Article

Journal of Marketing
2019, Vol. 83(3) 126-144

DOI: 10.1177/0022242919831996
journals.sagepub.com/home/jmx

Gear Manufacturers as Contestants in Sports Competitions: Breeding and Branding Returns

Yvonne van Everdingen, Vijay Ganesh Hariharan, and Stefan Stremersch

Abstract

Several manufacturers make substantial investments to compete in sports contests, using the gear they develop and market. However, no systematic analysis of the breeding (i.e., innovation) and branding (i.e., marketing) returns from such investments exists. In this study, the authors conceptualize and empirically estimate the breeding and branding returns that such manufacturers obtain. The authors gather data for 30 car brands of 16 manufacturers over the period 2000–2015 regarding their participation, spending, and performance in Formula One championships, annual patent citations, and research-and-development (R&D) budgets as well as monthly vehicle registrations, advertising expenditures, and Formula One TV viewership. The authors find that only gear manufacturers with relatively high levels of R&D spending obtain a positive and significant breeding return from competing in sports contests. While most brands obtain positive branding returns, the lower the level of advertising spending for the brand, the greater the branding returns they obtain from competing in these contests. Thus, research-intense (compared with advertising-intense) gear manufacturers have more to gain from competing in sports contests. These findings can help guide manufacturers in budget allocation decisions on sports competitions, R&D, and advertising.

Keywords

advertising spending, innovation performance, R&D spending, sales performance, sports competitions

Online supplement: https://doi.org/10.1177/0022242919831996

Many firms are sports sponsors in one way or another. Marketing researchers have posed a historical interest in examining the *branding* returns from such sponsorships and have shown that professional sports sponsoring increases the brand's exposure, recall, recognition, affect, trust, loyalty, and sales (e.g., Chung, Derdenger, and Srinivasan 2013; Jensen and Cobbs 2014; Mazodier, Henderson, and Beck 2018; Mazodier and Merunka 2012; Olson and Thjømøe 2009; Speed and Thompson 2000; Walraven, Bijmolt, and Koning 2014). However, in quite a few cases, firms' interest seems to go beyond such branding returns to achieve what we call *breeding* (i.e., innovation) returns from athletes using their gear in sports competitions.

Such breeding returns, beyond branding returns, from involvement in sports can be most easily envisioned in cases where gear manufacturers choose to go beyond mere sponsoring and actively compete in a sports contest. A gear manufacturer that competes in a sports contest participates with its own team that uses the manufacturer's gear and goes head-to-head against other participating contestants. Gear manufacturers may use the extreme conditions under which athletes in the team use their gear and closely cooperate in developing and testing new technologies that may improve their team's performance, entailing breeding returns. Moreover, branding returns from competing in a sports contest in this way may be different from branding returns from mere sponsoring. For example, one may envision that the performance of the firm as a contestant may affect its branding return.

The breeding and branding returns gear manufacturers may obtain from entering sports competitions are relevant to many firms. Race bike manufacturer Trek invests $14 million annually to compete with its Trek-Segafredo team in the Union Cycliste Internationale (UCI) World Tour (Stokes 2015), car manufacturer Daimler invests around $200 million annually to

Yvonne van Everdingen is Associate Professor of Marketing Management, Rotterdam School of Management, Erasmus University Rotterdam, The Netherlands (email: yeverdingen@rsm.nl). Vijay Ganesh Hariharan is Associate Professor of Marketing, Erasmus School of Economics, Erasmus University Rotterdam, The Netherlands (email: hariharan@ese.eur.nl). Stefan Stremersch is Desiderius Erasmus Distinguished Chair of Economics, Erasmus School of Economics, Erasmus University Rotterdam, The Netherlands, and Professor of Marketing, IESE Business School, University of Navarra, Spain (email: stremersch@ese.eur.nl).

compete with its Mercedes-AMG Petronas Motorsport team in the Formula One (F1) Championship (Sylt 2018b), and ski manufacturer Atomic invests approximately $9 million annually to compete with its own team in the International Ski Federation (FIS) Alpine Ski World Cup (Sempelmann, Lampl, and Kramer 2018). Competing firms may invest varying amounts in such sports competitions, with varying success, both of which may affect their breeding and branding returns. The allocation of resources to competing in sports contests is likely not independent of the firm's investment in other areas, of which research and development (R&D) and advertising seem most relevant as one considers the breeding and branding returns of competing in sports contests. This, in turn, raises the question of whether breeding and branding returns depend on the firm's R&D and advertising spending. Our key research question is therefore the following: To what extent do gear manufacturers that compete in sports contests gain positive outcomes in terms of breeding, branding, or both, and are these outcomes contingent on the gear manufacturer's R&D and advertising spending?

To the best of our knowledge, so far no study has conceptualized or systematically analyzed both branding *and* breeding returns that gear manufacturers obtain from competing in sports contests, nor whether such returns depend on the manufacturer's R&D spending (for breeding returns) and advertising spending (for branding returns). This is what the current study aims to offer. Analyses of breeding and branding returns are of great interest to marketing managers, analysts, and academics because they relate to accountability of board-level strategic investments (e.g., Rust, Lemon, and Zeithaml 2004).

Empirically, we constructed a novel data set on car manufacturers' participation, spending, and performance in the F1 World Championship. Our sample consisted of 30 automobile brands sold by 16 car manufacturers, among which 10 brands from 9 car manufacturers competed in F1 at some point during our sample period of 2000–2015. To examine the breeding effect, we supplemented F1 data with information on these 16 manufacturers' R&D spending and on their innovation performance (measured in terms of patent citations). To investigate the branding effect, we obtained the brands' advertising spending and sales performance, in terms of number of vehicle registrations in five countries (France, Germany, Italy, Spain, and the United Kingdom).

Our study provides the following new insights. First, competing in sports contests and R&D spending are complements-competing in sports contests generates a significantly positive breeding return only for gear manufacturers with relatively high levels of R&D spending (more than €3.8 billion annually in our F1 context). Second, we find that competing in F1 and advertising spending are substitutes. Brands with low advertising budgets obtain greater branding returns from competing in sports contests than those with high advertising budgets. While all brands in our sample obtain positive branding returns from participating and increasing their spending in F1, only brands with less than €10.6 million in monthly advertising benefit from improving their performance in F1. In summary, research-intense gear manufacturers (i.e., firms that spend heavily on R&D but limitedly on advertising) have more to gain from competing in sports contests, as compared with advertising-intense gear manufacturers (i.e., firms that spend little on R&D but heavily on advertising).

This article contributes to the existing literature in several ways. First, it shows that firms may obtain breeding and/or branding returns from their involvement in sports competitions, whereas prior literature has examined only branding returns and, thus, offers a partial view, at best. Second, it conceptualizes competing by a firm in sports contests as inherently different from mere sponsoring. It also provides an analytical framework for estimating the returns for firms that compete in sports contests and provides the first estimates of such returns ever reported in the literature. Third, we show that returns from competing in sports contests cannot be assessed without accounting for other related decisions of the respective firms, such as R&D and advertising spending. Fourth, for brand exposure, we are the first to empirically demonstrate that saturation effects occur even across greatly dissimilar exposure vehicles (in our case, car advertising and competing in F1 by car manufacturers). This complements prior literature that has demonstrated such saturation effects only among fairly similar exposure vehicles (e.g., Vakratsas and Ambler 1999). It may also contradict managerial practice to leverage sports investments with greater advertising spending.

The findings in this research are relevant not only to managers and analysts in the automotive industry specifically (including tier 1 suppliers) but also to other sports gear manufacturers, for which competing in sports contests is a relevant consideration (e.g., motorsports, cycling, skiing). They can use these findings to assess the potential economic outcomes of competing in sports contests. Moreover, these findings may guide gear manufacturers in a trade-off of budget allocation between contending in sports competitions on the one hand and R&D and advertising on the other hand.

Manufacturers' Investments in Sports Competitions

Manufacturers' investments in sports competitions can be classified in terms of the following two dimensions: the type of involvement in the sports contest (sponsor vs. contestant) and the type of deployed resources that the manufacturer uses in the sports contest (gear vs. nongear).

Type of Involvement: Contestant Versus Sponsor

The manufacturer is involved as a contestant if it competes in the sports contest with a team. In contrast, a manufacturer that is involved as a sponsor in sport contests provides financial and/or in-kind assistance (e.g., a company's products) to an individual athlete, a team, or a competition in return for access to the commercial potential of the sponsored object (IEG 2014; Meenaghan 1983).

For manufacturers, competing in sports contests is different from being a sponsor in three ways. First, the manufacturer owns all or part of the team and, therefore, has greater responsibility for and more control over the team than a sponsoring manufacturer. For example, when Red Bull became the owner of the Jaguar F1 team instead of being a sponsor, it incorporated the company name in the team name and gained control over the design of the car's paint scheme, which helped the firm gain higher visibility (Foster and Hoyt 2007).

Second, manufacturers that compete in sports face off against other contestants from similar industries in the sports competition. For example, Mercedes competes against other car manufacturers in F1, and Trek competes against other race bike manufacturers in the UCI World Tour. This is different in case of sponsors. For example, Wilson is the racket sponsor of various tennis players (e.g., Roger Federer), but these players do not form a Wilson team that competes in tennis championships against, for example, a Babolat team; rather, the individual tennis players compete against each other (e.g., Roger Federer competes against Rafael Nadal).

Third, the brand name of the manufacturer that competes in sports is strongly linked to the performance of the manufacturer's team in the competition. Contestants are ranked on the basis of their relative performance vis-à-vis competing brands in the sports contest (see, e.g., https://data.fis-ski.com/alpine-skiing/brand-ranking.html and http://www.skysports.com/f1/standings). In contrast, because sponsors do not compete themselves in the sports, they are not ranked on the basis of the performance of the athletes or teams they sponsor. For example, the Association of Tennis Professionals (ATP) rankings show the official singles rankings of the ATP World Tour, featuring the world's top-ranked players in men's professional tennis, but do not show the names of manufacturers whose rackets the players used.

Type of Deployed Resources: Gear Versus Nongear

We define "gear" as clothing, goods, and equipment made by the manufacturer to use in the sport. Gear manufacturers provide the set of tools that will enable the individual athlete or team to compete, whereas nongear manufacturers do not. For example, Nike sponsored Tiger Woods by providing him with Nike equipment, apparel, and shoes and is thus a gear sponsor. Trek, providing its own team with Trek race bikes to compete in the UCI World Tour, is a gear contestant.

From the manufacturer's point of view, two important (related) differences exist between deploying gear and nongear resources to a sports competition. First, for the manufacturer, there is a strong fit between the gear deployed in the sports competition and the gear sold in the commercial market, thereby bridging these two markets. For example, Nike sold golf balls in the main market similar to those used by Tiger Woods in golf tournaments. Second, in case of gear sponsors and contestants, resources and competencies deployed for the competition may spill over to the main market and vice versa, which may lead to technology transfers. As an example, Wilson and Roger Federer cocreated a tennis racket, the Wilson Pro Staff RF97 Autograph, first to be used by Roger Federer in his matches, but later on, a commercial version of the racket was sold to the main market (Amer Sports 2018). There have also been many technology transfers from F1 race cars to cars for the general public (e.g., antilock brakes, electronic throttles, traction control).

