Influence of green innovation strategy on brand value: The role of marketing capability and R&D intensity

Abstract

Green innovation has received growing attention from the business sector in recent years, yet few studies have examined the internal mechanisms and contingent conditions that link green innovation to a firm's brand value. By integrating the brand value literature with the resource-based view (RBV), our research investigates the moderating roles of marketing capability and R&D intensity in the influence of green innovation strategy (GIS) on brand value. The System-GMM method was used to estimate a dynamic panel data model based on firm-level panel data from 164 listed companies in the global automotive industry between 2011 and 2018. The results confirmed that GIS has a positive impact on brand value, showing that automotive firms can use GIS to improve their brand value. Furthermore, the contingent effects of a firm's marketing capability and R&D intensity were supported. Marketing capability and R&D intensity positively moderate the relationship between GIS and brand value. The effect of GIS on brand value is more significant for firms with high R&D intensity and high marketing capability investment compared to those firms with low intensity and low investment. This study provides crucial theoretical and managerial implications for managers.

1. Introduction:

Firms' economic activities have always had another facet to them, known as ecological imbalance. Of late, business entities have been seeing higher pressure from stakeholders to decrease the ecological effects triggered by business-related activities (Longoni *et al.*, 2018; Yu *et al.*, 2017). Consequently, companies are not just expected to assume ecological values to attain viable economic success (Tate and Bals 2018) but to also see ecological management as an indicator of their 'social performance' (Short *et al.*, 2016; Yawar and Seuring 2017). This entails organisational leaders' commitment to environmental ethics by means of policy design and its execution in daily functioning to decrease the likely ecological effects of business operations (El-Kassar and Singh 2018; Singh and El-Kassar 2019).

In recent times, green innovation has emerged as a prevalent notion as ecological decline and global warming continue to present grave threats to humanity (Kunapatarawong and Martínez-Ros 2016; Miao *et al.*, 2017). Sustainability is a vital issue, and green growth has been in demand like never before. Certainly, technological advancement is a key aspect powering green development; however, innovation is expensive as a whole. Thus, the main concern is if green innovation can enhance growth while sustaining its ecological advantages.

Green innovation is seen as a key factor impacting ecological sustainability, fiscal growth, and the standard of living (Bansal and Gao 2006; Dangelico and Pujari 2010). It pertains to hardware and software innovations that employ green processes and products. These encompass the technological advances that aid in averting pollution, conserving energy, recycling waste, designing green products, and overall corporate ecological management (Chen *et al.,* 2006; Li *et al.,* 2017). Notably, they are not limited to just regulatory compliance (Aragón-Correa et al., 2013). Green innovative organisations are those that deploy novel, evolving, and continually developing practices responsible for noticeable green development, such as products or technology (Chen *et al.,* 2006; Li *et al.,* 2017). Companies that intend to deploy green innovative technologies should formulate a green innovation approach in the first phase. As per Johnson and Scholes (1993), this approach is defined as a long-term prospect and direction that caters to the requirements of the market and the expectations of all parties involved. Moreover, Porter (1996) observed that the approach is centred on distinctive activities. Consequently, companies need to determinedly select a suite of activities that aid in blending the various values. When firms formulate a new eco-friendly approach, they have a tendency to design a green innovation strategy (GIS).

The automotive sector has made significant contributions to the global economy as well as individual mobility. However, its offerings and practices are major sources of ecological disparity (Nunes and Bennett 2010). Considering that automobiles trigger significant ecological impacts, the technological effects of the vehicle production process need to be scrutinised (Graedel and Allenby 1997; Keoleian *et al.*, 1997). Exercising ecological pressures helps decrease discharges and waste in automobile manufacturing, usage, and end-of-life. Such pressures are in the form of strict, intricate, and expensive protocols as well as demands from a rising number of stakeholders for enhanced ecological performance (Geffen and Rothenberg 2000). Persistent innovation is crucial to overpower pressures from consumers, rivals, and regulators (Porter and Van der Linde 1995). Earlier, the majority of automotive firms termed ecological compliance a supplementary manufacturing cost rather than a fundamental practice for averting unfavourable ecological effects. However, stringent ecological norms and environmentalists have altered the competitive landscape and patterns of firms. The rising costs of conventional means of compliance and advancements in material as well as process technologies have prompted some vehicle supply chain firms to espouse green innovative techniques to overcome ecological challenges (Richards and Pearson 1998).

Even though countries have generally agreed to shift towards a green growth path (the Paris Agreement), it is still important to ensure that this goal is incentive-consistent with each organisation, as it is basically the cornerstone of green innovation and progress. Stucki (2018), for instance, contended that companies would invest in green technologies only if there is profit involved. However, it remains to be seen whether eco-friendly technological investments can bolster organisational performance. Negative outlooks, like those stated by Palmer et al. (1995), indicate that companies espousing green innovation may endure incompetence and output losses. Conversely, Huang and Li (2017) observed that green innovation could enhance performance. Fernando et al. (2019) recommended that eco-innovation could enhance service innovation and drive business performance. Empirical observations pertaining this question are nevertheless lacking (Tang *et al.*, 2018) and susceptible to the sample choice, the mode of analysis, and the empirical strategy.

Previous reports have empirically determined the correlation between GIS and corporate financial performance (Chen *et al.*, 2006; Lai *et al.*, 2010; Lin *et al.*, 2019a, 2019b); however, how GIS activities affect these results is not clear. Some researchers argue that GIS does not significantly contribute to corporate performance (Hull and Rothenberg 2008). A lack of GIS is attributed to the issues that obstruct green innovation, like knowledge gaps, inadequate government support, and an aversion to taking risks in the capital market (Runhaar *et al.*, 2008). A majority of new green firms and ventures are vulnerable given that constant governmental subsidies will presumably decrease. These issues hinder managers from making competitive and environmental developments at the corporate level (Hull and Rothenberg 2008). Though organisations often overcome these issues and develop green innovative activities, these innovations are not always translated to higher levels of brand value (Link and Naveh 2006). For instance, Tesla produces electric cars that decrease ecological harm but are highly priced, thereby making them less practical than traditional vehicles. Thus, customers are not willing to use these innovative products. Furthermore, organisations that implement innovative green activities must invest more in training as well as in safety and product quality (Gelb and Strawser 2001). Additional costs are also incurred for risk prevention and research (López *et al.*, 2009).

Therefore, in this study, we investigated the influence of GIS on brand value. We also determined if marketing capability and R&D intensity moderate the association between GIS and brand value. Based on earlier studies which determined the impact of GIS engagement on firm performance, we adopted brand value as a measure of firm performance to analyse 164 selected carmakers from top global brands. A majority of previous studies have used GIS in combination with traditional financial indicators (Chen *et al.*, 2006; Chen and Liu 2018; El-Kassar and Singh 2019; Lin *et al.*, 2019a, 2019b; Tang *et al.*, 2018; Zhang *et al.*, 2019). To determine the effect of GIS, we argued that brand value is a single variable comprising various components and characteristics that are highly sensitive to GIS. In particular, we assumed brand value as an effective measure of corporate performance that integrates customer demand, brand strength (loyalty, reputation, market position) and economic earning. A similar assumption was made by Chu and Keh (2006), who stated that the corporate brand is an important corporate performance metric. Also, Fehle *et al*. (2008) mentioned that top global brands have hidden value and are not priced using traditional asset pricing models.

Our study aimed to fill the gaps in the literature by examining how GIS increases the brand value of organisations. Hence, we proposed a theoretical framework (refer to Figure 1) of the moderating mechanisms on which the GIS-brand value link is contingent upon. Specifically, this study sought to understand how corporations could increase their brand value through GIS by determining the moderating effects of firms' R&D intensity and marketing capability. The research methodology included a longitudinal analysis of the top automotive organisations in the world. Brand value was used as the dependent variable subject to the effects of GIS and all relative control variables. Our use of panel data offered a robust technique to control unobserved heterogeneity related to the intrinsic perception of GIS activities by organisations. We also measured GIS activities at the organisational level with the help of the CSRHub rating, which made the results highly specific and meaningful. Lastly, we discussed implications for organisations and governments that implement GIS activities to improve their brand value. This would help policymakers design better tools for innovative green activities.

