Outcome Uncertainty, Attendance, and Television Audience in NASCAR

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Abstract

Using data from the 2007, 2008 and 2009 NASCAR seasons, this paper shows that the uncertainty of outcome hypothesis pertains to both race attendance and television audience, with the former only responding to race-level uncertainty and the latter responding to both race-level and season-level uncertainty. Of the other contributing influences, the price of gasoline and the unemployment rate were both unrelated to race attendance during the sample period, counter to conventional wisdom expressed during the declining attendance and ratings of the 2009 season. We also find that NASCAR broadcasts lose audience when competing against other big-interest sporting events and that declines in both television ratings and audience size during the NASCAR season were not unique to 2009, again contradicting conventional wisdom. Overall, the empirical evidence suggests that declining competitive balance might have been the common factor that reduced both television audiences and race attendance during this period.

JEL* Classifications*: D23, L25, L83

Keywords*:* competitiveness, adjusted churn, motor sports, uncertainty of outcome

1. Introduction

The National Association for Stock Car Auto Racing (NASCAR) Sprint Cup Series has been one of the fastest growing sports over the past fifteen to twenty years, primarily caused by the transformation of NASCAR from a regional into a national sport.[1] This increased popularity was reflected by greater race attendance and national television viewership, both of which led to more lucrative sponsorships for the teams and media contracts for NASCAR.[2] This paper investigates to what extent race outcome uncertainty or in-race competitiveness, along with race and broadcast characteristics, and macroeconomic conditions influence race attendance and television viewership.

Investigating how outcome uncertainty impacts NASCAR is appropriate for a number of reasons. First, unlike other sports, NASCAR has no home team as forty-three teams compete simultaneously during a given race. This removes the potentially confounding issue of home-team bias but makes measuring outcome uncertainty a bit more difficult than in normal head-on-head competition. Second, at the end of the 2008 and early in the 2009 NASCAR seasons there was a noticeable decline in attendance and television audiences. While there have been a number of potential reasons offered to explain the decline, including changes in macroeconomic conditions, increasing competition for leisure time, and changes in competitive balance, there has been no empirical study of these various claims. Third, NASCAR continuously adjusts the rules so that driver skills and not technological advantages determine race outcomes, i.e., the rules changes ostensibly aim to improve competitive balance. Whether attendance and television viewership responds to any changes in competitiveness, either at the race or season level, is therefore an interesting empirical question concerning the financial well-being of the sport.

In 2004 NASCAR changed the way the sport crowns its season champion by introducing the "Chase for the Cup."[3] As argued by Depken and Hasen (2009), after the Chase field is determined driver incentives

[1] NASCAR is a family owned and operated race sanctioning and sponsoring firm founded in 1947 by Bill France. By the late 2000s more than half of the sport's races were held outside of the six states that comprised the historic home for the sport (Virginia, North Carolina, Tennessee, Georgia, Alabama, and Florida).

[2] The first live-broadcast of a NASCAR event was the 1979 Daytona 500. In 1999 NASCAR signed a six-year $2.4 billion broadcasting package with Fox Sports, FX, NBC, and TNT. In 2005, NASCAR signed an eight-year $4.8 billion broadcast package with Fox/SPEED Channel, ABC/ESPN, and TNT. The sports lower series, including the Nationwide and Camping World Truck Series, are now included in this arrangement. The nation-wide broadcasting was coincident with a nation-wide expansion of NASCAR to new tracks from California to Kansas City to Chicago.

[3] The Chase for the Cup originally involved the top ten drivers in terms of performance points at the end of the 26th race of the 36 race season. As of 2008, the Chase was expanded to include the top 12 drivers with a $1 million price

change, which might influence the expected competitiveness of the final ten races of the season. Finally, NASCAR races most often occur during the weekend with the season ending in November. Thus, although NASCAR's biggest race, the Daytona 500, occurs in February, the season champion is determined while NASCAR competes with college and professional football, the end of the professional baseball season, the end of the professional golf season, and the beginning of professional hockey which might further influence attendance and viewership beyond the competitiveness of the NASCAR events.

