Robin Solheim

The Value Contribution of Car Manufacturers That Go Racing

Master's thesis in Economics and Business Administration
Supervisor: Khine Kyaw
June 2020

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PREFACE AND ACKNOWLEDGEMENTS

This master thesis is the final work of my master's degree in Master of Science in Economics and Business Administration, with the Major Financial Analysis and Investment Financial Analysis at the Norwegian University of Science and Technology, NTNU Business School.

The purpose of the master thesis has been to do an event study to investigate the movements in the share price of car manufacturers around big race weekends.

To work with the thesis has been really educational and exciting, but also demanding and challenging at times. It has been really enjoyable and inspiring to study something that I am really passionate about.

Supervisor: Khine Kyaw

I am grateful for excellent research assistance by Khine Kyaw throughout the entire semester.

I take full responsibility for the content in this master thesis.

Robin Solheim

Trondheim, Thursday, June 25, 2020.

ABSTRACT

Motorsport is one of the best marketing options for car manufacturers. The cars fight side by side on track and the teams fight in the pit lane. Motorsport is a unique sport in one way, because the spectators can go to a store and buy almost the exact same car they see their heroes drive during a race weekend. For example, the iconic blue and yellow Subaru Impreza WRC car or the legendary Ford GT40, just too mention two really popular cars that motorsport made famous. Car manufacturers use tens of millions of dollars annually to support their racing division, even if it is just to beat another person or to build a brand. Still at question in racing programs for the car manufacturers is the economic value of the firm. Also largely unexamined in motorsport by car manufacturers is the impact of participation outcomes. For example, is it more valuable for car manufacturers that are winning races, or is it simply participation and, thus, exposure of the brand that brings value to the car manufacturers?

This study presents an event study analysis of the car manufacturers share price impact during some of the most prestigious races in the world of motorsport. The races in this study are the triple crown in motorsport, which are the Indianapolis 500 (IndyCar), the 24 Hours of Le Mans (Endurance Racing) and the Monaco Grand Prix (Formula One), plus Daytona 500 (NASCAR). This approach allows the use of historical data in the analysis of the value contribution to car manufacturers from a special race weekend.

The findings of this study show that car manufacturers that go racing viewed as a group have a hard time to gain any market value from these races. The background for this study is past papers that analysis the effects of the sponsoring firms of race cars and the old adage founded by Detroit's car manufacturers, "Win on Sunday, Sell on Monday".

SAMMENDRAG

Motorsport er en av de beste mulighetene for markedsføring for bilprodusenter. Bilene kjemper side om side på banen og teamene kjemper i depotet. Motorsport er en unik sport på en måte, fordi tilskuerne kan gå til butikken og kjøpe nesten den eksakt samme bilen som de ser deres helter bruke under en løpshelg. For eksempel, den ikoniske blå og gule Subaru Impreza WRC bilen eller legenden Ford GT40, bare for å nevne to veldig populære biler som ble kjente gjennom motorsport. Bilprodusenter bruker titalls millioner dollar årlig for å støtte deres racingavdeling, selv om det bare er for å slå en annen person eller for å bygge en merkevare. Fortsatt et spørsmål angående racingprogrammene for bilprodusenter er firmaets økonomiske verdi. Også effekten av deltakelsesresultatene er stort sett ikke undersøkt i motorsport ved bilfabrikantene. For eksempel, er det mer verdifullt for merkene som vinner løpene, eller er det rett og slett bare deltakelsen, og derfor bare synliggjøringen av merket som skaper verdi for bilprodusentene?

Denne studien presenterer en hendelsesundersøkelse av effekten av prispåvirkningen til bilprodusentenes aksjepris under noen av de mest prestisjefylte løpene i motorsportens verden. Løpene i denne studien er de tre kronjuvelene i motorsport, som er Indianapolis 500 (IndyCar), 24-timersløpet på Le Mans (utholdenhets racing) og Monaco Grand Prix (Formel En), pluss Daytona 500 (NASCAR). Denne tilnærmingen tillater bruken av historiske data i analysen av verdibidraget til bilprodusentene fra en spesiell løpshelg.

Funnene fra denne studien viser at de bilprodusentene som deltar i motorsport sett som en gruppe har det svært vanskelig for å oppnå en økende markedsverdi fra disse løpene. Bakgrunnen for denne studien er tidligere artikler som analyserer effekten av firmaer som sponser løpsbiler og det gamle ordtrykket grunnlagt av Detroits bilprodusenter «Vinn på søndag, Selg på mandag», (oversatt av undertegnede).

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1. INTRODUCTION

Henry Ford said with his famous quote that "Auto racing began 5 minutes after the second car was built" (Jones, 2010). Today motorsport is a world-wide billion-dollar industry (Perez, 2018; and George, 2019). (Henry, 2007, p. 1) define motorsport as being, "competitive racing by equivalent machines on a frequent basis, on designated tracks and circuits". In the motorsport world today, there is everything from small local races to some of the top sporting events in the world. Most of the car manufacturers around the world have some sort of motorsport history. Some car manufacturers have more history than others over the decades. The rules and specifications for racing cars usually change quite often, so car manufacturers typically have their periods of good and bad years. This also explains why some car manufacturers participate one year and the next year they have vanished from the sport. This study will look at four of the most known car races in the world. They have tens of millions watching the event every year. Car manufacturers these days are some of the biggest companies in the world. They are also public companies and are traded on different stock exchanges around the world. This leads to the study of this article.

The article will look into the share price movement of the car manufacturers around these events. It is a sample study where I will use the event study methodology to obtain average abnormal returns for car manufacturers during these four races from the years 2000-2019. The object is to analyze how much average abnormal return the racing division inside a car manufacturer can gain for the company in market value. The races can lead to increased car sales, more interest around the merchandise from the brand, and more publicity. The research questions studied in this paper tries to investigate if the car manufacturer have to go all in and aim for the victory, or if participation is enough. It will also dive into the effect of participation versus non-participation for car manufacturers in these four races. The motivation for this study is past papers that study the effect of the sponsoring companies of racing cars and the old adage founded by Detroit's car manufacturers, "Win on Sunday, Sell on Monday". (Cornwell, Pruitt, and Van Ness, 2001) found in their study a firm that gained statistically significant mean abnormal return over the event window where the sponsored car won at Indy 500. This paper will investigate the main object itself, the car manufacturer of the racing cars. Hopefully, this paper can contribute to see if car manufacturers go racing just for fun or if there is an economic incentive as well.

The results from previous studies suggest that there could be a positive result for car manufacturers that go racing. Meanwhile, in this study, the findings show that car

manufacturers have a hard time to earn market value around these races. It reveals the fact that the result does not change if you aim for the win or just going there to participate in the race.