Positioning in Prior Literature

The distinctions we make help clarify the positioning of the present study in the existing literature on sports sponsoring. So far, most studies have focused on nongear sponsors and have shown that sports sponsoring by means of providing nongear support entails branding effects. Olson and Thjømøe (2009), for example, show that extensive logo exposure from sponsoring a sports league increases brand recognition and likability equally as much as a 30-second TV ad. Walraven, Bijmolt, and Koning (2014) show that brand recall and recognition for Heineken increased over the brand's years of sponsoring the Union of European Football Association (UEFA) Champions League, with the largest increase in the second year. And, Mazodier and Merunka (2012) have shown that sponsoring a large sports event, such as the Summer Olympics, can increase brand trust and loyalty. The strength of such branding effects for nongear sponsors appears to vary depending on the fit between the sponsor and the brand and the successes of the sponsored objects (Jensen and Cobbs 2014; Mazodier and Merunka 2012; Olson and Thjømøe 2009; Speed and Thompson 2000; Walraven, Bijmolt, and Koning 2014).

A few studies have focused on the effects of being a gear sponsor. Chung, Derdenger, and Srinivasan (2013) is the first study to investigate the relation between sponsoring and the sales performance of the sponsoring brand. It shows a positive effect of being a gear sponsor—that is, it examines the effects of Nike's gear sponsoring (golf balls, among other equipment) of Tiger Woods on the brand's sales performance of golf balls, and how this effect depends on Tiger Woods's performance in the competition. In a subsequent study, Derdenger (2018) shows that this endorsement effect is stronger for novice golfers than for experts.

In contrast, the potential outcomes of manufacturers' investment in becoming a gear contestant have been completely ignored in the literature so far. This is an interesting context, because multiple gear contestants from the same industry typically participate in a particular sports competition (e.g., many large ski manufacturers participate with their own ski teams in the FIS Alpine Ski World Cup), with varying level of investments (e.g., ski manufacturer Head invests twice as much as ski manufacturer Atomic) and varying levels of success (e.g., both Head and Rossignol outperformed Atomic in the overall World Cup brand rankings in 2018). This provides a unique opportunity to investigate branding effects, as brands are shown to the audience in direct comparison to competitors' brands, which may lead to more pronounced branding effects. In addition, this context offers the opportunity to investigate breeding returns of

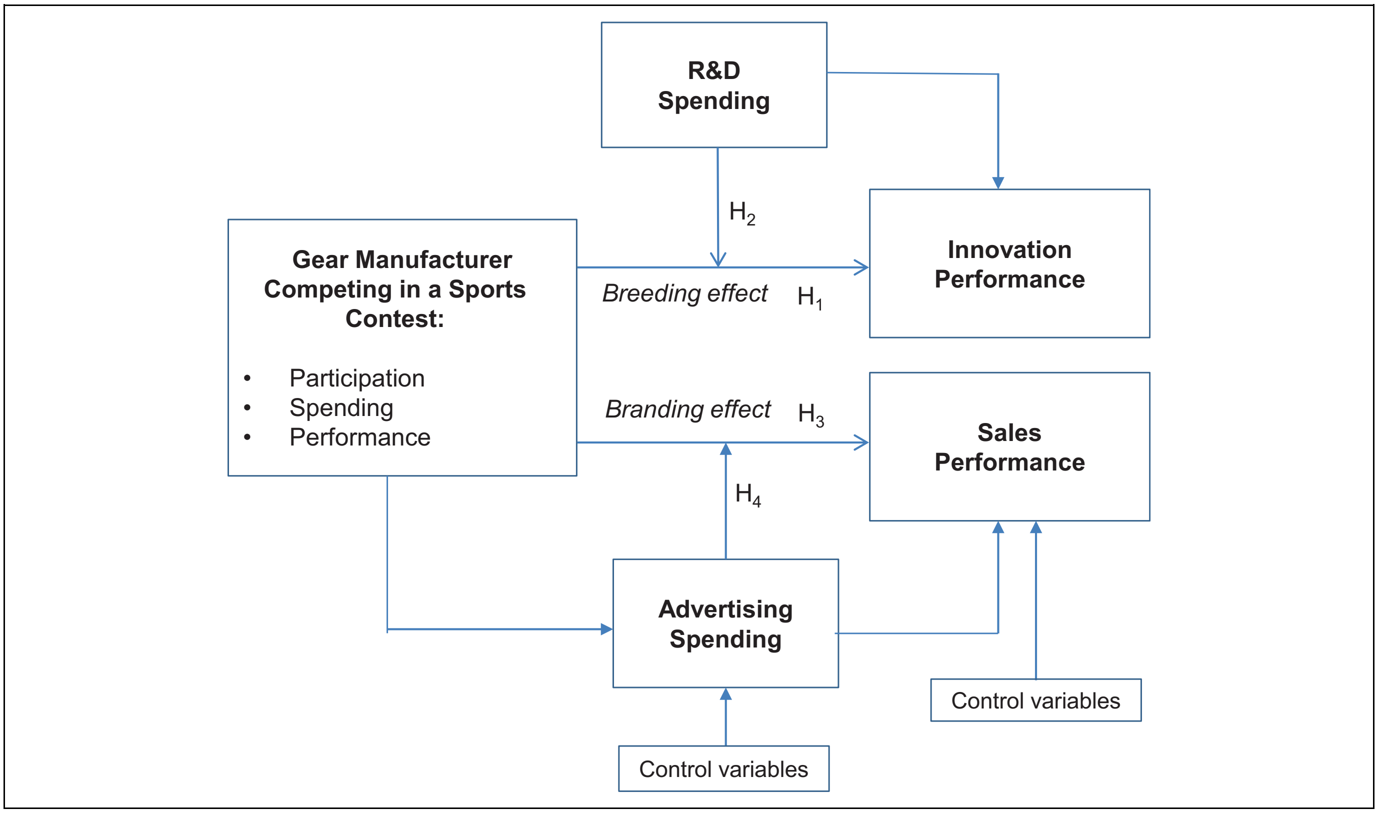

Figure 1. Conceptual model.

firms' involvement in sports competitions. Because gear contestants own participating teams, the teams' performance is directly related to the gear contestant's brand, and therefore, these gear manufacturers are most likely continuously searching for new product technologies that may help improve the teams' performance. In line with these considerations, this study contributes to the literature by examining the breeding and branding effects that result from manufacturers' participation, investments, and successes in sports competitions as gear contestants.

Conceptual Framework

Figure 1 graphically summarizes our conceptual framework and shows the relation between a gear manufacturer competing in a sports contest and its innovation and sales performance (i.e., the breeding and branding effects, respectively). We operationalize competing in three ways: participation, spending, and performance in the sports competition. Participation denotes that the manufacturer is one of the contestants. Contingent on participation, we investigate the influence of (1) the amount manufacturers spend on competing (spending) and (2) the level of success in competing in the sports contest (performance), as different levels of spending and performance may affect the breeding and branding returns.

The theoretical base of our conceptual framework relies on the resource-based view (RBV) of the firm, which states that a firm's resources and capabilities (i.e., a firm's capacity to deploy these resources) help give it a sustained competitive advantage (Wernerfelt 1984). We posit that the manufacturer's team is a resource, and competing in a sports contest can be viewed as a capability to leverage the manufacturer's asset of having its own team. The manufacturer's team is a resource that, either singly or with other manufacturer resources (e.g., R&D and advertising spending), can be the basis for a sustained competitive advantage in terms of an increase in the manufacturer's innovation performance and the brand's sales performance. Specifically, we hypothesize that R&D spending moderates the relationship between a gear manufacturer competing in a sports contest and its innovation performance because R&D is the most fundamental resource available to firms to produce technological know-how and generate innovations (Erickson and Jacobson 1992; Wuyts, Dutta, and Stremersch 2004). In a similar vein, we hypothesize that advertising spending moderates the relation between a gear manufacturer competing in a sports contest and the sales performance of its brand(s) because advertising is generally an important source to increase a brand's sales performance (e.g., Terui, Ban, and Allenby 2011).

Breeding Effect

We define the breeding effect as the effect of a gear manufacturer competing in a sports contest on its innovation performance (i.e., the manufacturer's innovation outputs; e.g., patents; Ahuja and Katila 2001). Atomic, for example, developed its "Doubledeck" ski technology first for use by professional athletes on the Atomic ski team that competes in the FIS Alpine Ski World Cup; after the technology was proven successful, the brand transferred this technology to its commercial skis.

Main breeding effect of competing by a gear manufacturer. Competing in sports contests is valuable to a gear manufacturer because it offers the manufacturer the opportunity to develop and test new technologies under the most demanding circumstances. Competing generates valuable resources and competencies for converting new product ideas into innovations, increasing a manufacturer's innovation performance (Chandy et al. 2006). The breeding effect of a gear manufacturer competing in a sports contest on its innovation performance can be explained as follows. First, a gear manufacturer competing in sports contests creates a parallel path of R&D activities in addition to its regular R&D processes. Because sports competitions are characterized as highly demanding in terms of both speed and accuracy, gear manufacturers that compete in such competitions develop and test new technologies specific to the demands of these sports competitions. This parallel path of R&D activities, along the technical frontier, can improve a firm's overall innovation performance (Abernathy and Rosenbloom 1969; Dahan and Mendelson 2001). Second, the immediate performance feedback from competing in a sports contest stimulates learning through trial-and-error experiences. When a gear manufacturer is experimenting with new technologies, the performance feedback provides insights into these technologies' usefulness and quality. Such feedback facilitates the development of tacit knowledge and the discovery of otherwise unnoticed opportunities, which may increase the gear manufacturer's innovation performance (Börjesson, Dahlsten, and Williander 2006; Boudreau, Lacetera, and Lakhani 2011).

In summary, we expect that a gear manufacturer competing in a sports contest improves its innovation performance, leading to the following hypothesis:

> **H_1:** Competing in a sports contest by a gear manufacturer is positively related to the gear manufacturer's innovation performance.

Moderating role of R&D spending on the breeding effect. We expect a direct relation between R&D spending and innovation performance as well as a positive moderating effect of R&D spending on the positive relation between a gear manufacturer competing in a sports contest and its innovation performance. Firms use R&D expenditures to create internal knowledge and to evaluate the potential outcomes of the created knowledge (Rosenberg 1990). Prior literature (Artz et al. 2010; Somaya, Williamson, and Zhang 2007) has shown that a higher level of R&D spending entails a higher likelihood of patents being granted and/or the granted patents being intellectually valuable (in terms of citations), suggesting a direct effect of R&D spending on a firm's innovation performance.

In addition to this direct effect, there are two reasons to expect a complementary effect between gear manufacturers competing in sports contests and these gear manufacturers' R&D spending. First, RBV theory emphasizes the role of firm-specific capabilities and competencies that stretch the firm's resources and help give it a sustained competitive advantage (Wernerfelt 1984). Previous literature has shown that R&D spending is positively related to three important capabilities that may harness the innovation opportunities that result from having a team in a sports competition (i.e., absorptive capacity, product development capabilities, and patenting skills). By actively engaging in R&D in a particular field—in this case, innovation development in their focal industry—manufacturers increase their absorptive capacity (i.e., the capacity to acquire, assimilate, and exploit information they generate in another context, such as competing in a sports contest; Cohen and Levinthal 1990). They may also increase their product development capabilities (i.e., the capacity to turn this information and knowledge into breakthroughs; Cohen and Levinthal 1990; Vorhies and Morgan 2005). Finally, the higher the R&D spending, the greater a firm's patenting skills, which may help in patenting the breakthrough innovations, resulting from technology testing by the manufacturer teams in the sports competitions (Somaya, Williamson, and Zhang 2007).

Second, higher R&D spending is an important resource for the generation of creative innovation ideas (Boudreau, Lacetera, and Lakhani 2011). The new ideas from the regular R&D process may find their way into the equipment used by the manufacturers' teams, and competing by these teams in sporting contests may then provide valuable testing ground.

