIS was seen to one of the major factors that affected environmental sustainability, financial growth and life quality (Porter, 1981; Bansal and Gao, 2006; Dangelico and Pujari, 2010). Implementation of the GIS is a vital tool which increases the sustainable growth of the manufacturing industries due to an increasing environmental pressure, especially in the automotive sector. Use of GIS embodies the idea of environmental protection for designing and packaging products and improving the differentiation-related advantage (Hart, 1995; Chen et al., 2006). The implementation of GIS could significantly increase the resource productivity of the companies (Porter and Van der Linde, 1995a,b). Therefore, the development of GIS would help in resolving the conflicts between environmental protection and economic development.

In this study, we have also attempted to examine the connection between the GIS and their effect on firm profitability in the automotive industry. Furthermore, this study also intended to determine the effect of firm size on the GIS and CFP in the automotive industry. This study collected the data from the CSRHub for a period ranging between 2011 and 2017 and investigated whether the green innovation investment would increase the shareholders' wealth. We also studied whether the significance of these activities varied based on the firm characteristics (like firm size) employing the dynamic panel data system GMM estimator. The empirical outcomes highlighted the significantly positive relationship between GIS and CFP. This positive relationship was persistent when this study attempted to control the endogeneity of GIS. We further noted that the effect of the negative relationship between the GIS and firm size on the CFP could be due to the fact that the GIS spending by the company provides an overall limited tangible benefit, and helps the company obtain better profits. A small firm size showed higher efficiency than the larger firms. This indicated that the agency costs (like the ineffective use of the corporate funds) encountered while implementing the GIS in the larger firms were the dominant factor that affected the strategic benefits which these firms could derive after the green innovation investments. Implementation of GIS could significantly upsurge the profitability of the smaller firms. Hence, the results indicated that the total benefits derived by the implementation of the GIS were not a one-size-fits-all and were dependent on the firm characteristics.

Based on the study results, we have put efforts to make three key contributions to the literature with regards to this topic. First, as per our knowledge, we are the first to examine the unique setting of GIS's role pertaining to firm size interactions. Also, prior studies have not considered longitudinal aspect pertaining to GIS (e.g., Aguilera-Caracuel and Ortiz-de-Mandojana, 2013; Gluch et al., 2009; Chen et al., 2006; Ge et al., 2018). This research offers insight regarding the growing need to understand the impact of firm size in justifying that the enhancement in green innovation improves firm-level financial performance.

Second, we put forward a significantly positive relationship that exists between CFP and GIS, which was crucial as it could help to solve the existing perspective defining the relationship. Our finding offers a holistic means to examine the firm's conditions that allow organisations to create green innovation initiatives as well as simultaneously enhance their financial performance. Moreover, we have stressed on the importance of the combination or configuration pertaining to the firm size, which could cast an impact on the automotive sector employing GIS. In this research study, we have provided in-depth insights by considering all the factors that could have a role in simulating the GIS of an organisation. Also, we have made an effort to aid governments and policymakers in designing impactful mechanisms and guidelines (instead of just creating regulations), thereby allowing the development of environmentally responsible attitudes.

Finally, many of the corporate finance and empirical management researchers recognise at least two potential sources of endogeneity: simultaneity and unobservable heterogeneity (Wintoki et al., 2012). However, one source of endogeneity that has usually been ignored (explicitly or implicitly) comes from the possibility that the current values pertaining to firm performance variables are regarded as a function of previous performance of the organisation. Overlooking this source of endogeneity could cast serious impacts for inference. This study has applied a system GMM estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) on the dynamic panel data to resolve the issue pertaining to endogeneity between the CFP and GIS, which offers evidence confirming their relationship. Moreover, employing this technique has allowed gaining an understanding of the unobservable heterogeneity as well as a better depth pertaining to this study.

This study was structured as follows: Section 2 provided a brief overview of the related literature with regards to the theoretical foundations. Section 3 describes the method, data sample collection techniques and the measurements for all variables. Section 4 presents the descriptive statistics, all correlation coefficients between the variables, and also the outcomes of the interactive effect of the firm size. Section 5 discusses all results and offers directions for future studies. Finally, Section 6 presented the conclusions and implications of this study.

2. Literature review and hypotheses development

2.1. Ecological modernisation theory (EMT)

The ecological modernisation (EMT) theory deals with analysing how contemporary industrialised societies handle environmental crises (Mol and Sonnenfeld, 2000). The EMT theory that defines environmental innovation is put forward as a possible solution to resolve the conflict between environmental protection and industrial development (Murphy and Gouldson, 2000). As there is a need to achieve environmental performance and profitability simultaneously, as envisaged under EMT, green management has emerged as a key management practice for organisations seeking to gain competitiveness via environmental innovation (Hall, 2001). EMT postulates that continued industrial development, instead of inevitably continuing to degrade the environment, provides the best choice to avoid the global ecological challenge (York and Rosa, 2003). The perspective central to EMT can be attributed to the era of modernity that provides a promise that technology development, industrialisation, capitalism and economic growth are not just potentially compatible with that of ecological sustainability but also could act as the major drivers to bring environmental reforms (Mol, 1997). EMT also implies the chance of it being inherent to the process of late modernisation which could be self-referential mechanisms (e.g. the requirement to internalise environmental effects to guarantee future production inputs) that could possibly result in ecological sustainability (York and Rosa, 2003).

EMT provides a theoretical lens to examine the relationship existing between innovation and environmental performance (Jänicke, 2008). It also motivates organisations to employ sustainable technology that allows decreasing the environmental impact on their business. EMT focuses on the chance of achieving ecological-economic ‘win-win’ solutions, above all, by ensuring cost minimisation as well as competition for innovation. As per EMT, the aim of the firm is to modify the direction of technological progress and to establish the compulsion pertaining to innovation benefitting the environment (Jänicke, 2008). Even though EMT offers a wide concept, in this study, we have emphasised on the impact cast by environmental performance on financial performance. The theoretical insight pertaining to EMT states that technological innovation would aid firms in enhancing both their economic and environmental performance. To this extent, EMT implies that firms can address environmental issues as barriers when technological change is complemented with organisational change (Park et al., 2010). We have contested that EMT needs to be regarded as a pertinent management theory that allows understanding and guiding management innovation and change that is ecologically oriented, at the level of firm analysis. The core theoretical underpinning that surrounds the EMT states that organisational technological innovation, like GIS, will aid the firms in enhancing both economic and environmental dimensions.

2.2. Green innovation strategy

Driessen and Hillebrand (2002) defined the concept of ‘green innovation strategy’ and stated that this concept may not be developed with an aim to reduce the environmental burden. However, it yields several important environmental benefits. In their study, Chen et al. (2006) defined GIS as the software or hardware innovative activities related to the green processes or products, like innovative technologies involved in preventing pollution, energy-saving, waste-recycling, designing green products, or even corporate environmental management. Organisation for Economic Co-operation and Development (OECD, 2009) defined GIS as the implementation or creation of novel, better-quality services/goods, processes, marketing techniques or institutional arrangements, that intentionally or unintentionally, can offer better environment compared to their other alternatives. This innovation includes many technological innovations required for preventing pollution, energy-saving, waste-recycling, designing green products, or even environmental management (Lai et al., 2003). It is seen to extend beyond regulatory compliance (Aragón-Correa et al., 2013). Hence, green innovative companies include those companies which are needed for implementing a process of improvement and constant growth which can lead to better and concrete green strategies engagements (i.e., green technologies and products) (Marcus and Fremeth, 2009).

2.3. Green innovation strategy and corporate financial performance

GIS is described as the development of green process and green products-related innovation strategies and decisions that associated with the engagement of green activities and environmental management systems (Eiadat et al., 2008; Tomomi, 2010; Dong et al., 2014). The ecological modernisation theory has encouraged companies to implement novel technological and scientific processes, which would help them strengthen the green processes and green products (Mu et al., 2009; Zhu et al., 2012). Here, this study has applied the definition presented by Huber (1985), who stated that ecological modernisation was a major economic theme involved in the eco-social switchover, as it could lead to the modernisation of the production and consumption cycles using intelligent and novel technologies.

GIS helps in decreasing the negative effect on the environment and also enhance the competitive advantage of the various industries. The companies that advocate the implementation of environmental innovation strategies would lead to the development of a novel business model and alter the rules which help in generating a better business opportunity (Chiou et al., 2011; Chen et al., 2012; Chang and Chen, 2013; Dong et al., 2014). Earlier studies showed that the implementation of GIS offered positive firm benefits and economic developments. In one study, Huang and Jim Wu (2010) observed that environmental innovation in high-tech firms could significantly improve the organisation's financial performance. Furthermore, Tomomi (2010) investigated many small or medium-sized Japanese companies and noted that the environmental strategies offer better opportunities to these companies to improve their business activities and provide them with a competitive advantage. Chiou et al. (2011) stated that if all suppliers implemented a green supply chain, they could easily fulfil the environmental design requirements and display a green innovative performance. Fraj et al. (2013) mentioned that the use of the GIS positively affected the environmental and economic performance in a business-to-business context. Dong et al. (2014) noted that the application of eco-innovative activities by the companies helps in the determination of their competitiveness and environmental performance. In their study, Yang et al. (2018) validated a new model which indicated that GIS offers several firm benefits.

Many researchers argued that the implementation of the GIS can slightly increase the firm innovation portfolios (Hull and Rothenberg, 2008). However, a lack of these GIS could be due to hindrances affecting this innovation, like the presence of a knowledge gap, inadequate governmental support and an aversion to the risks in the capital markets (Runhaar et al., 2008). For instance, many green firms or ventures were seen to be vulnerable as they were developed based on the expectation that the constant governmental subsidies would soon diminish. These issues have made the managers difficult to achieve competitive and environmental improvements in their firms (Hull and Rothenberg, 2008). Though the firms can overcome all the barriers and develop GIS, these innovations are unable to get translated to a higher financial performance level (Link and Naveh, 2006). For instance, Ringer is a manufacturer of nontoxic and natural pesticide, which decreases the ecological harm, however, it is more expensive and less effective compared to the conventional pesticides. Hence, customers do not easily accept these novel products. Furthermore, the firms that apply GIS can increase their product-quality, training and safetyrelated costs (Gelb and Strawser, 2001). However, there will be more cost incurred during the preventive of risk and research and development (López-Nicolás and Meroño-Cerdán, 2011).