This study adds value to the GIS literature in three ways. First, in contrast to previous studies, we investigate the influence of GIS activities on the specific aspects of an organisation's brand value. Although earlier findings have determined the impact of GIS activities on firm performance, there is scarcely any evidence on the effect of GIS activities on corporate brand value. Second, this report highlights the significance of two potential moderators – R&D intensity and marketing capability – in response to various scholars who called for an examination of moderating effects in the correlation between firm performance and GIS activities (Chan *et al.*, 2016; Grewatsch and Kleindienst 2017; Tariq and Chonglerttham 2019). In fact, to our knowledge, we are the first to study the effects of a firm's R&D intensity and marketing capability on its GIS and brand value, which helps firms in making and managing informed decisions. Thus, this study bridges the existing gaps in the theoretical literature.

Third, from a methodological standpoint, we contribute by using dynamic panel data System-GMM estimates and longitudinal data for the period between 2011 and 2018 in order to determine dynamism in the GIS-brand value relationship. Earlier studies noted that the correlation between firm performance and GIS is dynamic and that GIS affects corporate brand value. Hence, the probable endogeneity between brand value and GIS activities must be determined and controlled. Accordingly, we use longitudinal data to handle the issue of endogeneity, thereby generating statistically robust results which distinguish endogenous and exogenous changes in brand value.

The rest of this paper is structured as follows: Section Two reviews the literature and hypotheses which form the basis of this study; the methodology, specifying data collection and analysis procedures, is presented in Section Three; Section Four discusses key statistical findings; Section Five presents managerial and theoretical implications; and finally, Section Six addresses the limitations of the study with recommendations for future research.

2. Literature Review and Hypothesis Development:

2.1 The Resource-Based View (RBV)

We adopted the resource-based view (RBV) of the firm to scrutinise and elucidate the GIS-performance relationship from the perspective of the global car production industry. The relationship between GIS and organisational performance is quite old, with its roots in the eco-innovation literature (Barney 1991; Takeuchi *et al.*, 2007). Strategic management scholars agree that the RBV is an extensively acknowledged theory for explaining organisational competition and success (Barney *et al.*, 2011; Newbert 2008). This theory highlights that an organisation's resources and abilities are the main contributors of its competitive advantage.

The RBV effectually suggests how automotive companies exhibit and maintain a competitive edge (Barney 1991). As far a company's internal affairs are concerned, the RBV terms organisations as a package of resources. Specifically, intangible resources and competencies (e.g. innovation proficiencies, knowledge assets, reputation, culture, and IT) better meet the strategic attributes that attain and maintain a company's competitive edge (Newbert 2007). The VRIO structure emphasises the association between a company's strategy and internal resources, whereby a strategy has Value (V) if it presents a competitive edge, Rareness (R) if rivals do not exhibit it, Imitability (I) if it is not economical for other players to replicate, and Organisation (O) if the firm is appropriately organised to capitalise on all its resources for the strategy (Barney 1991).

Moreover, if a firm's strategic resources are rare and costly for competitors to mimic or replace with other resources that can accomplish similar tasks, the firm attains better long-term performance and constant competitive edge (Amit and Schoemaker 1993). The RBV assumes that distinct competencies obtained from internal as well as external resources present a viable competitive edge (Laosirihongthong *et al.,* 2014). In this context, GIS bolsters service innovation competencies, which encompass a vital intangible resource. Both are valued possessions for a firm and challenging for other entities to mimic. Thus, in the long span, GIS empowers an organisation to attain competitive edge and sustainability. The rationale behind the suggested association between GIS and viable business performance is also centred on the consideration that GIS urges companies to utilise raw materials efficiently, thereby reducing production costs and increasing revenue (Porter and Van der Linde 1995). By facilitating the ideal utilisation of resources to accomplish intended results, GIS aids a firm in enhancing competitiveness and differentiating itself from its rivals.

Environmental issues automatically alter societal perspectives with regards to the activities which damage the ecosystem. In response, firms must develop strategies to execute innovative activities to decrease the negative effect of their operational activities on the ecosystem. Green innovative activities are vital for a firm's survival and act as a weapon which preserves the firm's competitive advantage (Chiou *et al.,* 2011). In fact, GIS helps firms improve market position, establish brand reputation, bypass competition, generate breakthroughs, and attract customers (Mu *et al.,* 2009). In one review, Newbert (2007) collated empirical research related to the RBV of firms. They emphasised the abilities of firms instead of their resources and determined the potential effects and relevance of these factors on corporate performance. In essence, they found that resources alone are not enough; rather, organisations need to effectively and capably utilise these resources to benefit from them. A recent study (Liao *et al.,* 2009) highlighted the significance and relevance of firm capability compared to the resources available to them. Therefore, GIS processes need to incorporate the resources needed to develop novel processes and products.

2.2 Green Innovation Strategy (GIS)

A strategy is defined as the scope and direction of an organisation in fulfilling stakeholder expectations and market needs (Johnson and Scholes 1993). Accordingly, a green innovation strategy is described as innovative activities which decrease a firm's effect on the ecosystem, thereby allowing the organisation to achieve its eco-targets and environmental benefits (Wong *et al.*, 2013) while also building its competitive advantage. Green innovation activities emphasise waste reduction, pollution prevention, and the implementation of an environmental management system (Eiadat *et al.*, 2008) to meet stakeholder and market pressures. In existing business operations, pioneer firms that develop GIS activities display better corporate performance, image, and expansion into newer markets (Chen *et al.*, 2006; Lin *et al.*, 2019a, 2019b; Sarkar 2012). Song and Yu (2017) noted that firms must develop novel green innovation strategies to stimulate green innovation.

2.2 Brand Value

In modern-day business, developing brand value is a vital strategic concern for firms endeavouring to extend long-term profits instead of offering lower value "but with more immediate and quantifiable financial outcomes" (Melewar and Nguyen 2014). More managers are motivated to sacrifice short-run returns for long-term added value by providing brand name products or services (Aaker 1996). As a key driver of brand value (Aaker 1996), GIS increases an organisation's environmental responsiveness towards product stewardship, pollution prevention, and unpolluted technologies (Hart 1997). It has become an important means to derive competitive advantage by developing different environmentally friendly processes (Chang 2011; Chen 2011; DeBoer *et al.*, 2017; Zhu *et al.*, 2008) which ultimately improve brand value. GIS can generate brand differentiation, enhance a brand's value proposition, and revitalise a brand (Sriram *et al.*, 2007). These initiatives allow an organisation to distinguish its products and services by establishing a positive brand image and preserving its brand value. Additionally, a brand's investment in green innovation may boost its capability to effectively engage a broader array of marketing strategies than its competition (Barone and Jewell 2013). Hence, building a green innovative mechanism capable of sustained growth may be necessary for firms to affect positive brand construction.

The American Marketing Association defined a brand as the term, name, symbol, design, and other such features that define a seller's goods and services as different from those offered by others. Brands are identified as objects of value, whereby the valuation of a brand is usually performed on a strictly financial basis – in the same way as an individual company (see, for example, Damodaran 2007; Fernandez 2002). Brand equity refers to the total measure of a brand's worth which can be validated by determining the effectiveness of branding components. When markets are fluctuating and dynamic, brand equity is used as a marketing process to increase customer loyalty and customer satisfaction. However, it carries the side effect of low price sensitivity.

Thus, a brand refers to a promise that a firm makes to its customers about what they can expect from their products, including functional and emotional benefits. When a customer recognises a firm's brand and favours it over competitors', the firm has reached a high brand equity level. In the field of accounting, a brand is a valuable intangible asset in an organisation's balance sheet. Specific accounting standards have been developed to assess the brand equity of an organisation. Brand owners must thus manage brands well to create shareholder value. Brand valuation is seen to be a vital management technique which ascribes monetary value to a brand and helps in managing marketing investment (i.e. prioritised across the portfolio of brands) towards the maximisation of shareholder value. Though an organisation's balance sheet only reflects its acquired brand equity, the idea of offering value in a brand motivates marketing executives focus on long-term brand stewardship and value management as well.

With regards to GIS, a green brand derives many benefits and attributes based on its lower environmental effects. Thus, it promotes the perception of an environmentally friendly brand and discloses these benefits to environmentally aware customers. A corporate green brand embodies stakeholders' perceptions related to environmentally positive and green properties; as such, it is regarded as a significant determinant of customer satisfaction. Firms that invest in developing a green brand do not just avoid legal penalties and environmental protests, but also satisfy customer expectations of the brand's environmental sustainability and friendliness (Chen 2010).

2.3 GIS and Brand Value

The manufacturing sector, especially the automotive sector, needs to make attempts to protect the environment. Hence, they need to switch their manufacturing processes to be more environmentally friendly in satisfying customer needs and practising corporate environmental responsibility (Porter and Kramer 2006). Recently, organisations and business leaders have begun to consider environmental responsibility as an 'inescapable priority' (Porter and Kramer 2006). It has emerged as a critical and legitimate endeavour (Gelb and Strawser 2001), as corroborated by numerous studies since the year 2000 (e.g. Lockett *et al.,* 2006; McWilliams *et al.,* 2006; Quazi and O' Brien 2000; Schnietz and Epstein 2005).