In line with these arguments, we expect that R&D spending strengthens the positive effect of a gear manufacturer competing in a sports contest on its innovation performance, leading to the following hypothesis:

> **H_2:** The relationship between competing in a sports contest by a gear manufacturer and that gear manufacturer's innovation performance is positively moderated by the gear manufacturer's R&D spending.

Branding Effect

We define the branding effect as the effect of a gear manufacturer competing in a sports contest on the sales performance of its brands. For example, Renault's F1 title in 2006 entailed a direct increase in its car sales (European Communities 2006).

Main branding effect of competing by a gear manufacturer. Competing in a sports contest may positively influence a gear manufacturer's most important intangible resources (i.e., the brand's awareness, image, and reputation), thereby creating a sustainable competitive advantage and, eventually, higher sales (Aaker and Biel 1993; Conner 1991; Keller 2003). A gear manufacturer competing in a sports contest may generate branding returns for two main reasons. First, by entering sports competitions, gear manufacturers gain increased brand exposure because sports competitions have large viewership (e.g., 352.3 million people viewed the F1 championship globally in

2017; Sylt 2018a). The brand's exposure increases with the brand's performance in the competition because the better-performing brands will receive more media attention than those at the back of the pack (Jensen and Cobbs 2014). Literature on the mere-exposure effect suggests that repeated exposure to a brand's stimuli, such as words, pictures, logos, and brands, will entail an affective response toward these stimuli, leading to higher brand preferences and higher brand equity, which subsequently leads to higher sales performance (Aaker 1996; Janiszewski 1993; Olson and Thjømøe 2009; Zajonc 1968).

Second, in the context of gear manufacturers competing in sports contests, signaling is an important additional logic beyond mere exposure for explaining the effect of competing on the sales performance of the gear manufacturer's brand(s). Signaling refers to the action a seller takes to convey information about the unobservable product quality to the buyer (Rao, Qu, and Ruekert 1999). Previous studies on signaling have focused on the transmission of quality signals in different forms, including brands (Erdem, Swait, and Valenzuela 2006), brand alliances (Rao, Qu, and Ruekert 1999), prices (Schmidbauer and Stock 2018), advertising expenditures (Erdem, Keane, and Sun 2008), and warranties (Boulding and Kirmani 1993). We argue that competing in sports contests, under the extreme conditions these contests entail and directly in comparison with competitors' products, enables the respective firm to demonstrate the performance and quality of its products and brands. A new technology that a competing firm introduces in such contests may yield strong reputational and quality returns to the main market. Thus, competing in a sports contest acts as a positive signal on the quality of the manufacturer's brand(s), which may result in higher sales, as perceived quality has been shown to be one of the most important universal brand benefits influencing a consumer's brand purchase intention and brand choice (Erdem, Keane, and Sun 2008; Van der Lans, Van Everdingen, and Melnyk 2016).

In line with these arguments, we develop the following hypothesis:

> **H_3:** Competing in a sports contest by a gear manufacturer is positively related to the gear manufacturer's sales performance.

Moderating role of advertising spending on the branding effect. We postulate that advertising spending will moderate the relationship between a gear manufacturer competing in a sports contest and the sales performance of its brand(s) for two main reasons. One argument for a negative interaction effect of a gear manufacturer competing in sports contests and its advertising spending is the saturation effect. Because gear manufacturers repeatedly show their brands during sports competitions, simultaneously increasing advertising spending will lead to saturation resulting from an increased number of brand exposures (Campbell and Keller 2003; Schmidt and Eisend 2015; Vakratsas and Ambler 1999). This effect will be even more pronounced for brands with higher spending in sports competitions because higher spending leads to a more prominent display of the brand names, and logos. Similarly, the saturation effect will be greater for brands that perform well in the competition because better-performing brands receive more media attention and, thus, more brand exposures compared with brands that do not perform well (Chung, Derdenger, and Srinivasan 2013).

Second, according to Kirmani and Rao (2000), there is a negative interaction effect between two market signals that are similar in nature, owing to the reduced effectiveness of one signal in the presence of another signal of similar type. Because both competing in sports contests and advertising involve up-front expenditures, they are similar in nature. That is, both advertising spending and competing in sports contests can be viewed as (substitute) signals of high product quality, compared with rivals.[1] Therefore, we expect a negative interaction effect between them.

In line with these arguments, we develop the following hypothesis:

> **H_4:** The relationship between a gear manufacturer competing in a sports contest and the sales performance of its brand(s) is negatively moderated by its advertising spending.

Data

Empirical Context

The empirical context of our study is the F1 championship, which is the leading sports championship in single-seat auto racing, established by the Fédération Internationale de l'Automobile (FIA) in 1945. The F1 season runs from March to November and consists of a series of 19 Grand Prix races across different countries worldwide. Yet F1 has a strong heritage in Europe, where approximately 50% of the races still take place. Recent F1 race seasons have had an average of 11 teams participating with two cars, and every team enrolled in an F1 season competes in all the races of the year. At the end of the season, a world championship is awarded to one driver and one team with the highest total points earned during the races.

The F1 context constitutes a perfect environment for testing our breeding and branding effects hypotheses. In terms of breeding potential, F1 teams, in which the car manufacturer's R&D personnel closely collaborate with the drivers and technical engineers, generate hundreds of ideas a year to improve automobile performance (e.g., aerodynamics, suspension setup, weight distribution, fuel efficiency). Because races are typically every two weeks, there is a rapid cycle of developing new ideas, testing them, and analyzing whether the modifications

[1] Note that this expectation is solely based on the magnitude of advertising spending as a signal (i.e., the more a brand spends on advertising, the more it signals high quality) and not on advertising content that may be either aligned with or not aligned with competing in sports contests. We regard advertising content as outside the scope of the article and formulate this hypothesis ceteris paribus (thus, including independent of variation in advertising content). We return to this issue in the "Discussion" section.

improve race performance. We believe that F1 is also an interesting area in which to investigate branding effects, because participating car brands gain a lot of brand exposure primarily due to the TV viewership of F1 races (Jensen and Cobbs 2014).

Data Collection Procedure

Level of data collection. We collected data at the manufacturer-global-year level for the breeding analysis and at the brand-country-month level for the branding analysis. Patent data, which we use to measure innovation performance, is only unambiguously available at the manufacturer-global-year level, while data on car registrations, our measure of sales performance, is available at the brand-country-month level. Moreover, data for variables in the breeding part of the conceptual framework, such as R&D spending, are available only at the manufacturer-global-year level, whereas data for the variables in the branding part of the conceptual framework, such as advertising spending, are available at the brand-country-month level.

Sample of countries, brands, and manufacturers. We decided to focus on Europe because F1 has its heritage in Europe and is still strongly European oriented, with many F1 drivers being of European origin, and approximately half of F1 races every year take place in Europe. Within Europe, we selected five countries—France, Germany, Italy, Spain, and the United Kingdom—on the basis of data availability on brands' monthly sales performance and the highest percentage of F1 TV viewership. Specifically, the percentage of the population within a country that has watched 15 or more minutes of at least one race during the 2010 F1 season was 52% for France, 51% for Germany, 60% for Italy, 71% for Spain, and 56% for the United Kingdom (Formula One Global Broadcast Report 2010). Moreover, many drivers participating in F1 between 2000 and 2015 are from one of these countries (11 drivers of German origin, 11 drivers of U.K. origin, 8 drivers of French origin, 6 drivers of Italian origin, and 6 drivers of Spanish origin), and these countries produce highly successful drivers (e.g., Michael Schumacher, Sebastian Vettel, Nico Rosberg, Giancarlo Fisichella, Fernando Alonso, David Coulthard, Jenson Button, Lewis Hamilton). We are aware that our sample of countries enhances the likelihood of finding a branding effect. The branding effect we identify may thus be lower in countries with less heritage in F1, with smaller F1 viewership, or in which no races take place.

Table 1 lists the brands chosen in our sample countries for the branding analyses, the corresponding car manufacturers used in the breeding analyses, and the manufacturers' car brands that participated in F1 during 2000–2015, including the years in which they participated. We selected the 30 car brands (see Table 1, second column) using the following three criteria. First, we selected the top 20 brands in terms of vehicle registrations in our five sample countries. Second, we identified the brands that competed in F1 during our sample period. Among the top 20 brands, 7 brands competed in F1 during 2000–2015. We added Ferrari, Jaguar, and Lotus, which were not in the top 20 brands in terms of registrations but also competed in F1 between 2000 and 2015.[2] Third, we added seven niche brands that did not compete in F1 but are comparable to Jaguar, Ferrari, and Lotus in terms of the segments in which they operate: Aston Martin, Bentley, Lexus, Lamborghini, Maserati, Porsche, and Volvo. Our sample of 30 car brands accounts for more than 90% of passenger vehicle registrations in the five selected European countries. These 30 brands mapped into 16 car manufacturers (see Table 1, first column), among which 10 brands from 9 manufacturers competed in F1 at some point during our sample period (see Table 1, third column).[3]

Measurement of Variables

Operationalization of variables for the breeding model. The dependent variable in the breeding model is a manufacturer's innovation performance, which we measured as the total number of citations obtained by the manufacturer's patents that were granted during a given year. Prior studies have used this method to measure innovation performance (e.g., Hall, Jaffe, and Trajtenberg 2005; Wuyts, Dutta, and Stremersch 2004). There were, however, two issues in measuring the number of citations. First, for each patent, we observed only a portion of the period over which it could be cited. Specifically, it takes several years to realize patents' full citation potential. Second, the length of this observed citation period varied depending on when the manufacturer applied for the patent. For example, 13 years of citation data were available for patents applied for in 2001 (i.e., from 2001 to 2013),[4] whereas only 3 years of citation data were available for patents applied for in 2011 (i.e., from 2011 to 2013). We addressed this problem as follows. We first estimated the shape of the citation-lag distribution for each manufacturer using data on patents granted during 1986–1999. This distribution provides the fraction of citations that a manufacturer's patent obtains every year after the patent is granted. We used this distribution to calculate the total number of citations for patents granted in a particular year as follows. We first observed the total number of citations between the year in which the patent was granted until 2013 (e.g., three years for patents filed in 2011), and then we divided this value by the

[2] The key findings of our study are not sensitive to the exclusion of these three brands from our sample (see the "Robustness Checks" subsection).

[3] In some cases (BMW in 2010, Jaguar during 2003–2004, and Lotus during 2010–2015), although the brand name appeared in the team's name, the manufacturer did not supply the engine used in the races. Therefore, we do not expect breeding effects to be present for these cases. However, because the brand name appeared on the team's name, branding effects may still be present. Nevertheless, we show that the results of our breeding analyses are robust when we exclude these observations from our data set (see the "Robustness Checks" subsection).

[4] Patent information is based on the priority year and is made available after the date of publication of the application. There is a time lag of up to 30 months between the application of the patent and the availability of the information in the PATSTAT database (https://ec.europa.eu/eurostat/cache/metadata/EN/pat_esms.htm). Therefore, we use information on patents until December 2013.

Table 1. Selected Manufacturers and Brands.