2. PREVIOUS RESULTS AND RESEARCH QUESTIONS

2.1 Related Studies of Shareholder Wealth Creation

(Agrawal and Kamakura, 1995) looked at firms that announced different celebrity endorsement contracts. There were 110 contracts in the study. They found a significantly positive average excess return on the day of the event with 0.44 percent. These results indicate a positive impact of celebrity endorsements on expected future profits. The link to this article is that the drivers who get signed by these car manufacturers either are superstars or will be in the future. This may lead to a positive impact on the research questions analyzed in this article. This factor will not be a surprise for the firm in this article, while the drivers are already signed and are part of a team that participates. Meanwhile, the events give these drivers all the attention and the publicity the firm signed them to get.

(Edmans, Garcia, and Norli, 2007) did a study of investors' mood in the stock market after international soccer results. They could document an economically significant strong negative stock market reaction to losses by national soccer teams, but no evidence of a corresponding reaction to wins. They think the reason is how the tournament is set up with the knockout series. In a knockout series, the winning team advances and everyone move the focus to the next game, while the loser is knocked out from the tournament. The findings show that sports results can influence the mood of investors and therefore the stock market around sports events. This is an important finding for this study because it shows that sports have an impact on investors. The weekends of these races are happenings that people wait many months to arrive. It is hard to predict how the races will impact the investors since the events are singular. Maybe it will increase the good feeling because it is finally happening, or it will depend upon the outcome of the race. There could be both negative and positive impacts of this study.

2.2 Sponsorship Linking

The sponsors of an event can be categorized into three categories. There is some discussion about the sponsorship linking and the sponsorship effectiveness in recent articles. The category that is important in this study is *"strongly linked"*-products. This is where the performance of the product is shown in the event. This means all the car manufacturers that participate in

motorsport. The races are a place where the car manufacturers can show their products and how good they are for the public and car buyers. "This sport involves high-tech, durable and fast cars, that is why Mercedes participate, because going fast and long is made possible with a Mercedes-Benz.", this is just an example of a phrase where you can see that the product is strongly linked.

The two other categories are "*linked, but not strongly*" and "*nonlinked*". The difference in these categories is how well the product is related to the event where they participate as a sponsor.

2.3 Studies Examining Sponsorship Success

(Cornwell et al., 2001) looked at the share price impact of the firms sponsoring the drivers in Indy 500. Their findings show that there is a little chance for increasing overall corporate valuation where the products are not closely linked to the car industry. On the other hand, sponsors with logical or matched ties to the consumer car industry were more likely to register statistically and economically significant gains in their share prices around the time of their sponsorship victories. One firm they found gained significant market value from sponsoring the winning car of Indy 500 was STP. STP is a motor oil company where the most important product is an oil additive specifically designed to improve the lubricating properties of motor oil (STP, 2020). Their sponsored car won Indy 500 four times and the firm had a total race-related increase in market valuation of around $134 million. The findings in this study support the theory that the events should have a positive impact for the car manufacturers as a *"strongly linked"*-product. It is hard to say if they have to win or just have to participate to earn significant market value.

(Sullivan and Dussold, 2003) looked at the firm's effect of sponsoring race cars in the 2001 National Association for Stock Car Auto Racing (NASCAR) Winston Cup Series. They asked if the race cars were called stock cars, because firms could gain market value by having their logo on the car. They found that the 39 firms as a group realized positive abnormal returns on the trading days following each race where their team appeared. They also looked at what impact the winner's prize money had and the number of accidents the car was involved in. Prize money was a positive variable, while the number of accidents had a negative impact on the abnormal returns. This gives an understanding of the research questions investigated in this article. Since the 39 firms as a group gained positive abnormal returns, it may mean that it is enough for the car manufacturers to participate in the races to benefit from the event.

(Levin, Beasley, and Gamble, 2004) studied the brand loyalty of NASCAR fans towards sponsors. They looked into the beer industry and the findings show that NASCAR fans exhibited stronger brand loyalty than non-NASCAR fans to the sponsoring beer brands. It was particularly on the attitudinal component of brand loyalty, which means that the consumer who is a fan is not more likely to keep purchasing their favorite NASCAR-sponsor beer than a non-NASCAR fan. Instead, they show a stronger commitment to the brand and a greater willingness to pay more to get the brand. This is an important result for the study in this article because many of the brands in motorsport are listed as a luxury car, such as Ferrari, Mercedes-Benz, Porsche, and Audi, thus they are among the most expensive cars a consumer can buy (Car Logos, n.d.). So, since fans are willing to pay the price, the car manufacturers could see an increase in car sales and thus expects higher profits which makes the stock rise.

2.4 Their Own Sponsor

The previous studies about this topic have looked at the sponsors of the competing cars. No one has thought about the car manufacturers as their own sponsor when they drive around the circuit in 300+ km/h for fans worldwide. Car manufacturers use their racing programs to develop and to test new technologies. They hire the best engineers, mechanics, team leaders, and staff to give their maximal effort at the factory and on track. The results on the track bring more eyes to the brand, thus more dedicated people will work for them. This brings a circle of good research and development program that they can build the brand on for its future. Initially, they use it on the race cars and after a while, they will bring it to their road cars. This makes the racing program an arena to develop better road cars and to be in front of their competitors for the future.

2.5 Research Questions

In light of the previous findings of race-related gain in market valuation to firms and shareholders, this study offers the following research questions:

1. Is it enough just to participate in these big races to gain significant market value or do you have to go all in and aim for the win?
2. What about the years where the car manufacturers do not participate, does the outcome change concerning participation versus non-participation?

With the respective null hypothesis (H_0) that there are no average abnormal returns or cumulative average abnormal returns within the event window, whereas the alternative hypothesis (H_1) suggests the presence of average abnormal returns or cumulative average abnormal returns within the event window (Müller, 2020). This can be written as:

EQUATION 1: Hypothesis H$_0$ & H$_1$.

$$H_0 : AAR \text{ or } CAAR = 0$$
$$H_1 : AAR \text{ or } CAAR \neq 0.$$

2.6 The Efficient Market Hypothesis

The efficient market hypothesis states that share prices reflect all available information, thus stocks always trade at their fair value on exchanges. For this article that means the car manufacturers who participates or not are available in advance before the events. The uncertain variable are the results of the races. Car manufacturers that brings home a win to the brand are more surprising, than just participating. Given this a win should bring more movements in the share price of the winning car manufacturers than the others.

3. HISTORY

3.1 Ford v Ferrari

There are numerous reasons why car manufacturers go into racing. To this date the two best-known reasons in the motorsport history, is the history of Ford Motor Corporation and Ferrari, the article on Forbes is being used as main reference in the rewriting of the history (Tannert, 2019).