Conversely, many researchers believe that the GIS helps the firms improve their overall life quality, are profitable and efficient (Hart, 1995; King and Lenox, 2002). They also increase the requirement for the products amongst the environmentally-sensitive customers (Marcus and Fremeth, 2009). The implementation of the GIS helps in determining the performance of all green processes and products so that they compete in the market, which can be achieved by reducing the company's environmental effects (Chen, 2008; Chiou et al., 2011; Yang et al., 2018). The GIS helps in enhancing preventive pollution, which enables a company to save the operational costs and enable material reuse by recycling (Hart, 1995). Furthermore, a company that shows better environmental initiatives can gain better optimistic ecological image (Christmann, 2000), advantage from the premium pricing and higher revenues, because of a higher societal endorsement (Bansal, 2005). This societal endorsement helps the companies distinguish their services/products from their rivals (Rivera, 2002). Hence, the ethical (environmental) and responsible initiatives were seen to be a source of better and valuable opportunities (Porter, 2006; Porter et al., 2007). Also, GIS helps the firms to increase their efficient use of raw materials for decreasing the environmental costs and increasing their waste recycling (Chiou et al., 2011; Zhu et al., 2012). Innovative activities cause the firms to develop new processes for converting waste products into greener products which provide an alternative income source. Along with the green products, the GIS helps the firms to integrate the green concepts for reorganising and improving their business tactics.

Additionally, the GIS is able to fundamentally alter the competition in the industry. When the competition is fiercer, the firm is able to capitalise on the advanced technology for environmental innovation and address the environmental issues in the market. The GIS helps the firms to develop and reconfigure better and innovative processes for improving the competition and differentiating them from their competitors (Eiadat et al., 2008; Tomomi, 2010; Dong et al., 2014). Hence, the subsequent Hypothesis was developed:

Hypothesis 1. (H1): Green innovation strategy positively affects the corporate financial performance.

2.4. The moderating role of the firm size

As shown in the above section, GIS positively affects the CFP. However, this effect is an intricate and multi-faceted issue. Several factors can affect the firm performance such as the contextual and environmental variables like firm size (Yeung, 2008; Ramaswami et al., 2009). The firms with varying sizes use different data management strategies and can achieve a differing level of governmental benefit, thereby showing a different corporate performance.

It is generally believed that the larger firms are more visible, and are more socially responsive. In contrast, the smaller firms have to attain lesser pressures or acquire lesser environmental-related recognition, based on their lower visibility. It is also stated that the larger firms are less socially responsive and are more resistant to other effects (Meznar and Nigh, 1995), which is very contradictory. The effect of the firm size on the GIS is based on the access to all resources (Brammer and Millington, 2006). The large organisations are related to a superior financial or resources, and significantly influence their environmental initiative commitment (Johnson and Greening, 1999). The smaller companies have inadequate or constrained resources, which affects the GIS application. The final attribute is related to firm size. The larger organisations display advanced management processes (Donaldson, 2001) and perceive or handle the exterior situation differently, based on their experience (Miles, 1986). Thus, the internal system necessary for handling the issues is more advanced, which shows better receptiveness to the environmental issues (Brammer and Millington, 2006).

This is further summarised to indicate that the size of the firm highlights the more complex phenomena which affect the green innovation participation. Thus, broader conclusions can be derived from the firm size, provided the interrelation between all related attributes is also considered. This leads to the development of many theories that are investigated using integrative contributions. In this study, we have made a small effort to scrutinize the influence of the firm size on the correlation between the GIS and the CFP.

The different firm-level attributes can affect the engagement of the GIS. Hence, it is significant to comprehend these effects, as these firms can develop strategic value from the GIS. Apart from these effects, the firm size was considered to be important and unexamined (Madden et al., 2006; Hörisch et al., 2015). The firm size affects the strategic motivation, which can positively affect the GIS (McElroy and Siegfried, 1985; Adams and Hardwick, 1998). The larger firms showed a significant social effect, based on the scale of all their activities (Cowen et al., 1987); hence, they are required to be more socially responsible than the small firms. On the other hand, studies showed that small firms are involved in GIS activities, especially by giving donations (Madden et al., 2006). Therefore, the query that rises is what inspires the small firms to apply GIS activities, and also if this was economically justified?

The firms which have to undergo financial or slack resource constraint are likely to use the existing capitals for improving their competitive advantage using traditional ways of competition. The organisations with a higher cash flow show a better response to the stakeholder pressure, using discretionary activities like the GIS activities (McGuire et al., 1988), while the organisations with a low-profit-margin cannot participate in this discretionary behaviour, based on the creditor and shareholder requirements (Brammer and Millington, 2006). This inhibits the implementation of these companies in GIS actions. The resource-rich firms face a comparatively lesser constraint and are more likely to discharge their social responsibilities.

The firm operations can affect their green innovation involvement, at the functional and administrative level. The companies with an established decision-making process or organisation structure are more probable to participate in such activities since they consist of developed systems that can handle the external issues (Miles, 1986; Bhambri and Sonnenfeld, 1988; Donaldson, 2001). Due to their organisational maturity, these firms display clear structures, especially related to their ability and expertise, and were able to implement effective GIS activities. Furthermore, the firms make use of their firm's competencies for framing the GIS activities (Hess et al., 2002). These companies are facing greater pressure to warrant that their environmental commitments do not increase the organisational costs (Van de Ven and Jeurissen, 2005). Thus, they are seen to be specialists in implementing the GIS activities, based on their firm's competencies. The firms with a higher operational scale are able to efficiently re-allocate and re-organise their resources. These companies are very likely to initiate GIS activities and show a distinguishable environmental transformation. The scale-economies can increase the corporate environmental performance (Brammer and Millington, 2006), and the GIS activities are more effective if they are implemented on a larger scale. This could deter the firms with a small-scale operation to implement such activities. Furthermore, these firms could be dissuaded based on the probability that their involvement was not prominent and would not generate benefits. The firms also tend to avoid any

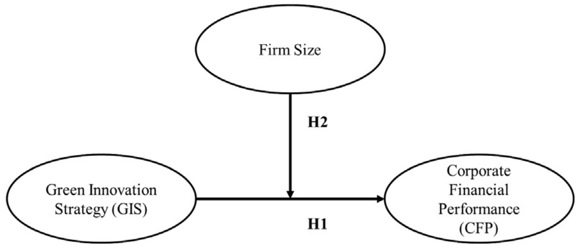

Fig. 1. Research framework.

participation in GIS activities, since ineffective or inadequate participation could negatively affect their reputation. Hence, the subsequent Hypothesis was proposed:

Hypothesis (H2). Firm size moderates the relationship between green innovation strategies and corporate financial performance, especially when the firm size is big, the relationship between the GIS and the CFP becomes stronger.

To test these hypotheses, the research framework (Fig. 1) demonstrates the relationships of GIS as part of the company vital strategy that effects on the CFP. This study also delves the moderating role of firm size in order to assess their influence between the GIS to CFP path.

3. Methodology

3.1. Data collection and samples

In this study, we compiled all the data from two datasets, i.e., the CSRHub (https://www.csrhub.com/csrhub/), which consists of all information regarding the measures of GIS. CSRHub is a leading research company that consists of the Environmental, Social and Governance (ESG) data. This approach is more advantageous as it addresses the limitations seen in other methods like the Viego and KLD. The CSRHub[1] database comprises data from more than 18,424 organisations from 132 countries in 10 regions. Thus, the CSRHub provides data from nine sources from the premier Socially Responsible Investment (SRI) firms, known as the ESG analysis firms, like the EIRIS, Carbon Disclosure Project (CDP), ASSET4 (Thomson Reuters), Governance Metrics International (merged with the Corporate Library), IW Financial, MSCI (ESG Intangible Value Assessment and the ESG Impact Monitor), Trucost, RepRisk, and Vigeo. Thereafter, the data collected from 265 NonGovernmental Organisations (NGOs) like the publications, associations, foundations, activist groups, union groups, governmental databases, and research reports, was augmented using data from other data sources. Hence, the CSRHub schema was seen to be associated with the firm's achievement and was based on the 0–100 rating scale. A higher score indicates a positive rating score (100 = very positive rating). Though the CSRHub updates all the values monthly, the Datastream updates all the financial data quarterly or annually. Thus, it could be seen that if the changes in the GIS significantly affected the firm performance, the Datastream data undergoes an annual change. Here, this study estimated the annual changes occurring in the GIS by taking an average of all the GIS scores for the consecutive 12 months, and thereafter combined the value with the Datastream data. All the industries were classified based on their 2-digit SIC codes and the companies with less than 7 observations were eliminated. The final data sample consisted of 163 firms and annual 1194 observations between 2011 and 2017.

3.2. Definition of variables and measurement

3.2.1. Green innovation strategy

In this study, we defined the GIS performance evaluation" based on the ISO 14031 standards, similar to that used in earlier studies by Chen et al. (2006), Campos et al. (2015), and Nguyen and Hens (2015). Thus, the performance of a GIS was defined as the performance of the hardware and software involved in any innovative activity that was implemented by the company with regards to the use of green processes or products. These also include the technologies required for preventing pollution, energy-saving, recycling of wastes, designing green products and corporate environmental management. Hence, in this study, we measured the GIS using three main CSRHub databases as follows:

3.2.1.1. Energy and climate change subcategory scores. This parameter measures the company's effectiveness while addressing the climatic changes using appropriate energy-efficient operations, strategies and policies, the development of better and renewable energy sources and alternative environmental technologies. This subcategory includes the energy usage, emission of CO_2 and other greenhouse gases.

3.2.1.2. Environmental policies and reporting the subcategory scores. This subcategory includes the company's intentions and policies for reducing its environmental effect and value streams to the levels which are healthy for the environment, in present and in future. This data comprises the firm's environmental reporting performance, its adherence to the environmental reporting standards like the Global Reporting Initiative, and its compliance with the investors', regulatory or stakeholders' request for transparency. This compliance data comprises of a breach of the accidental releases and regulatory limits.

