Effect of Green Innovation Strategy on Firm-Idiosyncratic Risk: A Competitive Action Perspective.

Abstract

Despite increasing concern for corporate environmental responsibility in numerous industries, the relationship between green innovation strategy (GIS) and idiosyncratic risk is a rarely scrutinised topic, particularly in the automotive domain. In this study, we empirically explore the association between GIS and idiosyncratic risk and analyse the moderating role played by the firm's competitive action. We rely on the secondary information sourced for 132 top automotive firms, in the period ranging from 2011 to 2017 by applying the System-GMM estimator to the dynamic panel data model. Our findings indicate that GIS significantly reduces the idiosyncratic risk of all firms, and this relationship strengthens with the increase in the competitive action of the firms. Our evidence supports "it pays to be green" firm heterogeneity argument. This study highlights the academic and managerial implications and focuses on the environmental issues published in environmental management literature.

Keyword: Green Innovation Strategy, Idiosyncratic Risk, Competitive Action, Automotive Industry, System GMM.

1. Introduction:

In the 20th century, the automotive sector was seen to be an essential and significant economic field (Maxton & Wormald, 2004). It is considered to be one of the major manufacturing sectors which contribute to the global economy. It offered several economic benefits and was related to numerous international issues like emission, energy consumption, trade and even safety (Nieuwenhuis & Wells, 2015). In the past few years, it is seen that the transportation field is responsible for about 27% of the total energy consumed and 33.7% of the total greenhouse emissions (Tie & Tan, 2013). Due to increasing concern regarding the environmental issues highlighted by the suppliers, customers, governments and even the public, the industries have begun developing many environmentally friendly goods (Dangelico et al., 2017; Green et al., 2012; Tseng et al., 2013; Tan et al., 2017; Wang & Dai, 2018). Hence, some innovative techniques have been developed by automotive firms for saving energy, reducing CO_2 emissions and air pollution in the transportation field, which are important challenges affecting the government (Hui, 2010).

In recent years, companies have to integrate ideas for protecting the environment. Hence, many automotive firms have begun using innovative green technology for managing their businesses (Lin et al., 2014; Lin et al., 2019). Effective management can reduce firm risk by increasing the value, increase the competitive advantage and improve the performance of the firm (Chang, 2011; Chang & Chen, 2013; Lin et al., 2019; Tang et al., 2018). In their study, Shrivastava, (1995) and Yu and Ramanathan (2016) have suggested that the firms need to develop different and innovative products, improve the overall product quality and decrease the production costs, based on the product and process innovations. Thus, constant innovation is seen to be a vital strategy which can overcome the pressures from the stakeholders (Porter & Van der Linde, 1995). The green innovation is seen to be an effective method for mitigating or preventing environmental damage (Porter & Van der Linde, 1995).

Despite all these regulations, some violations do occur. On 18th September 2015, Volkswagen was served with a U.S. Environmental Protection Agency's (EPA) notice, which stated that the Volkswagen "clean diesel" vehicles violated the Clean Air Act. The unethical practices implemented by Volkswagen significantly reduced their share prices. After the Volkswagen scandal came to light, the Volkswagen share prices showed a 33% decrease. Thus, this emission scandal caused the company a loss of billions of dollars (Gomez, 2016). Companies must operate in an environment-friendly manner, which can increase their social well-being and help them acquire firm-level competitiveness and better financial success (Aguilera-Caracuel, 2013; Bansal, 2002; 2005; Etzion, 2007; Starik & Kanashiro, 2013).

The managers of firms have to consider environmental issues while making decisions continually. On the other hand, their decisions must assist the company in promoting many social and ethical values and deriving better and sustainable economic benefits (Molina-Azorín et al., 2009). Agle et al. (2008) have unequivocally stated that the companies which are unable to ethically, legally and responsibly derive their profits do not deserve financial and non-financial successes. Therefore, managers, while taking decisions, must consider the ethical standpoint. The simultaneous implementation of the economic, environmental, and equity principles, is not whole-heartedly supported by the managers, as it challenges their assumption that the social equity and environmental integrity significantly affect the economic prosperity (Bansal, 2005).

Drawing on this notion, GIS has been recognised as a critical factor that impacts the life quality, environmental sustainability and the financial growth of the companies (Bansal

& Gao, 2006; Dangelico & Pujari, 2010). GIS can be described as innovative hardware or software that is developed based on the use of some green products and processes (Chen et al., 2003). This type of innovation also includes the technological innovations which are involved in preventing pollution, waste recycling, energy conservation, green product designs, and the corporate environmental management (Chen et al., 2006; Palmer & Truong, 2017). These innovations extend beyond the general regulatory compliances (Aragón-Correa et al., 2013). Furthermore, the GIS firms can be defined as those firms which are involved in constant and changing development, which often results in definite green development, either technological or product development (Marcus & Fremeth, 2009).

Even though GIS is vital in the existing industrial environment, many earlier studies have noted some ambiguities related to its performance (Grewatsch & Kleindienst, 2017: Lin et al., 2019; Przychodzen & Przychodzen, 2015). A few researchers have stated that GIS can improve the firms' competitiveness. Hence, the companies that engage in GIS can derive better social support from its internal and external stakeholders, and also access valuable resources (Aguilera-Caracuel & Ortiz-de-Mandojana, 2013; Hart, 1995; Porter & Van der Linde, 1995). However, some other studies have shown that the GIS has an insignificant or negative effect on the organisational performance, thereby indicating that the GIS does not improve the firms' competitiveness (Cordeiro & Sarkis, 1997; Graves & Waddock, 1999; Hassel et al. 2005). Mixed results have encouraged us to investigate how the firms face less risk if they engage in GIS, which can then lead better firm's performance. Many studies have offered insights into this topic. However, there are three significant limitations that need further investigation.

First, when earlier empirical researches evaluated the financial value of the GIS, they primarily focused on the accounting-based measures like the sales growth, profit return on the assets (Aguilera-Caracuel & Ortiz-de-Mandojana, 2013; Zhang et al., 2019), the marketing-based measures like earnings per share or Tobin's Q (Aguilera-Caracuel & Ortiz-de-Mandojana, 2013). However, they did not consider another vital parameter that can affect the corporate financial performance, i.e., the idiosyncratic risks affecting the stock prices of the firms. The idiosyncratic risk can be defined as the risk which affects a very diminutive number of assets and can be almost eradicated through diversification (Mishra & Modi, 2013). It is similar to unsystematic risk. The idiosyncratic risk is responsible for 80% of the total increase in the stocks, along with the security price fluctuations (Bansal & Clelland, 2004). It is also responsible for setting low capital cost by investors for the firms that showed a low risk (Merton, 1987; Shin & Stulz, 2000). Hence, the activities that allow the firms to decrease their idiosyncratic risk can help the managers to explore a wide array of strategic opportunities (Chatterjee et al., 1999). Additionally, a low idiosyncratic risk reflects a decrease in the future variance in the expected cash flow of the firms, which can lead to a higher shareholder wealth for the firms (Rappaport, 1986). Though many scholars have acknowledged the significance of the idiosyncratic risk for the shareholders and managers, very few studies have investigated the relationship between GIS and idiosyncratic risk for automotive firms.