Manufacturer	Selected Brand(s)	Brand(s) and Years in Which They Competed
BMW AG	BMW	BMW (2000–2010)[a]
Daimler AG	Mercedes-Benz	Mercedes-Benz (2000–2015)
Fiat Automobiles S.p.A.	Alfa Romeo, Fiat, Ferrari, Lancia,[b] Maserati	Ferrari (2000–2015)
Ford Motor Company	Aston Martin (until 2007), Ford, Jaguar (until 2008), Volvo (until 2010)	Ford (2003, 2004) Jaguar (2000–2004)[a]
General Motors Company	Opel (Vauxhall in the United Kingdom)	Did not participate
Groupe PSA	Citroen, Peugeot	Peugeot (2000)
Groupe Renault	Renault	Renault (2001–2015)
Honda Motor Co., Ltd	Honda	Honda (2000–2008, 2015)
Hyundai Motor Company	Hyundai	Did not participate
Kia Motor Corporation	Kia	Did not participate
Mazda Motor Corporation	Mazda	Did not participate
Nissan Motor Company Ltd	Nissan	Did not participate
Porsche AG[c]	Porsche	Did not participate
Proton Holdings Berhad	Lotus	Lotus (2010–2015)[a]
Toyota Motor Corporation	Lexus, Toyota	Toyota (2002–2009)
Volkswagen Group	Audi, Bentley, Lamborghini, Seat, Skoda, Volkswagen	Did not participate

[a]Outsourced development of the race team: BMW (2010), Jaguar (2000–2004), and Lotus (2010–2015). Our key findings are robust to the exclusion of these data points from our sample. See "Robustness Checks" subsection.
[b]Lancia brand is not sold in the United Kingdom.
[c]Despite the connection between Porsche AG and the Volkswagen Group, we treat them as two separate entities. Until 2012, Porsche AG and Volkswagen had strong ties, including equity stakes in both directions. In 2012, the two companies actually merged, but they reported separately until the end of our data period.

fraction of the citation-lag distribution that lies in this time interval (Hall, Jaffe, and Trajtenberg 2005).

We measured the moderator variable (i.e., manufacturer's R&D spending) as the ratio of yearly spending in R&D in euros to the number of employees within the organization to control for different sizes of manufacturers. Prior studies (e.g., Scherer 1986) have found R&D spending per employee to be less sensitive to the spurious effects of business cycles, accounting manipulations, and asset sales than R&D spending as a proportion of sales.

We operationalize the independent variable (i.e., competing as a gear manufacturer) in three ways: F1 participation, F1 spending, and F1 performance. F1 participation is a dummy variable that takes a value of 1 during the years in which a manufacturer participated in F1 as a gear contestant, and 0 otherwise. We operationalize F1 spending as the yearly spending of the gear manufacturer on its F1 team in euros. Such spending may cover out-of-pocket expenses, such as materials, contracts with first-tier suppliers on components, or employees on the manufacturer's payroll dedicated to the participating team. We measure F1 performance as the number of points the manufacturer's team accumulated during the entire F1 season. We distinguish between F1 participation and F1 spending because some manufacturers participate in F1 without any spending. For instance, the manufacturer Proton Holdings Berhad participated between 2010 and 2015 using the Lotus brand name. However, the manufacturer neither spent any money on the team nor managed the team. Similarly, Ferrari did not make any direct financial contribution to its team's budget between 2013 and 2015. This is because the payments that Ferrari received from the Formula One Group have increased in recent years; therefore, it was no longer necessary for the manufacturer to offer financial backing to the team. In these two cases, we treat the manufacturers (and the corresponding brands) as participants but treat their spending as zero.

Operationalization of variables for the branding model. One of the dependent variables in the branding analyses is the brand's sales performance, which we measured as the total vehicle registrations of the brand across all its models in a given country during a particular month. We measured advertising spending, which is both a dependent and a moderating variable in the branding analyses, as the total advertising spending of a brand in a country in euros across all media types in a given month.

A brand as gear contestant in F1 is the independent variable in the branding model, which we also expressed in three levels: F1 participation, F1 spending, and F1 performance. F1 participation is a dummy variable that takes a value of 1 during months in which a brand participated in at least one F1 Grand Prix race and 0 otherwise. We measured the monthly F1 spending by multiplying the brand's annual F1 spending by the proportion of races in a year that took place in the particular month. All manufacturers except Ford participated with a single brand during our sample period. Therefore, we considered the manufacturer's F1 spending to be equal to the brand's F1 spending. Ford participated with the Jaguar brand name in 2000, 2001, and 2002, and with both the Ford and Jaguar brand names in 2003 and 2004. We allocated Ford's (manufacturer) F1 spending to its individual brands as follows. We allocated the entire manufacturer's F1 spending to the Jaguar brand for 2000–2002 and split the manufacturer's F1 spending between the Ford and Jaguar brands during 2003 and 2004. We assume that the manufacturer spent the same amount of money on the Ford brand in 2003 and 2004 as it did prior to 2000 when participating with only the Ford brand, and the rest of the manufacturer's spending was allocated to the Jaguar brand. Such allocation is also in line with publicly available information (e.g., GPUpdate 2003). We note, however, that our findings of the branding analyses are not sensitive to alternative allocations of F1 spending to the Ford and Jaguar brands (see the "Robustness Checks" subsection). We measured a brand's monthly F1 performance as the number of points accumulated by that brand during a particular month. Note that for F1 participation, F1 spending, and F1 performance, we assigned the same value for all countries.

We included four control variables in the branding model. First, because different countries may have varying levels of exposure to the brands during different racing months, we controlled for country-specific monthly exposure of participating brands by including the monthly number of viewers that watched the live F1 races on TV in the particular country. Second, we included the number of new product introductions of each brand in a particular month as a control variable because we expected it to influence sales performance. We defined this variable as the number of new products, denoted as a unique combination of brand, segment, model, body group, and generation year, introduced by the brand during that month. Third, we included the effects of lagged advertising spending and lagged sales performance on current advertising spending to capture carryover effects and state dependence (Dekimpe and Hanssens 1999). Finally, we included competitors' sales performance and competitors' advertising spending and measured them as the total number of new vehicle registrations and total advertising spending of all other brands in that country during the particular month, respectively.

Data Sources

For the breeding analysis, we collected data on innovation performance, R&D spending, and F1 competing, in terms of participation, spending, and performance, for the 16 manufacturers. We obtained data on innovation performance in terms of yearly patent applications and their corresponding citations from the Worldwide Patent Statistical Database (PATSTAT) of the European Patent Office from 2000 to 2013, a period of 14 years. We obtained data on yearly R&D spending (2000–2013) from the car manufacturers' annual reports.[5] We converted all R&D spending figures reported in other currencies to euros using historical exchange rates. For most firms, the fiscal year matched the calendar year (January to December). We adjusted the R&D spending of other firms with a different fiscal year so that it matches with the calendar year. Finally, we gathered information on car manufacturers' yearly participation and performance in F1 from ESPN (www.espn.co.uk/f1/), and we obtained yearly spending in U.S. dollars for all car manufacturers that participated in F1 between 2000 and 2015 from Formula Money. We used historical exchange rates to convert U.S. dollars to euros.

For the branding analysis, we collected monthly data on sales performance and advertising spending of the selected 30 brands across the five countries between January 2000 and December 2015 (192 months).[6] We obtained data on sales performance in terms of monthly new passenger vehicle registration for each car brand-model, in every segment, body group, and generation year across the five European countries from R.L. Polk & Co. We obtained data on country-specific brand level monthly advertising spending for all car brands from Nielsen Company. Advertising spending figures in France, Germany, Italy, and Spain are expressed in euros and those in the United Kingdom are expressed in British pounds. We converted pounds to euros using historical exchange rates. We use the same sources mentioned previously to obtain information on the brands' F1 participation, spending, and performance. Finally, we obtained information on the monthly number of television viewers who watched the live F1 races in every country of our sample from Eurodata TV Worldwide.[7]

Descriptive Statistics

Tables 2 and 3 provide means, standard deviations, and correlations among different variables we used in the breeding and branding analyses, respectively. Patent citations (innovation performance) are positively correlated with a manufacturer's F1 participation ($r = .252$), F1 spending ($r = .479$), and R&D spending ($r = .094$) but negatively correlated with a manufacturer's F1 performance ($r = -.111$). A brand's new vehicle registrations (sales performance) are positively correlated with a brand's F1 participation ($r = .079$), F1 spending ($r = .113$), F1 performance ($r = .048$), and advertising spending ($r = .495$).

Empirical Analysis

Breeding Analysis

Model specification. In line with prior studies (e.g., Artz et al. 2010; Ernst 2001), we used a one-year lag between R&D spending and patent citations. Because we consider a gear manufacturer that competes in a sports contest as a resource that creates a parallel path of R&D, we consider a one-year lag also for the effect of a gear manufacturer competing in F1 on patent citations. Specifically, we modeled innovation performance, measured as the number of patent citations ($InnPerf_{my}$), of manufacturer m in year y as follows:

[5] Porsche's annual reports were not available prior to 2004. For these early years we assumed Porsche's R&D spending to be 8% of its owner Volkswagen Group's R&D spending, which was the case during the fiscal year 2005–2006.

[6] Registration data are available in Germany until September 2015 and in France until August 2013.

[7] For Spain, reliable viewership data is available only from 2004. Therefore, we drop the observations prior to 2004 for Spain from our branding analysis.

Table 2. Descriptive Statistics for the Variables Used in the Breeding Analysis.

Variable	Mean (SD)	Innovation Performance	F1 Participation	F1 Spending	F1 Performance	R&D Spending
Innovation performance (patent citations in '000s)	6.943 (9.476)	1.000				
F1 participation (no/yes)	.341 (.475)	.252	1.000			
F1 spending (billion €s)	.044 (.071)	.479	.851	1.000		
F1 performance (in hundreds of points)	.643 (1.595)	−.111	.562	.321	1.000	
R&D spending (million €s per employee)	.018 (.012)	.094	−.110	−.020	−.154	1.000

Notes: All variables in the breeding analysis are measured at the manufacturer-global-year level.

Table 3. Descriptive Statistics for the Variables Used in the Branding Analysis.

Variable	Mean (SD)	1	2	3	4	5	6	7	8	9
1. Sales performance—vehicle registrations (in thousands)	5.699 (9.113)	1.000								
2. F1 participation (no/yes)	.132 (.338)	.079	1.000							
3. F1 spending (billion €s)	1.784 (5.801)	.113	.782	1.000						
4. F1 performance (in hundreds of points)	.033 (.150)	.048	.569	.421	1.000					
5. Advertising spending (million €s)	5.496 (8.533)	.495	.063	.095	.067	1.000				
6. New product introductions	.085 (.346)	.111	.100	.113	.088	.069	1.000			
7. F1 TV viewers (in millions)	.675 (2.023)	.070	.856	.701	.467	.089	.087	1.000		
8. Competitors' sales performance—vehicle registrations (in millions)	.178 (.080)	.176	.054	.069	−.010	−.092	.018	.076	1.000	
9. Competitors' advertising spending (in billion €s)	.184 (.142)	−.056	.003	−.012	.028	.431	−.008	.083	−.065	1.000

Notes: All variables in the branding analysis, except F1 participation, F1 spending, and F1 performance, are measured at the brand-country-month level. F1 participation is measured at the brand-global-year level and F1 spending and performance are measured at the brand-global-month level.

$$\ln(\text{InnPerf}_{my}) = \mu_m + \theta_1 \text{F1}_{my-1} + \theta_2 \overline{\ln(\text{R\&D}_{my-1})} + \theta_3[\text{F1}_{my-1} \times \overline{\ln(\text{R\&D}_{my-1})}] + \epsilon_{my}, \quad (1)$$

where μ_m denotes a manufacturer-specific fixed effect, F1_{my-1} denotes manufacturer m as a gear contestant in F1 in year y − 1, expressed in terms of F1 participation (F1part_{my-1}), log of F1 spending ($\ln[\text{F1spend}_{my-1}]$) or log of F1 performance ($\ln[\text{F1perf}_{my-1}]$), $\text{R\&D}_{my-1}$ denotes the manufacturer m's R&D spending in year y − 1. We log-transform F1 spending, F1 performance, and R&D spending to allow for their decreasing marginal returns on the manufacturer's innovation performance. As we operationalized being an F1 contestant in three different ways, we estimated Equation 1 three times, each time with another operationalization of the F1 variable (participation, spending, or performance). Because we mean-centered $\ln(\text{R\&D}_{my-1})$, θ_1 captures the effect of F1 participation, spending, or performance for a manufacturer with mean level of R&D spending; θ_2 captures the simple effect of R&D spending; θ_3 captures the interaction between F1 participation, spending, or performance and R&D spending; $\varepsilon_{my} \sim N(0, \sigma_\varepsilon^2)$ and is the error term. We estimate the model in Equation 1 using ordinary least square regression.