3.2.1.3. Resource management subcategory scores. This category determines how effectively the company uses all resources for manufacturing or delivering the products and services, like the company's suppliers. This also includes the firm's ability to decrease the usage of materials, water and energy and the determination of effective solutions for improving the supply chain management. Furthermore, this subcategory also contains the environmental performance with respect to its production size and the manner in which it is monitored using the operation linked Eco-Intensity Ratios (EIRs) for the energy and water resources, well-defined as the resource consumption per released/formed unit. The resources contain the raw materials and the packaging materials used for production and packaging of products and similar other processes. The Resource Management data includes waste and recycling performance. Furthermore, the recycling data was associated with the ratio of the amount of waste that is recycled to the total amount of waste. The data also includes the manner in which the company manages all the operations for benefiting the local watershed and air shed and the manner in which the company affects the land usage and local ecological stability. All water resource-related data also comprises the consumption of drinking water, industrial waters and steam. For deriving the GIS data, this study calculated the mean scores for the three subcategories as follow:

[1] See detail of the CSRHub Ratings Methodology: https://esg.csrhub.com/csrhub-ratings-methodology.

$$GIS = \left[\frac{\textbf{Energy and Climate Change} + \textbf{Environmental Policy and Reporting} + \textbf{Resource Management}}{3}\right]$$

3.2.2. Corporate financial performance (CFP)

The CFP was measured using the accounting measures described below:

Return on Assets (ROA): It is defined as the percentage for determining the profitable nature of the company, related to the total assets. For calculating the ROA, we collected all data from the DataStream regarding the total earning of the company before the interest taxes, repayments and also the total assets of every company during the study period. Thereafter, we computed the Return on Assets as follows:

$$Return\ on\ Assets = \frac{EBITA\ (Earning\ Before\ Tax,\ Interest\ and\ Amortisation)}{Total\ Assets}$$

Another measure of profitability includes the Return on Equity (ROE). This parameter is expressed as a percentage and defined as the net income which is returned as the percentage of the shareholder's equity. This factor was manually calculated by collecting all the data from the DataStream based on the earnings before the interest taxes, amortisations and shareholder equity, as follows:

$$Return\ on\ Equity = \frac{EBITA\ (Earning\ Before\ Tax,\ Interest\ and\ Amortisation)}{Total\ Equity}$$

The last accounting measure includes the Return on Sales (ROS), which refers to the ratio which is used for measuring the operational efficiency. This factor was also expressed as a percent value and was manually computed by collecting all data from the DataStream for the total revenue and net income as follows:

$$Return\ on\ Sales = \frac{Net\ Income}{Total\ Revenue}$$

3.2.3. Control variables

Here, this study included a set of variables for controlling the potential effects on the relationship between the GIS and the CPF. The various control variables described in earlier studies included the firm size, firm risk, research and development intensity, advertising intensity, and slack resources. Firm size was seen to be a significant control variable and used the total assets of the company as the indicator variable regarding its size. In their study, McWilliams and Siegel (2001) stated that an omission of the advertising and R&D factors from the model which studies the relationship between the social and financial performances of a company could lead to erroneous results. This could be because of the following reasons: First, the process of the product differentiation includes the investments in all those R&D projects that add to the social or environmental attributes of a product, which can be easily acknowledged by the customers. Second, the advertising helps in increasing consumer awareness regarding the environmentally-friendly products and the manner in which they differ from the other products. Thus, advertising was seen to be an indicator of the environmental responsiveness of the company to the market. Here, we have computed the R&D factor using the ratio of the R&D expenditures to the total sales, whereas advertising refers to the ratio of the advertising expenses to the total sales. Several studies attempted to control the firm risk. This study investigated many reports (Waddock and Graves, 1997; McWilliams and Siegel, 2001), before measuring the risk, which was calculated as the ratio of the total debts to the total assets. This study also included the slack resource, which was calculated as the ratio between the free cash flow and the company's total assets.

3.3. Empirical model

3.3.1. System Generalisation Method of moment (GMM)

According to this study, two major issues have to be resolved in this study. First, we exploited the dynamic data structure and studied the past CFP for determining the current CFP (Surroca et al., 2010). Secondly, while investigating the relationship between the GIS and the CFP, the existing CFP could be correlated with the unobservable and the observable factors (like the unobservable and observable heterogeneity), which helps in determining the GIS-related decisions. Specifically, the firms which relied on the high-quality products or processes showed a higher GIS commitment. However, the contribution of the GIS to the CFP would be overstated if the endogeneity issues were not properly calculated.

This study used the system Generalised Method of Moments (GMM) estimator, proposed earlier by Arellano and Bover (1995) and Blundell and Bond (1998). This estimator is particularly formulated for circumstances with 1) "small T, large N" panels, meaning fewer time periods and various individuals; 2) a linear functional relationship; 3) a single left-hand-side variable that is dynamic, depending on its own past realizations; 4) independent variables that are not strictly exogenous, meaning correlated with past and possibly current realizations of the error; 5) fixed

Table 1
Descriptive statistic.

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	1129	0.1253	0.1152	−2.2000	0.5774
ROE	1129	0.4847	1.3588	−4.5000	29.0400
ROS	1119	0.7183	2.2555	−7.3333	14.0000
GIS	1129	55.1327	9.1333	28.1767	79.0690
R&D Intensity	1129	0.0191	0.1035	0.0000	1.5131
Advertisement Intensity	1129	0.1087	0.0962	0.0000	0.5536
ln total assets	1129	8.4112	1.8941	2.7801	13.0843
Leverage	1129	1.2382	4.6004	−0.6341	90.4000
Free Cash Flow	1129	0.0387	0.0800	−0.4533	0.5177
ln revenue	1119	8.3706	1.8334	0.1310	12.4798

individual effects; and 6) heteroskedasticity and autocorrelation within individuals, but not across them. This estimator helped in overcoming issues like the dynamic panel bias and the potential endogeneity of the regressors. Hence, this estimator was used rather than the traditional panel OLS or Within Group estimations approach (Arellano and Bover, 1995; Blundell and Bond, 1998, 2000; Blundell et al., 2001; Bond et al., 2001; Hoeffler, 2002). Furthermore, the OLS levels and Within Groups estimations were inconsistent and biased, since (i) OLS levels often neglect the unobserved time-invariant firm effects; and (ii) The Within Groups approach considers the unobserved country-specific effects within a specific time period using the dynamic panel data model (Nickell,

Table 2
Bivariate correlation matrix.

	1	2	3	4	5	6	7	8	9	10
ROA	1									
ROE	0.1804	1								
ROS	−0.0189	−0.0115	1							
GIS	0.0383	0.0267	−0.0205	1						
R&D Intensity	0.0399	0.0318	−0.0072	-.01202	1					
Advertisement Intensity	0.0303	0.0236	−0.0431	−0.0510	0.0550	1				
ln total assets	−0.0318	−0.0235	0.0404	0.0789	−0.0429	−0.4651	1			
Leverage	−0.0037	0.9206	−0.0102	0.0137	0.0232	0.0118	0.0060	1		
Free Cash Flow	0.2004	0.0879	−0.0200	0.0651	0.0361	0.1857	−0.2306	−0.0278	1	
ln revenue	0.0582	0.0112	−0.1533	0.0014	0.0014	−0.3295	0.6942	0.0158	−0.01320	1

Table 3
The effect of GIS on CFP.

Variables	Dynamic system GMM		
	Panel 1	Panel 2	Panel 3
	ROA	ROS	ROE
ROA_{t-1}	0.627***		
	(0.0926)		
ROS_{t-1}		0.791***	
		(0.000835)	
ROE_{t-1}			0.00246***
			(0.000951)
GIS	0.000611**	0.00325***	0.00158**
	(0.000242)	(0.000600)	(0.000712)
R&D Intensity	0.0285	−0.0440	11.24***
	(0.191)	(1.475)	(1.617)
Advertisement Intensity	−0.153	−0.223	−0.251
	(0.100)	(0.535)	(0.245)
ln total assets	0.0251***	0.0942*	0.0690**
	(0.00575)	(0.0660)	(0.0276)
Leverage	7.61e-05	0.000124	0.289***
	(0.000239)	(0.00188)	(0.00313)
Free cash	0.300***	0.477**	0.745***
	(0.0672)	(0.823)	(0.188)
Dummy R&D Intensity	0.0489	−1.908***	−1.956***
	(0.0716)	(0.639)	(0.398)
Dummy Advertisement Intensity	−0.00424	0.0410	0.375**
	(0.0334)	(0.207)	(0.177)
Constant	−0.216***	−0.423	−0.432
	(0.0731)	(0.695)	(0.320)
Year Dummy	Yes	Yes	Yes
Observations	966	955	966
Number of firms	163	162	163
No of Instruments	26	26	26
AR1	−2.87 (0.004)	0.30 (0.062)	−2.07 (0.039)
AR2	1.124 (0.263)	0.26 (0.797)	0.02 (0.984)
Hansen Test	16.45 (0.422)	13.76 (0.744)	30.49 (0.116)
Different in Hansen Test	4.052 (0.853)	9.02 (0.341)	22.26 (0.104)

Notes: All models are estimated by using the Blundell and Bond (1998) dynamic panel data system GMM estimations and Roodman (2009) - Stata xtabond2 command. The standard errors are reported in parentheses, except for Hansen test, AR (1), AR (2) and Difference-in-Hansen which are p-values. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. Time dummies are included in the model specification, but the results are not reported to save space. The instruments employed in the first-differenced equation are two or more lags of the levels of the endogenous variables, while one lag of the first-difference of the endogenous variables is used as instrument in the difference equation.

Table 4
The contingency effect of firm size on GIS − CFP link.