Studies show that GIS activities help organisations improve life quality, reduce risk, increase profits, and boost efficiency (Hart 1995; King and Lenox 2002; Lin et al., 2019a, 2019b). They also increase the demand for products among environmentally sensitive customers (Alfred and Adam 2009). Next, GIS activities decrease pollution and minimise operational costs by reusing all materials after recycling (Hart 1995; Porter and Van der Linde 1995). Moreover, organisations that display good environmental initiatives are likely to earn a positive ecological reputation (Christmann 2004), which leads to benefits from premium pricing and higher sales due to societal approval (Bansal 2005). This enables firms to differentiate their goods against competitive firms (Rivera 2002). Thus, it is noted that responsible and ethical environmental activities offer several opportunities (Porter 2006; Porter and Reinhardt 2007).

In their study, Chen (2014) stated that organisations carry out GIS to be able to manufacture environmentally friendly products that decrease environmental damage. Furthermore, Carrion-Flores and Innes (2010) mentioned that GIS activities spur the demand for better environmental performance. Indeed, GIS is related to corporate environmental management and the fulfilment of eco-targets; hence, it improves firm performance (Chen et al., 2006; Kammerer 2009). GIS is found to help firms avoid penalties and environmental protests in addition to improving productivity, corporate reputation, green awareness image, new market penetration, and competitive advantages (Chen *et al*., 2006; Mu *et al*., 2009). Zhu *et al.* (2012) further observed that GIS supports firms in promoting their brand and decreasing waste, which further stimulates market share and novel business opportunities. This observation was supported by the Toyota Prius Hybrid scenario, which turned into a status symbol and an example for green-labelling product strategies (Bonini and Oppenheim 2008).

Researchers have highlighted the effect of GIS on brand value (Agarwal *et al*., 2003; Chen 2014), specifically noting that brand value is increased by GIS (Hyvarinen 1990; Rothwell 1992). Thus, innovative green activities differentiate firms as successful. Though corporate performance is often assessed at the macro-level (i.e. firm performance), it is argued that the critical viewpoint is based on an organisation's product performance and its brand (i.e. micro performance). Thus, an organisation's innovative behaviour is focused on improving its market performance, which is related to the specific brand marketed by the organisation. Doyle (1989) stated that successful brands reflect novel innovations and new position concepts, which allow organisations to develop distribution channels as well as market segments and exploit gaps formed by environmental changes. Accordingly, a differentiated and effective customer proposition is seen to be necessary for creating a successful brand name (Doyle 2001). It requires perceiving novel ways to deliver higher value to customers in a manner that sets a brand apart from its competitors. Based on the RBV, we predicted that GIS is a critical organisational resource that a firm uses to enhance its brand value and earn goodwill among key stakeholders. We thus proposed the following hypothesis:

Hypothesis 1 (H1): *Green innovation strategy positively affects corporate brand value*.

2.4 Integration of GIS and Marketing Capability

Previous literature has argued that GIS and marketing capability help organisations increase their brand value. GIS is a voluntary organisational activity developed to generate benefits for stakeholders and shareholders (Esen 2013; Mackey *et al.*, 2007). Thus, GIS refers to firm activities which help in resolving environmental problems through the development of protective strategies that reduce, prevent, and control environmental effects. Such effects take into account potential hazards as well as the treatment, sanitisation, and disposal of waste, thus including all clean-up related expenses. Hence, by increasing GIS activities, an organisation can respond better to public requirements and government regulations.

Marketing competencies are the integrative practices of applying a company's knowledge, expertise, and resources to market-linked requirements. They empower a company's GIS to supplement value to its products and cater to competitive demands (Martin and Javalgi 2019). They also play a vital part in the use of market-linked resources to respond to the evolving environment (Moorman and Day 2016).

Marketing ability helps firms determine and respond to market changes like technological revolution and competitor moves. It also allows firms to leverage their partners' resources and capabilities for value creation, facilitating the prediction of implicit and explicit customer needs. Thus, firms can develop radically novel products and add new attributes to existing products to satisfy the needs of potential and current customers. This ensures that they able to stabilise, survive, and prevent shocks in facing competition with novel value propositions and technologies.

The RBV implies that firms' GIS activities develop their brand image and reputation, which are considered rare, valuable, and inimitable resources that strengthen their competitive position (McWilliams and Siegel 2000, 2011). A favourable brand image and reputation would lead to the development of strong positive relationships with various stakeholders, building a support network that is a precious resource in reinforcing a firm's competitive position. Marketing capability refers to diverse competitive moves (e.g. capacity expansion, product introduction, sales and marketing campaigns) that enhance the competitive position of a firm and contribute to its brand value (Chen 2011; Hur *et al*., 2014; Tang *et al.*, 2018). Additionally, marketing capability denotes an organisation's dedication to competitive aggressiveness and product quality (Lin *et al.,* 2019a, 2019b). It contributes to the expansion of new international ventures by affecting an organisation's decision on entry modes, such as a tremendous resource engagement in foreign markets (Ripolles 2011).

Here, we predicted that marketing capability positively moderates the relationship between GIS and brand value since a firm, as a business entity, must satisfy its environmental and economic responsibilities (Aupperle *et al.*, 1985). Realisation of monetary responsibility is a vital criterion for public evaluation of a firm, as the public always seeks to determine if a firm provides goods and services that comply with community requirements (Mohr *et al.*, 2001). Thus, it is assumed that marketing capability reflects the economic responsibility of a firm, making it an important factor that complements the positive effects of GIS (Padgett and Galan 2010). When an organisation engages its marketing capability, a simultaneous engagement in GIS activities would derive support from stakeholders like customers, employees, and suppliers (Godfrey 2005). GIS is regarded as a natural "sincere" step for a firm that stakeholders react to positively based on quality and pricing; this effect is intensified by marketing capability. Thus, resource acquisition from different stakeholders using GIS activities is even more beneficial with a high marketing capability. In other words, the brand value of firms is improved when they fulfil their environmental and economic responsibilities through GIS and marketing capability. Based on these arguments, we proposed the following hypothesis:

Hypothesis 2 (H2)*: Firms' marketing capability significantly moderates the relationship between GIS and brand value, such that the positive effect of GIS on brand value is stronger when firms possess high marketing capability.*

2.5 Integration of GIS and R&D Intensity

Earlier studies indicate that R&D investment affects the development and competitiveness of a country (Conner 1991; Tidd *et al.*, 2001), whereby it leads to better growth and performance (Padgett and Galan 2010; Sirmon and Hitt 2003; Weerawardena and Mavondo 2011). Likewise, research shows that the amount spent on R&D activities favourably and effectively influences a firm's productivity (Wakelin 2001) and long-term performance (Hitt *et al.*, 1997). R&D intensity is a dynamic capability of a firm (Sharma *et al.*, 2016; Wilden and Gudergan

2015) that leads to the innovation of new products (Gupta *et al.*, 1986). Traditionally, innovations in the automotive sector steer the development of novel production standards and technologies (e.g. hybrid vs conventional vehicles) as well as changes in product formulations in response to regulations. For example, the advent of the electric car has led to new product formulations and marketing activities like consumer segmentation and branding. McWilliams and Siegel (2000) mentioned that product differentiation is a result of the investment made in R&D projects to improve the environmental and societal attributes of a product that are quickly recognised by consumers.

In this study, we posit that a firm is better able to identify and resolve diverse managerial problems creatively if it achieves the positive link between brand value and GIS. This capacity is not only related to the firm's environmental capability, but also to its innovative or R&D capability. For example, the overall R&D capability of a firm helps it formulate effective techniques to efficiently use raw materials and decrease costs related to waste disposal and materials. It further enables firms to develop productive methods to convert waste into recycled products, which further increases profits. Also, R&D grants firms novel methods to reduce pollution emissions without affecting productivity. The discussion above implies that firms with a high innovation capability display a stronger positive effect of GIS on their brand value. Based on the assumption that a firm's R&D intensity represents its innovative capability, we proposed a third hypothesis as follows:

Hypothesis 3 (H3): *Firms' R&D intensity significantly moderates the relationship between GIS and brand value, such that the positive effect of GIS on brand value is stronger when firms possess high R&D intensity.*

3. Methodology:

3.1 System Generalisation Method of Moments (GMM)

In this study, we applied dynamic panel data to the System Generalised Method of Moments (SYS-GMM) estimator recommended by Arellano and Bover (1995) and Blundell and Bond (1998). This estimator was developed to tackle the following circumstances: 1) few time periods and different individuals; 2) linear functional relationships; 3) single left-hand-side dynamic variable based on earlier findings; 4) independent variables related to past and present errors; 5) fixed individual effects; and 6) heteroscedasticity and autocorrelation among, but not across, individuals. Previous studies have highlighted several limitations when attempting to predict the relationship between GIS and brand value. In particular, results derived from the Ordinary Least Squares (OLS) method and fixed effect models revealed endogeneity issues. Three types of endogeneity were characteristically noted in these studies, i.e. unobserved heterogeneity, simultaneity, and dynamic endogeneity.