Enzo Ferrari was a guy who loved racing and winning was in his blood. Enzo Ferrari built specific cars so he could go racing and win trophies. After a while, he struggled financially because the racing was so expensive. He got the idea that he could start making road cars so he could sell them to support his racing program. While Henry Ford founded Ford Motor Corporation in the early 1900s on behalf of his driving skills, winning races attracted investors. But in the post-World War II era, that racing spirit was gone (Payne, 2019). Ford Motor Corporation was best known as the company that built the first-ever common man car, the Model T (Ford, 2020). The main point for him was to sell road cars. In the 60s Ford struggled to sell cars and to get any market share. The company tried to rethink their strategy and looked

at Ferrari. The idea was that they needed some of that winning spirit back and brand image that Ferrari had built through its legacy of winning big international races. So, Henry Ford II tried to make a deal with Enzo Ferrari that went south. Henry Ford II got so angry that he said that he was going to beat Enzo Ferrari in his own backyard, at the 24 Hours of Le Mans.

Ford Motor Corporation went into racing after the sales went down from road cars and he needed a boost to get the sales going again. Henry Ford II spent hundreds of millions of dollars into his racing program that had the mission to beat Ferrari at Le Mans (Garcia, 2019). This rivalry goes down in motorsport history as the hardest competition between two car manufacturers. The story also tells two different histories from two of the biggest car manufacturers in the world.

3.2 Win on Sunday, Sell on Monday

"Win on Sunday, Sell on Monday" is the old adage founded by Detroit's car manufacturers (Cornwell et al., 2001). The background for the quote is that they saw improved sales of road-going cars after they succeeded on the race tracks (Nye, 1994). (Grant-Braham, 2008) refers to the citation of Maurice Hamilton, *When the Minis won the Monte Carlo Rally, that blew their sales sky high, particularly in Europe.* There are many quotes and citations of car manufacturers that use motorsport to sell their road-going cars throughout history.

"We were in racing not for the glory and heroics but strictly for business" said W.O. Bentley… "No-one ever attempted to dispute that competition success was the cheapest way of selling cars" (Cruickshank, 2007).

Referring back to previous results where I mentioned that drivers are superstars and objects for the car manufacturers. This is confirmed by Bugatti that acknowledged celebrity endorsement by employing Grand Prix drivers as sales people in showrooms (Saward, 2006, p. 45), and Bugatti also found success on track to be good for sales (Saward, 2006, p. 38).

The last two I will mention are from the Formula one sport. (Grant-Braham, 2008) refers to, (F1 Racing, 2006a). Toyota said "we go racing to sell cars", and the ambition for Toyota in F1 was to, "moving metal at rates greater than General Motors, and so to capture the *numero uno* slot". Toyota wanted to be the biggest car manufacturer in the world, and so they did back in 2009 (LeBeau, 2010).[1] Renault another car manufacturer who is heavily involved in Formula

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[1] Tesla surpasses Toyota and becomes the most valuable car manufacturer in the world at $190bn on June 10, 2020. Source: "The Telegraph", an award-winning multimedia news brand.

One, reconstructed the quotation. Renault said that, "Formula one doesn't sell cars the next morning – it's for the next ten to fifteen years" (Rowlinson, 2005).

All these phrases from the past show that many car manufacturers see a spike in their road-going cars sale when they succeed on the racing circuit. This gives a link between winning races and expected future earnings.

One contradiction to this could be that the top teams are also the ones who spends the most amount of money. The total budget for the top three teams in Formula One during the 2018 season ($1120m), exceeded the budget of the rest of the seven teams in the series ($1095m) (Rencken, 2018a&b). It is hard to interpret what role this will have on my study. Is it worth spending so much money to be the most successful team in the racing series, or can the wins make up for it? It can have both a negative and positive impact for this study.

4. DATA

4.1 The Indianapolis 500

The Indianapolis 500-mile race (Indy 500) is the largest one-day sporting event in the world, with an annual attendance of about 400,000 people and a worldwide media audience (The Washington Post, 1999). The first Indy 500 was held in 1911, which makes it to the world's oldest currently operational car race. It takes part at the Indianapolis Motor Speedway (IMS) "The Racing Capital of the World" in the United States of America (Davidson, 2020). It is called "The Greatest Spectacle in Racing" and has one of the biggest cash purses of any sport with $15,090,536 in 2020 (Silvestro, 2020).[2]

For the Indy 500 the car manufacturers only supply the engine for the formula cars, but the event is a great arena to show off their cars inside the speedway. The two car manufacturers who have participated with engine units in the Indy 500 are General Motors (GM) and Honda. The final practice session called "Carb Day" for Indy 500 is set on Thursday before the race weekend.[3] History suggests that the fastest teams on "Carb Day" enters Victory Lane far more often than the slower teams, so this is a good indicator for the upcoming race (Cornwell et al., 2001, p. 24). The race weekend has always been scheduled in conjunction with Memorial Day in the U.S., so the NYSE is closed the following Monday after the race.

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[2] The last two winners of the race, Simon Pagenaud (2019) and Will Power (2018) received winner's checks of $2,669,529 and $2,525,454, respectively. Source: "IMS", the official homepage for the Indy 500.

[3] Carb Day was moved to Friday prior to the Indy 500 race in 2005.

4.2 The 24 Hours of Le Mans

The 24 Hours of Le Mans is the sporting event that topped everything else and became the number one sporting event in the world in 2010 (National Geographic, 2010). The first Le Mans trace back to 1923, which makes it the world's oldest active sports car race in endurance racing. The race includes prototype high-performance cars (LMP), dedicated race cars, and streetcars (GT). The race has no set distance so the winner is the car, driven by a team of three drivers, that covers the greatest distance in 24 hours (BMW, 2019). Thus, it is being called "The Grand Prix of Endurance and Efficiency". It takes part at a semi-permanent racecourse, The Circuit des 24 Heures du Mans, also known as Circuit de la Sarthe. The city of Le Mans is located in France in Europe. This is the race with probably the best-known motorsport history in the world between Ford and Ferrari. It is also the race with the most participations of car manufacturers. The first free practice and first qualifying session are being held on the Wednesday prior to the race weekend.

4.3 The Monaco Grand Prix

The Monaco Grand Prix is a Formula one (F1) race held on the Circuit de Monaco, located in the streets of Monaco on the French Riviera in Western Europe. The race is known for its glamour and prestige. This is the race where superstars gather and the race every driver wants to win. People who live in Monaco can watch the race from their balcony and people with big yachts can park in the harbor to watch the formula cars drive past them. The iconic Grand Prix race was first held in 1929. It is one of the most intense and demanding races on the F1 calendar due to its narrow streets and guard rails covering the outside of the track. The first free practice of the week is on Thursday prior to the race weekend.