Estimation results. Table 4 reports the parameter estimates of the breeding model. Columns 3, 5, and 7 contain the parameter estimates of the model that includes only the main effects of competing in F1 and R&D spending, but not the interaction between the two, when the F1 variable is measured as F1 participation, F1 spending, and F1 performance, respectively. It shows that the main effect of competing in F1 (i.e., the effect of competing independent of the R&D level) on innovation performance is significant when competing in F1 is operationalized as F1 participation or F1 spending, but not when it is operationalized as F1 performance. Therefore, we can confirm H_1, except when we operationalize competing by performance.

Columns 4, 6, and 8 of Table 4 contain the parameter estimates of the full model that includes the simple effects of competing in F1 (θ_1) and R&D spending (θ_2) as well as the interaction effect between them (θ_3) when the F1 variable is measured as F1 participation, F1 spending, and F1 performance, respectively. Note that one cannot interpret these simple effects as main or marginal effects of F1 involvement, in the presence of the interaction effects between F1 and R&D spending (i.e., they cannot be used to test H_1). We find that the interaction effect (θ_3) is positive and significant at the .01 level in all three models.

To interpret these findings, we plotted the effects of a car manufacturer competing in F1 on its innovation performance for the 5th percentile (€5,567) to the 95th percentile (€35,989) of annual R&D spending per employee in our data set (mean R&D spending per employee = €18,177). Figure 2, Panel A, shows the effect of manufacturers' participation on innovation performance across different levels of R&D spending. We obtained the mean effects (see the solid line) and the 95%

Table 4. The Effects of Manufacturers Competing in F1 on Innovation Performance (Breeding Analysis).

		Estimates for the Model in Which Competing in F1 Is Measured As…					
		F1 Participation		Log of F1 Spending		Log of F1 Performance	
Variable	Parameter	Main Effects Only	Full Model	Main Effects Only	Full Model	Main Effects Only	Full Model
F1 participation (H_1)[a]	θ_1	.470***	.151	N.A.	N.A.	N.A.	N.A.
F1 spending (H_1)[a]		N.A.	N.A.	.027***	.010	N.A.	N.A.
F1 performance (H_1)[a]		N.A.	N.A.	N.A.	N.A.	.038	−.055
R&D spending per employee	θ_2	.419***	.334**	.424***	.342**	.407***	.295**
F1 participation × R&D spending per employee (H_2)	θ_3	N.A.	1.145***	N.A.	N.A.	N.A.	N.A.
F1 spending × R&D spending per employee (H_2)		N.A.	N.A.	N.A.	.062***	N.A.	N.A.
F1 performance × R&D spending per employee (H_2)		N.A.	N.A.	N.A.	N.A.	N.A.	.346***
R^2		.860	.865	.860	.866	.854	.864
Number of observations		205					

*$p < .10$.
**$p < .05$.
***$p < .01$.
[a]Because R&D spending per employee is mean-centered, the simple effect of F1 participation, spending, or performance denotes the effect for a manufacturer with mean level of R&D spending per employee.
Notes: N.A. = not applicable.

confidence intervals (see the dotted lines). Similarly, Figure 2, Panels B and C, respectively plot the effect of 1% increase in F1 spending and the effect of 1% increase in F1 points on innovation performance across different levels of R&D spending. The breeding effect is significant at the 5% level when both the dotted lines indicating the 95% confidence interval are above or below the x-axis. All three figures show that there is a synergistic effect of car manufacturers competing in F1 and R&D spending. Combining the simple effect of F1 and the interaction effect between F1 and R&D spending, we find a significant, positive effect of F1 participation, spending, and performance on innovation performance for manufacturers with high (above-mean) levels of R&D spending (specifically, greater than €18,200, €17,800, and €23,500 annual R&D spending per employee or €3 billion, €2.9 billion, and €3.8 billion annual R&D spending for F1 participation, F1 spending, and F1 performance, respectively). This finding supports H_2.

Branding Analysis

Model specification. We modeled sales performance, measured as the number of new passenger vehicle registrations, ($SalesPerf_{ijt}$) for brand i in country j at month t, as follows:

$$\begin{aligned}\ln(\text{SalesPerf}_{ijt}) = \; & \alpha_{ij} + \beta_1 \text{F1}_{it} + \beta_2 \text{AdGW}_{ijt} \\ & + \beta_3(\text{F1}_{it} \times \text{AdGW}_{ijt}) \\ & + \beta_4[\text{F1}_{it} \times \overline{\ln(\text{Viewers}_{jt})}] \\ & + \beta_5 \sum_{k=0}^{12} \text{NPI}_{ijt-k} \\ & + \beta_6 \ln(\text{CompSalesPerf}_{ijt}) + \varepsilon_{ijt},\end{aligned} \tag{2}$$

where α_{ij} denotes the brand-country fixed effect, which captures time-invariant brand-specific and country-specific effects.[8] Incorporating such fixed effects alleviates the risk of endogeneity arising from idiosyncratic variations in brands (e.g., mainstream vs. niche brands) and countries (Papies, Ebbes, and Van Heerde 2017, p. 602). $F1_{it}$ denotes the brand's manufacturer being a gear contestant in F1, which we operationalize as either F1 participation ($F1part_{it}$), log of F1 spending ($\ln[F1spend_{it}]$) or log of F1 performance ($\ln[F1perf_{it}]$) of brand i in a particular month t, and $AdGW_{ijt}$ is the advertising goodwill of brand i in country j in month t. We employ the standard Nerlove and Arrow (1962) exponential decay goodwill model for each country-brand combination. Specifically, we model the goodwill as $AdGW_{ijt} = \rho AdGW_{ijt-1} + \sqrt{Ad_{ijt}}$, where Ad_{ijt} is the advertising spending of brand i in country j at month t, and ρ is the carryover parameter, which we find using a grid search (Narayanan, Desiraju, and Chintagunta 2004).[9] The squared-root term accounts for the decreasing marginal returns from advertising spending. $Viewers_{jt}$ denotes the number of people watching the live F1 races in country j in month t. We interact $Viewers_{jt}$ with $F1_{it}$ because we expect the effect of F1 TV viewership on sales performance to depend on the extent to which the brand competes in F1 (e.g., if it participates,

[8] We regret that we do not have information on monthly prices of passenger vehicles. Because there is very little variation in prices at the brand level (most price variation occurs at the model level or because of customizations), we believe that the effect of the price level on sales performance is captured by the fixed effect in Equation 2.
[9] We estimated the model with different values of the carryover parameter and chose the model with the highest R^2. We obtained the highest model fit when the carryover parameter was set to 86%.

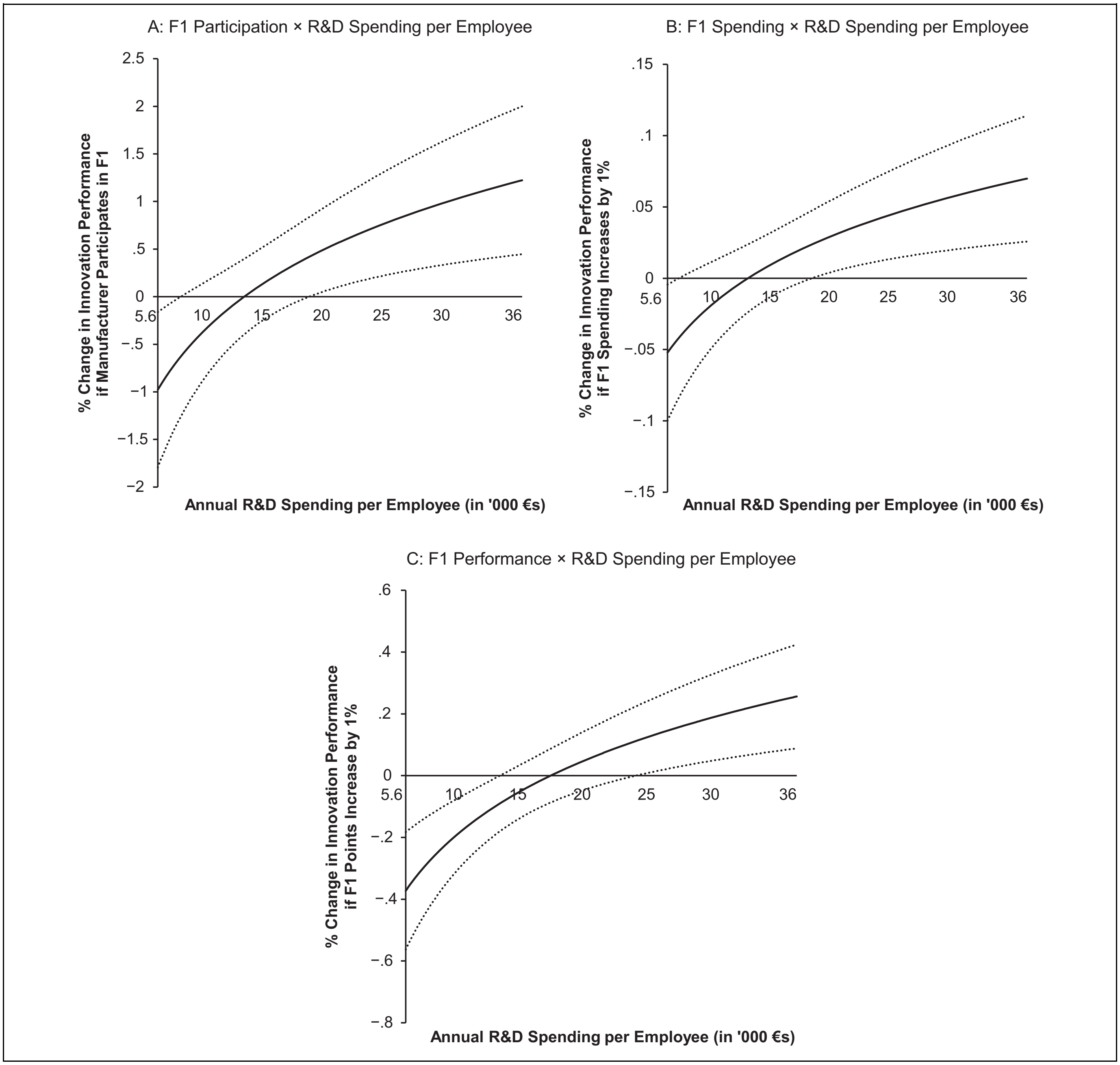

Figure 2. Interactions between competing in F1 and R&D spending per employee on innovation performance.
Notes: The dotted lines represent 95% confidence intervals. Innovation performance is measured as patent citations.

spends a certain amount, and has won a certain number of points). NPI_{ijt} denotes the number of new products introduced by brand i in country j during the month. We model the effect on sales performance of new products introduced by the brand during the last 12 months (i.e., $\sum_{k=0}^{12} NPI_{ijt-k}$). $CompSalesPerf_{ijt}$ denotes the number of registrations of all other brands in the country.