Variables	Dynamic System GMM		
	Model 1	Model 2	Model 3
	ROA	ROS	ROE
ROA_{t-1}	0.540***		
	(0.0853)		
ROS_{t-1}		0.735***	
		(0.00983)	
ROE_{t-1}			0.00404*
			(0.00215)
GIS	0.00571***	0.300***	0.517***
	(0.00140)	(0.0725)	(0.0799)
Size	0.0730***	1.656***	3.329***
	(0.0125)	(0.634)	(0.569)
Size*GIS	−0.000598***	−0.0350***	−0.0612***
	(0.000153)	(0.00905)	(0.0101)
R&D Intensity	0.00259	−0.550	−0.308
	(0.179)	(0.496)	(0.344)
Advertisement Intensity	−0.127	−0.650	−1.278
	(0.0799)	(4.083)	(1.892)
ln total assets	−0.0111	−0.0164	−0.538***
	(0.0145)	(0.314)	(0.201)
Leverage	−0.000230	−0.00101	0.286***
	(0.000249)	(0.00127)	(0.00776)
Free cash	0.280***	0.756	1.240***
	(0.102)	(0.829)	(0.429)
Dummy R&D	0.0131	−0.197	−0.335
	(0.0668)	(2.256)	(0.340)
Dummy Advertisement Intensity	0.0233	0.457	−0.244
	(0.0322)	(2.403)	(1.619)
Constant	−0.530***	−14.33***	−22.91***
	(0.105)	(4.034)	(4.401)
Year Dummy	Yes	Yes	Yes
Observations	957	955	957
Number of Firms	162	162	162
No of Instruments	29	29	29
AR1	−2.73 (0.006)	−2.51 (0.012)	−2.90 (0.004)
AR2	0.73 (0.468)	0.37 (0.712)	1.68 (0.093)
Hansen Test	22.82 (0.198)	17.44 (0.425)	13.37 (0.717)
Different in Hansen Test	8.74 (0.462)	8.75 (0.364)	5.82 (0.667)

Notes: All models are estimated by using the Blundell and Bond (1998) dynamic panel data system GMM estimations and Roodman (2009) - Stata xtabond2 command. The standard errors are reported in parentheses, except for Hansen test, AR (1), AR (2) and Difference-in-Hansen which are p-values. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. Time dummies are included in the model specification, but the results are not reported to save space. The instruments employed in the first-differenced equation are two or more lags of the levels of the endogenous variables, while one lag of the first-difference of the endogenous variables is used as instrument in the difference equation.

1981; Hsiao, 2014). Furthermore, the coefficient estimates of the lagged dependent variables derived from the OLS levels and Within Groups estimators were considered to be the approximate upper and lower limits, respectively (Bond et al., 2001; Hoeffler, 2002).

This system GMM is seen to yield efficient and consistent estimates in the regression model, wherein the independent variables were not strictly exogenous, i.e., these estimates were correlated with the past and the existing realizations of error, if the autocorrelation and heteroscedasticity in the estimates are existent (Roodman, 2009a). Furthermore, this estimator controls the endogeneity issues by instrumenting all lagged dependent and other endogenous variables with the variables that are believed to be unrelated to the fixed effects (Nickell, 1981; Roodman, 2009a). Compared to the difference GMM estimator, proposed earlier by Arellano and Bond (1991), the System GMM was more efficient as it assumed that the initial differences between the instruments were uncorrelated with all fixed effects, which, included additional instruments (Roodman, 2009a). Furthermore, the System GMM yielded effective estimates in the cases where the series were similar to random walks, while the Difference GMM estimator was subjected to large sample bias, in such scenarios (Blundell and Bond, 1998). The Difference GMM estimator was more biased downwards than the Within Groups estimator if all instruments were weaker (Blundell and Bond, 2000; Hoeffler, 2002).

Tables 3 and 4 present the System GMM regression results for the automotive companies, derived using Eqs. (2) and (5) in the 7-year period, between 2011 and 2017. It was believed that the two-step system GMM estimator yielded efficient estimates compared to a 1-step system GMM approach. It was noted that the efficiency gain was very small and the asymptotic standard errors related to the two-step GMM estimators were seriously biased downwards in the finite samples (Blundell and Bond, 1998; Hoeffler, 2002). Since there are extra groups in this study, we used a two-step system GMM estimation method. In the case of all the estimates, the lagged dependent variables were presumed to be predetermined, while the control variables were considered to be endogenous.

The stability of the System GMM estimators was dependent on the assumptions that the error terms do not show serious correlation issues, the validity of all instruments and additional moment restrictions. For verifying the validity of all assumptions, we further applied the Arellano-Bond test for determining a no serial correlation between the error terms, while we applied the Hansen test for all instruments, and a Difference-in-Hansen test for the additional moment restrictions. The table also reports the specification test results for all System GMM estimations. Based on all the tests, the System GMM equations were appropriately specified.

Furthermore, the Arellano-Bond test results need a lack of AR (2) serial correlation between all error terms. The Hansen test also assesses if the instruments were uncorrelated with an error term; while the Difference-in-Hansen test determines the validity of the additional moment restriction in Eqs. (2) and (5).

3.3.2. Model

The empirical model which was used in this report was an extension of the model described earlier by many researchers (Li et al., 2017; Wong et al., 2018). Thereafter, it is a common activity to examine all empirical relationships between the GIS and the CFP, with the help of the following linear growth equation. Based on various models, the CFP relationship for the firm, *i,* in time, *t*, was a function of GIS and control variables as follows:

$$Corporate\ Financial\ Performance = \int Green\ Innovation\ Strategy \tag{1}$$

We estimated the relationship between CFP (ROA, ROE or ROS), based on its lagged value, CPF_{it-1}, and the GIP variables (rating or scores defined earlier), GIP and a set of firm-level control variables (i.e., in total assets, leverage, R&D, advertisement costs, free cash flow and annual dummies), labelled $CONTROL_{it}$, using the following regression equation:

$$CFP_{it} = á + âCFP_{it-1} + ãGIS_{it} + \delta_J \sum_{j=5}^{n} CONTROL_{it} + ì_j + å_{it} \tag{2}$$

where |â|<1. The disturbances, μ_{it} and $å_i$, were not cross-correlated and showed the properties:

$$E\ (å_i) = 0;\ E(ì_{it}) = 0;\ E(å_i ì_{it}) = 0 \tag{3}$$

All time-varying errors were presumed to be uncorrelated:

$$E(\mu_{it} ì_{is}) = 0 \text{ with } t \neq s \tag{4}$$

i = 1, …, 163; t = 2011 …, 2017.

Based on the study, no additional conditions were imposed on the $ì_{it}$ variance, since the moment conditions needed for model estimation, requires no homoscedasticity. CFP represents the existing firm performance, GIS refers to the total GIS scores for firm, *i,* in the period, *t*; CFP_{t-1} denotes the firm performance with 1 period lag; *CONTROL* refers to the control variables (*ln total assets* refer to the log of total assets; leverage, free cash flow and time dummies); μ_i refers to unobserved firm-specific fixed effects; while, $å_{it.}$was an error term. A robustness test was carried out using other dependent variables like ROE and ROS.

For confirming the moderating role of the firm size in the automotive sector, we established some models and also studied the relationship between the GIS and CFP. The model which studied the effect of the interactions between the GIS and firm size on CFP was:

$$CFP_{it} = á + âCFP_{it-1} + ãGIS_{it} + \gamma_1 GIP_{it} * SIZE_{it} + \delta_J \sum_{j=5}^{n} CONTROL_{it} + ì_i + å_{it} \tag{5}$$

The above-mentioned variables accounted for all probable interactions between GIS and firm size, while the affiliation of the product of variables with GIS was included as the regressor.

4. Results and discussion

In Step 1 of the empirical study, we aimed to offer direct empirical evidence for describing the dynamic correlation between GIS and CFP. We used the ROA as a CFP measure (Table 3) and thereafter, replicated these estimates using the ROE and ROS measures (Table 3) for assessing if the results were sensitive to the particular CFP indicators. Lastly, we tested the interactive effect of the GIS and firm size on the CFP (Table 4).

4.1. Descriptive statistics and correlation results

Tables 1 and 2 present the descriptive and correlation results noted in the study. Table 1 describes the mean and median values of the main and control variables. The average GIS scores for the companies investigated in the study during the time period between 2011 and 2017, was 55.12, which indicated that the GIS performance was even and all GIS initiated by the automotive sector was optimistic. This result was consistent with that observed by Vaz et al. (2017). With regards to the financial variables, the maximal and the minimal ROA values were 0.58 and −2.20, respectively; while those for ROE were 29.04 and −4.5, respectively and ROS were 14.00 and −7.33, respectively. Furthermore, the respective average values were 0.13, 0.48, and 0.72. In comparison, the effect of the mean firm size on the total assets and revenue was seen to be 8.41 and 8.37, which indicated that there was no significant difference between the 2 proxies. For determining the likelihood of the presence of multicollinearity between the variables, we investigated the degree to which every variable was explained using other model variables, using the Variance Inflation Factor (VIF) (Hair et al., 1998). The results showed that the VIF values were below the maximal acceptable value of 10, with the values ranging between 1.03 and 7.74, and the tolerance ranged between 0.96 and 0.12. Also, the mean VIF value of 3.43 suggested that the data points showed no multicollinearity-related issue in the study.

4.2. GIS-CFP relationship

Table 3 presents the system GMM estimates for Model 1. CFP was measured using ROA. Table 3 also presents the CFP results that were determined using the ROE and ROS measures, for Models 2 and 3. Using the system GMM estimator, we validated the standard tests for misspecification, i.e., a 2nd-order serial correlation test (i.e., AR (2) test); Hansen test for other-identifying restrictions and a Difference-in-Hansen test that determines the validity of additional moment restrictions. We also controlled the no. of instruments against the group. The positive coefficient of the lagged dependent variables showed that the CFP was persistent, i.e., CFP was dependent on its earlier realisation. Results indicated that irrespective of the estimation techniques, the control variables showed no difference. We noted that the total assets (e.g., firm size) and slack resources positively affected CFP. Factors like RnD, leverage or advertising ratio did not affect the ROA.

This study compared the ROA, ROE and ROS values, and noted that these values were similar, except the ROE and the ROS negatively affected the R&D intensity. This could be due to the fact that a higher R&D expense negatively affected the CFP, as it also increased the finances required for implementing the new strategies (Hall and Weiss, 1967). However, only the ROE showed a positive correlation with the leverage, which indicated that the debt played a positive role in decreasing the agency issues as it discouraged the free cash flow over-investment by the self-serving managers (Jensen, 1986; Stulz, 1990; Harvey et al., 2004).

For testing Hypothesis 1, we applied the regression Model 1 in

Table 3, which showed a positive correlation between GIS and ROA (ã = 0.000666, $p < 0.05$). This confirmed Hypothesis 1 that GIS positively affected CFP. Table 3 also indicated that the GIS coefficient positively affected the ROS and the ROE estimates (ã = 0.0033, $p < 0.001$; ã = 0.0016, $p < 0.05$). These findings were not based on the reverse causality and were consistent with Hypothesis 1. Thus, all results supported the earlier evidence regarding the synergistic correlation between GIS and CFP (Hart, 1995; Porter and Van der Linde, 1995a,b; King and Lenox, 2002). Implementation of GIS activities increases the CFP, which helps the companies display a better corporate reputation, thereby highlight their social responsibility (Cordano and Frieze, 2000; Cronin et al., 2011; Sheng et al., 2011). Also, the proactive green innovators attract several clients, which further increase the market share of all companies.