The SYS-GMM presents reliable and efficient estimates in a regression model that does not contain strictly exogenous independent variables, where estimates are related to past and present errors or heteroscedasticity and autocorrelation among the estimates are noted (Roodman 2009). Unbalanced panels are also flexibly accommodated by this method. This estimator controls endogeneity issues by pairing lagged dependent and endogenous variables with variables not connected to fixed effects (Roodman 2009). For estimators to have consistency, two conditions must be met. First, no serial correlation should be demonstrated by the error term. Arellano and Bond (1991) proposed an autocorrelation test on residuals to determine if this condition is met. Second, the validity of the instruments must be guaranteed. The overall validity of our instruments was established using the test of over-identifying restrictions, i.e. the Hansen test. Furthermore, the instruments in the level equations were not correlated with the fixed effects.

3.2 Empirical Model

We presented an empirical framework that extends the models described in earlier studies (Lin *et al.*, 2019a, 2019b; Tang *et al.*, 2018; Zhang *et al.*, 2019). Our model determines the relationship between brand value and GIS based on the linear growth equation described below. After analysing several models, we concluded that the brand value of a firm, *i*, for time, *t*, as a function of GIS and other control variables, is computed as:

$$Brand\_Value = f\ (Green\ Innovation\ Strategy) \quad (1)$$

We also noted the relationship between brand value (based on its lagged value, $Brand\_Value_{it-1}$), the GIS variable (i.e. score or rate), as well as firm-level or GIS control variables (labelled as $CONTROL_{it}$) using the following regression equation:

$$Brand\_Value_{it} = \alpha + \beta Brand\_Value_{it-1} + \gamma GIS_{it} + \delta_J \Sigma^{n}_{j=5} \lambda CONTROL_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

Where $|\beta|<1$ and assume there is no correlation between the disturbances, μ_i and ε_{it}. Their properties were displayed as:

$$E(\varepsilon_{it}) = 0;\ E(\mu_i) = 0;\ E(\varepsilon_{it}\mu_i) = 0 \qquad (3)$$

Furthermore, we presumed that time-varying errors showed no correlation:

$$E(\varepsilon_{it}\varepsilon_{is}) = 0 \text{ with } \forall t \neq s \qquad (4)$$

$$i = 1, \ldots, 132;\ t = 2011 \ldots, 2018.$$

The factor of brand value indicates the performance of an existing firm, while GIS indicates the GIS score of this firm, *i*, for time, *t*. $Brand\_Value_{t-1}$ denotes the firm's period lag value of 1; *CONTROL* represents all control variables (ln revenue and ln total assets, which are the log of total assets and log of revenue, respectively, along with free cash flow, leverage, and time dummies); μ_i refers to unobserved firm-related fixed effects; and ε_{it} is the error term. In their study, Soto (2009) observed that no additional conditions should be imposed on the μ_i variance since a majority of the moment conditions needed for estimating a model require no homoscedasticity.

To determine the moderating roles of marketing capability and R&D intensity in automotive firms' brand value, we developed several models and established the relationship between brand value and GIS. We used the following model to highlight the interaction effects of marketing capability and R&D intensity on the GIS-brand value relationship:

$$Brand\_Value_{it} = \alpha + \beta Brand\_Value_{it-1} + \gamma_1 GIS_{it} + \gamma_2 (GIS_{it} * Moderator_{it}) + \delta_J \Sigma^n{}_{j=5} \lambda CONTROL_{it} + \mu_i + \varepsilon_{it} \qquad (5)$$

The above-mentioned variables present the interactions between GIS and the moderators (i.e. R&D intensity and marketing capability), where the link between the product of the variables and GIS is used as a regressor.

3.3 Data Collection and Sample

In this study, data was compiled using two datasets. First, CSRHub (https://www.csrhub.com/csrhub/) was employed as the source of data on GIS measures.

CSRHub is a prominent research organisation which collects Environmental, Social, and Governance (ESG) data. This is indeed desirable as it addresses the limitations of other techniques like KLD and Viego. The CSRHub[1] database consists of data from around 18,424 organisations, spread across 132 countries and 10 regions. It presents data from nine sources including Socially Responsible Investment (SRI) firms (called ESG analysis firms), ASSET4 (Thomson Reuters), MSCI (ESG Intangible Value Assessment and ESG Impact Monitor), Carbon Disclosure Project (CDP), IW Financial, EIRIS, Governance Metrics International (which merged with Corporate Library), RepRisk Trucost, and Vigeo. This is supplemented by data collected from 265 Non-Governmental Organisations (NGOs) such as associations, union groups, activist groups, publications, governmental databases, foundations, and research reports. Thus, the CSRHub schema comprehensively assesses and rates the achievements of a firm on a scale ranging from zero to 100. A high score indicates a positive performance (i.e. 100 is the most positive rating). The CSRHub database is updated monthly, while Datastream updates its financial data on a quarterly or annual basis. It was noted that changes in a firm's GIS could significantly affect its performance in real-time, whereas Datastream data only undergoes an annual change. In this study, we assessed annual changes due to GIS by considering the average value of GIS scores for 12 successive months and combining it with Datastream data. Firms were categorised using their 2-digit SIC codes, and those with less than eight observations were deleted. Finally, the data sample included 164 firms and 1,312 annual observations from 2011 to 2018.

3.4 Definition of Variables and Measurements

3.4.1 Brand Value

Goodwill

Goodwill indicates the value of a company which exceeds the value of its assets minus liabilities. Goodwill shows that a business has worth beyond its physical assets as a result of its management skill, brand recognition, customer loyalty, favourable location, and employee quality. Any factor which increases firm value in addition to its assets over liabilities is thus regarded as goodwill. When an organisation is sold, it aims to derive value above its tangible assets, i.e. goodwill. A good brand name is always favoured by customers, who are ready to offer a premium price for the name. This loyalty is valuable when a brand is sold in the future. Corporate accountants have started refining their views on goodwill and consider it vital for

[1] See details of the CSRHub Rating Methodology at https://esg.csrhub.com/csrhub-ratings-methodology

customer loyalty. It is interesting to note that as customer loyalty influences company branding, a clear relationship exists between brand value and goodwill. Hence, goodwill has been included as an intangible component that helps firms earn ‘super profits’ or profits higher than their tangible assets. This idea of goodwill is important as it indicates that it is a beneficial asset which is controlled by an organisation. This asset could be realised after the company is sold; however, its existence indicates that it can be assessed or subjected to internal valuation at any time. This is a different perspective than that used in conventional techniques, which state that goodwill is acknowledged only when a company has to be sold.

Intangible Assets

Firms may have several intangible assets, such as personnel (skilled workers, scientists, and managers), specific company processes, distribution agreements (which retain a product and eliminate competition), and patents (which protect a product for a long period). Intangible assets have defined values and can theoretically be assessed as goodwill. However, practically, only aspects related to goodwill like patents are used for valuation. Other intangibles are easily separated, including brand value. A brand has been recognised as an asset in a company which manufactures products; however, it has generally been ignored by manufacturing industries. These firms fail to recognise that brands have value, especially on a balance sheet. A company’s brand value and name are usually considered to be the same in industrial markets, which presents a few difficulties. The internal valuation of goodwill is thus a subject of contention among accountants, as some believe that goodwill only arises when a business is sold and hence, it cannot be added as an intangible factor on balance sheets. Given this scenario, in this study, goodwill was regarded as the difference between the price paid for a business and the value of its net assets.