4.4 The Daytona 500

The Daytona 500-mile race is the big season opener in the NASCAR Cup Series. The inaugural race was held in 1959 at Daytona International Speedway in Daytona Beach, Florida. It is considered the most prestigious and important race in NASCAR and is being called "The Great American Race" (NASCAR, 2020a). The cash purse is even bigger than in Indy 500 with $23.6 million in 2020, the largest purse in the history of American motorsport (NASCAR, 2020b).[4]

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[4] The 2015 winner, Joey Logano, earned about $1.6 million. Source: "Sportingnews" a web-based sport news page.

The 2006 Daytona 500 had the sixth largest average live global TV audience of any sporting event that year with 20 million viewers (Initiative, 2006). This is the season opener so the practice starts about a week before the race and thus there have been plenty of driving on the track before the race itself.

4.5 Race Results

Race results from the years 2000-2019 with the respective race dates are obtained from each of the events' homepage or the official archive file from the series organization. The official homepage for the Indy 500 (www.indianapolismotorspeedway.com) and the 24 Hours of Le Mans (www.lemans.org/en/24-hours-of-le-mans) has an archive file with the past results. The Formula 1 organization (www.formula1.com) has archive files of all the races back to 1950, including the Monaco GP. The Daytona 500 race results are collected from the comprehensive racing statistics website (www.racing-reference.info). There is a total of 80 races being analyzed in this study, where there have been four races each for the last 20 years.

4.6 Car Manufacturers

The car manufacturers industry is a bit twisty regarding ownerships. (May, 2016) article was being referred to regarding who owns whom in the car industry which was posted on the webpage completecar. This study includes car manufacturers from the USA, Europe, and Japan. The criteria for being in this study are that the car manufacturers have participated in more than five of these events being studied in this article either with the engine or the car. The historic daily returns for the stocks listed on the New York Stock Exchange (NYSE) are downloaded from the University of Chicago's Center for Research in Security Prices (CRSP) daily stock data, via the Wharton Research Data Services (WRDS). The European and Japanese daily ending stock prices are downloaded from Yahoo, and the returns are obtained by using the following formula:

EQUATION 2: Daily stock returns.

$$r_t = \ln\left(\frac{P_t}{P_{t-1}}\right),$$

where:

P_t is price at the end of day t; and

P_{t-1} is price at the end of day $t-1$.

Table 1 shows the car manufacturers analyzed with the number of races participated for each race studied in this article.

Table 1

Number of races participated for each car manufacturer from the years 2000-2019*

Race Brand	Indy 500	24 Hours of Le Mans		Monaco GP	Daytona 500
		LMP	GT		
BMW		2	6	10	
Chrysler			8		7
Ferrari			10	12	
Ford		4	13		20
GM	14	3	18		19
Honda	17	7		13	
Mercedes				20	
Nissan		9			
Peugeot		12			
Porsche		5	11		
Renault				19	
Toyota		9	1	8	13
VW		18	20		

*Where the stock history is available & participated more than five years with either car or engine.

TABLE 1: Number of races participated from the years 2000-2019.

5. EMPIRICAL METHODOLOGY

The event study methodology is first being used in a paper by (Fama, Fisher, Jensen, and Roll, 1969) in a paper for stocks split. It is used in this study to analyze the stock price movement around a special event. The methodology has enjoyed extremely wide acceptance in the fields of finance, accounting, economics, and insurance. The methodology involves the estimation of a time series of the car manufacturers stock market returns to measure the effects of the races upon the stock prices of the car manufacturers. The abnormal returns are the difference between the excess return (actual return – risk-free rate) and the expected return. The expected returns for the different car manufacturers are calculated by using the five-factor model from (Fama and French, 2014). In this study, the factors for the U.S., the European, and the Japanese stock market have been used appropriately regarding what stock exchange the car manufacturers are listed on. The expected return was calculated by making an estimation window containing 150 days beginning from 170 days prior and ending 21 days before the date of each race. Which

leaves the event window to be from (-20…0…20), where 0 is the first trading day after the event. Then the excess returns are used as the dependent variable in a regression, with the five factors being the independent variables. The output from the regression was used in the following equation to calculate the expected return for each car manufacturer for every single event:

EQUATION 3: Expected daily returns.

$$ER = Intercept + X1 * F1 + X2 * F2 + X3 * F3 + X4 * F4 + X5 * F5,$$

where:

Intercept is the coefficient of the intersection between the excess returns and the five factors;

X_i are the coefficients obtained from the regression output for each factor;

F_i are the five factor parameters downloaded from the website of Kenneth R. French (French, 2020).

The abnormal return is calculated by subtracting the expected return from the excess return. This can be written as:

EQUATION 4: Abnormal returns.

$$AR_{it} = Excess\ R_{it} - Expected\ R_{it},$$

where:

R_{it} is the return for each day and car manufacturer analyzed in this article.

The abnormal returns were collected together from every year for each car manufacturer to obtain the average abnormal return, with the following formula:

EQUATION 5: Average abnormal returns.

$$AAR_t = \frac{1}{N} \sum_{i=1}^{N} AR_{it}.$$

The cumulative average abnormal return (CAAR) for event days t_1 to t_2 was calculated by summing the average abnormal returns between each of these dates of interest with the following formula:

$$CAAR = \sum_{t_1}^{t_2} AAR_t.$$

Before the AAR and CAAR are ready to be tested for significance level in a standard normal z-table they have to be standardized. This is being done so there is an opportunity to look up the p-value for standardized AARs on single days and standardized CAARs for event windows. Abnormal return test statistics are taken from (Hillier and Marshall, 2002) who refers to (Boehmer, Musumeci, and Poulsen, 1991) and are estimated as follows: the abnormal returns are first standardized to give the standardized abnormal returns (SAR):

EQUATION 7: Standardized abnormal returns.

$$SAR_{it} = AR_{it} \Big/ \hat{\sigma}_i \sqrt{1 + \frac{1}{T_i} + \frac{(R_{mt} - \bar{R}_m)^2}{\sum_{E=-170}^{-21}(R_{mt} - \bar{R}_m)^2}},$$

where:

$\hat{\sigma}_i$ are security i's standard deviation of abnormal returns during the estimation period;

T_i are the number of trading days in the estimation period of security i; and

$\bar{R}_m$ is the average market return during the estimation period.