Use of GIS activities helps the firms increase productivity, avoid environmental protests/penalties, enhance corporate reputation, develop new markets, foster a green awareness-related image, and achieve a 1st-mover based competitive advantage (Chen et al., 2006; Mu et al., 2009; Lau et al., 2010). Zhu et al. (2012) stated that these eco-innovative activities help the firms decrease their waste and increase brand promotion, which stimulates their market shares and generate new business opportunities. This was supported by the Toyota Prius Hybrid case, which was a status symbol vehicle and used green-labelling product strategies (Bonini and Oppenheim, 2008). Based on a resource-based view, the corporate reputation was an intangible asset and source of competition, as it was rare, inimitable and valuable (Aragón-Correa and Sharma, 2003). Based on a financial view, the market investors offered a higher premium to the firms with a good image (Konar and Cohen, 2001).

4.3. Moderation effect of the firm size on the correlation between the GIS and CFP

Table 4 presents the model, which describes the interaction between the GIS and firm size (SIZE*GIS). Brambor et al. (2006) stated that the variables need not be individually interpreted, as they were not important. Table 4 showed that the coefficient values related to GIS and firm size were negative, while the interactive terms were seen to be statistically significant determinants of the CFP for all 3 models. For example, in the case of Model 1, the interaction coefficient value between the firm size and GIS showed a significantly negative moderating effect on ROA (â = −0.000598, $p < 0.01$). Such empirical results showed that the firm size played a vital role in moderating the effect of GIS on the CFP. However, if the interactive term showed a negative sign, and was significant, the moderating effect of the GIS on the CFP weakened with increasing firm size. Thus, the GIS showed a higher detrimental effect on the CFP. Hence, this result supported the view that smaller firms could easily recognise better opportunities. They were seen to be more flexible while adjusting their research plans or during the implementation of their GIS activities. Furthermore, the smaller firms were better able to adjust the employee incentives for providing optimal innovative efforts, and they also allowed a lesser rigid management structure which helped the important employees devote more time for innovative activities, and not for management-related activities (Rogers, 2004). This disproved Hypothesis 2.

For interpreting and understanding the nature of this interaction, this study presented the moderating correlation graphically (Fig. 2) (Aiken et al., 1991). As shown in the figure, the slope of GIS on the ROA for the larger firms was negative and significant (−0.0036, $p < 1$), however, it was still positive and slightly significant for the smaller firms (0.0164, $p < 1$). Hence, compared to the larger firms, the smaller firms could derive a higher financial benefit after implementing their GIS which Fig. 3, and Fig. 4 also displayed the same results. Figs. 2–4 also indicated that the smaller firms, which implemented GIS, lowered the damage inflicted onto the organisation, and also helped in increasing the support from the high-identification stakeholders. Furthermore, the small firms

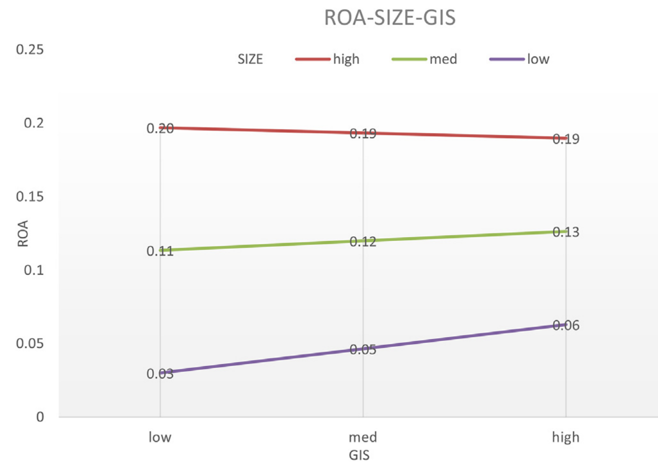

Fig. 2. Effects of GIS on ROA: Contingent on firm size.

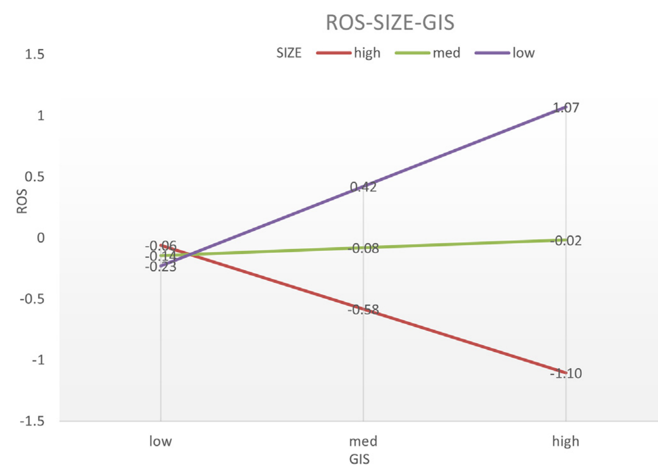

Fig. 3. Effects of GIS on ROS: Contingent on firm size.

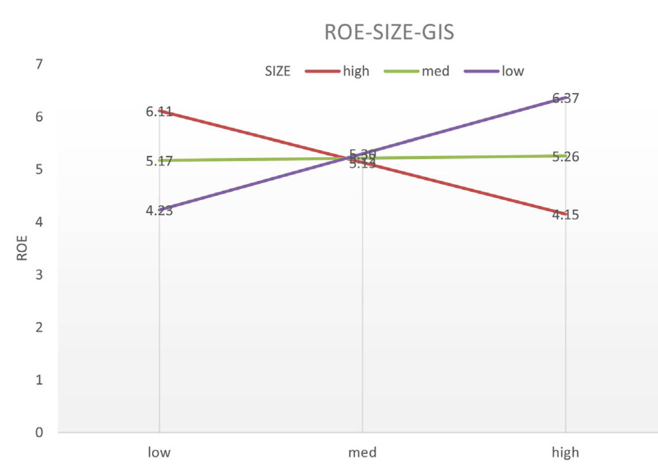

Fig. 4. Effects of GIS on ROE: Contingent on firm size.

were probably close-structured, which indicated a differing governance structure compared to the larger firms (Demsetz, 1983). Though a majority of the smaller firms face a performance-based issue, they offer better benefits than the larger firms. Their size also makes them more flexible and independent from the institutional bureaucracy (Leal-Rodríguez et al., 2015). These results were in direct contrast to those presented by the Schumpeterian Hypothesis (Scherer, 1970), which stated that the larger firms showed higher technological progress than the smaller firms, and therefore, displayed a better firm performance.

Here, this study noted that the firm size significantly affected the performance of the automotive companies. Thus, the firm size was an external environment indicator and affected the business performance. Even though GIS can drive firm's sustainability and growth, despite the fact GIS is implemented, an incur of higher cost is unavoidable and an alteration in organisational normal practises will transform an organisation becoming more fragile, and even tarnish the sustainable competitive advantages. The traditional economic trade-off debate suggests that companies impose higher costs to enhance better environmental performance and that these costs surpass the monetary benefits gained from them (e.g., Friedman, 1970; Greer and Bruno, 1998). Moreover, by improving environmental performance a firm is simply transferring societal costs to the firm (e.g., Bragdon and Marlin, 1972). Consequently, this approach proposes that engaging environmental initiatives might be both lossmaking money and unsuitable for firms.

Many researchers stated that the larger firms were effective innovators. Any firm, which already possesses monopoly power, was less motivated towards innovation, as it felt threatened by its competitors, or due to the fact that the sale of new products could affect the sale of the existing products. Some studies (Mansfield, 1968; Mansfield et al., 1971) indicated that the larger firms, which included many people in the decision-making process and consisted of a long chain of command, showed lower flexibility and inefficient managerial coordination. It was stated that as the firm size increased, the firms became very bureaucratic. Furthermore, this study would also be less motivated to investigate the larger firms, since their efforts would not yield a higher personal benefit as the smaller firms. Also, the unexpected results would be lost in the shuffle, in the larger firms than the smaller firms. Thus, the relative strength of the smaller firms was based on their behavioural characteristics. For example, higher the motivation displayed by the management and workers, the better the variation and improvisation in all tasks performed by the workers, tacit knowledge resulting in specialised skills, and higher the flexibility and communication (Nooteboom, 1994; Rothwell and Dodgson, 1994). As the advantages displayed by the larger firms were the limitations of the smaller firms and vice versa, they could be summarised as the advantages offered by the smaller and larger firms.

A majority of the empirical findings showed that the small and the medium-sized firms conducted more efficient R&D than the larger firms. The small firms and the independent investors were disproportionately responsible for the major innovations (Acs and Audretsch, 1990), which was similar to the observations made by Vossen (1998), who stated that the smaller firms were more cost/profit efficient. The smaller firms showed a higher innovative output compared to their innovative inputs due to many reasons. Firstly, the R&D activities of small firms are usually underestimated in several standard surveys, since the formal R&D carried out in different R&D departments is generally measured (Kleinknecht and Reijnen, 1991). Many researchers investigated the different components of the innovation costs and noted that the large firms showed a higher R&D investment compared to the small firms (Archibugi et al., 1995; Felder et al., 1996). If this was different from the manner in which it was measured, the R&D activities cannot appropriately estimate the innovative input of the small firms. Secondly, Acs et al. (1994) showed that small firms could effectively take better advantage of the knowledge spill-over from the corporate or university R&D departments. Thirdly, the economic value of all the innovative activities differed between the smaller and larger firms, as noted by Cohen and Klepper (1992), who noted that under specific stochastic conditions, the large firms produce lesser innovations for every dollar spent on the R&D activities; however their innovations were of a better average quality.

Furthermore, due to the fact that the small firms generated more innovations compared to their input, Zenger (1994) stated that the apparent organisational diseconomies of scale far outweighed the technological economy of scale in the R&D. Based on the above-mentioned explanations regarding the organisational characteristics depending on the firm size, it was concluded that the small or large firms were not better innovators. Rather, the small or the larger firms were better at differentiating the various innovations, or their role varied in the industry cycle, in a “dynamic complementary” manner (Nooteboom, 1994). The larger firms were better at innovating as they made good use of economy of scope or scale, or consisted of a large team of experts and specialists, for conducting basic, science-based innovations or large-scale applications, which were of a higher economic value (Cohen and Klepper, 1992). The smaller firms were better innovators since their effect of scale were not (yet) vital and they could make good use of their proximity and flexibility to the market demands, like developing new products or new market combinations, modifying the existing products for the niche markets, or developing small-scale applications. Furthermore, their efficiency in generating these innovative products was also improved by their capability to take advantage of the knowledge spill-over from the larger company's R&D departments (Acs et al., 1994).