3.4.2 Green Innovation Strategy

We assessed GIS performance using ISO 14031 standards, which is similar to the technique used in earlier studies (Campos *et al.*, 2015; Chen *et al.*, 2006; Nguyen and Hens 2015). They defined GIS performance as the performance of the software and hardware used for any innovative activity carried out by a firm for green products or processes. These include the technologies used to prevent pollution, recycle waste, save energy, and design green products or corporate environmental management activities. Hence, in this study, we measured GIS with three major CSRHub sub-databases, described below:

Energy and Climate Change Subcategory

This parameter measured the efficiency of a company in addressing climate change by applying appropriate energy-saving processes, policies, and strategies, as well as by developing renewable and better energy sources or alternative environmental technologies. This subcategory includes the emission of greenhouse gases like CO_2 and energy usage.

Environmental Policies and Reporting Subcategory

In this subcategory, we determined a company's intentions and policies for decreasing environmental effects as well as the extent to which their value streams are environment-friendly in the present and future. The data in this category comprises firms' environmental reporting performance, adherence to reporting standards like Global Reporting Initiative, and compliance with transparency requests made by stakeholders, regulators, and investors. Additionally, this compliance data also includes breaches of regulatory limits or accidental releases.

Resource Management Subcategory

In this category, we determined the efficiency of a company in using all its resources to manufacture and deliver products and services to its suppliers. This includes a firm's capability to reduce material usage, minimise wastage of water and energy, and implement more effective solutions to improve the supply chain. This subcategory highlighted the environmental performance of a firm with regards to its production size and its monitoring methods with the help of production-related Eco-Intensity Ratios (EIRs) for water and energy resources, which is defined as resource consumption per released/produced unit. These resources involve all raw materials and packaging materials used for producing and packaging products, or for similar processes. Resource Management data includes the waste and recycling performance of a firm. This recycling data is reflected by the ratio of recycled waste to total waste amounts.

We derived the GIS score by estimating the average scores for the three subcategories in the following manner:

$$= [\quad \frac{\quad}{h \quad + +]\ (6)\ 3}$$

3.4.3 Control Variables

Similar to previous studies that investigated the link between GIS and brand value, we took into account several firm characteristics as control variables that could influence this relationship (Lin *et al.*, 2019a, 2019b; Tang *et al.*, 2018; Zhang *et al.*, 2019). Control variables included in earlier studies include firm risk, firm size, slack resources, and profitability. Firm size is indeed a vital control factor which measures the total assets of a company as an indicator of its size. Many studies have also tried to control firm risk. As per earlier research (McWilliams and Siegel 2000), we measured firm risk (leverage) as the ratio of total debts to total assets. We also included slack resources, referred to as the ratio of free cash flow to total assets in the firm. Finally, we considered the volatility of firms' ROA, which is estimated as the standard deviation of the ROA for five years, in order to determine uncertainty in the form of profit volatility (Luo and Bhattacharya 2009).

4. Results and Discussion

4.1 Descriptive Statistics and Correlation Analysis

The descriptive statistics of the automotive firms in this study have been summarised in Table 1 to provide an overview of the fundamental structure of the data, including the mean, standard deviation, and maximum and minimum values for the main variables. The means for goodwill and intangible assets that reflect firms' brand value were found to be 0.11 and 0.10, respectively, which implies that in the majority of cases, brand value remains at a low level. The respective standard deviations of 0.03 and 0.39 signify that goodwill scores are clustered around the mean while intangible asset scores are more widely spread. Besides that, GIS was found to have the highest standard deviation of 6.84 with a mean of 52.47. Sales, general expenses, and administration (SG&A) intensity, as a proxy for a firm's market capability, was found to have a mean value of 0.12 and a standard deviation of 0.08. This signifies that the total cost spent on marketing capability is almost 12 percent of firm revenue. Moreover, the quantification of firm-level innovation was achieved through R&D intensity, which had a mean of 0.03 and a standard deviation of 0.06. The mean of competitive action was greater than that of innovation, specifying that firms are keener to invest in competitive action than innovation.

As stated by Gujarati and Porter (2009), the problem of multicollinearity may arise due to high correlation among the variables. In the event of such a problem, there would be a bias in the reliability of the estimates (Acock 2008). Table 2 presents the Pearson correlation matrix of all the dependent and independent variables in this study. It was found that the Pearson coefficients were comparatively low among all the variables (i.e. less than 0.80); thus, the multicollinearity problem was non-existent in this study. Pearson's correlation matrix is also applied to quantify the direction and strength of linear correlations between independent and dependent variables.

Table 2 further shows that all the parameters in the sample reported VIF values ranging from 1.01 to 1.55, with a mean of 1.29 and a tolerance average of 0.78, confirming that there was no multicollinearity issue in the sample.

4.2 The Relationship between GIS and Brand Value

Table 3 presents the major findings of the first research hypothesis pertaining the effect of GIS on brand value. Specifically, it shows the estimations of the regressions of goodwill and intangible assets through the two-step System GMM. In Models 1 and 2 on goodwill and intangible assets, respectively, the lagged dependent variable (brand value) was statistically significant, indicating that the dynamic System GMM is a suitable estimator. With regards to the control variables, in Models 1 and 2, marketing intensity coefficients were positive and significant at p<0.01 for both models (β = 2.27; β = 2.24). Meanwhile, R&D intensity (β = - 1.07; β = -0.83), total revenue (β = -0.38; β = -0.28), and leverage (β = -0.0002; β = -0.0003) had adverse effects on both the models. Nevertheless, firm size had a positive effect (β = 0.35;
β = 0.25) on intangible assets and goodwill, while the free flow of cash had no impact on brand value as a whole. GIS appeared to have a positive and significant effect on goodwill (β = 0.001, p-value = 0.01) and intangible assets (β = 0.001, p-value = 0.01). Overall, the analysis confirmed that GIS has a positive and significant (p<0.01) association with both parameters of brand value. Hence, Hypothesis 1 was supported.

Insert Table 3 Here

4.3 The Moderating Effect of Marketing Capability on the Relationship between GIS and Brand Value

The second research hypothesis posited the moderating role of marketing capability on the relationship between GIS and brand value in the automotive sector. Model 1 in Table 4 shows the results of this moderating effect on intangible assets, where the coefficients were significant for the interaction term GIS*Marketing Capability (β= 0.035, p<0.01). Model 2 in Table 4 shows that the moderation of GIS*Marketing Capability also presented a significant and positive impact (β= 0.03, p<0.01) on goodwill. Therefore, the results supported Hypothesis 2.

Insert Table 4 Here

To further demonstrate this positive moderating effect graphically, this study followed Aiken and West's (1991) plotting technique and applied +1 and −1 standard deviations as provisional values for testing the significance of simple slopes. We then plotted the interaction effect of marketing capability between GIS and brand value, shown in Figures 2 and 3. The simple slopes' regressions were positive and statistically significant (p<0.01), providing further support for Hypothesis 2. As shown in Figures 2 and 3, the highest level of performance is achieved when GIS and marketing capability are both high. Additionally, the figures show the importance of marketing capability for GIS in particular, as there is a major difference in performance when GIS is high but marketing capability is low. Thus, GIS is essential for a successful branding strategy. In turn, marketing capability is vital to make the best use of a strong GIS. Together, the findings suggest that GIS and marketing capability collectively contribute towards the value of a company's brand. To illustrate, even though the same level of GIS activities is possessed by two different companies, the company that has a better marketing capability is more likely to enhance its brand value than the other company.

Insert Figure 2 Here

Insert Figure 3 Here

4.4 The Moderating Effect of R&D Intensity on the Relationship between GIS and Brand Value

As observed in Models 1 and 2 in Table 5, the moderation of the interaction term GIS*R&D Intensity established a positive and statistically significant association with goodwill ($\beta = 0.03$, $p<0.01$) and intangible assets ($\beta = 0.01$, $p<0.10$). Based on these results, the moderation of R&D intensity has a positive effect on brand value, characterised by goodwill and intangible assets. Thus, it is believed that a high level of R&D intensity strengthens the relationship between brand value and GIS, which is in support of Hypothesis 3.

Insert Table 5 Here

To examine these interaction effects further, in Figures 4 and 5, we charted the results using the method of Aiken and West (1991). In these graphs, we showed the effects on brand value for two levels of R&D intensity, low (-1 standard deviation from the mean) and high (+1 standard deviation from the mean). We then plotted brand value regressed on different levels of GIS. Figures 4 and 5 show that the highest level of brand value is achieved when both GIS and R&D intensity are high, thereby aligning with Hypothesis 3. The simple slopes of regression in Figures 4 and 5 (high R&D intensity, high GIS) are statistically significant and positive as well. Moreover, brand value is higher at all points when R&D intensity is high, regardless of the level of GIS; this is a noteworthy additional discovery. This finding, consistent with our theoretical model, affirms that innovation maximises brand value.