From the downloaded files (French, 2020), I obtained the market return from the three different places where the car manufacturers are listed. For each day in the event period, the cross-sectional standard deviation of the standardized abnormal returns is then calculated as follows:

EQUATION 8: Cross-sectional standard deviation of the standardized abnormal returns.

$$\sigma_{SAR_t} = \sqrt{\frac{\sum_{i=1}^{N}(SAR_{it} - \sum_{i=1}^{N} SAR_{it} / N)^2}{N(N-1)}}.$$

The standardized cross-sectional test statistic is thus:

EQUATION 9: Standardized cross-sectional test statistic.

$$Z = \frac{\sum_{i=1}^{N} SAR_{it} / N}{\sigma_{SAR_t}}.$$

With reference to (Hillier and Marshall, 2002) the individually standardized abnormal returns are assumed to be cross-sectionally independent and distributed normally. By the central limit theorem, the distribution of the sample average standardized abnormal returns are normal. (Boehmer et al., 1991) report that the test is correctly specified even when there is a variance increase in the event period. This may be a case in this study. The first reason is regarding how high the car manufacturers are related to motorsport, and the second reason may be that the event itself attracts more investors to look at the stocks. This can cause an increase in the volume of trades, thus causing an increase in return volatility around these dates.

Figure 1 following is a graph to show how the CAARs for a car manufacturer around the dates of a race can look like. It is used as an illustration for how the cumulative average abnormal returns can look like if the event has a positive impact on the firm and therefore give a spike in the share price.

Figure 1

Illustration of the cumulative average abnormal returns in event studies. This shows a significant movement around the event window with an upward going slope. The illustration is taken from the analysis of Ferrari at the Monaco GP.
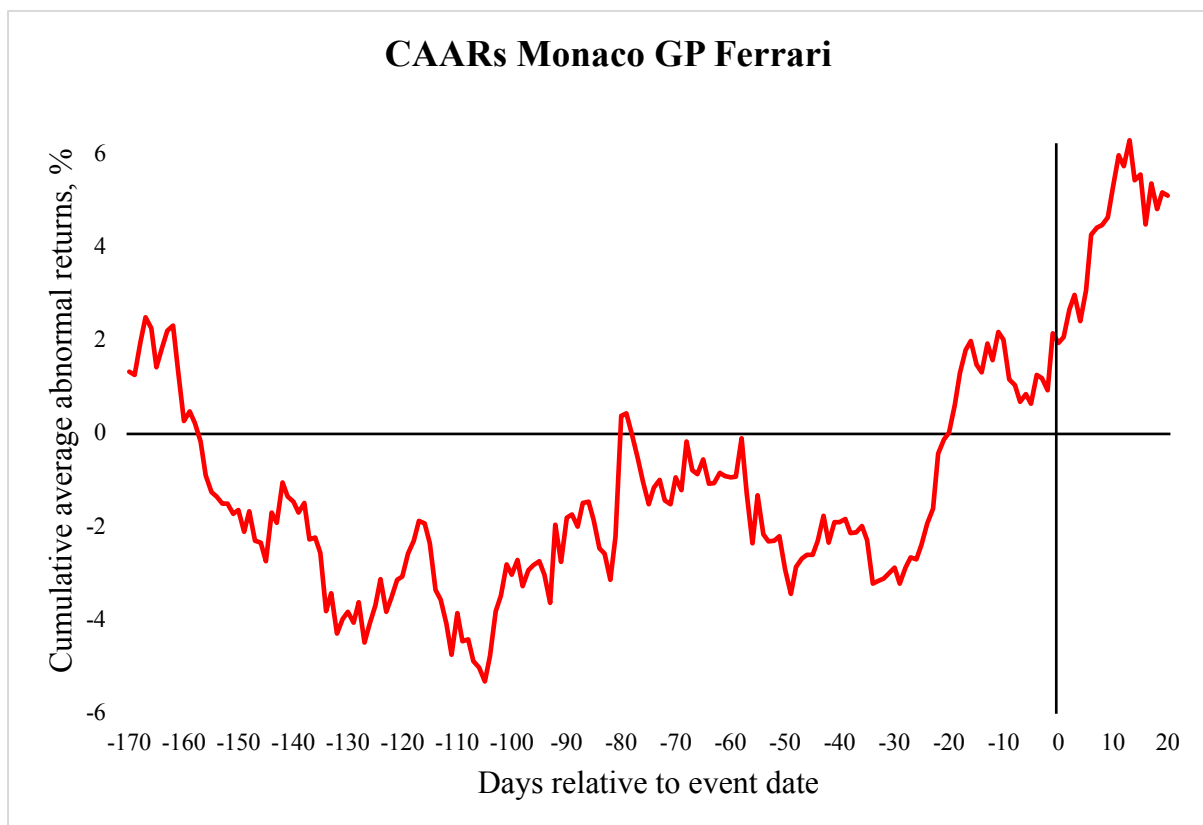

FIGURE 1: Illustration of the cumulative average abnormal returns in event studies.

6. EMPIRICAL RESULTS

The study is divided into three parts, to see if there is any difference between the winning teams, participation, and non-participation for the car manufacturers. The last two will be used if there are more than five observations of more than two car manufacturers. The events will be looked at individually to see if the investors have a different view of the races and thus what race makes the most impact on the share prices. The following three tables show the average abnormal returns for the single days around the event day and the cumulative average abnormal returns through the event windows for the car manufacturers in percentage form, with the following z-scores and stars to identify significance level.

6.1 The Winners

Table 2 "the winners table" provides statistics for the winning car manufacturer for each year of the race. Indy 500 winners have a bad pre-event trend with four negative AARs, which one of them is statistically significant at the 90 % significance level. The first trading day after the event is positive, but not statistically significant. The days after the race have mainly positive AARs. Day nine (+) and ten (-) are statistically significant on the same level of significance, but they have different signs. There are no big movements in any direction, so the event windows have small CAARs. The shortest window has a negative sign, but the rest have positive signs. This in total means they follow the market closely around the date of the event. Some single days turns out to underperform the market slightly with negative statistically AARs. The alternative hypothesis for CAAR ≠ 0 is being rejected and the null hypothesis is true, there is zero statistically significant CAAR over the event windows.

In the Le Mans LMP class Volkswagen has been dominant with their Audi's and Porsche's in the last years. They have won 17 out of the 20 races. The AARs are really close to the mean over all the dates, except the last trading day before the event. Day minus one has a statistically negative AAR at the 95 % significance level. All the event windows have negative signs, but none are statistically significant.

For the GT class General Motors lead with eight victories. In the days before the event the winners in the GT class notice two days with statistically significant movements. One positive at 90 % and one negative at 95 % significance level. The days after are mostly negative, which makes the event windows to be negative. There are no statistically significant event windows so the null hypothesis for CAARs is true.

In the Monaco GP, Mercedes-Benz went away with the victory 11 times, while Renault follows with six and Ferrari after that with only two victories. The fourth trading day before the race has a big AAR on 0.7 % which are statistically significant at the 95 % significance level. That is the only one and the next days do not show a trend in any way, again making the event-windows small. For day four the alternative hypothesis is true, there is a positive abnormal return, but rejects the alternative hypothesis for all the event windows.