Second, some researchers have used a contingency approach to determine the various factors that influence the impact of green innovation on performance. Chen et al. (2006) have noted the relationship between the environmental dynamism that moderates the GIS–firm performance relationship. Martinez-del-Rio et al. (2015) have studied the Spanish agricultural firms and have noted that GIS shows a higher effect on firm performance if the munificence is high. In their study, Leonidou et al. (2010) have stated that the external factors like the public concern and regulatory intensity can affect the positive relation between green management and competitive advantage. However, the external environmental forces are beyond the control of the specific firms, and therefore, the researchers have used contingent environmental factors to offer advice to the firms so that they could proactively derive maximal benefits of the green innovation. Hence, uncertainty persists in the various causes because of the mixed results with regards to the performance effects of the GIS. This calls for a complete investigation of GIS. In this study, we attempted to remove this uncertainty by determining the benefits of competitive advantage in GIS. None of the earlier studies has explored the boundary conditions that are set by the competitive action on the influence of the GIS on the idiosyncratic risks. Though GIS creates a better value for the firms in the competitive market, the firms must employ a suitable strategy for capturing the potential benefits (Kim et al., 2018). The environmental and economic responsibilities coexist and can overlap (Carroll, 1979; Schwartz & Carroll, 2003), since the activities that fulfil these responsibilities (like green innovation and competitive action) can decrease the firm risks. Based on the characteristics of the GIS and competitive action, integration of both these constructs is a better approach for elucidating the complicated GIS and idiosyncratic risk relationship.

Third, earlier studies used a cross-sectional instead of a longitudinal data set due to a lack of the longitudinal GIS data (e.g., Aguilera-Caracuel & Ortiz-de-Mandojana, 2013; Chen et al., 2006; Lin et al., 2014; Weng et al., 2015). This drawback can affect the result generalisation. Use of cross-sectional data set can weaken the conclusions related to the causal effect. The positive relationship between GIS and the attention paid to the social issues can be due to the influence of the unobservable variables, which indicate a probable endogeneity problem. This study follows the recommendations made by Chen et al., (2006) and Lin et al. (2014), who argue that a constant data collection is required for deriving comprehensive results on a longitudinal basis. Based on the limitations described, this study addresses the research question: "What is the relationship between the GIS and the idiosyncratic firm risk over a period of time", and "How this relationship is affected due to the firms' competitive action?"

The present study contributes to the literature regarding GIS in three ways. First, unlike the earlier studies, this study adds more value to the existing literature as it investigates the effect of the GIS on the distinctive facets of the company's idiosyncratic risk. Though prior empirical studies have studied the effect of GIS on the organisational performance, there is limited empirical evidence on the impact of the GIS on the firm's idiosyncratic risk. One needs to account for the higher firm risk, as high risk can cause many unpleasant events, like layoffs, which have to be considered by any company management during their decision-making stage (Miller & Bromiley 1990). This study has offered a better insight into the debate, i.e., "Does it pay to be green?"

Second, this study highlights the significance of probable moderators, in response to the environment-management scholars, who stated that one must determine the extent of the effect of the potential moderators on the relationship between the GIS and firm's financial performance (Chan et al., 2016; Dangelico & Pontrandolfo, 2015; Grewatsch & Kleindienst, 2017; Tariq & Chonglerttham 2019). This study has contributed to the existing literature by determining the moderating role played by the firm's competitive actions. To the best knowledge of the authors, this is the first study which examines the effect of the firm's competitive action on GIS and idiosyncratic risks, which are necessary for the management for making informed decisions. Hence, this study can bridge the gap between theoretical and empirical research.

Third, this study has used a dynamic panel data System-GMM estimates along with the longitudinal data for the period ranging from 2011 to 2017, for determining the dynamism present in the relationship between the GIS and the idiosyncratic risks. This has resulted in statistically-robust results. The insights derived from this study can indicate whether any endogenous changes occurred in the idiosyncratic risk or if the changes occur because of exogenous forces. Previous studies have stated that the relationship between GIS and firm performance is dynamic with GIS affecting the financial performance of a firm (McGuire et al., 1988). Hence, one needs to control the potential endogeneity between the GIS and the idiosyncratic risk. In this study, we use longitudinal data to handle the endogeneity problem.

The next subsections have described the existing literature, general approach and the data used. After that, the results were presented and discussed. Finally, the researchers have presented some limitations and made recommendations for future studies.

2. Theoretical Framework and Hypotheses Development:

2.1 Green Innovation Strategy (GIS):

In this study, we define green innovation strategy (GIS) as the innovations made in processes, products or business models, which make the company more environmentally sustainable (Chen et al., 2006). Green innovation comprises strategies anticipated to lessen or salvage environmental effects of pollution manufacturers or resource consumers, or to reduce consumption of resources in expectation of adverse effects. Large technologically innovative companies can develop green innovation to address the environmental concerns of their stakeholders and to decrease the environmental effect of their operation and service events (Chen, 2008; Chiou et al., 2011; Weng & Lin, 2011). The companies become more environmentally sustainable if they decrease the negative environmental effect of their activities and increase the positive effect of environmental quality. As a result, the GIS is defined as a process which is used for identifying, implementing and monitoring novel ideas to improve the environmental performance of the companies along with its competitiveness (Chen et al., 2006; Chiou et al., 2013). This identification includes an understanding of the various environmental demands (like new environmental legislation, shortage of resources and public pressure), competitor's activities and even the customers' needs and acceptance of the environmentally-friendly products, along with other parameters which must be considered while developing new processes and products. Implementation indicates the development of new ideas in the market and monitoring refers to the activity that offers feedback to the company with regards to its green innovation for improving sustainable and innovative activities (Chen et al., 2006).

Two significant benefits can be derived by implementing GIS in the automotive industries. First, it includes monetary rewards after the development of environmentally sustainable products along with financial benefits which increase the competitiveness. The customers, in general, wish to purchase environmentally-friendly services and products. Hence, GIS is seen to be an essential requirement for the firms as it offers a higher chance of fulfilling customer demands without affecting the environment. In the past, the firms have considered the investment in eco-friendly activities as an excessive investment; however, in the existing ecological conditions and an increasing sense of environmentalism, firms have begun changing their policies, competitive strategies, and patterns (Porter & Reinhardt, 2007). Second, the 'green' label is seen to be an incentive which encourages continuous innovation and help in developing novel market opportunities for the firms that can satisfy the customer demands, increase value and improve firms' performance (Chen, 2008). For example, Newsweek has reported that the Japanese automaker, Toyota, was named the world's greenest company, and was ranked 16th in Newsweek's Global 500 greenest companies in 2017. However, it was ranked 1st in the automotive sector. In 2014, Toyota introduced the first-ever asset-backed Green Bond in the automotive sector. Green Bonds refer to tools wherein the proceeds are exclusively applied to the activities and projects which promote climate and environmentally-sustainable initiatives, enable the development and sale of green vehicles, and also help in advancing Toyota's environmental commitment.

2.2 Idiosyncratic Risk:

The firm's stock risk is a fundamental parameter in the financial sector (Hamilton, 1994). A higher risk, indicated by the increasing volatility of firm stock prices, suggests an uncertain and vulnerable cash flow in future, which affects the corporate capital budget, and induces a high capital financing, thereby affecting the firm stock wealth in future. In the past, some financial economists like Ang et al. (2006) have shown that the investors price the firm-idiosyncratic risk in the financial markets. They have noted that a significant monthly difference of –1.06% between the mean returns in the portfolios shows the maximal and minimal idiosyncratic stock volatility. Thus, the firm's idiosyncratic risk is related to the firm's value and contributes to a higher share of the overall stock risk. Goyal and Santa-Clara (2003) have stated that the idiosyncratic risk is responsible for 85% of the mean stock variance measure, whereas the systematic risk constitutes 15%. Gaspar and Massa (2006) have stated that the idiosyncratic volatility constitutes 81%, while systematic volatility is 19%.

Idiosyncratic risk, or unsystematic risk, refers to the risk occurring due to price changes that result due to the unique circumstances for a particular stock. The idiosyncratic risk shows no or little correlation with the market risk and is eliminated in a diversified portfolio. The idiosyncratic risk is seen to be vital to the option traders, and the arbitrageurs as their investment profit depend on the total risk rather than the market risk (Xu and Malkiel, 2003).