Insert Figure 4 Here

Insert Figure 5 Here

5. Implications

5.1 Theoretical Implications

In the last decade, researchers have shown growing interest in the green innovations of various organisations. However, most industry and academic studies focused only on accounting-based outcomes such as return on assets (ROA), return on equity (ROE), and net profit. Another parameter related to firms' financial performance, i.e. brand value, was scarcely regarded by these studies. Accordingly, this study sought to determine the effect of GIS on the brand value of a firm. Some studies have found that these constructs are positively correlated; however, scholars have called for further research to understand the roles of various omitted variables in this relationship. In fact, it has been an ongoing debate in the literature that more effective models are needed to examine these boundary parameters. Therefore, we assessed the critical moderating roles played by firms' marketing capability and R&D intensity in the GIS-brand value link.

Using dynamic data in a System-GMM regression, our results showed that GIS positively affects brand value, supporting Hypothesis 1. We also analysed the two-way interactions between GIS-R&D intensity and GIS-marketing capability with brand value as the dependent variable. The findings revealed that GIS possesses a positive synergistic effect on marketing capability and R&D intensity. It was also noted that the correlations between (1) GIS and R&D intensity and (2) GIS and marketing capability positively impact a firm's brand value, which proved Hypotheses 2 and 3.

Our empirical results supplement the published literature both theoretically and practically. In this study, we attempted to provide evidence on the relationship between GIS and brand value under the assumption that in addition to decreasing adverse environmental effects, a higher GIS improves the reputation and brand value of a firm. We thus confirm that the impact of GIS on firm performance is not limited to profitability, as proven by the correlation between brand value and GIS. This acts as further proof towards settling the debate of "Does it pay to be green?" Moreover, this study applied the RBV theory, which suggests that any organisation that enhances its R&D intensity and marketing capability can better promote its GIS activities. Consequently, firms with higher GIS acquire and improve an environment-friendly reputation along with differentiation benefits. Overall, our study has established the configurations of firm-related factors that improve the positive effect of GIS on a firm's brand value.

5.2 Managerial Implications

This study offers vital implications for managers, especially in the automotive industry, who aim to leverage the R&D intensity and marketing capability of their firm after implementing GIS. As one of the significant economic contributors in the world, automotive firms are vulnerable to both opportunities and challenges in the rapidly expanding world market. Since GIS positively affects the brand value of a firm, managers should note that investment in GIS can engender new market prospects, increase revenues, stabilise stakeholder relationships, and create a financial advantage, exclusive of any increase in firm costs (Gotschol *et al.*, 2014; Li *et al.*, 2017). To secure significant advantages in the evolving business environment, managers should recognise the crucial function of GIS in enhancing brand value apart from dealing with stakeholders' pressure. Consumer concerns have grown to focus on environmental protection aspects in addition to technical modifications. Hence, GIS, particularly in the automotive industry, may play a role in fulfilling customer requirements and improving customer satisfaction because of its environmental collaboration nature. Additionally, strong GIS can positively sway consumers' mentality and thus add monetary value in terms of revenue and income. Since substantial resources and goals are necessary to accomplish eco-innovative actions, a firm manager must design effective strategies to capture and strengthen consumer perceptions to ultimately enhance brand value.

In addition, managers must consider the impacts of the internal and external environment on firm behaviour when making GIS decisions. Specifically, attention must be paid to the dynamic relationships between the marketplace, rivals, and customers, consistent with dynamic capability characteristics. A consideration of R&D intensity and marketing capability can assist managers in this context. Our results help managers understand the importance of a firm's internal resources, i.e. R&D intensity and marketing capability, in improving the positive effect of GIS on brand performance. With better marketing capability and product market development, GIS has greater beneficial impacts on brand value. Similarly, managers must maximise and leverage innovative capabilities and R&D investment in GIS to improve corporate reputation and brand value.

6. Limitations and Future Research Directions

Though this study presented valuable findings, it is not without a few limitations. First, we used a sample of public-listed companies in the automotive sector, to the exclusion of other sectors such as air transport and maritime. Since these sectors also contribute to the economy of the country, upcoming studies should include them in empirical settings. In the future, researchers also need to compare the GIS levels of non-listed and listed companies to understand which firms implement environmentally friendly activities and derive financial gains. Second, we investigated the moderating roles of only two internal resources, marketing capability and R&D intensity, with regards to the GIS-brand value relationship. Other internal and external parameters, like organisational culture, can potentially influence this relationship as well. We thus propose future studies to incorporate additional internal and external factors of the firm in their framework. Finally, this study focused only on public-listed organisations in developed countries. Firms in developed countries are generally more aware of environmental issues and more likely to apply green initiatives to ensure sustainable growth. As such, our results may not accurately represent developing countries which are subject to varying regulations, legislations, economic issues, and organisational structures. Thus, the current research should be replicated in various settings to verify and generalise our results.

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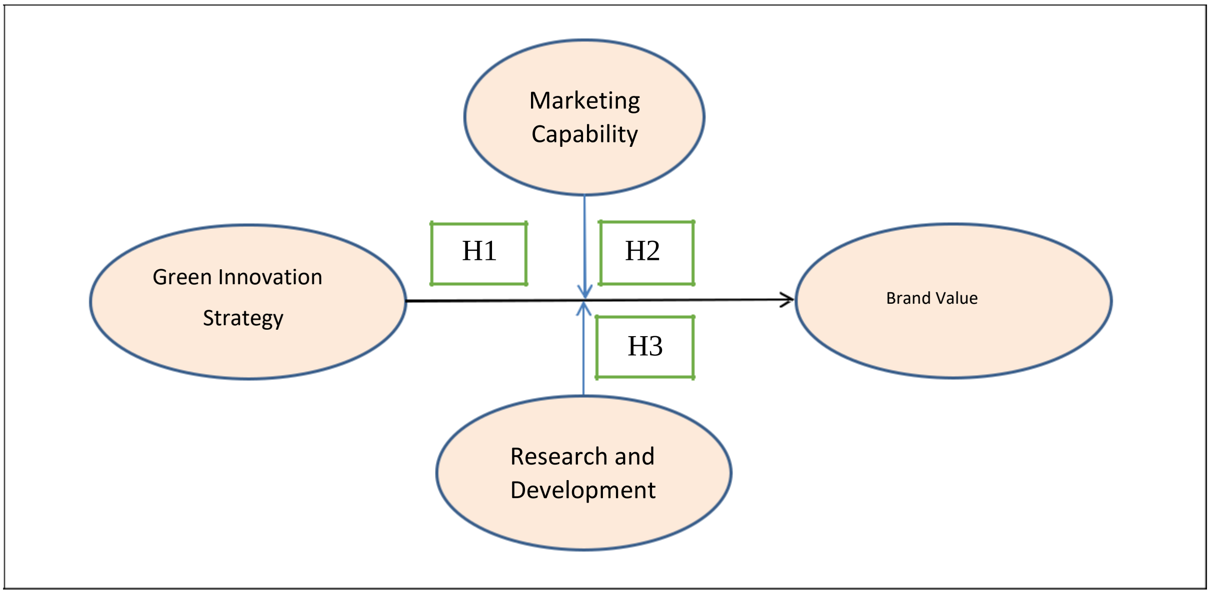