Using data from the 2007, 2008 and 2009 NASCAR seasons, we test whether race outcome uncertainty, measured by the adjusted churn developed by Mizak, et al. (2007), and the overall competitiveness of NASCAR's Sprint Cup Series, as measured by dispersion of season-total performance points, influences attendance, television viewership, and television ratings; the latter two measured by Nielsen and the former reported by NASCAR. We find evidence that race-level uncertainty influences both attendance and the television audience. However, season-level competitiveness only influences the television audience. Furthermore, variables that describe the macroeconomic environment, the specifics of the broadcast network, the specifics of the race, and whether there is another high-profile sporting event on the day of the race, do not share a statistically meaningful relationship with race attendance yet have a statistically significant relationship with television viewership.

2. The Related Literature

The Literature Concerning Outcome Uncertainty

Knowles, Sherony, and Haupert (1992) laid out the following clear definition for the "uncertainty of outcome hypothesis":

> Uncertainty of outcome hypothesis (UOH) is predicated on the assumption that fans receive more utility from observing contests with an unpredictable outcome, and posits that the more evenly team playing abilities are matched the less certain the game's outcome and the greater the game's attendance will be.

Rottenberg (1956) was the first to apply the concept to the sports industry and Sloane (1971) and El-Hodiri and Quirk (1971) discuss the importance of the UOH to the economics of sport. Sloane (1971) distinguished between long run uncertainty of outcome, characterized by the variation in championship teams over an extended period of time, and short run uncertainty of outcome, characterized by the uncertainty of particular games and by extension for a particular season's championship. Szymanski

for the driver who finishes thirteenth in season-end performance points; the $1 million prize is to provide sufficient incentive for drivers not in the Chase to continue to race at or near their peak performance.

(2003) provides a more developed taxonomy by distinguishing between game uncertainty, season uncertainty and championship uncertainty. While early references to the UOH were primarily theoretical, there is a large literature that empirically tests the hypothesis in various sports including professional baseball, football, rugby, cricket, and college football.[4]

When investigating outcome uncertainty, attendance has generally been the variable of focus.[5] Szymanski (2003) reviews twenty-two different tests of the UOH at all levels of uncertainty, finding general support for the impact of outcome uncertainty on attendance. The UOH literature has, however, focused on sports in which two teams compete head-to-head and there are clearly delineated home and visiting teams. However, any home team bias can prove to be a confounding factor making an accurate test of the UOH difficult. NASCAR differs from other sports in which the UOH has been tested: there is no home driver (team) and each race has forty-three drivers (teams) competing simultaneously.

The Literature of NASCAR

With NASCAR's increased popularity, economists have used NASCAR to look at a variety of economic questions. The research involving NASCAR falls into three areas: investigation of the reward structure in NASCAR, the relationship between team performance and sponsor stock returns, and the impact of safety on driver behavior. Highly nonlinear payoffs are often used in rank-order tournaments to encourage risk taking and greater individual effort. However, in a motorsport such as NASCAR risky behavior can impose considerable negative externalities on other drivers. Thus NASCAR utilizes a much flatter reward structure than traditional rank-order tournaments. Becker and Huselid (1992) find that greater disparity between the highest and lowest reward in NASCAR and the International Motor Sports Association (IMSA) is correlated with increased hazardous behavior. Von Allmen (2001) argues that NASCAR's relatively flat reward structure might have three underlying motivations: increasing sponsorship exposure, reducing sabotage (a moral hazard that occurs when drivers take risks in order to increase their share of the purse and impose costs on other drivers), and that the high cost of fielding a NASCAR team requires

[4] For professional baseball see Knowles, Sherony and Haupert (1992) and Woodland and Woodland (1994); for professional basketball see Berri, Schmidt and Brook (2004); for professional football see Welki and Zlatoper (1999), Putsis and Sen (2000), and Paul and Weinbach (2007); for rugby see Peel and Thomas (1997); for Australian Rules Football see Borland (1987) and Borland and Lye (1992); for cricket see Paton and Cooke (2005); for soccer see Forrest and Simmons (2002), Peel and Thomas (1988), and Jennet (1984); for college football see Depken and Wilson (2006), Fizel and Bennett (1989), and Price and Sen (2003).