2.3 Green Innovation Strategy (GIS) and Idiosyncratic Risk:

Earlier studies have presented mixed results with regards to the relationship between GIS and financial performance (Przychodzen & Przychodzen, 2015). Grewatsch and Kleindienst (2017) have stated that 59% of the studies have noted a positive relationship while 41% of the studies have reported mixed or insignificant results between the green activities of the firm and its financial performance. The literature which suggests a positive relationship state that addressing all environmental concerns can improve the competitive position of the firm since the environmental improvement decreases the production costs and compliance (Chang, 2011; Ge et al*.,* 2018; Porter & Van der Linde, 1995; Yew & Zhu, 2019). An effective implementation of GIS positively affects the firm's financial performance as it increases productivity, creates a differential advantage and establishes the firm's reputation (Gotschol et al., 2014; Kam-Sing & Wong, 2012; Lin et al., 2014; Przychodzen & Przychodzen, 2015). On the other hand, the studies that have indicated a negative relationship argue that the firms face a trade-off between the GIS and financial performance relationship, since the environmental efforts lead to an additional financial burden for the organisations, and could increase their economic disadvantages (Walley & Whitehead, 1994). Many researchers have stated that the direct relationship between GIS and financial performance cannot be established because of a problem in measuring the GIS and various measures applied for their operations (King & Lenox, 2001), use of different measures of financial performance (Albertini, 2013) and failure to determine the role played by the potential moderators (Grewatsch & Kleindienst, 2017). These inconclusive results indicate that it is essential to further investigate the relationship between GIS and financial performance.

This study states that a high GIS allows the green firms to decrease their idiosyncratic risk, because of their stable relations with the government, employees, customers, financial institutions and the environmentally-concerned stakeholders. For instance, the firms with a high GIS do not have to worry about the increasing governmental fines and penalties for their poor environmental performance or the customer who boycotted the firm's products that were developed using non-sustainable practices (Mishra & Modi, 2013). Furthermore, the reputation of the green firms helps in improving their ability to continually avail the capital from any financial institution, which further decreases the firm's risk and stabilises their cash flows. Similar arguments have been presented by Sharfman and Fernando (2008), who state that a decrease in the pollution and use of hazardous substances can decrease the firm's litigation risk, improves its profitability and lowers the risk. On the other hand, firms with a low GIS have to undergo a high risk, as they are subjected to many governmental fines and penalties. Even the customers boycott their non-sustainable products, and financial institutes reduce their capital supply. Based on these arguments, we have hypothesised that:

Hypothesis (H1): Green innovation strategy is negatively correlated to the firm's idiosyncratic risk.

2.4 Competitive Action:

In any marketing research, the competitive actions are specific, externally oriented, and observable actions which are undertaken by the firm for improving their performance in a defined period of time (Smith et al., 2001). These actions are strategic or tactical. The strategic actions require significant expenditure, long-time period, and more departure from the general status quo in comparison to the tactical activities (Miller & Chen, 1996). A few examples of these strategic activities include the introduction of many new products/services; joint collaborative arrangements and major facility expansions. Some examples of tactical activities include the advertising campaigns, price changes, marketing, new product introductions, and capacity expansions, which highlight the aggressive search for new techniques which can attract more customers. A constant competitive action can improve financial performance and competitive position. Many researchers have stated that competitive actions are an antecedent of differential firm performance (D'Aveni, 1994; Grimm & Smith, 1997; Smith et al., 1991). They have noted that the market competition generally forces the companies to make some moves and countermoves which can neutralise, destroy, or make the competitive advantages of their opponents out-dated. Though the "dynamic strategic interactions" occurring amongst the firms are complex one can see the pattern of movement and response or punches and counterpunches, in more competitive sectors (D'Aveni 1994). Every competitive action helps the firms acquire a competitive advantage, wherein a series of small and patterned moves (like a large number and wide range of activities) over some time helps the company derive a sustainable and competitive advantage, which is measured in financial terms like market shares and profits.

2.5 The Interaction Effect of GIS and Competitive Action on Idiosyncratic Risk:

As described above, this study predicts that the competitive action can negatively moderate the relationship between the GIS and idiosyncratic risks since the firms are a business entity and need to simultaneously fulfil their environmental and economic responsibilities (Aupperle et al., 1985; Carroll, 1979). Fulfilment of their economic responsibility is necessary for firms since the public generally consider the firms' economic responsibilities which depend on whether these firms can offer better goods and services that can satisfy the public demands (Mohr et al., 2001). Hence, the competitive actions, which reflect the firms' economic responsibilities, are seen to be a necessary condition which complements the effects of green innovation on their environmental responsibility (Liu et al., 2018; Tuzzolino & Armandi, 1981). The competitive actions highlight the extent to which the firms invest in attracting the customers' attention to their strategies (Slotegraaf et al., 2003). This is considered to be a useful technique which can augment the positive effects of GIS as it describes the differentiation advantage of the green firms that is based on the environment-friendly product features. This sends a positive signal or message to the customers and other stakeholders with regards to the firms' green innovative activities. This finally strengthens the firms' reputation and increases profitability, thereafter, reducing their idiosyncratic risk (De Boer, 2003).

In this study, we argue that though GIS decreases the firm's idiosyncratic risk by improving its differentiation advantage, productivity, and reputation, without implementing any competitive action, these firms are unable to send a strong positive message to their customers and draw their attention towards the firm's green activities. The GIS requires competitive actions for promoting the firm's green activities along with their novel products, in order to increase the customer base. Similarly, Wagner (2010) has stated that the firms which rely on their competitive actions are able to capture their customers' attention, where customers are ready to pay extra for improving the firms' sustainable performance, thereby reducing the idiosyncratic risks. Additionally, by engaging in green activities, the firm derives its legitimacy from the different environment-friendly stakeholders. Thus, it is seen that the competitive action highlights the firm's green innovative activities, increases the customer's willingness to pay for the green products, increases the firm's reputation, stabilises its relationship with the different stakeholders and differentiates the green firms. This further improves the firm's profitability and decreases its idiosyncratic risk. Hence, we hypothesize that:

Hypothesis (H2): Competitive action moderates the relationship between green innovation strategy and idiosyncratic risk, especially when the competitive action is high, the relationship between green innovation strategy and idiosyncratic risk becomes stronger.

To test these hypotheses, the research framework (Figure 1) demonstrates the relationships of GIS as part of the company vital strategy that effects on the idiosyncratic risk. This study also delves the moderating role of competitive action in order to assess their influence between the GIS to idiosyncratic risk.

Insert Figure 1 Here

3. Research Methodology:

3.1. Data Collection and Samples:

This study has compiled the data from two different datasets, i.e., CSRHub (https://www.csrhub.com/csrhub/), which includes all information related to the GIS measures. CSRHub is a leading research company which includes the Environmental, Social and Governance (ESG) data. It is noted that the CSRHub[1] database includes data for 18,424 organisations that operate in 10 regions of 132 countries. Hence, the CSRHub offers data from nine sources of the premier Socially Responsible Investment (SRI) firms, or the ESG analysis firms, such as the EIRIS, ASSET4 (Thomson Reuters), Carbon Disclosure Project (CDP), IW Financial, Governance Metrics International (that was merged with Corporate Library), MSCI (ESG Intangible Value Assessment and ESG Impact Monitor), RepRisk, Trucost and Vigeo. Then, the CSRHub collected the data from 265 Non-Governmental Organisations (NGOs), such as the associations, publications, foundations, government databases, union groups, activist groups, and research reports, which was then augmented with the help of the data collected from some other data sources. Thus, the CSRHub schema was associated with the company's achievement and depended on a 0-100 rating scale. A high score indicates a positive score (i.e., 100 = very positive). CSRHub updates the values on a monthly basis; however, the DataStream generally updates the financial data every quarter or yearly. If the changes made in the GIS drastically affect the firm's performance, the DataStream data usually undergoes annual changes. In this study, the researchers determined the annual GIS changes after averaging the GIS scores for a consecutive 12

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

months and then combined these values with the DataStream data. The industries were categorised based on their 2-digit SIC codes. Thereafter, the companies having less than seven observations were also eliminated. Finally, the data sample included 132 firms and 924 annual observations, for a period ranging from 2011 to 2017.