Figure 1: Theoretical Framework

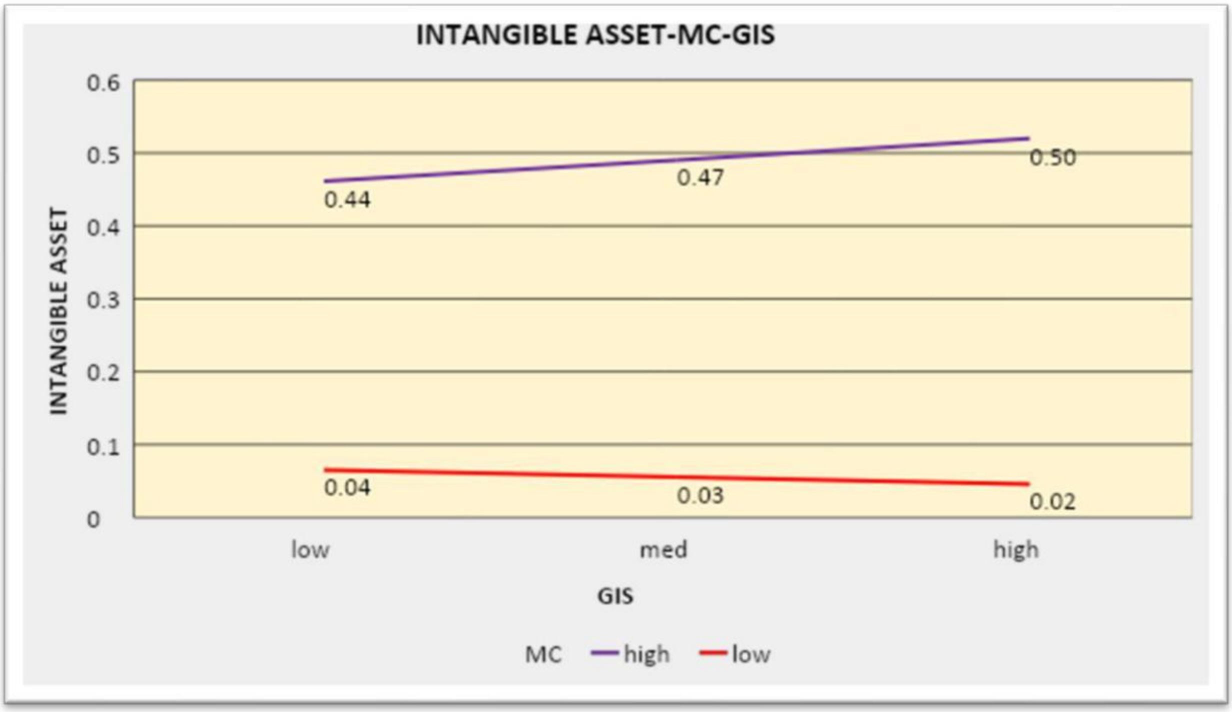

Figure 2: Effects of GIS on Intangible Asset: Contingent on Marketing Capability

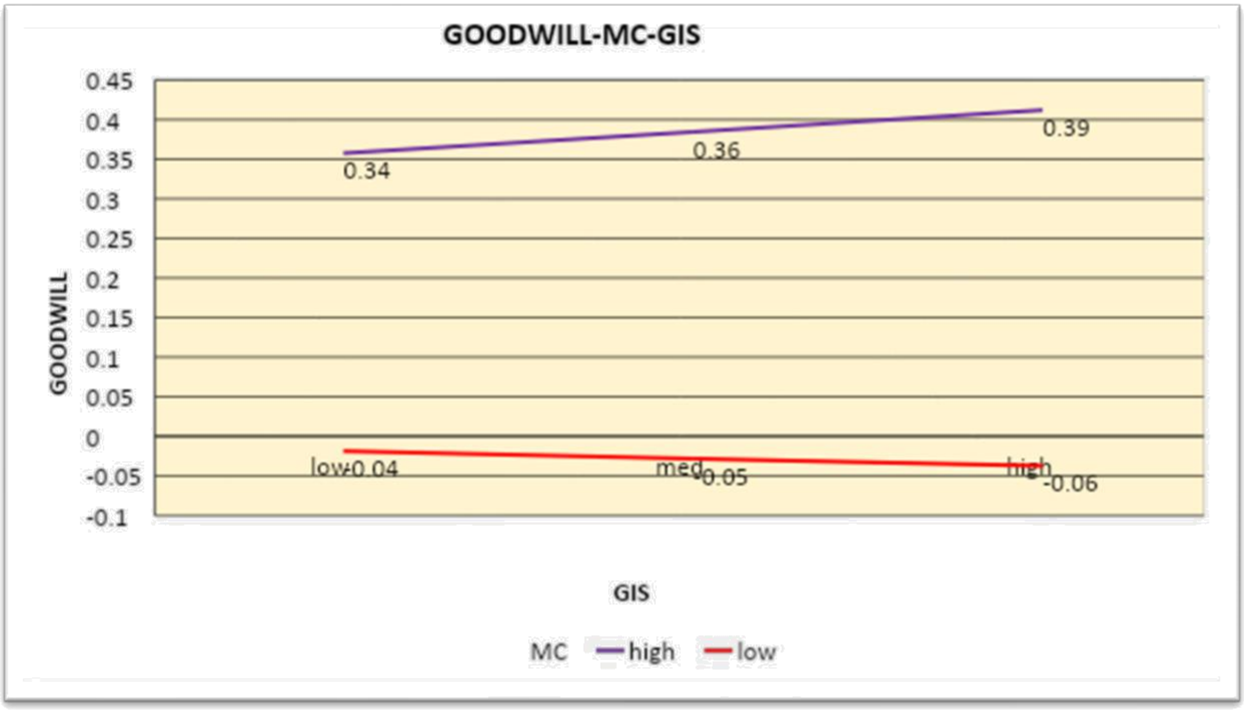

Figure 3: Effects of GIS on Goodwill: Contingent on Marketing Capability

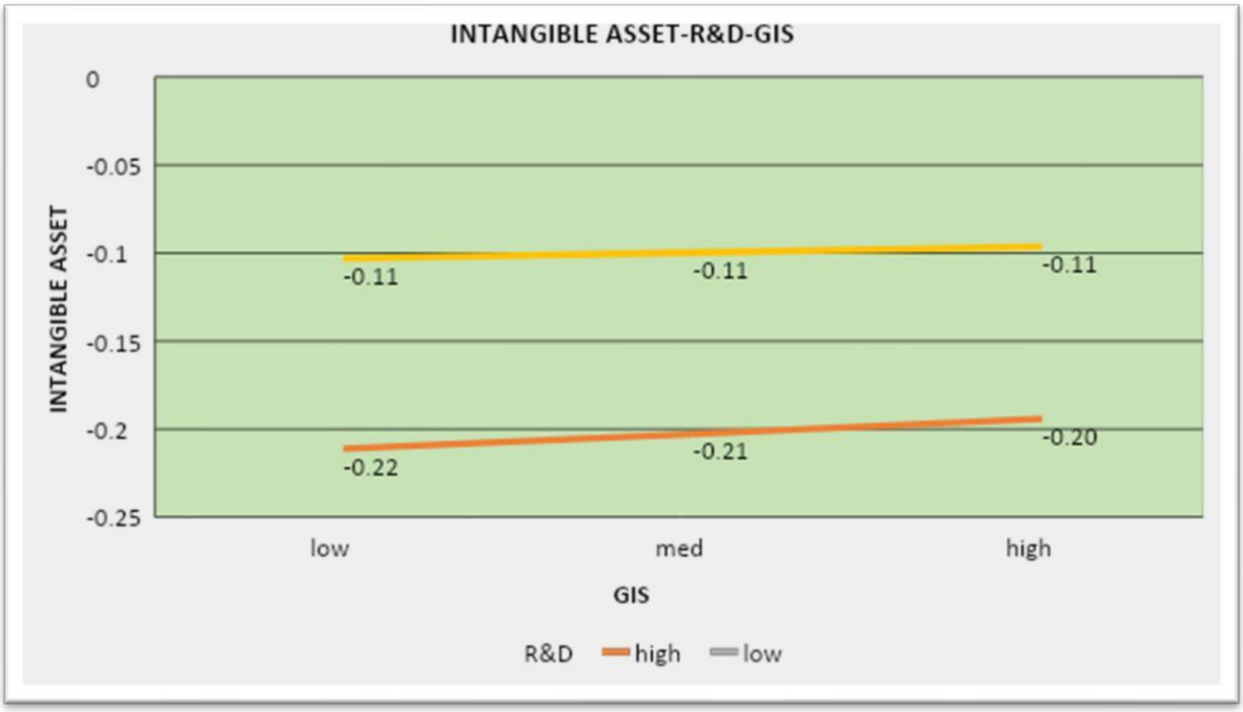

Figure 4: Effects of GIS on Intangible Asset: Contingent on R&D Intensity

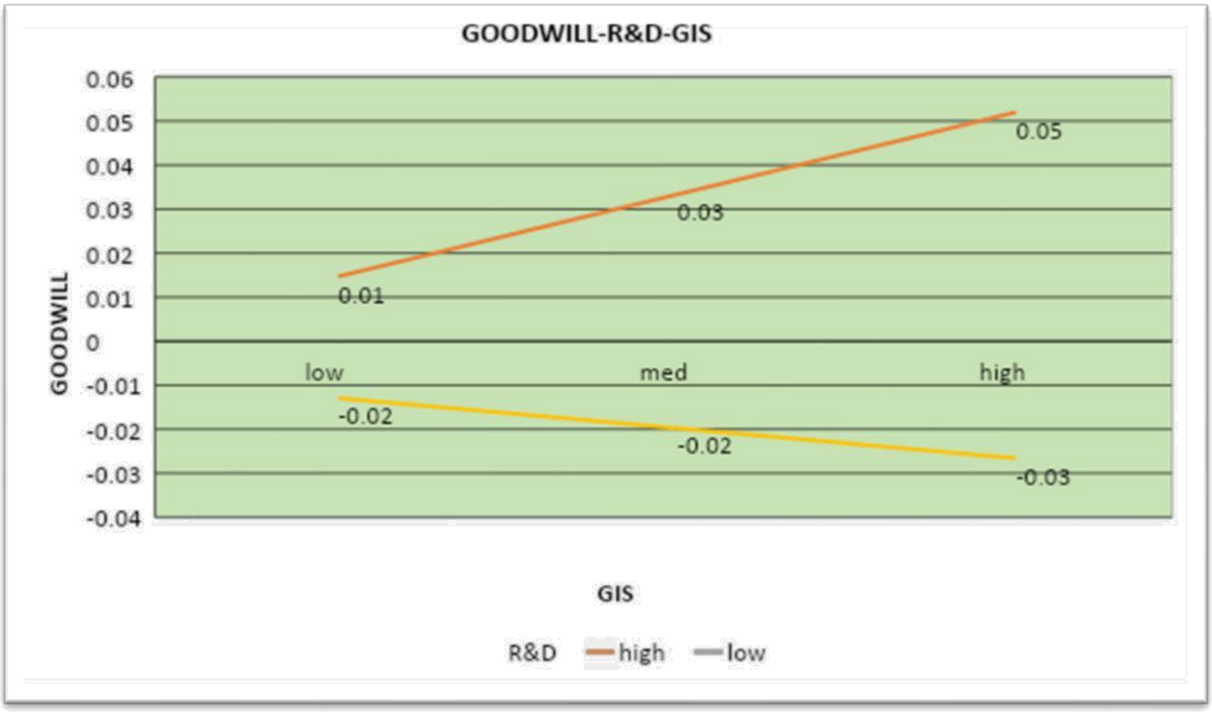

Figure 5: Effects of GIS on Goodwill: Contingent on R&D Intensity

Table 1 Descriptive Statistic (N=164)

Variable	Symbol	Variable	Mean	Std. Dev.	Min	Max
Green Innvation Strategy	GIS	Independent	52.471	6.842	31	72
Goodwill	Goodwill	Dependent	0.112	0.034	0.010	5.860
Intangible Asset	Intangible Asset		0.101	0.395	0.180	7.472
Market capability	Market Capability	Moderator	0.125	0.088	0.0004	0.541
R&D intensity	R&D Intensity		0.036	0.066	0.000	1.020
Leverage	Leverage	Control	1.877	5.926	-45.704	21.500
Firm Size	ln Total Assets		3.744	0.774	2.110	6.010
Total Revenue	ln Revenue		3.762	0.743	2.000	5.940
Free Cash Flow	Free Cash Flow		0.054	0.525	-1.535	8.493
Return on Assets	ROA		0.191	0.722	-0.331	10.071

Note: All values are based on the original values.

Table 2 Correlation Matrix (N=164)

	Goodwill	Intangible Asset	GIS	Marketing Capability	R&D Intensity	ln Total Asset	ln Revenue	Free Cash Flow	Leverage	ROA
Goodwill	1									
Intangible asset	0.5094	1								
GIS	0.0774	0.0982	1							
Marketing capability	0.0648	0.0766	0.0183	1						
R&D Intensity	-0.0441	0.4643	-0.01	0.4643	1					
ln Total Asset	0.0641	0.074	0.3481	-0.2328	-0.1393	1				
ln Revenue	0.0920	0.1021	0.3367	-0.3179	-0.1803	0.0958	1			
Free Cash Flow	0.0001	0.0015	0.0046	-0.0423	-0.0894	0.0657	0.0838	1		
Leverage	0.401	0.021	-0.0107	-0.0045	0.0579	0.0144	0.0199	-0.0146	1	
ROA	0.578	0.0471	0.1068	0.1046	-0.0534	0.069	0.0099	0.0078	0.0026	1

Note: All values are based on the original values.

Table 3: Relationship between GIS and brand value (N = 164, T= 2011 – 2018)

VARIABLES	Model (1) Goodwill	Model (2) Intangible Asset
$Goodwill_{t-1}$	0.527***	
	(0.00892)	
$Intangible\ Asset_{t-1}$		0.546***
		(0.00862)
GIS	0.000671***	0.000857***
	(0.000257)	(0.000291)
Leverage	-0.000179*	-0.000276**
	(0.0000949)	(0.000123)
Free Cash Flow	-0.0368	-0.0139
	(0.0320)	(0.102)
ln Revenue	-0.379***	-0.280***
	(0.0425)	(0.0391)
ln Total Assets	0.347***	0.264***
	(0.0399)	(0.0348)
ROA	1.070***	0.832***
	(0.0959)	(0.0675)
Constant	-0.0621	-0.170**
	(0.0689)	(0.0813)
Year	Yes	Yes
Observations	1131	1131
Number of firms	164	164
Number of instruments	64	64
AR(1)	0.89(0.376)	-0.75(0.435)
AR(2)	0.85(0.398)	-0.55(0.581)
Hansen Test	56.23(0.351)	53.33(0.462)