5. Conclusions

In this study, this study has developed a novel theoretical model which examined the relationship between the GIS, firm size and the CFP. The results obtained from this study could make important contributions to the existing literature regarding the sustainable development into the innovation and the strategy management (Zhu et al., 2012; Dong et al., 2014; Fargnoli et al., 2014; Pekovic et al., 2016). In the past few years, many companies have begun developing and implementing ecological modernisation techniques which helped them conduct their operations in an environmentally-innovative manner. This study noted that the application of the GIS activities positively affected the CFP. The results could also contribute to the existing green management literature and offer more empirical support to the ecological modernisation theory, which stated that the companies must recognise the issues which hinder the environmental adaptation of the industrial development and the economic growth. The ecological modernisation theory was seen to be an important theory for the environmental innovation as it could offer solutions for resolving the conflicts between the industrial development and the environmental protection (Zhu et al., 2012). The ecological modernisation theory stated that the green enterprises consider the implementation of the environmental innovative activities as an effective opportunity for asserting their social role and responsibilities (Dong et al., 2014; Pekovic et al., 2016). Furthermore, an environmental commitment was seen to stimulate the green activities and the environmental innovation strategies. These results were in line with other studies which observed that the environmental GIS activities help the firms derive many benefits, like economic performance, corporate reputation, and novel product-related success (Chiou et al., 2011; Fraj et al., 2013; Dong et al., 2014; Yang et al., 2018). The firms can incorporate green concepts into their processes and products for improving resource efficiency, reducing waste and increasing resource recovery for improving performance and sustainability.

Furthermore, this study could make significant contributions to the literature since it applied the concept of firm size to the GIS activities. The results offer empirical evidence which highlights the correlation between the firm size and CFP. This study emphasised the moderating role of the firm size. The larger firms showed a higher negative effect of the GIS and the CFP. Hence, the companies must always consider their firm size before transitioning from the GIS to the firm performance.

5.1. The implications of the study

This new trend of the environmental legislation for novel product development has been increasing. The automobile manufacturers are under high pressure for developing appropriate strategies for meeting the challenges occurring due to an uncertain business environment (Huang and Jim Wu, 2010; Cheng et al., 2014). Many environmental regulations like WEEE, RoHS and REACH, have triggered the firms to increase the environmental sustainability of their processes and products (Fargnoli et al., 2014). The car manufacturers need to constantly comply with environmental standards (Cheng et al., 2014). There is a higher demand for developing novel car parts based on the green services and products; hence the car manufacturers must implement GIS activities for complying with the regulations and legislation for environmental protection (Chiou et al., 2011; Dong et al., 2014; Fargnoli et al., 2014). This study showed that the GIS played a vital role in the automotive industry. The results also indicated that this study fulfilled the objection and showed that the implementation of GIS activities could help the companies show a superior performance by managing the environmental risks and developing better capabilities for a constant improvement of the green processes and products.

5.2. The implication for the managerial staff

This study offered several managerial implications. The implementation of GIS activities affected the competitiveness and firm profits. The managers can resolve many environmental management problems during the strategic planning stage, i.e., managers can develop better environmental GIS for integrating the ecological activities in their business operations (Eiadat et al., 2008; Zhu et al., 2012; Fraj et al., 2013; Cheng et al., 2014). The managers have to identify the ecological issues and implement environmental innovative activities for addressing these issues. The managers need to understand the manner in which the environmental incentive programs can be executed, which would help them promote the sustainable development of the green processes and products. The environmental innovation can help the firms achieve a waste reduction or elimination, recovery of resources and dematerialisation and reuse of resources. These factors can positively affect the GIS.

This study also highlights that the firm employing a GIS enjoys performance as long term and perpetual and not short lived. It is crucial for organisations to acknowledge that there is a rise in cost or the short-term loss pertaining to advantages led by GIS implementation in the early stage that result in long-term advantages. Also, this paper shows that the implementation path pertaining to a GIS would aid enterprise managers to gain a better understanding regarding the change brought by GIS in the original organisational practices and structure. Thus, enterprise managers need to focus on organisational practices, which include integrating flexible organisational practices and constantly depending on new information to diversify practices further, thus laying down the foundation for enterprises that allows them to implement green activities efficiently.

Finally, this study considers firm size to be a situational variable and examines the action path as well as the impact of a GIS on an organisation's sustainable performance that were of various sizes, and a comparison was made for the different results for these different levels. At the micro-level, this study considers firm size since it can influence GIS and moderate the association among GIS and CFP. For example, small firms and large firms might vary in GIS perceptibility and decision-making preferences. GIS need considerable investment and might be a high cost (Hull and Rothenberg, 2008). Larger firms are usually the main target of environmental complaints from government, societies, social media and customers, and they regularly become distinctive cases and references in dealing with environmental matters (Welch et al., 2000; Nishitani, 2009). Therefore, better understanding of whether and under what circumstances GIS improves CFP is monetarily meaningful to managers who have been engaging or are being advised to adopt GIS. This study claims that firms practices GIS activities to convey a good message and send green signals to external stakeholders, resolve the information asymmetry, and obtain positive feedback from various stakeholders. For example, public listed firms (larger organisations) are required to declare their CSR reports annually.

This study can be of significant practical value by allowing enterprises to understand how and when to implement a GIS. The conclusion can aid enterprise managers in understanding the meaningfulness of context-based green innovation. This means that enterprise managers should not engage in green innovation blindly, and GIS implementation needs to be done appropriately for each of the specific situations.

5.3. Implications for the policy developers

The implementation of GIS activities can prove to be advantageous to the firms and even the society at large. These activities must be encouraged by all policy-makers and governmental bodies. Though the GIS at every level could positively affect the CFP, this was not universally true for the large firms. In this study, we stated that interactive term (GIS*Size) showed a negative sign, and was significant, the moderating effect of the GIS on the CFP weakened with increasing firm size. Thus, the GIS showed a higher detrimental effect on the CFP. Hence, the policymakers should take care both side of the firms either large or small, the governmental policies must encourage green innovations strategies in the firms that due to the development of progressive measures like rebates, grants or other punitive measures like quotas or tariffs. These activities increase the significance of green innovation strategies amongst the managers, who can help in resolving environmental management-related issues. For instance, The Paris Climate Agreement was signed by many countries who pledged to decrease the emissions and environmental pollution. Development of GIS was seen to be an important step in reducing emissions. More effective tools need to be established by the government that go beyond green subsidies or grants to support and encourage green strategies. They also need to assess if these green subsidies were not as effective as anticipated – for example, access to cheaper capital to conduct green projects (notably via direct participation by the government and subsidised loans), subsidies to green R&D, consumer mandates, feed-in tariff policies pertaining to renewable energy and green public procurement rules. Firms that have received grant or green subsidies need to be put under scrutiny to improve the probability of subsidies being utilised effectively (Lin et al., 2015). Next, as an alternative to framing policies derived from a particular theory, government authorities need to focus on listening to practitioners to gain a better understanding regarding what issues firms are facing when employing green strategies, particularly those large firms that can perform well even when GIS is in place.

A consequential practical implication is that if smaller companies decide to gain greater CFP through GIS, formerly they will need also to pay attention to priority in resource distribution to the GIS engagement. This study results also propose that such strategic resource allocation is not incompatible with the pursuit of CFP objectives that many smaller companies face the resource and knowledge constraints and understate the problems small firms can meet in managing the inconsistent pressures involved in the concurrent pursuit financial and environmental objectives. The environmental policy-makers necessity identifies the limitations which resource and knowledge constraints enact on the attainment of environmental performance goals controlled for smaller companies and offer suitable funding and training support programs that help in the development of the capability for smaller companies to innovate and enhance their environmental and CFP.

5.4. Limitations and future suggestions

Some limitations were noted during the interpretation of all the results of this study. Firstly, the self-reporting data could lead to a common method variance. This study recommends that future studies must adopt objective data for evaluating green innovative performance. Secondly, the cross-sectional data could cause the occurrence of the firm-specific effects (Fraj et al., 2013; Pekovic et al., 2016). In future, the researchers must use a longitudinal research design for validating the causal inferences. Furthermore, this study only focused on the automotive sector in the world, which could have many limitations. However, focusing only on the automotive sector could ensure positive innovation-related results. On the other hand, in future, the researchers must focus on different industries in other countries, for deriving additional insights and comparing all the results.

Acknowledgments

This research was supported by Grant Universiti Putra Malaysia (GUPM) (GP-IPS9536600).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2019.04.214.