3.2 Variable Operationalization:

3.2.1 Green Innovation Strategy:

In this study, we evaluated the GIS using the ISO 14031 standards, like other studies published earlier (e.g., Campos et al., 2015; Chen et al., 2006; Nguyen & Hens, 2015). The GIS was described as the performance of all the hardware and software involved in the innovative activities implemented by the companies that used green products and processes. These included the technologies needed for energy-saving, pollution prevention, waste recycling, designing of green products and corporate environmental management. Thus, GIS was measured with the help of three major CSRHub databases.

3.2.1.1 Energy and Climate Change Subcategory Scores:

This factor measured the company's efficiency in addressing the climatic changes by using suitable energy-efficient policies, strategies and operations, and developing better and renewable energy sources or alternative environmental technologies. Furthermore, this subcategory also included the energy usage and emission of many greenhouse gases like CO_2.

3.2.1.2 Environmental Policies and Reporting the Subcategory Scores:

The environmental policies-related subcategory included the firm's intention and policies used for decreasing the environmental effects and the value streams to levels which were better for the environment, presently and even in future. Furthermore, this data included the company's environmental reporting performance, adherence to various environmental reporting standards such as the Global Reporting Initiative, along with its compliance with the regulators, stakeholders and investors' request for transparency. The compliance data included any breach of accidental releases and regulatory limits.

3.2.1.3 Resource Management Subcategory Scores:

By using this category, the researchers attempted to determine how effectively the firm used the available resources while delivering or manufacturing services and products, like the suppliers. This subcategory also included the company's ability to reduce the use of water, energy and materials; and also offered effective solutions that could be used for improving the supply chain management. Additionally, this subcategory consisted of the environmental performance with regards to the production size and how it was operated using the Eco-Intensity Ratios (EIRs) for water and energy resources. It was described as the resource consumption per released or formed unit. These resources consisted of the raw and packaging materials which were used for producing or packaging the products, along with other similar processes. The Resource Management data comprises of the performance of waste disposal and recycling. Also, the recycling data was seen to be related to the ratio of recycled waste to the total quantity of waste. This data also presented the manner in which the firm managed the operations which could benefit the local air sheds and watersheds, and the way in which the company operations affected the land usage and the stability of the local ecology. The water resource-related data included the consumption of the drinking waters, industrial waters or steam.

For calculating the GIS data, we estimated the average scores for all the three subcategories in the following manner:

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

3.2.2 Idiosyncratic Risk:

The researchers applied the stock-response model for assessing the manner in which the firm's GIS decreased the firm's idiosyncratic risks. The stock-response model was based on the 4-factor benchmark model that was described in the finance studies (Carhart, 1997; Fama and French, 1993; 2006):

$$R_{id} = R_{fd} + \beta_{1i}(R_{md} - R_{fd}) + \beta_{2i}SMB_d + \beta_{3i}HML_d + \beta_{4i}UMD_d + \varepsilon_{id} \tag{1}$$

Wherein; R_{id} refers to the return on the stock, i, for the day, d; R_{fd} refers to the risk-free rate for day, d; R_{md} represents the market returns for day, d; SMB_d refers to the difference between the mean returns on the small and big stocks' value-weighted portfolios for the day, d; HML_d refers to the difference between the mean returns on the higher and lower book-to-market stocks' value-weighted portfolios for the day, d; UMD_d refers to the difference between the mean return value of the prior high return portfolios on day, d; while ε_{id} refers to the estimated error value for the Carhart 4-factor model for day, d. With the help of this daily data, the model can determine the expected stock-returns for firm, i on day, d. In this study, we followed the method described by Carhart (1997) and used this model for every firm in the sample, for each year, and collected the relevant information from Dr French's website and the Thomson Reuther database. Based on the earlier research (Bharadwaj et al., 2011), we used the annualised standard deviation value for the residual (ϵ_{id}) that was estimated for every firm as the measure of the firm's idiosyncratic risk.

3.2.3 Control Variables:

In this study, we included a set of variables that could control the probable effects of the relationship between GIS and idiosyncratic risk. The different control variables included the firm size, research and developmental intensity, firm profitability and slack resources. The firm size was a vital control variable which used the company assets as an indicator of its size. In one study, McWilliams and Siegel (2000) mentioned that the omission of R&D factor from a model that studied the relationship between the firm performance and GIS of the company could present erroneous results. In this study, we estimated the R&D factor by determining the ratio between R&D expenditure and total sales. Many studies tried controlling the financial performance. Here, as prior financial performance can contribute to a firm's current GIS (McGuire et al., 1988), we accommodated this by including returns on assets (ROA) as a control variable for the GI impact of prior GIS. Finally, we also included and calculated the slack resource as a ratio between the free cash flow and total assets of the company. Additional, slack availability is a requirement for manage to pay for a GIS (e.g. Seifert et al., 2003). More prominent companies are more likely to hold the slack resources essential to undertake and ease green initiatives.

3.3 Empirical Model:

3.3.1 System-Generalised Method of Moment (GMM):

As shown in this study, two main issues had to be resolved. Firstly, we investigated the dynamic data structure and also investigated the past idiosyncratic risk in order to estimate the existing idiosyncratic risk. Second, when we investigated the relationship occurring between the GIS and firm's idiosyncratic risk, the current idiosyncratic risk was correlated with all observable and unobservable factors (like observable and unobservable heterogeneity), which helped in making the GIS-related decisions. In particular, the firms that relied on high-quality processes and products showed high GIS commitment. On the other hand, the contribution made by the GIS to the firm's idiosyncratic risk was seen to be overstated, if all endogeneity issues remained unresolved.

In this study, we applied the System-GMM estimator, which was proposed by Arellano and Bover (1995) and by Blundell and Bond (1998). They formulated this estimator for handling the circumstances having: 1) "small T, large N" panels, i.e., lesser time intervals and numerous individuals; 2) a linear functional relationship; 3) a dynamic and single left-hand-side variable, which was based on its earlier realisations; 4) some independent variables which were not strictly exogenous, wherein they correlated with the earlier and existing realisations of error; 5) fixed individual effects; and 6) autocorrelation and heteroscedasticity within, but not across the individuals.

The System-GMM estimator was used for resolving the issues like probable endogeneity and dynamic panel bias noted in the regressors. Therefore, this estimator was preferred compared to conventional panel OLS or the Within Group estimation methods (Arellano & Bover, 1995; Blundell & Bond, 1998; 2000; Blundell et al., 2001; Bond et al., 2001; Hoeffler, 2002). Also, the OLS level and the Within Groups estimation methods were not consistent and biased, because (i) The OLS levels generally neglected all the unobserved time-invariant firm effects; while (ii) The Within Groups estimation method considered the unobserved country-specific effects in a particular time period with the help of the dynamic panel data model (Hsiao, 2014; Nickell, 1981). It was also seen that the coefficient estimates for the lagged dependent variables derived using the OLS levels and Within Groups estimators, were considered as the approximate values of the upper and lower limits, respectively (Bond et al., 2001; Hoeffler, 2002).