Different in Hansen Test	11.03(0.200)	18.86(0.076)

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. System GMM model is estimated by using the Blundell and Bond (1998) dynamic panel system GMM estimations and the Stata module Xtabond2 developed by Roodman (2006).

Table 4 The moderating effect of marketing capability on the impact of GIS on brand value. (N = 164, T = 2011 – 2018)

VARIABLES	Model (1) Intangible Asset	Model (2) Goodwill
Intangible Asset$_{t-1}$	0.542***	
	(0.00787)	
Goodwill$_{t-1}$		0.523***
		(0.00916)
GIS	-0.00277***	-0.00260***
	(0.000552)	(0.000611)
Marketing Capability*GIS	0.0348***	0.0322***
	(0.00465)	(0.00543)
Marketing Capability	0.813***	0.815***
	(0.275)	(0.304)
Leverage	-0.000262	-0.000153
	(0.000206)	(0.000179)
Free Cash Flow	-0.0188	-0.0336
	(0.0253)	(0.0357)
ln Revenue	-0.297***	-0.402***
	(0.0361)	(0.0442)
ln Total Assets	0.282***	0.371***
	(0.0344)	(0.0401)
ROA	-0.594***	-0.916***
	(0.0852)	(0.104)
Constant	0.0762	-0.00939
	(0.0691)	(0.0817)
Year	Yes	Yes
Observations	1131	1131
Number of firms	164	164
Number of instruments	65	65
AR(1)	-0.81(0.418)	-0.86(0.392)
AR(2)	-0.70(0.483)	0.74(0.456)
Hansen Test	52.86(0.479)	57.17(0.323)
Different in Hansen Test	23.07(0.010)	13.46(0.199)

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. System GMM model is estimated by using the Blundell and Bond (1998) dynamic panel system GMM estimations and the Stata module Xtabond2 developed by Roodman (2006).

Table 5: The moderating effect of R&D intensity on the impact of GIS on brand value. (N= 164, T = 2011 – 2018).

VARIABLES	Model (1) Intangible Asset	Model (2) Goodwill
Intangible Asset$_{t-1}$	0.547***	
	(0.00831)	
Goodwill$_{t-1}$		0.527***
		(0.00960)
GIS	0.000649*	-0.000204
	(0.000382)	(0.000369)
R&D Intensity*GIS	0.00565*	0.0327***
	(0.0101)	(0.00995)
R&D Intensity	-1.294**	-2.831***
	(0.503)	(0.527)
Leverage	-0.000303**	-0.000176*
	(0.000122)	(0.000102)
Free Cash Flow	-0.0117	-0.0465
	(0.0283)	(0.0365)
ln Revenue	-0.278***	-0.380***
	(0.0373)	(0.0442)
ln Total Assets	0.259***	0.341***
	(0.0344)	(0.0400)
ROA	2.395***	2.248***
	(0.0879)	(0.0601)
Constant	-0.165**	-0.00143
	(0.0791)	(0.0719)
Year	Yes	Yes
Observations	1131	1131
Number of firms	164	164
Number of instruments	65	65
AR(1)	-0.77(0.440)	-0.90(0.369)
AR(2)	-0.59(0.555)	0.080(0.427)
Hansen Test	52.10(0.509)	54.48(0.418)
Different in Hansen Test	19.88(0.030)	14.71(0.143)

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. System GMM model is estimated by using the Blundell and Bond (1998) dynamic panel system GMM estimations and the Stata module Xtabond2 developed by Roodman (2006).