The car manufacturers at the Daytona 500 have divided the trips to victory lane closely between them over the years. Chrysler has one victory in the time the stock history was available, Ford has six, General Motors has the most with nine and Toyota as the newest car manufacturer to race in the event has two trips to victory lane at Daytona International Speedway. Still they did not manage to add AARs to be positive in any of the event windows. The last trading day before the race have a huge loss of 0.8% which is statistically significant at the 99 % significance level. They could also show a strong day 20 effect with AAR on 1% which is statistically significant at the 95 % significance level.

Table 2

Statistics for the winning car manufacturers at each race

Race	Indy 500		Le Mans LMP		Le Mans GT		Monaco GP		Daytona 500	
Event Days	AAR %	z-stat.	AAR %	z-stat.	AAR %	z-stat.	AAR %	z-stat.	AAR %	z-stat.
(-5)	-0.008	-1.47	-0.001	-0.38	0.008	1.72*	-0.002	-0.57	-0.002	-0.81
(-4)	-0.002	-0.84	-0.001	-0.28	0.000	-0.04	0.007	2.23**	0.000	-0.08
(-3)	-0.004	-1.67*	0.000	0.09	0.003	1.45	-0.001	-0.20	-0.001	-0.27
(-2)	0.003	0.87	-0.003	-0.81	-0.006	-1.98**	-0.004	-1.17	-0.002	-0.91
(-1)	-0.002	-0.62	-0.008	-2.32**	0.000	0.12	0.000	-0.03	-0.008	-2.70***
(0)	0.002	0.71	0.001	0.30	0.002	0.68	0.003	1.08	0.001	0.35
(1)	-0.004	-1.52	0.000	0.12	-0.001	-0.21	0.003	0.76	-0.003	-0.97
(2)	0.010	1.31	0.001	0.22	-0.004	-0.97	0.000	0.18	0.002	0.60
(3)	0.003	0.79	0.001	0.38	0.004	0.93	-0.004	-1.44	-0.001	-0.36
(4)	0.004	1.51	-0.005	-1.07	-0.003	-0.51	0.002	0.52	0.006	0.75
(5)	0.000	0.13	0.002	0.63	-0.003	-0.52	-0.002	-0.49	0.002	0.40
(10)	-0.004	-1.84*	-0.001	-0.26	-0.004	-1.06	-0.004	-1.64	-0.001	-0.27
(15)	-0.001	-0.52	-0.003	-1.11	-0.001	-0.23	0.001	0.26	-0.007	-1.49
(20)	0.000	-0.10	0.000	0.01	0.000	0.16	-0.001	-0.25	0.010	1.91*
Event Windows	CAAR %	z-stat.	CAAR %	z-stat.	CAAR %	z-stat.	CAAR %	z-stat.	CAAR %	z-stat.
(-1, +1)	-0.004	-0.11	-0.006	-0.14	0.002	0.05	0.005	0.13	-0.010	-0.26
(-2, +2)	0.009	0.03	-0.008	-0.11	-0.009	-0.11	0.002	0.04	-0.010	-0.17
(-2, +5)	0.017	0.09	-0.010	-0.07	-0.010	-0.07	-0.002	-0.02	-0.003	-0.08
(-2, +10)	0.012	0.01	-0.016	-0.09	-0.019	-0.09	-0.013	-0.09	-0.009	-0.09
(-2, +15)	0.014	0.01	-0.014	-0.05	-0.026	-0.08	-0.017	-0.08	-0.015	-0.08
(-5, +15)	0.001	-0.03	-0.015	-0.05	-0.014	-0.03	-0.014	-0.06	-0.018	-0.08

Notes: * Significant at the 90 % significance level. ** Significant at the 95 % significance level. *** Significant at the 99 % significance level.

Put together with the winning car manufacturers share price for each year from the years 2000-2019. Reported average abnormal returns for single days and cumulative average abnormal returns for event windows are in % form. Z-stat. are based on the standardized AAR and CAAR.

TABLE 2: Statistics for the winning car manufacturers at each race.

6.2 Results for Participations

Table 3 sums up the statistics and level of significance for the car manufacturers that participated in the race. Indy 500 has days with negative AARs in the pre-event, this turns after the event. Most of the dates after the race has a positive sign. There are no one big enough to be statistically significant. Event windows are too small to be significant.

For the participating car manufacturers at the 24 Hours of Le Mans can show to mainly positive AARs throughout the event window, but they are very small. They have some negative days which are statistically significant at the 90 and 95 % significance level. Day 11 shows a statistically significant positive AAR at the 95 % significance level. The sum of the days makes the event windows small and none of them are statistically significant.

Monaco GP participations notice divided signs in the pre-event days, but mainly small positive abnormal returns after they have competed in the race. There are one negative at the 95 and one positive at the 90 % significance level in the pre-event days. In the aftermath of the race there are no statistically significant observations. All event windows have a positive sign, but they are too small to be significant.

At the Daytona 500 the investors are optimistic the last days before the event, but the following days after shows negative AARs. The following days have some negative signed statistically significant AARs, while only one positive. Therefore, all the CAARs event windows are negative, but none are statistically significant.

Overall the best individual car manufacturer who could notice a big gain in CAARs during the event period was Ferrari. They participated at the 24 Hours of Le Mans and the Formula One race in Monaco. See appendix for figures of the event period.

Table 3

Statistics for car manufacturers where they participated in the races

Race	Indy 500		Le Mans		Monaco GP		Daytona 500	
Event Days	AAR %	z-stat.	AAR %	z-stat.	AAR %	z-stat.	AAR %	z-stat.
(-5)	-0.004	-1.11	0.001	1.45	-0.003	-1.98**	0.001	0.57
(-4)	-0.003	-1.34	0.000	0.26	0.002	1.33	0.001	0.62
(-3)	-0.002	-0.94	0.002	1.52	-0.002	-0.87	0.004	1.18
(-2)	-0.001	-0.33	-0.001	-0.95	-0.002	-1.39	-0.004	-2.30**
(-1)	-0.001	-0.60	-0.003	-1.69*	0.004	1.69*	0.000	-0.24
(0)	0.003	1.44	0.000	0.34	0.001	1.15	0.001	0.48
(1)	-0.003	-1.37	0.000	-0.02	0.000	0.46	-0.004	-1.63
(2)	0.007	1.35	-0.003	-1.78*	0.002	0.78	-0.003	-1.85*
(3)	0.001	0.44	0.001	1.24	0.000	-0.46	-0.002	-0.75
(4)	0.002	0.96	-0.004	-2.38**	0.001	0.28	0.003	1.18
(5)	0.002	0.59	0.000	0.13	0.000	-0.26	0.002	0.82
(10)	-0.002	-0.90	0.001	0.64	0.000	-0.40	0.003	1.31
(15)	0.001	0.51	0.001	0.17	0.001	1.11	-0.004	-1.88*
(20)	0.000	-0.17	0.001	0.96	0.000	-0.19	0.005	2.16**
Event Windows	CAAR %	z-stat.	CAAR %	z-stat.	CAAR %	z-stat.	CAAR %	z-stat.
(-1, +1)	-0.001	-0.03	-0.002	-0.04	0.005	0.12	-0.003	-0.06
(-2, +2)	0.005	0.02	-0.007	-0.08	0.006	0.06	-0.010	-0.14
(-2, +5)	0.009	0.06	-0.010	-0.06	0.007	0.03	-0.007	-0.07
(-2, +10)	0.012	0.04	-0.003	-0.02	0.009	0.02	-0.006	-0.05
(-2, +15)	0.012	0.03	0.001	0.00	0.009	0.01	-0.013	-0.06
(-5, +15)	0.003	-0.01	0.004	0.02	0.006	0.00	-0.006	-0.03