[5] Forrest, Simmons and Buraimo (2005) and Alavy, et al. (2006) analyze the impact of outcome uncertainty on television ratings for the English Premier League (soccer). Paul and Weinbach (2006) investigate the impact of outcome uncertainty on the ratings for the NFL's Monday Night Football.

the sport to have a more egalitarian reward system. Depken and Wilson (2004) empirically find support for reduced sabotage but no evidence to support the cost argument. Schwartz, Isaacs and Carilli (2007) argue against von Allmen's sabotage effect by showing that once driver-skill differences are taken into account the linear point system does not reduce aggressive behavior.

Groothius, Groothius, and Rothoff (2009) suggest that while the distribution of the race purse might be relatively linear, the payoff structure becomes considerably more non-linear when including the value of "time on camera," which is generally greater for those drivers near the front of the pack. This suggests that the structure of the total rewards earned in NASCAR may be closer to traditional tournament theory than previously suggested. In a similar vein, Depken and Mackey (2009) show that multi-car teams have an advantage over single-car teams, which leads to greater real dollar earnings. They show that, while multiple cars provide team owners with the potential to circumvent the flatter payoff structure in NASCAR, this advantage does suffer from diminishing returns.

Mahar, Paul, and Stone (2005) investigate how sponsoring a NASCAR team impacts a firm's stock performance and find that a sponsor's stock performance on the first trading day after a race was positively correlated to the sponsored car's performance. However, this correlation only holds for sponsors that sell directly to consumers or for sponsors that sell products in the auto industry; the relationship does not hold for sponsors that sell primarily to businesses. Durr, Eaton and Broker (2009) show that a portfolio of corporations that sponsor NASCAR teams consistently outperforms the S&P 500. However, the authors conclude that sponsorship does not directly cause higher stock returns, but is a signal of financial stability that indirectly results in higher returns.

The third area focuses on the behavioral impact of NASCAR's safety regulations. This path of research builds on the work of Peltzman (1975), who argues that drivers tend to drive more aggressively when they feel safer in their vehicles. In the years following the death of Dale Earnhardt, Sr. in the 2001 Daytona 500, NASCAR implemented a series of safety enhancements including the Haans head-restraint system, impact-absorbing walls, and new aerodynamics built into the "Car of Tomorrow," which was introduced in 2008. These additional safety systems, combined with changes in how NASCAR penalizes drivers for overly aggressive driving, have correlated with zero fatalities in NASCAR's three premier series since 2001 despite hundreds of accidents. These changes provide a natural test of whether professional drivers respond the same as previous theories predict. Sobel and Nesbit (2007) find clear support for the conclusion that drivers act more reckless after improvements in safety. O'Roark and Wood (2004) find that restrictor-plate races, which should result in a safer race because top speeds are reduced, tend to have

more accidents that eliminate cars from the race but do not result in an increase in driver injuries.[6] This suggests that drivers behave more reckless when safety improves, which is consistent with Peltzman's original theory.

3. Outcome Uncertainty in NASCAR

Whether race outcome uncertainty influences NASCAR attendance is not immediately clear. The NASCAR season is comprised of thirty-six races during the year, but each track hosts only one or two races during the year.[7] As a result, NASCAR fans generally decide long in advance whether to attend and for how long they will stay in the race area; many fans stay at the race site for multiple days preceding the race to participate in various preliminary events, including driver practice, race qualifying, concerts, and interaction with drivers and other fans. The commitment required by many who attend a specific NASCAR event might be the result of the long distance many fans travel to reach the event, which might mitigate the impact of the outcome uncertainty on NASCAR attendance. This is especially true in comparison to other sports where long-distance travel is generally not involved and many more regular season sporting events are held at the same venue.