References

Acs, Z.J., Audretsch, D.B., 1990. Innovation and Small Firms. Mit Press.
Acs, Z.J., Audretsch, D.B., Feldman, M.P., 1994. R & D spillovers and recipient firm size. Rev. Econ. Stat. 336–340.
Adams, M., Hardwick, P., 1998. An analysis of corporate donations: United Kingdom evidence. J. Manag. Stud. 35 (5), 641–654.
Aguilera-Caracuel, J., Ortiz-de-Mandojana, N., 2013. The Financial Performance of Green Prospector Firms: a Contingent Approach (No. 13.02).
Aiken, L.S., West, S.G., Reno, R.R., 1991. Multiple Regression: Testing and Interpreting Interactions. Sage.
Aragón-Correa, J.A., Martín-Tapia, I., Hurtado-Torres, N.E., 2013. Proactive environmental strategies and employee inclusion: the positive effects of information sharing and promoting collaboration and the influence of uncertainty. Organ Environ 26 (2), 139–161.
Aragón-Correa, J.A., Sharma, S., 2003. A contingent resource-based view of proactive corporate environmental strategy. Acad. Manag. Rev. 28 (1), 71–88.
Archibugi, D., Evangelista, R., Simonetti, R., 1995. Concentration, firm size and innovation: evidence from innovation costs. Technovation 15 (3), 153–163.
Arellano, M., Bond, S., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Rev. Econ. Stud. 58 (2), 277–297.
Arellano, M., Bover, O., 1995. Another look at the instrumental variable estimation of error-components models. J. Econom. 68 (1), 29–51.
Bansal, P., 2005. Evolving sustainably: a longitudinal study of corporate sustainable development. Strat. Manag. J. 26 (3), 197–218.
Bansal, P., Gao, J., 2006. Building the future by looking to the past: examining research published on organizations and environment. Organ. Environ. 19 (4), 458–478.
Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. J Econom 87 (1), 115–143.
Bhambri, A., Sonnenfeld, J., 1988. Organization structure and corporate social performance: a field study in two contrasting industries. Acad. Manag. J. 31 (3), 642–662.
Blundell, R., Bond, S., 2000. GMM estimation with persistent panel data: an application to production functions. Econom. Rev. 19 (3), 321–340.
Blundell, R., Bond, S., Windmeijer, F., 2001. Estimation in dynamic panel data models: improving on the performance of the standard GMM estimator. In: Nonstationary Panels, Panel Cointegration, and Dynamic Panels. Emerald Group Publishing Limited, pp. 53–91.
Bond, S., Hoeffler, A., Temple, J., 2001. GMM Estimation of Empirical Growth Models.
Bonini, S.M., Oppenheim, J.M., 2008. Helping 'green' products grow. McKinsey Q. 3 (2), 1–8.
Bragdon, J.H., Marlin, J., 1972. Is pollution profitable. Risk Manag. 19 (4), 9–18.
Brambor, T., Clark, W.R., Golder, M., 2006. Understanding interaction models: improving empirical analyses. Polit. Anal. 14 (1), 63–82.
Brammer, S., Millington, A., 2006. Firm size, organizational visibility and corporate philanthropy: an empirical analysis. Bus. Ethics Eur. Rev. 15 (1), 6–18.
Campos, L.M., de Melo Heizen, D.A., Verdinelli, M.A., Miguel, P.A.C., 2015. Environmental performance indicators: a study on ISO 14001 certified companies. J. Clean. Prod. 99, 286–296.
Chang, C.H., Chen, Y.S., 2013. Green organizational identity and green innovation. Manag. Decis. 51 (5), 1056–1070.
Chen, Y.S., 2008. The driver of green innovation and green image–green core competence. J. Bus. Ethics 81 (3), 531–543.
Chen, Y.S., Lai, S.B., Wen, C.T., 2006. The influence of green innovation performance on corporate advantage in Taiwan. J. Bus. Ethics 67 (4), 331–339.
Chen, Y.S., Chang, C.H., Wu, F.S., 2012. Origins of green innovations: the differences between proactive and reactive green innovations. Manag. Decis. 50 (3), 368–398.
Cheng, C.C., Yang, C.L., Sheu, C., 2014. The link between eco-innovation and business performance: a Taiwanese industry context. J. Clean. Prod. 64, 81–90.
Chiou, T.Y., Chan, H.K., Lettice, F., Chung, S.H., 2011. The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan. Transport. Res. E Logist. Transport. Rev. 47 (6), 822–836.
Christmann, P., 2000. Effects of "best practices" of environmental management on cost advantage: the role of complementary assets. Acad. Manag. J. 43 (4), 663–680.
Cohen, W.M., Klepper, S., 1992. The tradeoff between firm size and diversity in the pursuit of technological progress. Small Bus. Econ. 4 (1), 1–14.
Cordano, M., Frieze, I.H., 2000. Pollution reduction preferences of US environmental managers: applying Ajzen's theory of planned behavior. Acad. Manag. J. 43 (4), 627–641.
Cowen, S.S., Ferreri, L.B., Parker, L.D., 1987. The impact of corporate characteristics on social responsibility disclosure: a typology and frequency-based analysis. Account. Org. Soc. 12 (2), 111–122.
Cronin, J.J., Smith, J.S., Gleim, M.R., Ramirez, E., Martinez, J.D., 2011. Green marketing strategies: an examination of stakeholders and the opportunities they present. J. Acad. Mark. Sci. 39 (1), 158–174.
Dangelico, R.M., Pujari, D., 2010. Mainstreaming green product innovation: why and how companies integrate environmental sustainability. J. Bus. Ethics 95 (3), 471–486.
Demsetz, H., 1983. The structure of ownership and the theory of the firm. J. Law Econ. 26 (2), 375–390.
Donaldson, L., 2001. The Contingency Theory of Organizations. Sage.
Dong, Y., Wang, X., Jin, J., Qiao, Y., Shi, L., 2014. Effects of eco-innovation typology on its performance: empirical evidence from Chinese enterprises. J. Eng. Technol. Manag. 34, 78–98.
Driessen, P., Hillebrand, B., 2002. Adoption and Diffusion of Green Innovations.
Eiadat, Y., Kelly, A., Roche, F., Eyadat, H., 2008. Green and competitive? An empirical test of the mediating role of environmental innovation strategy. J. World Bus. 43 (2), 131–145.
Fargnoli, M., De Minicis, M., Tronci, M., 2014. Design Management for Sustainability: an integrated approach for the development of sustainable products. J. Eng. Technol. Manag. 34, 29–45.
Felder, J., Licht, G., Nerlinger, E., Stahl, H., 1996. Factors determining R&D and innovation expenditure in German manufacturing industries. In: Determinants of Innovation. Palgrave Macmillan, London, pp. 125–154.
Fraj, E., Martínez, E., Matute, J., 2013. Green marketing in B2B organisations: an empirical analysis from the natural-resource-based view of the firm. J. Bus. Ind. Mark. 28 (5), 396–410.
Friedman, M., 1970. A theoretical framework for monetary analysis. J. Political Econ. 78 (2), 193–238.
Ge, B., Yang, Y., Jiang, D., Gao, Y., Du, X., Zhou, T., 2018. An empirical study on green innovation strategy and sustainable competitive advantages: path and