Notes: * Significant at the 90 % significance level. ** Significant at the 95 % significance level.

Put together with the share prices from the years 2000-2019 when the car manufacturers participated in the race. It shows the average abnormal returns for single days and cumulative AARs for event windows in % form. Z-statistics are based on the standardized AAR and CAAR.

TABLE 3: Statistics for car manufacturers where they participated in the races.

6.3 Results for Non-Participations

The car manufacturers included in this analysis are the ones that have participated some years, but also have been absent from the race more than five years. This is to see if the results change regarding if the car manufacturers participate in the race or not. There are less car manufacturers here, so the sample are smaller. Table 4 with the statistics for this analysis follows on the next page.

First looking at the early pre-event dates for Le Mans where day -16 is negative statistically significant at the 95 % significance level. The days closer to the event date are mainly negative and have one statistically significant observation at the 90 % significance level. The following days are slightly positive, but then again, negative statistically significant AARs on day four and ten. Days eight, nine and 14 can show to strong positive statistically significant AARs at the 95 and 99 % significance level. These ones are also followed up with a big negative AAR on day 17 which are statistically significant at the 99% significance level. All these changes in the signs makes the event windows closer to the mean. The two longest windows have the highest CAARs, but not close to significant.

For the Monaco GP there is a really interesting observation the first trading day after the race. The average abnormal return is on 0.5 % and is statistically significant at the 99 % significance level. Thus, the car manufacturers that do not participate in the Monaco GP outperforms the market on that day. After some days on day seven the opposite arrives with a negative statistically AAR at the 95 % significance level, with a positive statistically AAR at the 90 % significance level on day 11. Again, the typical pattern with heavy changes in the sign for AARs are documented. The CAARs for event windows are small and mainly negative, but not statistically significant.

Table 4

Statistics for car manufacturers where they did not participate in the races

Race	Le Mans		Monaco GP	
Event Days	AAR %	z-stat.	AAR %	z-stat.
(-5)	0.002	1.79*	0.000	0.08
(-4)	-0.001	-0.76	0.001	0.77
(-3)	-0.001	-0.33	0.000	0.28
(-2)	-0.003	-1.69*	-0.002	-0.97
(-1)	-0.001	-1.35	-0.003	-1.37
(0)	0.000	-0.40	0.005	3.49***
(1)	0.001	0.77	-0.001	-0.25
(2)	0.002	1.17	-0.001	-0.66
(3)	0.001	0.14	-0.003	-1.03
(4)	-0.005	-1.75*	0.001	0.37
(5)	-0.002	-0.41	-0.001	-0.38
(10)	-0.003	-1.70*	-0.003	-1.69*
(15)	0.000	-0.28	0.002	1.09
(20)	-0.002	-0.82	-0.001	-0.73
Event Windows	CAAR %	z-stat.	CAAR %	z-stat.
(-1, +1)	0.000	-0.04	0.002	0.12
(-2, +2)	-0.001	-0.03	-0.001	0.01
(-2, +5)	-0.006	-0.05	-0.003	-0.02
(-2, +10)	0.001	0.00	-0.014	-0.08
(-2, +15)	0.008	0.02	-0.012	-0.04
(-5, +15)	0.008	0.02	-0.012	-0.03

Notes:

  * Significant at the 90 % significance level.

*** Significant at the 99 % significance level.

Put together with the share prices from the years 2000-2019 when the car manufacturers did not participate in the race. It shows the average abnormal returns for single days and the cumulative average abnormal returns for event windows. Z-statistics are based on the standardized AAR and CAAR.

TABLE 4: Statistics for car manufacturers where they did not participate in the races.

7. CONCLUSIONS

This study has presented an empirical investigation of the value contributions of car manufacturers that go racing. This has been done to see if car manufacturers can gain statistically significant market value by their racing division. By employing abnormal returns to trace the race-related movement in stock prices. The study contains four of the biggest races in the world and examines the impact of participation/non-participation and victories in those races. The findings of the study provide little evidence that the racing division can provide value for the car manufacturers as a group. However, on single days there can be heavy movements

in the share price around the dates of the events. There is hard to know what direction it will move in as there has been a lot of changes in the signs of the AARs throughout this analysis.

The cumulative average abnormal returns registered by car manufacturers around the time of these four races shows that the winning car is not the winner in the stock market. None of the races have statistically significant event windows for the winners of the races examined in this study. That uncovers the first hypothesis that maybe for some car manufacturers participation is enough to gain market value. The alternative hypothesis is being rejected and the null hypothesis is true. There are no cumulative average abnormal returns for the winners of these four races to be gained.

Regarding the second hypothesis there are no evidence for either of them over the event windows. Both participating and non-participating car manufacturers can show to statistically significant AARs on single days, but there is no pattern in them. Monaco GP has positive event windows during the years the car manufacturers did participate, but negative when they did not participate. None of them are statistically significant though. So, it is hard to say if there is a difference, but from the pattern it can look like the car manufacturers who participates have a slighter smaller chance at gaining market value from the dates around Monaco GP.

There are no statistically significant results over the event windows for the years where the car manufacturers did not participate in the race. That means the entire car industry does not get a positive influence from the big races, but the single days AARs for the non-participating car manufacturers show some heavy movements in the share prices as well as the other two categories. After these results it is hard to say what is the most important factor and if it is even possible to gain race related market value for the entire group of car manufacturers.