The System-GMM yielded consistent and effective values in the regression model, where the independent variables in the model were not exogenous but were correlated to the earlier and existing realisations of error when the heteroscedasticity and autocorrelation in all estimates were noted (Roodman, 2009). This estimator also controlled all the endogeneity issues as it used the lagged dependent and endogenous variables along with variables which were not related to the fixed effects (Nickell, 1981; Roodman, 2009). In comparison to the difference GMM estimator that was proposed by Arellano and Bond (1991), the System GMM was more effective as it presumed that the initial differences occurring between the instruments were not correlated with fixed effects, which also included other instruments (Roodman, 2009). Also, the System-GMM could derive effective values when the series was similar to the random walks, whereas, in these cases, the Difference GMM estimator displayed a higher sample bias (Blundell & Bond, 1998). Furthermore, the Difference GMM estimator showed a higher bias downwards compared to the Within Groups estimator, if the instruments were weak (Blundell & Bond, 2000; Hoeffler, 2002).

Tables 3 and 4 describe the System-GMM regression data for the various automotive companies that were derived with the help of Eq. 3 and 6, for the period ranging between 2011 and 2017. The two-step system GMM estimator presented efficient values in comparison to the one-step GMM method. Furthermore, the one-step GMM method showed small efficiency gains and asymptotic standard errors which were associated with the two-step GMM estimators and were biased downwards in finite samples (Blundell & Bond, 1998; Hoeffler, 2002). As there were many other groups in the study, we used the two-step System GMM method. For all the estimates, we presumed that the lagged dependent variables were predetermined, whereas the control variables were presumed as endogenous.

Furthermore, the stability of these System-GMM estimators was based on the presumption that the error terms did not display any correlation issues and also assumed the validity of the instruments and the additional moment restrictions. In order to verify the validity of the assumptions, we used the Arellano-Bond test in order to determine no serial correlation between the error terms and Hansen test for the other parameters and the Difference-in-Hansen test for other moment restrictions. Tables 3 and 4 present the different specification test results for the System GMM values. After using all tests, the System-GMM equations were determined. It was seen that the Arellano-Bond test results required a lack of AR (2) serial correlation between the error terms. Hansen test was used for determining if the instruments were not correlated to the error term, whereas the Difference-in-Hansen test was used for testing the validity of additional moment restrictions, using equations 3 and 6.

3.3.2 Model:

In this study, the empirical model used was an extended version of the model presented earlier (e.g., Cai et al., 2016; Li et al., 2017; Wong et al., 2018). This model was used for investigating the various relationships between GI and Idiosyncratic risk, using the below-mentioned linear growth equation. After studying many models, the researchers noted that the firm's idiosyncratic risk, *i,* for time, *t*, was the function of the GIS and different control variables, as shown in the following equation:

$$\textit{Idiosyncratic risk} = f\,(\textit{Green Innovation Strategy}) \qquad (2)$$

We determined the correlation between the idiosyncratic risk, depending on its lagged valued, Idiosyncratic $risk_{it-1}$, and all GIS variables (rate or score described earlier), GIS and the firm-level control variables (such as ln revenue, ln total assets, R&D intensity, free cash flow, ROA, and time dummies), which were labelled as $CONTROL_{it}$, with the help of the regression equation presented below:

$$Idiosyncratic\_risk_{it} = \alpha + \beta Idiosyncratic\_risk_{it-1} + \gamma GIS_{it} + \delta_J \sum_{j=5}^{n} CONTROL_{it} + \mu_i + \varepsilon_{it} \quad (3)$$

Wherein $|\beta|<1$. The disturbances, μ_i and ε_{it}, showed no cross-correlation, and displayed the following properties:

$$E\,(\varepsilon_{it}) = 0;\ E(\mu_i) = 0;\ E(\varepsilon_{it}\mu_i) = 0 \quad (4)$$

The time-varying errors were also assumed to have no correlation:

$$E(\varepsilon_{it}\varepsilon_{is}) = 0 \text{ with } \forall t \neq s \quad (5)$$

$$i = 1,\ \ldots,\ 132;\ t = 2011\ldots,\ 2017.$$

Soto (2009) showed that no conditions had to be imposed on μ_i variance, as the majority of the moment conditions required for the model estimation, did not require any homoscedasticity. The idiosyncratic risk factor represented the current firm performance, GIS represented the GIS scores for the firm, *i,* for time, *t*; while idiosyncratic $risk_{t-1}$ refers to the firm having a period lag of 1; *CONTROL* represents the control variables (i.e., ln total assets and ln revenue, which denote the log of the total assets and the log of the revenue respectively; ROA, free cash flow and the time dummies); μ_i denotes the unobserved firm-specific fixed effects; and ε_{it} was the error term. We conducted the robustness test with the help of other dependent variables such as the systematic risk and leverage.

In order to verify the moderating role played by the firm size in the automotive manufacturing field, we developed a few models and investigated the relationship between GI and the idiosyncratic risk. The following model determined the effect of all interactions occurring between GIS and competitive action on idiosyncratic risk:

$$Idiosyncratic\ risk_{it} = \alpha + \beta Idiosyncratic\ risk_{it-1} + \gamma_1 GIS_{it} + \gamma_2 (GIS_{it} * Competitive\ Action_{it}) + \delta_J \sum_{j=5}^{n} CONTROL_{it} + \mu_i + \varepsilon_{it} \quad (6)$$

All the variables described above were seen to account for the possible interactions that take place between the GIS and competitive action, whereas the affiliation of all products of the variables with the GIS was used as the regressor.

4. Results and Discussion:

The statistics and the correlation matrix for all variables used in the study are given in Table 1 and 2. We observe that the correlation between all these variables show a statistical significance (as per the t-value) and fulfil the study objectives. These results have been derived from the control variables related to the other variables. Furthermore, the correlation matrix indicates that the variables used in the study show no multicollinearity, as their value is less than 0.80. It is also seen that the mean for Variance Inflation Factor (VIF) is 4.35 (less than 10), and this indicates that multicollinearity issue does not exist.

Insert Table 1 Here

Insert Table 2 Here

4.1 Testing the Effect of GIS on Idiosyncratic Risk

Table 3 describes the dynamic and the static results, Pooled OLS and the Fixed Effect model along with the System-GMM values for the firm's idiosyncratic risk. These values have been determined by applying the GIS, which has helped in assessing the effect after disregarding the dynamic relationship between the GIS-Idiosyncratic risk and the heterogeneity. All results have been validated for the different misspecification tests (like the Hansen test used for other restrictions and the second-order serial correlation test, i.e., AR 2 test) by using of the System-GMM model specifications. Additionally, the positive and the significant coefficients related to the lagged dependent variables confirm the currency of the idiosyncratic risk value, which relied significantly on its past value. As described in Table 3, the significant and positive coefficients of the lagged dependent variables of the System-GMM exist between the Pooled OLS model and the Fixed Effects model. An earlier study by Bond et al. (2001), they have shown similar results when an unbiased and competent System-GMM estimator has been used. In this study, we have used the two-step System GMM estimator for calculations of estimators and Hansen test for determining the other restrictions. The results show that the firm's total asset and the free cash flow did not affect the idiosyncratic risk. The total revenue and R&D intensity show a positive effect on the firm's idiosyncratic risk. A mixed correlation is seen between the idiosyncratic risk and the ROA.