β_1 captures the main/simple effect of the brand competing in F1 on sales performance, β_2 denotes the main/simple effect of advertising goodwill on sales performance, and β_3 denotes the interaction effect between the brand competing in F1 and advertising goodwill. Because we mean-center $\ln(Viewers_{jt})$, β_1 and β_3 capture the simple effect of the brand competing in F1 and interaction effect between the brand competing in F1 and advertising goodwill respectively for an average level of F1 TV viewership. Moreover, β_4 captures the effect of the number of viewers for gear contestants depending on the level of the brand competing in F1, β_5 denotes the effect of new product introductions during the past 12 months, β_6 denotes the effect of competitors' sales performance, and ε_{ijt} is the error term.

In Equation 2, advertising spending may be endogenous to sales performance because the unobservable monthly shocks in car registrations may be correlated with those affecting advertising spending (e.g., an important sales exhibition may occur in a given month in a given country). We model such endogeneity by including an instrumental variable and by modeling the error terms of the sales performance (Equation 2) and advertising spending equations (see Equation 3) to be correlated with each other. We use the brand's total monthly advertising spending in the other four countries as the instrumental variable. The brand's advertising spending in other countries is likely to be related to the brand's advertising spending in the focal country because manufacturers allocate advertising budgets across countries (Bigné 1995; Fisher et al. 2011). However, we expect the advertising spending in other countries to be exogenous to sales performance in the focal country. The advertisements in each of the five countries in our analysis were most likely in different languages (i.e., French in France, German in Germany, Italian in Italy, Spanish in Spain, and English in the United Kingdom). Moreover, manufacturers customize advertising content to local markets (e.g., Sandler and Shani 1992). To check whether the advertising spending in other countries is a reasonable instrument for advertising spending, we carried out an auxiliary regression in which we used the log of advertising spending as the dependent variable and the log of the total advertising spending in the other four countries as the independent variable. The R^2 of this regression is .590, indicating that using advertising spending in other countries to account for advertising endogeneity is a reasonable instrument (Stock and Watson 2015).

In addition to accounting for the endogeneity of advertising spending, we are interested in examining the effect of how the brand competes in F1 on advertising spending (see Figure 1). In line with this, we modeled the advertising spending for brand i in country j in month t (Ad_{ijt}) (in logarithmic units) as follows:

$$\begin{aligned}\ln(Ad_{ijt}) = \; & \gamma_{ij} + \delta_1 F1_{it} + \delta_2[F1_{it} \times \overline{\ln(Viewers_{jt})}] \\ & + \delta_3 NPI_{ijt} + \delta_4 \ln(Ad_{ijt-1}) \\ & + \delta_5 \ln(SalesPerf_{ijt-1}) + \delta_6 \ln(CompAd_{ijt}) \\ & + \delta_7 \ln\left(\sum_{j' \neq j} Ad_{ij't}\right) + \xi_{ijt},\end{aligned} \tag{3}$$

where γ_{ij} denotes a country-brand specific fixed effect to account for time-invariant brand-specific and a country-specific advertising level, Ad_{ijt-1} denotes lagged advertising spending, $SalesPerf_{ijt-1}$ denotes lagged sales performance, $CompAd_{ijt}$ denotes advertising spending of all other brands in the country during a particular month to account for competitive pressure in advertising spending or a common trend in advertising patterns, and $\sum_{j' \neq j} Ad_{ij't}$ denotes the total advertising spending for brand i in all four countries other than the focal country j in month t, which is the instrumental variable for advertising. We model the error terms of Equations 2 and 3 to be jointly distributed as $[\varepsilon_{ijt} \;\; \xi_{ijt}]' \sim N(0, \Sigma)$. We estimate these equations using seemingly unrelated regression technique as suggested by Papies, Ebbes, and Van Heerde (2017, p. 591). Similar to the breeding analysis, we estimated the branding model three times, each time with another operationalization of the F1 variable (F1 participation, F1 spending, or F1 performance).

Estimation results. Table 5 reports the parameter estimates of the branding model. Columns 4, 6, and 8 contain the estimates of the model excluding the interaction effect between competing in F1 and advertising goodwill. Examining the parameter estimates of the sales performance equation (see the upper part of Table 5), we find for the main-effects-only model that the main effect of competing in F1 (i.e., the effect of competing independent of the level of advertising goodwill) is significant if we operationalize competing as participation and spending, but not in the case of performance. Therefore, H_3 is confirmed, except when we operationalize competing as performance.

In the full model (see columns 5, 7, and 9 of Table 5), the simple effects of being a gear contestant (β_1) and advertising goodwill (β_2) are positive and significant at the .01 level in all three models. The size of the simple effects is calculated taking into account the level of the other independent variable. Because the models include an interaction effect between competing in F1 and advertising goodwill, we cannot separately interpret the simple effects (i.e., the simple effects do not offer an appropriate test of H_3). The interaction effect between competing in F1 and advertising goodwill (β_3) is negative and significant at the .01 level in all three models.

To interpret these findings, we plotted the effect of competing in F1 on sales performance for the 5th percentile (€0)[10] to the 95th percentile (€21.8 million) of monthly advertising spending in our data set (assuming equal values of past advertising goodwill). In Figure 3, Panel A, we show the effect of a brand's participation in F1 on sales performance across different levels of monthly advertising spending. Similarly, in Figure 3, Panels B and C, we plot the effect of a 1% increase in F1 spending and the effect of a 1% increase in F1 points on sales performance, respectively, across different levels of monthly advertising spending. We obtained the mean effects (solid lines) and the 95% confidence intervals (dotted lines). The branding effect is significant when both the dotted lines indicating the 95% confidence interval are above or below the x-axis. These findings indicate that higher advertising spending lowers the effect of the brand competing in F1, thus supporting H_4. This suggests a substituting effect between competing in F1 and advertising spending. Nevertheless, all brands have a positive branding effect from F1 participation and F1 spending and brands that spend less than €10.6 million on monthly advertising also have a positive branding effect from F1 performance.

In addition to the effects of F1 and advertising, we find that β_4 is positive and significant at the .01 level, indicating that an increase in the number of F1 TV viewers strengthens the positive effect of the brand competing in F1 on sales performance.

[10] This indicates that 5% of our observations have zero advertising spending. This is not uncommon given that we measure advertising spending at the monthly level.

Table 5. The Effects of Brands Competing in F1 on Sales Performance and Advertising Spending (Branding Analysis).

Dependent Variable	Independent Variable	Parameter	Estimates for the Model in Which Competing in F1 Is Measured As…					
			F1 Participation		F1 Spending		F1 Performance	
			Main Effects Only	Full Model	Main Effects Only	Full Model	Main Effects Only	Full Model
Sales performance	F1 participation (H_3)	β_1	.076***	.128***	N.A.	N.A.	N.A.	N.A.
	F1 spending (H_3)		N.A.	N.A.	.006***	.012***	N.A.	N.A.
	F1 performance (H_3)		N.A.	N.A.	N.A.	N.A.	−.002	.016***
	Advertising goodwill	β_2	.032***	.033***	.032***	.033***	.033***	.033***
	F1 participation × Advertising goodwill (H_4)	β_3	N.A.	−.004***	N.A.	N.A.	N.A.	N.A.
	F1 spending × Advertising goodwill (H_4)		N.A.	N.A.	N.A.	-4.3×10^{-4}***	N.A.	N.A.
	F1 performance × Advertising goodwill (H_4)		N.A.	N.A.	N.A.	N.A.	N.A.	−.001***
	F1 participation × Number of F1 TV viewers	β_4	.021***	.023***	N.A.	N.A.	N.A.	N.A.
	F1 spending × Number of F1 TV viewers		N.A.	N.A.	.003***	.004***	N.A.	N.A.
	F1 performance × Number of F1 TV viewers		N.A.	N.A.	N.A.	N.A.	.016***	.017***
	New products introduced in last 12 months	β_5	.018***	.018***	.018***	.018***	.018***	.018***
	Competitors' sales performance	β_6	.959***	.960***	.958***	.958***	.966***	.966***
Ad spending	F1 participation	δ_1	.150***	.150***	N.A.	N.A.	N.A.	N.A.
	F1 spending		N.A.	N.A.	.004	.004	N.A.	N.A.
	F1 performance		N.A.	N.A.	N.A.	N.A.	.033*	.033*
	F1 participation × Number of F1 TV viewers	δ_2	−.036	−.036	N.A.	N.A.	N.A.	N.A.
	F1 spending × Number of F1 TV viewers		N.A.	N.A.	.003	.003	N.A.	N.A.
	F1 performance × Number of F1 TV viewers		N.A.	N.A.	N.A.	N.A.	.019	.019
	New product introductions	δ_3	.018	.018	.019	.019	.019	.019
	Lagged advertising spending	δ_4	.447***	.447***	.447***	.447***	.447***	.447***
	Lagged sales performance	δ_5	.030	.030	.031	.031	.033	.033
	Competitor's advertising spending	δ_6	.922***	.922***	.923***	.923***	.921***	.921***
	Advertising spending in other four countries (IV)	δ_7	.112***	.112***	.113***	.113***	.112***	.112***
R^2			.956	.956	.956	.957	.956	.956
Number of observations			24,810					

*$p < .10$.
**$p < .05$.
***$p < .01$.
Notes: N.A. = not applicable; IV = instrumental variable.

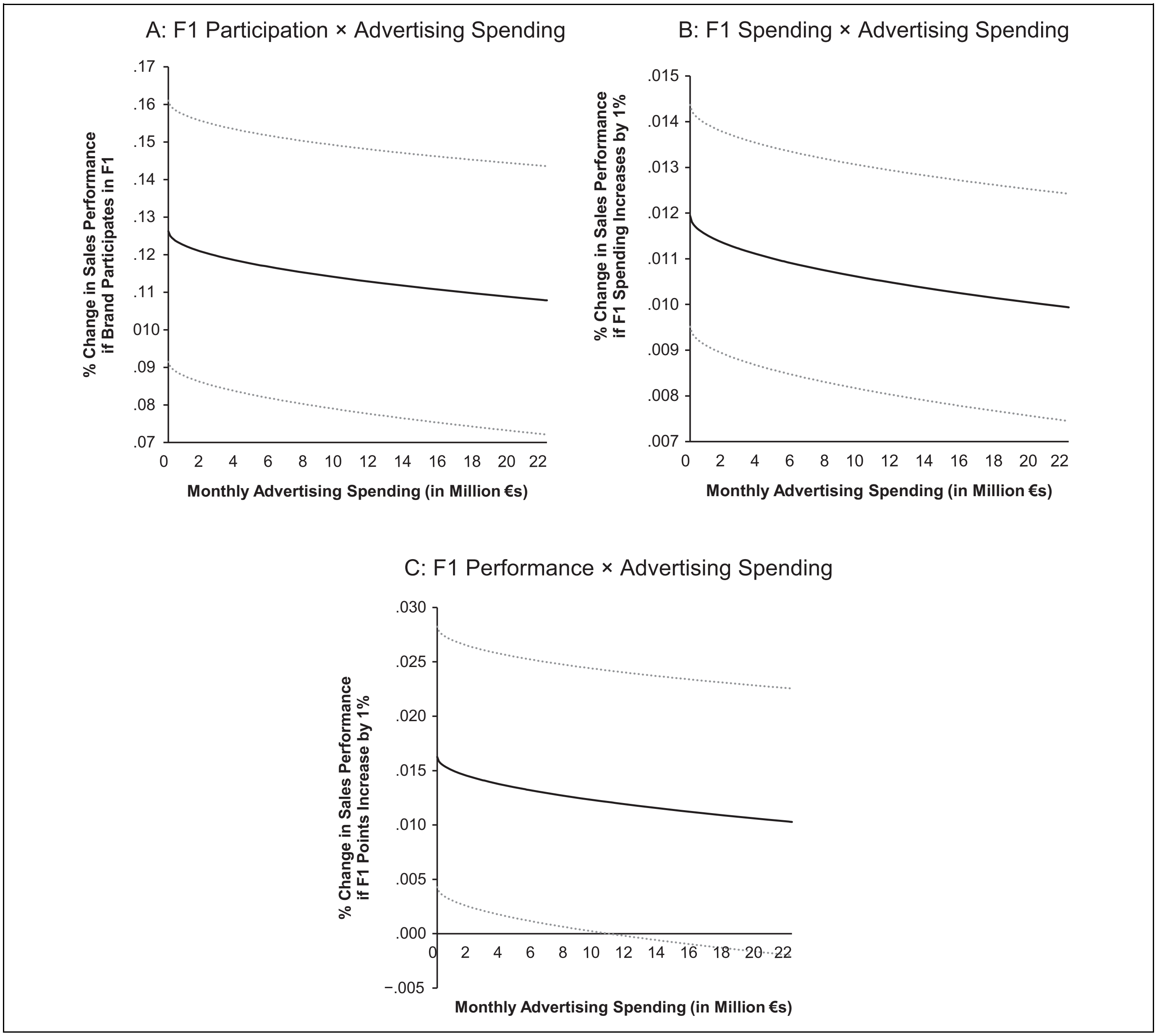

Figure 3. Interactions between competing in F1 and advertising spending on sales performance.
Notes: The dotted lines represent 95% confidence intervals. Sales performance is measured as vehicle registrations.