If we go back to the history section and look into the history of car manufacturers. Maybe one answer is to try to find the brand that is closest linked to the racing itself. Ferrari is a car manufacturer that works around the racing and make only sports cars. The other car manufacturers have a mix of many different categories of cars. Maybe that is one reason the results change a lot. The final conclusion is that the null hypothesis is true and that there are no abnormal returns overall for car manufacturers around these dates of events either positive or negative. For single days there are days with both negative and positive statistically significant AARs, but most of them are not. The car manufacturers follow the market closely regarding these big happenings that show their products.

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9. APPENDIX

9.1 Ferrari 41-Day CAAR

These two graphs which follows on the next page shows the cumulative average abnormal returns for the event window (-20, +20) for Ferrari in the two races they participated in. Ferrari was the individual car manufacturer who got the most CAAR around these races out of the car manufacturers in this study.
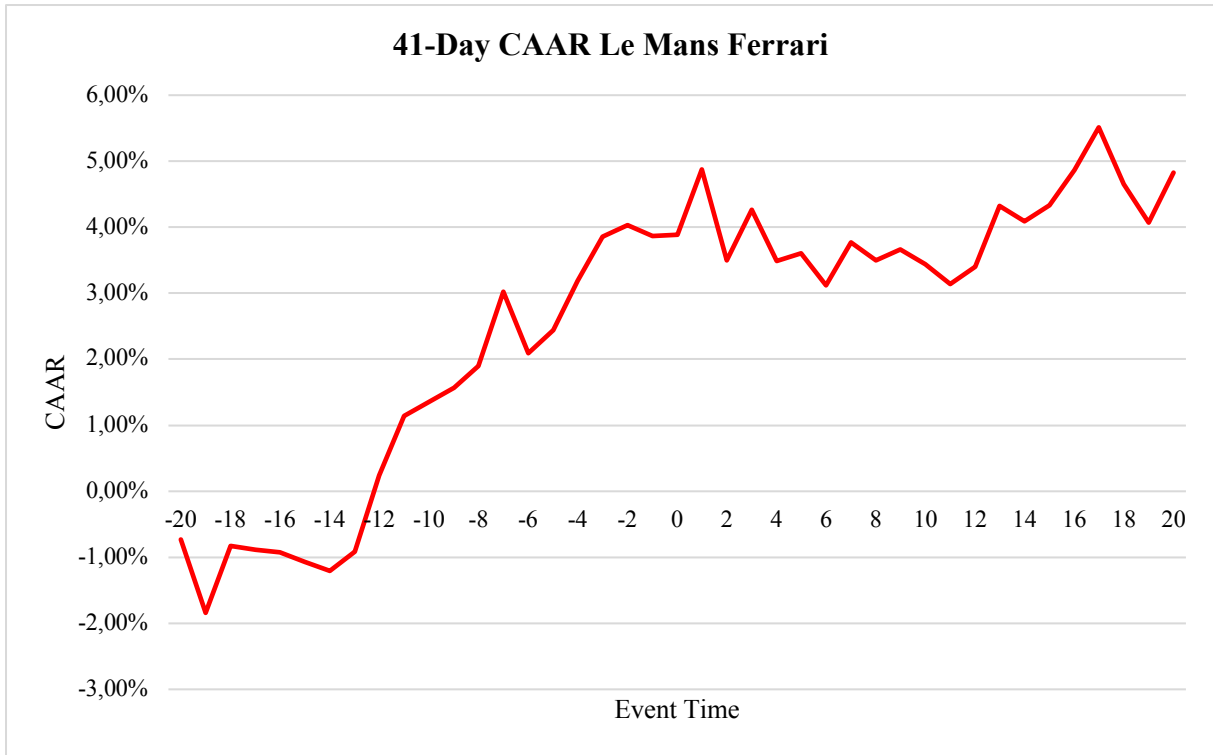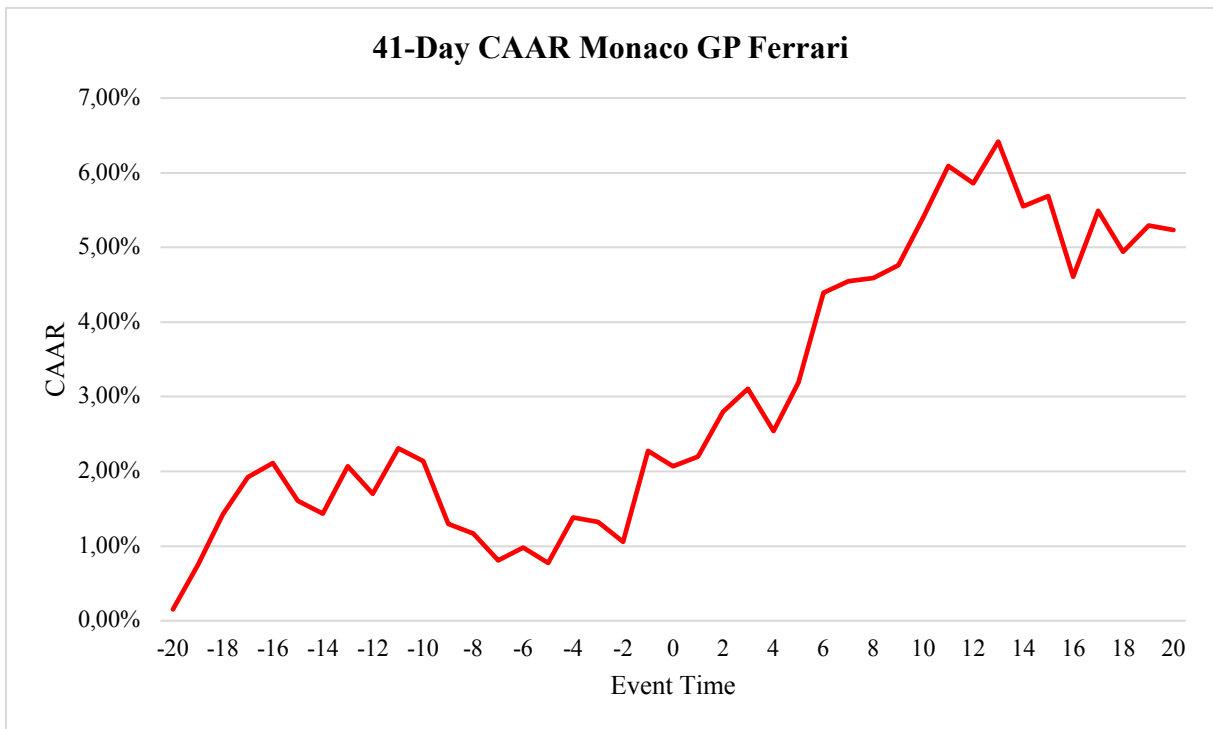
FIGURE 2: Ferrari CAAR Le Mans event window.

FIGURE 3: Ferrari CAAR Monaco GP event window.