As shown in this study, some biases arise if we overlook the dynamic relationship between the GIS and firm's idiosyncratic risk (i.e., Fixed-Effects model) along with the unobservable heterogeneity (i.e., the Pooled OLS model). As described in Table 3, we note a negative relationship (based on Pooled OLS estimate model, i.e., Model 3 and the Fixed Effects estimate model, i.e., Model 2) between the firm's idiosyncratic risk and GIS, similar to the Dynamic model System-GMM, i.e., Model 5. However, a neutral relationship is noted between the static Pooled OLS model (Model 1) and dynamic fixed-effects model (Model 4). Thus, we consider the dynamics prior to estimating the relationship between the GIS and the firm's idiosyncratic risk. Since biased results have been noted after implementing the OLS estimates and Fixed-Effects models, we highlight the results generated by the System-GMM model. Their results indicate that the GIS negatively affects the firm's idiosyncratic risk. Data shows the effect on H1; thereby highlighting the fact that GI affects the idiosyncratic risk. Hence, we validate the presence of a negative relationship between GIS and the firm's idiosyncratic risk activities. The earlier studies have displayed similar results (e.g., Becchett et al., 2015; Harjoto & Laksmana, 2018; Mishra et al., 2013; Li et al., 2017; Luo &Bhattacharya. 2009).

Insert Table 3 Here

4.2. Testing the Interactive Effect of GIS and Competitive Action on the Idiosyncratic Risk: In this study, we determine the interactive effect of the GIS and competitive actions on the firm's idiosyncratic risk. The regression analysis of the System-GMM estimator has been presented in Table 4. The Arellano and the Bond test for autocorrelation offered evidence for the presence of a first-order autocorrelation (AR1) and absence of a second-order autocorrelation (AR2), thereby supporting the general model validity. On the other hand, the Hansen test shows the consistency of the GMM instruments. It is seen that this method controls the probable correlation between all regressors and unobserved factors. Table 4 describes the results for the traditional determinants of the firm's idiosyncratic risk.

Furthermore, Table 4 also presents the regression model results that have been used for the proposed hypotheses. The interaction between the GIS and competitive action along with their effects on the firm's idiosyncratic risk has been assessed using Model 3, as shown in Table 4. We used Model 3 in order to test Hypothesis 2, as it is seen to be a specified model that depicts all the effects of each variable. This model includes the interactive term between the GIS and the competitive action. Brambor et al. (2006) have stated that it is not essential to interpret every individual coefficient during the GIS and competitive action interaction, as these coefficients may not be relevant to this study. We have proposed Hypothesis 2 in order to predict whether the competitive action negatively moderates the relationship between the GIS and the firm's idiosyncratic risk. It is noted that as the competitive action increases, the negative correlation between the GIS and the firm's idiosyncratic risk also increases. When Model 3 is used, a negative but significant coefficient is noted after the interaction between the GIS and the competitive action (β= -0.585, p-value < 0.010). These results highlight the detrimental effect of GIS on the firm's idiosyncratic risk when it interacts with the competitive action. This result validates the Hypothesis 2.

Insert Table 4 Here

Figure 2 describes this effect in further details. Based on the results of the Model 3 presented in Table 4, in this study, we used the Aiken and West (1991) strategy in order to plot the significant interactive effects (p-value < 0.05) in order to accurately depict the moderating effects. Figure 2 presents the effect of the GIs on the firm's idiosyncratic risk for the high and low levels of competitive action. Furthermore, a standard deviation that is lower or greater than the average value indicates a low or high level of the various moderating variables, respectively.

As presented in Figure 2, if the GIS value increases by 1 value of the standard deviation value below the mean to 1 value is higher than the mean, the firm's idiosyncratic risk showed a decrease to -2.60 from 4.19. This occurs in firms that have higher competitive action. On the other hand, the firms with a lower competitive action indicate an increase in idiosyncratic risk to -0.39 from -6.80. Thus, if the GIS increases from 1 value of the standard deviation lesser than the average to 1 value higher than the mean, the firm's with a high competitive action shows a 162.05% decrease in their idiosyncratic risk; whereas the firms with a low, competitive action shows a 113.23% increase in their idiosyncratic risk. Figure 1 indicates that the GIS effect shows a low to high variation, whereas the GIS and the firm's idiosyncratic risk when the relationship changes from positive to negative.

Furthermore, the competitive action was seen to moderate the GIS effect on the firm's idiosyncratic risks. A significantly negative correlation is noted between all the factors in the companies which show high competitive action. The interaction patterns between all parameters are consistent with the prediction. To conclude, as per the definition of the idiosyncratic risk, the results of this study show that the firms with a higher GIS can achieve a low risk, whenever the competitive action was high.

Insert Figure 2 Here

Typically, traditional results tables report only model parameters. In a linear-additive model, these are the quantities of interest since the coefficients, and standard errors describe what we know about the marginal effect of each independent variable. However, this is not the case with multiplicative interaction models. Thus, this study also presents a simple figure (Figure 3) that graphically illustrates how the marginal effect of GIS changes across the observed range of competitive action in the form of a marginal effect plot. The solid sloping line in Figure 3 indicates how the marginal effect of GIS changes with the level of competitive actions. The dashed curves around the marginal effect line depict a 95% confidence interval, thereby identifying the values of competitive action at which the marginal effect of GIS is statistically significant.

As is apparent from inspection of Figure 3, GIS has a statistically significant negative effect on idiosyncratic risk over most of the sample values of competitive action (from -7.8 to -2.2). For example, when competitive action is equal to 2.0, the marginal effect of GIS on is equal to idiosyncratic risk approximately 0.50 percentage points. Critically, since the confidence interval bands do not cross 0 for values of competitive action smaller than or equal to -2.2, we can conclude that the marginal effects are statistically different from zero (at the 95% level) over the range of GIS from -7.8 to 2.2. A closer look at the histogram reveals that approximately 75% of the observations in the sample have values of competitive action smaller than or equal to -2.2. This plot provides unambiguously strong evidence for hypothesis 2 because each of its three predictions receives strong empirical support.

Insert Figure 3 Here

5. Conclusions:

In the past few years, many researchers have shown a lot of interest in the GIS of different organisations. However, a majority of the academic and financial studies have only focused on accounting-based measures like ROE, ROA, and net profit. Another important parameter related to the corporate financial performance, i.e., the idiosyncratic risk involved in the firm's stock prices, was disregarded by these scholars. In this study, we investigated the correlation between the firm's GIS and the idiosyncratic risk. Several recent studies reported that GIS and the firm's idiosyncratic risk showed a slightly negative relationship; however, some studies stated that additional research was required for determining the role played by all omitted variables that affected this relationship. There is an on-going debate, and better models are needed for investigating these issues. Here, we analysed the critical role played by the firm's competitive actions and thereafter explained the GIS activity interface.

In this study, we have described several results that highlighted the correlation between the firm's idiosyncratic risk and GIS. Firstly, they considered the dynamic data for estimating the System-GMM regression. The results indicated that GIS showed a significant but negative correlation with the firm's idiosyncratic risk. Secondly, we also investigated the two-way interaction occurring between the firm's competitive activities and GIS, while considering idiosyncratic risk as the dependent variable. Results indicated that the competitive actions negatively interacted with the GIS, which indicated synergy. Furthermore, the interaction occurring between the competitive actions and GIS negatively affected the idiosyncratic risk, which supported Hypothesis H2.

The results noted in this study were supplemented by the existing literature as it offered several practical and theoretical findings. This study has attempted to offer evidence regarding the relationship between the GIS and the firm performance, which showed that along with reducing the harmful environmental effects, a high GIS could improve the firm's profitability and also decrease the risk. This study did not restrict the firm's financial performance with regards to its profitability, as it offered evidence related to the correlation between the GIS and the firm's idiosyncratic risk. Finally, it offered evidence for settling the on-going debate, i.e., "Does it pay to be green?"

Furthermore, this study used the resource-based view, which indicated that any firm that consisted of competitive action could significantly promote their GIS efforts. Because of the competitive action, the firms having a high GIS could acquire and improve the firm's environment-friendly reputation, and their differentiation benefits. This study also analysed the moderating role played by the competitive actions on the GIS and its relationship with firm risk. Finally, this study noted the various configurations of the environment-related factors which strengthened the negative effect of the GIS on the firm risk.