β_5 is positive and significant at the .01 level in all three models. This indicates that sales performance has a positive relationship with the number of new products introduced during the last 12 months. Competitors' sales performance (β_6) is positively related to the sales performance of the focal brand and is significant at the .01 level for all three models. This could capture the trend in automobile registrations for all brands in the country.

The lower part of Table 5 presents the parameter estimates of the advertising equation (Equation 3). We find that δ_1 is positive and significant at the .01 level for the model in which competing in F1 is measured as F1 participation, positive and significant at the .10 level for the model in which competing in F1 is measured as F1 performance, and insignificant for the model in which competing in F1 is measured as F1 spending. This indicates that brands spend more on advertising when they participate in F1 or perform well in F1.

Furthermore, regarding the control variables in the advertising equation, δ_2, δ_3, and δ_5 are not significant. Lagged advertising spending (δ_4) has a positive and significant ($p < .01$) effect on current advertising spending, for all three models. δ_6 is positive and significant for all three models at the .01 level. This denotes that an increase in advertising spending of other brands in the country leads to an increase in the focal brand's advertising. This may capture either a competitive response or a trend in advertising spending among all brands within a country. Finally, we find that the instrumental variable (δ_7) is positive and significant for all three models ($p < .01$), denoting that advertising spending in other countries has a significant effect on the brand's advertising spending in the focal country.

Robustness Checks

We checked the robustness of our results in four ways. First, we excluded data points from the breeding analysis in which the manufacturer outsourced the gear (engine) used during a racing season (see Table A1 in the Web Appendix). Specifically, although BMW withdrew from racing in 2010, the BMW Sauber F1 team competed using Ferrari engines (Noble and Beer 2009). Similarly, Jaguar used Cosworth engines and Lotus used Cosworth, Renault, and Mercedes engines during the years they competed in F1. Second, we allocated an equal amount of F1 spending to Ford and Jaguar during 2003 and 2004, when both the manufacturer's brands participated in F1, and reestimated the branding model with F1 spending (see Table A2 in the Web Appendix). Third, we excluded the niche brands that competed in F1 during our sample period (Ferrari, Jaguar, and Lotus) from our branding analyses to examine whether we observe the negative moderation effect between a manufacturer being a gear contestant and its advertising spending due to the differences between large and small brands in our sample (see Table A3 in the Web Appendix). Finally, although we treat breeding and branding analyses differently, we checked for the robustness of the inclusion of innovation performance and R&D spending in the branding analysis. Following Artz et al. (2010), we employed a three-year lag for the effect of R&D spending and a two-year lag for the effect of innovation performance (see Table A4 in the Web Appendix). We note that our findings are robust to all the aforementioned changes. The results of these analyses reaffirm our main findings that the manufacturer's R&D spending and competing in F1 are complementary of each other whereas the brand's advertising spending and competing in F1 are substitutes.

Discussion

Managerial Implications

We provide useful insights for managers and analysts, specifically those in the automotive industry, including tier 1 suppliers in that industry, and more generally to those in sports gear industries, for which being involved as a gear contestant in sports competitions is a relevant consideration. First, we show that manufacturers with higher R&D spending stand to gain more from the breeding consequences of investments in sports competitions. For example, we show in Figure 2, Panel A, that car manufacturers that spend at least €3.8 billion annually on R&D (e.g., BMW, Honda) benefit from competing in F1, while manufacturers that spend less than that (e.g., Fiat, Renault) do not. Thus, if manufacturers decide to invest in F1 to enhance their patent base, they have to complement it with a high R&D budget to fully exploit the innovation potential that F1 offers.

Second, we show that a gear manufacturer's brand competing in sports contests and the gear manufacturer's advertising spending for that brand are substitutes in inducing an increase in sales performance of that manufacturer's brand(s). The branding returns are the largest among brands that have the lowest advertising (e.g., Ferrari, Jaguar, Lotus). Competing in a sports contest clearly helps the gear manufacturer build its brand by showing its products and brand(s) in a relevant context. Therefore, manufacturers do not have to complement competing in sports contests with a large advertising budget.

In summary, our findings may guide manufacturers in budget allocation decisions on sports competitions, R&D, and advertising. Our two main findings imply that firms that already spend a lot on advertising and relatively little on R&D have much less to gain from being a gear contestant in sports competitions as compared with firms that spend little on advertising and spend a lot on R&D. Thus, research-intense firms have more to gain from investing heavily in sports competitions as a gear contestant, as compared with advertising-intense firms. This study provides primary evidence from the automotive industry but is generalizable in logic to other industries. Both skiing and cycling, for example, have prime competitions of similar status as F1 in automotive to which our conceptual framework would generalize.

Theoretical Implications

Our study adds to the literature on investments in sports competitions as follows. First, it shows that firms may obtain breeding and/or branding returns from competing in sports contests, whereas previous literature examined branding returns from only sponsoring and, thus, offers a partial view, at best. Second, our study conceptualizes how competing in a sports contest is inherently different from merely sports sponsoring. It also provides an analytical framework for estimating the returns for firms that compete in sports contests and provides the first estimates of such returns ever reported in the scholarly literature. Third, our findings also add to the RBV theory, as we show a new type of resource (i.e., owning a manufacturer team) as well as new type of capability (i.e., competing in sports contests), that together may lead to a competitive advantage (i.e., breeding and branding effects). Fourth, our evidence of significant interaction effects between different manufacturer resources suggests that the returns to a manufacturer's resource should not be studied in isolation but in combination with other resources that could be exploited to achieve the same outcome, which is in line with the RBV. Specifically, we report that a gear manufacturer's R&D spending strengthens the effect of the relation between competing in sports contests and its innovation performance, while a gear manufacturer's advertising spending for a competing brand weakens the effect of the relation between competing and the brand's sales performance. Competing in F1 and advertising heavily at the same time is less effective. We are the first to empirically demonstrate that saturation effects occur even across greatly dissimilar exposure vehicles (in our case, car advertising and competing in F1).

This complements prior literature that has demonstrated such saturation effects only among fairly similar exposure vehicles (e.g., Vakratsas and Ambler 1999). It may also contradict managerial practice to leverage sports investments with greater advertising spending.

Research Agenda for Investigating Outcomes of Investments in Sports Competitions

As with any first exploration of a new phenomenon, several interesting future research directions remain, specifically for studies focusing on competing in as well as sponsoring sports contests. First, one could test the conceptual framework used in this article in another context, such as the Tour the France, or in other markets (e.g., emerging countries) to show the generalizability of the breeding and branding effects of competing by gear manufacturers in sports contests.

Second, a useful extension of the current study would be to examine and compare branding effects (e.g., brand sales performance) between competing in and sponsoring of a sports contest. So far, studies have investigated the branding effects for gear and nongear sponsors separately, while our study focuses on the branding effects of gear contestants only. A comparison of the branding effects and the underlying theories that drive potential differences in consumer responses to sponsoring and competing might provide valuable new insights.

Another interesting research topic related to the branding effects might be the extent to which a specific link in manufacturers' advertisements to the investments in the sports competitions (e.g., "We sell on Monday what we race on Sunday," or in relation to success, "If we can do it there, we can do it everywhere") would positively elevate the branding effects. A related issue would be to investigate the mediating effect of advertising spending on the relationship between competing in sports contests and sales performance, especially when the relationships between the variables are nonlinear in nature.

A fourth avenue for further research is to investigate the extent to which being a gear sponsor, rather than a gear contestant, would also lead to breeding effects in terms of a better innovation performance, and if so, if these breeding effects are comparable to, or stronger than, or weaker than the breeding effects of gear contestants. So far, studies on gear sponsors have only provided evidence for a positive branding effect (e.g., Chung, Derdenger, and Srinivasan 2013), while breeding effects of being a gear sponsor have been totally neglected. However, because gear sponsors do collaborate with athletes to develop new products (e.g., Wilson collaborated with Roger Federer to develop new tennis rackets [Amer Sports 2018]), it is relevant to investigate whether and to what extent these collaborations between the gear sponsor and the sponsored athletes entails breeding effects (e.g., patents or patent citations) for the sponsoring manufacturer. And, relatedly, it would be worth investigating what role the strength of the linkage between the manufacturer's R&D and the sponsored or competing team's R&D plays in developing impactful corporate patents.

To conclude, as many manufacturers have increasingly been involved in sports competitions over the past few centuries, either as a contestant or a sponsor, the return on these investments has become an important management priority. Although academic research has covered several relevant branding issues related to manufacturers being a sponsor, the aforementioned research areas suggest that the outcomes of manufacturers' investments in sports competitions would still be an important research area for years to come.

Acknowledgment

The authors thank Adnan Tula for his help in data collection and data cleaning.

Author Contributions

The authors contributed equally to the article.

Associate Editor

Aric Rindfleisch served as associate editor for this article.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The authors thank Erasmus Committee for Promoting Applied Research (CSTO), Erasmus Research Institute of Management (ERIM), Erasmus Center for Marketing and Innovation, and IESE Business School for their financial support.

References

Aaker, David (1996), *Building Strong Brands*. New York: The Free Press.

Aaker, David, and Alexander L. Biel (1993), *Brand Equity and Advertising: Advertising's Role in Building Strong Brands*, 1st ed. Abingdon, UK: Taylor and Francis.

Abernathy, William J., and Richard S. Rosenbloom (1969), "Parallel Strategies in Development Projects," *Management Science*, 15 (10), B486–B505.

Ahuja, Gautam, and Riitta Katila (2001), "Technological Acquisitions and the Innovation Performance of Acquiring Firms: A Longitudinal Study," *Strategic Management Journal*, 22 (3), 197–220.

Amer Sports (2018), "Wilson and Roger Federer Reveal the New Pro Staff RF 97 Autograph Racket," *Amer Sports* (June 19), https://www.amersports.com/2018/06/wilson-and-roger-federer-reveal-the-new-pro-staff-rf-97-autograph-racket/.