boundary. Sustainability 10 (10), 3631.
Gelb, D.S., Strawser, J.A., 2001. Corporate social responsibility and financial disclosures: an alternative explanation for increased disclosure. J. Bus. Ethics 33 (1), 1–13.
Gluch, P., Gustafsson, M., Thuvander, L., 2009. An absorptive capacity model for green innovation and performance in the construction industry. Constr. Manag. Econ. 27 (5), 451–464.
Green Jr., K.W., Zelbst, P.J., Meacham, J., Bhadauria, V.S., 2012. Green supply chain management practices: impact on performance. Supply Chain Manag.: Int. J. 17 (3), 290–305.
Greer, J., Bruno, K., 1998. Greenwash: the Reality behind Corporate Environmentalism. IBON Foundation Incorporated. Third World Network.
Hair Jr., J.F., Anderson, R.E., Tatham, R.L., Black, W.C., 1998. Multivariate Data Analysis. Prentice-Hall, New Jersey.
Hall, B.K., 2001. Organic selection: proximate environmental effects on the evolution of morphology and behaviour. Biol. Philos. 16 (2), 215–237.
Hall, M., Weiss, L., 1967. Firm size and profitability. Rev. Econ. Stat. 319–331.
Hart, S.L., 1995. A natural-resource-based view of the firm. Acad. Manag. Rev. 20 (4), 986–1014.
Harvey, C.R., Lins, K.V., Roper, A.H., 2004. The effect of capital structure when expected agency costs are extreme. J. Financ. Econ. 74 (1), 3–30.
Hess, D., Rogovsky, N., Dunfee, T.W., 2002. The next wave of corporate community involvement: corporate social initiatives. Calif. Manag. Rev. 44 (2), 110–125.
Hoeffler, A.E., 2002. The augmented Solow model and the African growth debate. Oxf. Bull. Econ. Stat. 64 (2), 135–158.
Hörisch, J., Johnson, M.P., Schaltegger, S., 2015. Implementation of sustainability management and company size: a knowledge-based view. Bus. Strateg. Environ. 24 (8), 765–779.
Hsiao, C., 2014. Analysis Of Panel Data (No. 54). Cambridge university press.
Huang, Y.C., Jim Wu, Y.C., 2010. The effects of organizational factors on green new product success: evidence from high-tech industries in Taiwan. Manag. Decis. 48 (10), 1539–1567.
Huber, J., 1985. Die Regenbogengesellschaft: okologie und Sozialpolitik (The Rainbow Society: Ecology and Social Politics). Fisher Verlag, Frankfurt am Main.
Hui, S., 2010. Multi-objective optimization for hydraulic hybrid vehicle based on adaptive simulated annealing genetic algorithm. Eng. Appl. Artif. Intell. 23 (1), 27–33.
Hull, C.E., Rothenberg, S., 2008. Firm performance: the interactions of corporate social performance with innovation and industry differentiation. Strat. Manag. J. 29 (7), 781–789.
Jänicke, M., 2008. Ecological modernisation: new perspectives. J. Clean. Prod. 16 (5), 557–565.
Jensen, M.C., 1986. Agency costs of free cash flow, corporate finance, and takeovers. Am. Econ. Rev. 76 (2), 323–329.
Johnson, R.A., Greening, D.W., 1999. The effects of corporate governance and institutional ownership types on corporate social performance. Acad. Manag. J. 42 (5), 564–576.
King, A., Lenox, M., 2002. Exploring the locus of profitable pollution reduction. Manag. Sci. 48 (2), 289–299.
Kleinknecht, A., Reijnen, J.O., 1991. More evidence on the undercounting of small firm R&D. Res. Pol. 20 (6), 579–587.
Konar, S., Cohen, M.A., 2001. Does the market value environmental performance? Rev. Econ. Stat. 83 (2), 281–289.
KPMG, 2012. Expect the Unexpected: Building Business Value in a Changing World. Executive Summary (accessed 24.11.18). https://www.kpmg.com/dutchcaribbean/en/Documents/KPMG%20Expect_the_Unexpected_Exctve Smmry_FINAL_WebAccessible.pdf.
Lai, S.B., Wen, C.T., Chen, Y.S., 2003. The exploration of the relationship between the environmental pressure and the corporate competitive advantage. December. In: Paper Presented at the 2003 CSMOT Academic Conference, Hsinchu, Taiwan.
Lau, A.K., Tang, E., Yam, R.C., 2010. Effects of supplier and customer integration on product innovation and performance: empirical evidence in Hong Kong manufacturers. J. Prod. Innov. Manag. 27 (5), 761–777.
Leal-Rodríguez, A.L., Eldridge, S., Roldán, J.L., Leal-Millán, A.G., Ortega-Gutiérrez, J., 2015. Organizational unlearning, innovation outcomes, and performance: the moderating effect of firm size. J. Bus. Res. 68 (4), 803–809.
Li, D., Cao, C., Zhang, L., Chen, X., Ren, S., Zhao, Y., 2017. Effects of corporate environmental responsibility on financial performance: the moderating role of government regulation and organizational slack. J. Clean. Prod. 166, 1323–1334.
Lin, H., Zeng, S.X., Ma, H.Y., Chen, H.Q., 2015. How political connections affect corporate environmental performance: the mediating role of green subsidies. Hum. Ecol. Risk Assess. Int. J. 21 (8), 2192–2212.
Link, S., Naveh, E., 2006. Standardization and discretion: does the environmental standard ISO 14001 lead to performance benefits? IEEE Trans. Eng. Manag. 53 (4), 508–519.
López-Nicolás, C., Meroño-Cerdán, Á.L., 2011. Strategic knowledge management, innovation and performance. Int. J. Inf. Manag. 31 (6), 502–509.
Madden, K., Scaife, W., Crissman, K., 2006. How and why small to medium size enterprises (SMEs) engage with their communities: an Australian study. Int. J. Nonprofit Voluntary Sect. Mark. 11 (1), 49–60.
Marcus, A.A., Fremeth, A.R., 2009. Green management matters regardless. Academy of Management Perspectives 23 (3), 17–26.
Mansfield, E., 1968. Industrial Research and Technological Innovation; an Econometric Analysis.
Mansfield, E., Rapoport, J., Schnee, J., Wagner, S., Hamburger, M., 1971. Innovation and discovery in the ethical pharmaceutical industry. In: Research and Innovation in the Modern Corporation. Palgrave Macmillan, London, pp. 157–185.
McElroy, K.M., Siegfried, J.J., 1985. The effect of firm size on corporate philanthropy. Q. Rev. Econ. Bus. 25 (2), 18–26.
McGuire, J.B., Sundgren, A., Schneeweis, T., 1988. Corporate social responsibility and firm financial performance. Acad. Manag. J. 31 (4), 854–872.
McWilliams, A., Siegel, D., 2001. Corporate social responsibility: a theory of the firm perspective. Acad. Manag. Rev. 26 (1), 117–127.
Meznar, M.B., Nigh, D., 1995. Buffer or bridge? Environmental and organizational determinants of public affairs activities in American firms. Acad. Manag. J. 38 (4), 975–996.
Miles, R.H., 1986. Managing the Corporate Social Environment: A Grounded Theory. Prentice Hall.
Mol, A.P., 1997. Ecological modernization: industrial transformations and environmental reform. Int. Handbook Environ. Sociol. 138–149.
Mol, A., Sonnenfeld, D., 2000. Ecological modernisation around the world: an introduction. Environ. Pol. 9, 3–14.
Mu, J., Peng, G., MacLachlan, D.L., 2009. Effect of risk management strategy on NPD performance. Technovation 29 (3), 170–180.
Murphy, J., Gouldson, A., 2000. Environmental policy and industrial innovation: integrating environment and economy through ecological modernisation. Geoforum 31 (1), 33–44.
Nguyen, Q.A., Hens, L., 2015. Environmental performance of the cement industry in Vietnam: the influence of ISO 14001 certification. J. Clean. Prod. 96, 362–378.
Nickell, S., 1981. Biases in dynamic models with fixed effects. Econometrica: J. Econ. Soc. 1417–1426.
Nilsson, M., Hillman, K., Magnusson, T., 2012. How do we govern sustainable innovations? Mapping patterns of governance for biofuels and hybrid-electric vehicle technologies. Environ. Innov. Soc. Trans. 3, 50–66.
Nishitani, K., 2009. An empirical study of the initial adoption of ISO 14001 in Japanese manufacturing firms. Ecol. Econ. 68 (3), 669–679.
Nooteboom, B., 1994. Innovation and diffusion in small firms: theory and evidence. Small Bus. Econ. 6 (5), 327–347.
Organisationl for Economic Co-operation and Development (OECD), 2009. Eco-innovation in industry – enabling green growth. http://www.oecd.org/document/62/0,3746,de_34968570_34968855_44452670_1_1_1_1,00.html. Available at:
Park, J., Sarkis, J., Wu, Z., 2010. Creating integrated business and environmental value within the context of China's circular economy and ecological modernization. J. Clean. Prod. 18 (15), 1494–1501.
Pekovic, S., Rolland, S., Gatignon, H., 2016. Customer orientation and organizational innovation: the case of environmental management practices. J. Bus. Ind. Mark. 31 (7), 835–848.
Petts, J., 1998. Environmental responsiveness, individuals and organizational learning: SME experience. J. Environ. Plan. Manag. 41 (6), 711–730.
Porter, M.E., 1981. The contributions of industrial organization to strategic management. Acad. Manag. Rev. 6 (4), 609–620.
Porter, M.E., Reinhardt, F.L., Schwartz, P., Esty, D.C., Hoffman, A.J., Schendler, A., et al., 2007. Climate Business. Business Climate. Harv. Bus. Rev. 1.
Porter, T.B., 2006. Coevolution as a research framework for organizations and the natural environment. Organ. Environ. 19 (4), 479–504.
Porter, russo M.E., Van der Linde, C., 1995a. Toward a new conception of the environment-competitiveness relationship. J. Econ. Perspect. 9 (4), 97–118.
Porter, M., Van der Linde, C., 1995b. Green and Competitive: Ending the Stalemate. The Dynamics of the Eco-Efficient Economy: Environmental Regulation and Competitive Advantage, vol. 33.
Ramaswami, S.N., Srivastava, R.K., Bhargava, M., 2009. Market-based capabilities and financial performance of firms: insights into marketing's contribution to firm value. J. Acad. Mark. Sci. 37 (2), 97.
Rivera, J., 2002. Assessing a voluntary environmental initiative in the developing world: the Costa Rican Certification for Sustainable Tourism. Pol. Sci. 35 (4), 333–360.
Rogers, M., 2004. Networks, firm size and innovation. Small Bus. Econ. 22 (2), 141–153.
Roodman, D., 2009. How to do xtabond2: an introduction to difference and system GMM in Stata. STATA J. 9 (1), 86–136.
Rothwell, R., Dodgson, M., 1994. Innovation and size of firm. Handbook Indus. Innov. 324.
Runhaar, H., Tigchelaar, C., Vermeulen, W.J., 2008. Environmental leaders: making a difference. A typology of environmental leaders and recommendations for a differentiated policy approach. Bus. Strateg. Environ. 17 (3), 160–178.
Russo, M.V., Fouts, P.A., 1997. A resource-based perspective on corporate environmental performance and profitability. Acad. Manag. J. 40 (3), 534–559.
Scherer, F.M., 1970. Industrial Market Structure and Economic Performance, first ed. Rand McNally College Publishing Company, Chicago.
Sheng, S., Zhou, K., Li, J.J., 2011. The effects of business and political ties on firm performance: evidence from China. J. Mark. 75 (1), 1–15. https://doi.org/10.1509/jmkg.75.1.1.
Shrivastava, P., 1995. The role of corporations in achieving ecological sustainability. Acad. Manag. Rev. 20 (4), 936–960.
Smith, M., Crotty, J., 2008. Environmental regulation and innovation driving ecological design in the UK automotive industry. Bus. Strateg. Environ. 17 (6), 341–349.
Stulz, R., 1990. Managerial discretion and optimal financing policies. J. Financ. Econ. 26 (1), 3–27.

Surroca, J., Tribó, J.A., Waddock, S., 2010. Corporate responsibility and financial performance: the role of intangible resources. Strat. Manag. J. 31 (5), 463–490.

Tie, S.F., Tan, C.W., 2013. A review of energy sources and energy management system in electric vehicles. Renew. Sustain. Energy Rev. 20, 82–102.

Tomomi, T., 2010. Environmental management strategy for small and medium-sized enterprises: why do SMBs practice environmental management? Asian Bus. Manag. 9 (2), 265–280.

Tseng, M.L., Wang, R., Chiu, A.S., Geng, Y., Lin, Y.H., 2013. Improving performance of green innovation practices under uncertainty. J. Clean. Prod. 40, 71–82.

Van Beurden, P., Gössling, T., 2008. The worth of values–a literature review on the relation between corporate social and financial performance. J. Bus. Ethics 82 (2), 407.

Van de Ven, B., Jeurissen, R., 2005. Competing responsibly. Bus. Ethics Q. 15 (2), 299–317.

Vaz, C., Rauen, T., Lezana, Á., 2017. Sustainability and innovation in the automotive sector: a structured content analysis. Sustainability 9 (6), 880.

Vossen, R.W., 1998. Relative strengths and weaknesses of small firms in innovation. Int. Small Bus. J. 16 (3), 88–94.

Waddock, S.A., Graves, S.B., 1997. The corporate social performance–financial performance link. Strat. Manag. J. 18 (4), 303–319.

Welch, E.W., Mazur, A., Bretschneider, S., 2000. Voluntary behavior by electric utilities: levels of adoption and contribution of the climate challenge program to the reduction of carbon dioxide. J. Policy Anal. Manag. 19 (3), 407–425.

Wintoki, M.B., Linck, J.S., Netter, J.M., 2012. Endogeneity and the dynamics of internal corporate governance. J. Financ. Econ. 3 (105), 581–606.

Wong, C.W., Miao, X., Cui, S., Tang, Y., 2018. Impact of corporate environmental responsibility on operating income: moderating role of regional disparities in China. J. Bus. Ethics 149 (2), 363–382.

Wu, F., Yeniyurt, S., Kim, D., Cavusgil, S.T., 2006. The impact of information technology on supply chain capabilities and firm performance: a resource-based view. Ind. Mark. Manag. 35 (4), 493–504.

Yang, D., Wang, A.X., Zhou, K.Z., Jiang, W., 2018. Environmental strategy, institutional force, and innovation capability: a managerial cognition perspective. J. Bus. Ethics 1–15.

Yeung, A.C., 2008. Strategic supply management, quality initiatives, and organizational performance. J. Oper. Manag. 26 (4), 490–502.

York, R., Rosa, E.A., 2003. Key challenges to ecological modernization theory: institutional efficacy, case study evidence, units of analysis, and the pace of eco-efficiency. Organ. Environ. 16 (3), 273–288.

Zenger, T.R., 1994. Explaining organizational diseconomies of scale in R&D: agency problems and the allocation of engineering talent, ideas, and effort by firm size. Manag. Sci. 40 (6), 708–729.

Zhu, P., Chen, Y., Wang, L.Y., Zhou, M., 2012. Treatment of waste printed circuit board by green solvent using ionic liquid. Waste Manag. 32 (10), 1914–1918.