This study also offered critical managerial implications for all researchers who wished to study the competitive actions of the firm after the implementation of the GIS. As the GIS negatively affects the idiosyncratic risk, all managers must note that any investment in the GIS could help in developing novel market opportunities, increasing sales, stabilising its correlation with the important stakeholders and deriving financial advantage, without increasing the company's costs (Gotschol et al., 2014; Li et al., 2017). The results noted in this study stated that the GIS improved the corporate reputation and subsequently decreased the firm's idiosyncratic risk. This helped the stakeholders and stockholders interpret and understand the performance of the GIS.

Additionally, the results also allowed the managers to understand the firm's internal resources, especially competitive action, as it could increase the positive effects of the GIS. Hence, the business managers must recognise the role played by the GIS, so that they could inform the market regarding the beneficial effects of the GIS and helped them display better financial performance.

Limitations and future research:

Despite the different results presented in this study, the study does present some limitations. Firstly, this study used a sample consisting of publicly-listed automotive companies; however, it did not include other sectors like maritime and air transport. As these other sectors also contribute to the current economy, future studies must incorporate them in their empirical settings, thereby including the generalised results. Also, in the future, the researchers must compare the GIS levels of the listed and non-listed companies for understanding which of the firms incorporate environment-friendly activities and derive better financial gains.

Secondly, in this study, we studied the moderating role played by the competitive actions in the relationship between GIS and idiosyncratic risk. Several internal or external parameters affect the firms, like the organisational culture, which moderates the effect of the GIS on the risk. Hence, we proposed a solution that incorporated the firm's internal and external factors in their future settings. Lastly, this study only focused on publicly-listed manufacturing companies in developed countries. These developed countries were aware of the various environmental issues and implemented many green initiatives for ensuring their sustainable growth. However, these results are not an accurate representation of other developing countries, since they are subjected to different legislation, regulations, organisational structure and economic issues. Hence, this study must be replicated in different settings for measuring the generalisation of the results and offering better empirical evidence for verifying the study results.

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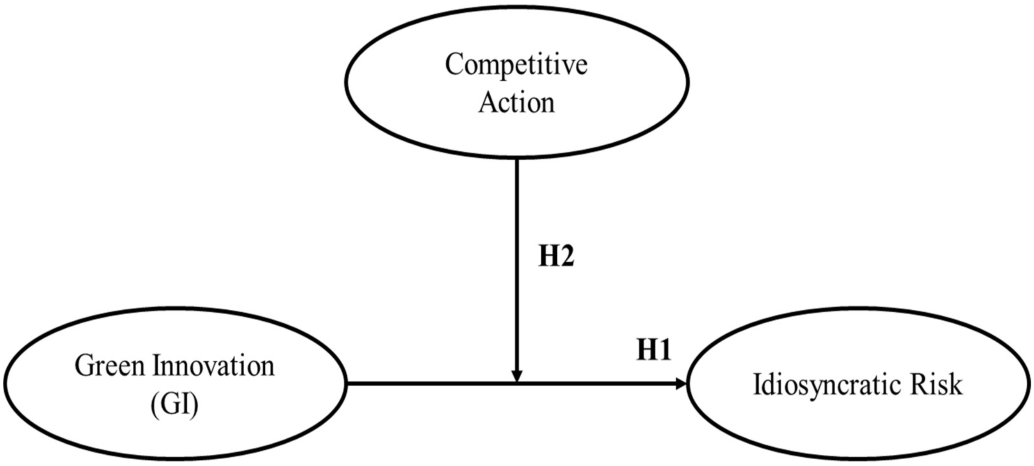

Figure 1 Research Framework

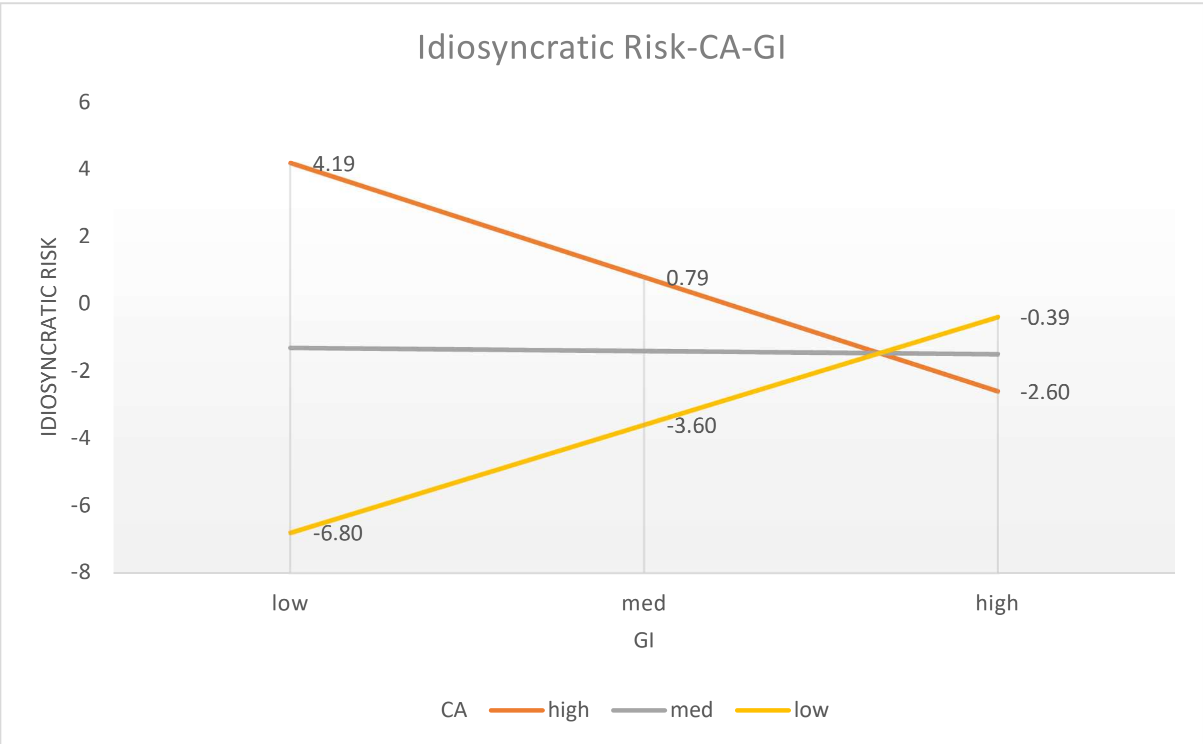

Figure 2 Effects of GIS on Idiosyncratic Risk: Contingent on Competitive Action (CA)