Artz, Kendall W., Patricia M. Norman, Donald E. Hatfield, and Laura B. Cardinal (2010), "A Longitudinal Study of the Impact of R&D, Patents, and Product Innovation on Firm Performance," *Journal of Product Innovation Management*, 27 (5), 725–40.

Bigné, J. Enrique (1995), "Advertising Budget Practices: A Review," *Journal of Current Issues and Research in Advertising*, 17 (2), 17–31.

Börjesson, Sofia, Frederik Dahlsten, and Mats Williander (2006), "Innovative Scanning Experiences from An Idea Generation Project at Volvo Cars," *Technovation*, 26 (7), 775–83.

Boudreau, Kevin J., Nicola Lacetera, and Karim R. Lakhani (2011), "Incentives and Problem Uncertainty in Innovation Contests: An Empirical Analysis," *Management Science*, 57 (5), 843–63.

Boulding, William, and Amna Kirmani (1993), "A Consumer-Side Experimental Examination of Signaling Theory: Do Consumers Perceive Warranties as Signals of Quality?" *Journal of Consumer Research*, 20 (1), 111–23.

Campbell, Margaret, and Kevin Lane Keller (2003), "Brand Familiarity and Advertising Repetition," *Journal of Consumer Research*, 30 (2), 292–304.

Chandy, Rajesh, Brigitte Hopstaken, Om Narasimhan, and Jaideep Prabhu (2006), "From Invention to Innovation: Conversion Ability in Product Development," *Journal of Marketing Research*, 43 (3), 494–508.

Chung, Kevin Y.C., Timothy P. Derdenger, and Kannan Srinivasan (2013), "Economic Value of Celebrity Endorsements: Tiger Woods' Impact on Sales of Nike Golf Balls," *Marketing Science*, 32 (2), 271–93.

Cohen, Wesley M., and Daniel A. Levinthal (1990), "Absorptive Capacity: A New Perspective on Learning and Innovation," *Administrative Science Quarterly*, 35 (1), 128–52.

Conner, Kathleen R. (1991), "A Historical Comparison of Resource-Based Theory and Five Schools of Thought Within Industrial Organization Economics: Do We Have a New Theory of the Firm?" *Journal of Management*, 17 (1), 121–54.

Dahan, Ely, and Haim Mendelson (2001), "An Extreme-Value Model of Concept Testing," *Management Science*, 47 (1), 102–16.

Dekimpe, Marnik G., and Dominique Hanssens (1999), "Sustained Spending and Persistent Response: A New Look at Long-Term Marketing Profitability," *Journal of Marketing Research*, 36 (4), 397–412.

Derdenger, Timothy P. (2018), "Examining the Impact of Celebrity Endorsements Across Consumer Segments: An Empirical Study of Tiger Woods' Endorsement Effect on Golf Equipment," *Marketing Letters*, 29 (2), 123–36.

Erdem, Tülin, Michael P. Keane, and Baohong Sun (2008), "A Dynamic Model of Brand Choice When Price and Advertising Signal Product Quality," *Marketing Science*, 27 (6), 1111–25.

Erdem, Tülin, Joffre Swait, and Ana Valenzuela (2006), "Brands as Signals: A Cross-Country Validation Study," *Journal of Marketing*, 70 (1), 34–49.

Erickson, Gary, and Robert Jacobson (1992), "Gaining Comparative Advantage Through Discretionary Expenditures: The Returns to R&D and Advertising," *Management Science*, 38 (9), 1264–79.

Ernst, Holger (2001), "Patent Applications and Subsequent Changes of Performance: Evidence from Time-Series Cross-Section Analyses on the Firm Level," *Research Policy*, 30 (1), 143–157.

European Communities (2006), "Regulation (EC) No 139/2004: Merger Procedure," Case No COMP/M.4066 - CVC / SLEC, http://ec.europa.eu/competition/mergers/cases/decisions/m4066_20060320_20212_en.pdf.

Fisher, Marc, Sönke Albers, Nils Wagner, and Monika Frie (2011), "Dynamic Marketing Budget Allocation Across Countries, Products, and Marketing Activities," *Marketing Science*, 30 (4), 568–85.

Foster, George, and David Hoyt (2007), "Red Bull and Auto Racing: Sponsor or Own a Formula One Team?" Case SPM-35, Graduate School of Business, Stanford University.

GPUpdate (2003), "Wilson hoopt op groter budget voor Jaguar," (August 29), https://www.gpupdate.net/nl/f1-nieuws/12732/wilson-hoopt-op-groter-budget-voor-jaguar.

Hall, Bronwyn H., Adam Jaffe, and Manuel Trajtenberg (2005), "Market Value and Patent Citations," *RAND Journal of Economics*, 36 (1), 16–38.

IEG (2014), *IEG's Guide to Sponsorship*. Chicago: IEG LLC.

Janiszewski, Chris (1993), "Preattentive Mere Exposure Effects," *Journal of Consumer Research*, 20 (3), 376–92.

Jensen, Jonathan A., and Joe B. Cobbs (2014), "Predicting Return on Investment in Sport Sponsorship," *Journal of Advertising Research*, 54 (4), 435–47.

Keller, Kevin Lane (2003), *Strategic Brand Management: Building, Measuring, and Managing Brand Equity*. Upper Saddle River, NJ: Prentice Hall.

Kirmani, Amna, and Akshay R. Rao (2000), "No Pain, No Gain: A Critical Review of the Literature on Signaling Unobservable Product Quality," *Journal of Marketing*, 64 (2), 66–79.

Mazodier, Marc, Conor M. Henderson, and Joshua T. Beck (2018), "The Long Reach of Sponsorship: How Fan Isolation and Identification Jointly Shape Sponsorship Performance," *Journal of Marketing*, 82 (6), 28–48.

Mazodier, Marc, and Dwight Merunka (2012), "Achieving Brand Loyalty Through Sponsorship: The Role of Fit and Self-Congruity," *Journal of the Academy of Marketing Science*, 40 (6), 807–20.

Meenaghan, John A. (1983), "Commercial Sponsorship," *European Journal of Marketing*, 17 (7), 5–73.

Narayanan, Sridhar, Ramarao Desiraju, and Pradeep K. Chintagunta (2004), "Return on Investment Implications for Pharmaceutical Promotional Expenditures: The Role of Marketing-Mix Interactions," *Journal of Marketing*, 68 (4), 90–105.

Nerlove, Marc, and Kenneth J. Arrow (1962), "Optimal Advertising Policy Under Dynamic Conditions," *Economica*, 29 (11), 129–42.

Noble, Jonathan, and Matt Beer (2009), "Theissen Confirms Ferrari Engine Deal," Autosport (September 24), https://www.autosport.com/f1/news/78822/theissen-confirms-ferrari-engine-deal.

Olson, Erik L., and Hans M. Thjømøe (2009), "Sponsorship Effect Metric: Assess the Financial Value of Sponsoring by Comparisons to Television Advertising," *Journal of the Academy of Marketing Science*, 37 (4), 504–15.

Papies, Dominik, Peter Ebbes, and Harald van Heerde (2017), "Addressing Endogeneity in Marketing Models," in *Advanced Methods for Modeling Markets*, Peter Leeflang, Jaap Wieringa, Tammo H.A. Bijmolt, and Koen H. Pauwels, eds. Berlin: Springer, 581–627.

Rao, Akshay R., Lu Qu, and Robert W. Ruekert (1999), "Signalling Unobservable Product Quality Through a Brand Ally," *Journal of Marketing Research*, 36 (2), 258–68.

Rosenberg, Nathan (1990), "Why Do Firms Do Basic Research (with Their Own Money)?" *Research Policy*, 19 (2), 165–74.

Rust, Roland T., Katherine N. Lemon, and Valerie A. Zeithaml (2004), "Return on Marketing: Using Customer Equity to Focus Marketing Strategy," *Journal of Marketing*, 68 (1), 109–27.

Sandler, Dennis M., and David Shani (1992), "Brand Globally but Advertise Locally? An Empirical Investigation," *International Marketing Review*, 9 (4), 18–31.

Scherer, Frederic M. (1986), *Innovation and Growth: Schumpeterian Perspectives*. Cambridge, MA: MIT Press.

Schmidbauer, Eric, and Axel Stock (2018), "Quality Signaling via Strikethrough Prices," *International Journal of Research in Marketing*, 35 (3), 524–32.

Schmidt, Susanne, and Martin Eisend (2015), "Advertising Repetition: A Meta-Analysis on Effective Frequency in Advertising," *Journal of Advertising*, 44 (4), 415–28.

Sempelmann, Peter, Andreas Lampl, and Angelika Kramer (2018), "Marcel Hirschner und Atomic: Das Geheimnis der Sieger-Ski," *Trend* (June), https://www.trend.at/wirtschaft/marcel-hirscher-atomic-geheimnis-sieger-ski-9000735.

Somaya, Deepak, Ian O. Williamson, and Xiamomeng Zhang (2007), "Combining Patent Law Expertise with R&D for Patenting Performance," *Organization Science*, 18 (6), 922–37.

Speed, Richard, and Peter Thompson (2000), "Determinants of Sport Sponsorship," *Journal of Academy of Marketing Science*, 28 (2), 226–38.

Stock, James, and Mark Watson (2015), *Introduction to Econometrics*. Upper Saddle River, NJ: Pearson.

Stokes, Shane (2015), "Behind the Scenes of the Pro Cycling Business Model," *Cycling Tips* (August 14), https://cyclingtips.com/2015/08/behind-the-scenes-of-the-pro-cycling-business-model.

Sylt, Christian (2018a), "F1 TV Audience Reverses By 40 Million Under New Measurement System," *Forbes* (January 6), https://www.forbes.com/sites/csylt/2018/01/06/f1-tv-audience-reverses-by-40-million-under-revised-measurement-system/#7b3c485c3a52.

Sylt, Christian (2018b), "Mercedes' F1 Engine Investment Accelerates To $250 Million," *Forbes* (September 23), https://www.forbes.com/sites/csylt/2018/09/23/mercedes-f1-engine-investment-accelerates-to-250-million/#5f712e595fe7.

Terui, Nobuhiko, Masataka Ban, and Greg Allenby (2011), "The Effect of Media Advertising on Brand Consideration and Choice," *Marketing Science*, 30 (1), 74–91.

Vakratsas, Demetrios, and Tim Ambler (1999), "How Advertising Works: What Do We Really Know?" *Journal of Marketing*, 63 (1), 26–43.

Van der Lans, Ralf, Yvonne van Everdingen, and Valentyna Melnyk (2016), "What to Stress, to Whom and Where? A Cross-Country Investigation of the Effects of Perceived Brand Benefits on Buying Intentions," *International Journal of Research in Marketing*, 33 (4), 924–43.

Vorhies, Douglas W., and Neil A. Morgan (2005), "Benchmarking Marketing Capabilities for Sustainable Competitive Advantage," *Journal of Marketing*, 69 (1), 80–94.

Walraven, Merel, Tammo Bijmolt, and Ruud Koning (2014), "Dynamic Effects of Sponsoring: How Sponsoring Awareness Develops over Time," *Journal of Advertising*, 43 (2), 142–54.

Wernerfelt, Birger (1984), "A Resource-Based View of the Firm," *Strategic Management Journal*, 5 (2), 171–80.

Wuyts, Stefan, Shantanu Dutta, and Stefan Stremersch (2004), "Portfolios of Interfirm Agreements in Technology-Intensive Markets: Consequences for Innovation and Profitability," *Journal of Marketing*, 68 (2), 88–100.

Zajonc, Robert B. (1968), "Attitudinal Effects of Mere Exposure," *Journal of Personality and Social Psychology*, 9 (2), 1–27.