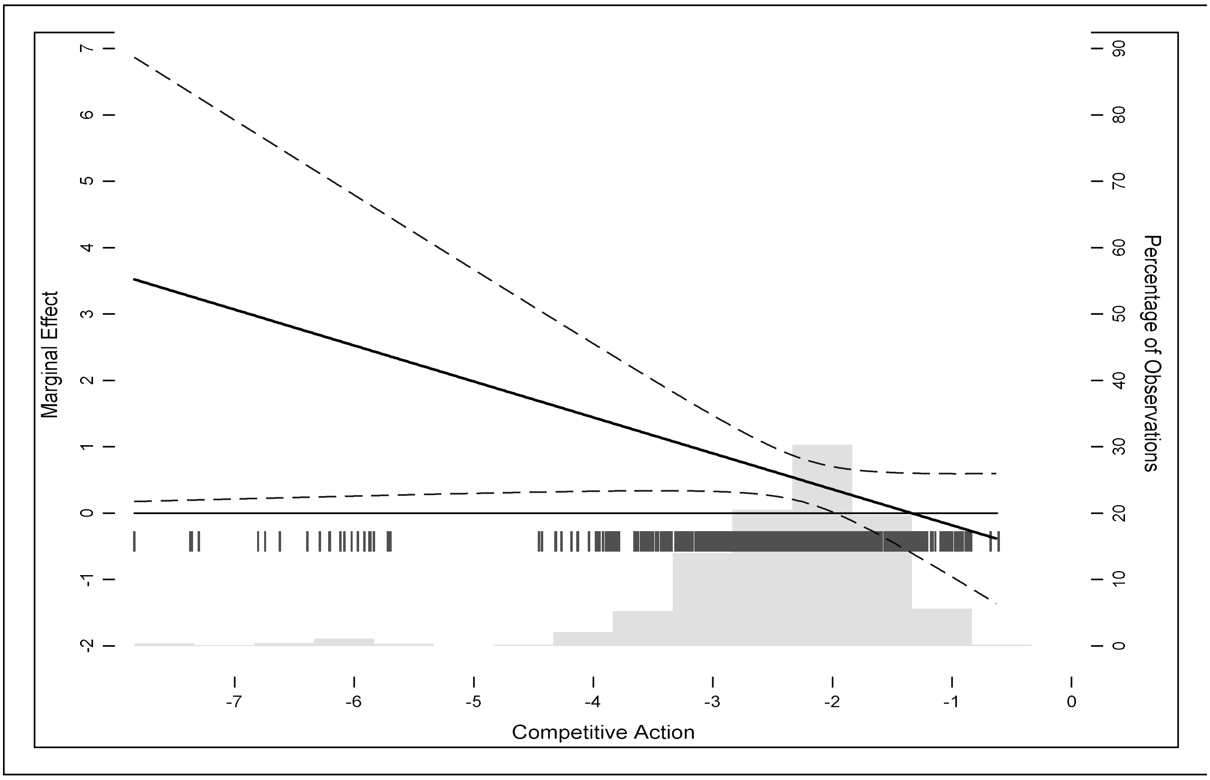

Figure 3 Marginal Effects of GIS on Idiosyncratic Risk: Contingent on Competitive Action (CA)

Table 1 Descriptive Statistic

Variable	Obs	Mean	Std. Dev.	Min	Max
Idiosyncratic risk	924	0.061103	0.442187	-4.93754	4.290948
GIS	924	52.47181	6.839678	30.99680	71.99490
Competitive action	924	-2.390356	0.908788	-7.835524	-0.607625
ln total assets	924	3.739523	0.770762	2.113943	6.007861
ln revenue	924	3.758671	0.738403	2.001734	5.943428
Free cash flow	924	0.054981	0.523199	-1.530880	8.495114
R&D intensity	924	0.032564	0.056900	0.0000486	1.0245100
ROA	924	0.188816	0.721816	-0.329590	10.068000

Notes: All statistics are based on original data values.

Table 2 Correlation Matrix

	Idiosyncratic risk	GIS	Competitive action	*ln* total assets	*ln* revenue	Free cash flow	R&D intensity	ROA
Idiosyncratic risk	1							
GIS	-0.0309	1						
Competitive action	-0.0259	0.0183	1					
ln total assets	0.0218	0.3481	-0.2328	1				
ln revenue	0.0343	0.3367	-0.3179	0.9528	1			
Free cash flow	0.0034	0.0046	-0.0423	0.0657	0.0838	1		
R&D intensity	-0.0300	-0.0100	0.4643	-0.1393	-0.1803	-0.0894	1	
ROA	0.0004	0.1068	0.1046	0.0690	0.0996	0.0078	-0.0534	1

Notes: All statistics are based on original data values.

Table 3 Green Innovation Strategy and Idiosyncratic Risk (N=132 firms, T= 7, period = 2011- 2017)

	Static		Dynamic		
	OLS	Fixed Effect	OLS	Fixed Effect	System-GMM
Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Idiosyncratic Risk$_{t-1}$			0.266***	0.458***	0.338***
			(0.102)	(0.109)	(0.0726)
GIS	-0.00282	-0.00890***	-0.00458*	-0.0183	-0.0125***
	(0.00206)	(0.00329)	(0.00256)	(0.00419)	(0.00318)
ln total assets	-0.0574	0.4000	-0.0745	0.5350	-0.0770
	(0.0736)	(0.2610)	(0.0817)	(0.3680)	(0.1930)
ln revenue	0.0847*	0.114**	0.111	0.252*	0.596**
	(0.0662)	(0.2810)	(0.0739)	(0.3510)	(0.2330)
Free cash flow	-0.00285	-0.00190	0.000348	-0.00642	0.00165
	(0.00959)	(0.0325)	(0.0105)	(0.0642)	(0.0580)
R&D intensity	-0.1510	2.6690***	-0.1880	4.9510***	8.7450***
	(0.2410)	(0.3750)	(0.3930)	(0.9260)	(0.5180)
ROA	-0.00192*	0.0179**	-0.00121*	0.0234*	-0.0191***
	(0.00358)	(0.0550)	(0.00401)	(0.0658)	(0.0470)
Constant	0.1110	-1.4870*	0.1830	-2.0720*	-1.4690**
	(0.0980)	(0.8520)	(0.1180)	(1.1420)	(0.6970)
Year	Yes	Yes	Yes	Yes	Yes
Observations	924	924	792	792	792
R-squared	0.005	0.043	0.037	0.159	
Number of firms		132		132	132
Number of instruments					21
R Squared	0.0046	0.0430	0.0370	0.1594	
AR1					-2.56(0.011)
AR2					-1.07(0.284)
Hansen Test					20.90(0.075)
Different in Hansen Test					6.29(0.392)

Notes: 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. System GMM model is estimated by using the Blundell and Bond (1998) dynamic panel system GMM estimations and Roodman (2009) - Stata xtabond2 command.

Table 4 Effect of Competitive Action and Green Innovation Strategy on Idiosyncratic Risk (N=132 firms, T= 7, period = 2011- 2017)

	System-GMM		
Variable	Model 1	Model 2	Model 3
Idiosyncratic Risk$_{t-1}$	0.223***	0.339***	0.303***
	(0.0739)	(0.0725)	(0.0137)
GIS		-0.0125***	0.0572***
		(0.00319)	(0.0194)
Competitive action	-0.345	-0.251	33.38***
	(0.354)	(0.392)	(8.731)
GIS*Competitive action			-0.585***
			(0.152)
ln total assets	0.0426	-0.0671	-0.475*
	(0.205)	(0.192)	(0.244)
ln revenue	0.441	0.573**	0.815**
	(0.280)	(0.236)	(0.317)
Free cash flow	-0.0212	0.00132	-0.00135
	(0.0711)	(0.0576)	(0.0610)
R&D intensity	8.565***	8.852***	5.706***
	(0.561)	(0.481)	(0.648)
ROA	-0.0345	-0.0202	0.0345
	(0.0444)	(0.0463)	(0.128)
Constant	-1.953**	-1.393*	-4.727***
	(0.785)	(0.719)	(1.395)
Year	Yes	Yes	Yes
Observations	792	792	792
Number of firms	132	132	132
Number of instruments	21	21	21
AR1	-2.64(0.008)	-2.55(0.011)	-2.99(0.003)
AR2	-0.50(0.618)	-1.08(0.281)	-0.67(0.601)
Hansen Test	17.37(0.183)	20.94(0.074)	17.55(0.130)
Different in Hansen Test	4.05(0.670)	7.01(0.428)	6.56(0.476)

Notes: 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. System GMM model is estimated by using the Blundell and Bond (1998) dynamic panel system GMM estimations and Roodman (2009) - Stata xtabond2 command.