However, it is much more likely that television audiences are more sensitive to changes in the competitiveness of NASCAR. First, watching a NASCAR race on television does not require planning weeks or months in advance and does not incur considerable direct costs. Furthermore, by its very nature the costs of switching from the NASCAR broadcast to other entertainment options on television is very low; in contrast, once an individual is in attendance at a NASCAR race it is very costly to substitute entertainment. To the extent the television audience's expectations of a competitive race are not met, the television audience might be more likely to switch away from the NASCAR event to an alternative activity.

[6] Currently two tracks require restrictor plates: Talladega (Alabama) and Daytona (Florida). A restrictor plate is a small piece of metal installed on the engine's intake that restricts the airflow into the engine and therefore lowers the engine's output and the top speed the car can obtain. Restrictor plate races in NASCAR are notorious for "grouping," that is large numbers of cars driving in a group. In these situations even small mistakes can lead to accidents that "collect" a large number of cars.

[7] Lowe's Motor Speedway, *nee* Charlotte Motor Speedway, is the only track that hosts three events: the Coca-Cola 600 and the All-star Race in May and the NASCAR Banking 500 in October. In the 2009 season Watkins Glen (NY), Sonoma (CA), Las Vegas (NV), Kansas City (KS), Homestead (FL), Chicago (IL), Indianapolis (IN), and Darlington (SC) all hosted one race.

In the literature, at least three levels of outcome uncertainty have been defined: event-level, season-level and inter-season uncertainty. In the case of NASCAR, the first two seem to be of most concern to fans and are therefore the focus of analysis here. Yet it is not immediately clear what outcome uncertainty actually applies in the case of NASCAR. Each NASCAR race entails 43 drivers on a closed course, most often an oval track with four turns but occasionally on a triangular track and twice a year on road courses. Television broadcasts naturally focus on the several cars near the front of the race or the season standings, but those in attendance often focus on cars that are not near the front of the field. The so-called races-within-the-race, say between two drivers in positions 21 and 22, are not often displayed on the television but can be of intense interest to the fans in attendance.

Traditional measures of competitive balance, such as the idealized standard deviation (Fort and Quirk, 1995), the Normalized Herfindahl-Hirschman Index (Depken, 1999), or the Competitive Balance Ratio (Humphreys, 2002), do not seem appropriate for a NASCAR race. Thus, an alternative measure is needed. One possibility is margin of victory. Of the 322 Sprint Series races from 2000 through 2008, the average margin of victory reported by NASCAR was 1.43 seconds, yet this only measures the "competitiveness" between the winner and second place; it does not indicate anything about the competitiveness of the remainder of the field. An alternative might be the number of lead changes in a given race. From 2000 through 2008 the average race had 10.27 lead changes. Yet this measure does not reflect how much of the race is run between lead changes or how much passing throughout the entire field has occurred by the end of the race. Ultimately, the aforementioned measures are not very satisfying given the nature of a NASCAR race.

Because of the large number of participants and the rank-order reward system of NASCAR, any measure of competitiveness within a NASCAR race would ideally reflect the difference between the starting and finishing positions of the drivers and would encompass the entire field of drivers. Such a measure would provide a relative gauge of competitiveness in terms of a driver's ability to advance or to be moved back within a race. The "adjusted churn" measure developed by Mizak, et al. (2007) would seem to be an instrument that captures these two desirable characteristics of a measure of competitiveness or uncertainty of outcome. The churn was originally defined to quantify the change in finishing position of the teams in a league from one year to the next. We apply it here to measure competitiveness within a race. The adjusted churn (C) is measured as:

$$CHURN_t = \sum_{i=1}^{N} \frac{| f_{i,t} - f_{i,t-1} |}{N},$$

where $f_{i,t}$ is the finishing position of driver *i* at the end of race *t* and $f_{i,\,t-1}$ is the starting position of driver *i* prior to race *t* and *N* is the number of drivers participating. The maximum churn (MAXCHURN) possible in an N driver field is N/2 if N is even or $(N^2 - 1)/2N$ if N is odd. The adjusted churn, which falls between zero and one, is then calculated as the ratio of the churn to the maximum churn:

$$ADJCHURN_t = \frac{CHURN_t}{MAXCHURN_t}$$

An adjusted churn of zero (one) would indicate that all drivers finished in the same (reverse) position they started, which would suggest minimum (maximum) within-race competitiveness or uncertainty of outcome. Neither extreme is likely to happen in a NASCAR race, but in general, more competitive races would have an adjusted churn closer to one and less competitive races closer to zero. The adjusted churn is calculated for each race in the sample and the adjusted churn for the previous three races at a particular track is used to proxy for NASCAR fans' expected competitiveness of a particular race.[8]

Another question is how to measure uncertainty of outcome at the season level. At the end of each race, performance points are awarded to each starting driver based on finishing position at the end of the race. The race winner receives 185 points with the distribution of points following a relatively flat gradient through the forty-third position, which receives 34 points.[9] The purpose of the season-total points system is two-fold. First, it rewards consistency in performance, perhaps reducing the incentive to engage in risky behavior undertaken to gain an additional one or two positions and their associated increase in performance points and race earnings (see von Allmen, 2000). Second, the points system determines the winner of the season-level championship. At the end of the 26th race, the top twelve drivers in performance points qualify for the "Chase for the Cup," which takes place during the last ten races of the season. The drivers in the Chase have their accumulated points "reset" for the purposes of determining the season champion, although they are awarded race points in the same manner as non-Chase drivers.[10] For

[8] This assumption requires that the measurement error on the part of the fans is not correlated with any of the explanatory variables in the econometric models. This does not seem to be a strong assumption. We experimented using the average competitiveness of the past two and past four Sprint Cup Series races at the particular track but obtained qualitatively similar results as reported here.

[9] Under the current system which began in 2004, the winner receives 180 points. The runner-up receives 170 points and the next four finishers are separated by five points each. Then, the seventh through tenth place finishers are separated by four points and everyone else is separated by three points thereafter. Five additional points are awarded to those that lead a lap and the driver that leads the most laps. From 1975 through 2003, the winner received 175 points with the remainder of the field receiving the same as the current system.

[10] Starting in 2008, the top twelve drivers have their season point total "reset" to 5,000 plus ten points for every race victory. The bonus points are intended to provide incentive for those drivers at or near the top of the points standings to pursue race victories rather than reducing effort going into the Chase. Those drivers not in the Chase retain the points they have earned through the first 26 races of the season.

those drivers who do not qualify for the Chase, there is a $1 million bonus for the driver who finishes thirteenth in points, that is, the driver who finishes the season with the most performance points among non-Chase drivers.

To measure the concentration of performance points over the course of the season, we calculate the Herfindahl-Hirschman Index (HHI) of performance points heading into each race, that is, before each race is run. The HHI is calculated as the sum of the squared market shares of performance points and evolves over the course of the season:

$$HHI_t = \sum_{i}^{N} (MS_{i,t})^2 \ ,$$

where $MS_{i,t}$ is the market share of performance points for driver *i* before race *t*. Before the first race of the season, all drivers have zero points and therefore the HHI equals zero. Over the course of the season the market shares of performance points vary as drivers place better or worse and thus the HHI also varies over the course of the season. Generally, the lower (higher) the HHI the more (less) egalitarian the distribution of performance points across drivers over multiple races.

4. Data and Empirical Methodology

To test whether outcome uncertainty is important in NASCAR's Sprint Cup series, three measures of fan interest are employed: race attendance, Nielsen television ratings, and Nielsen television viewership. Attendance is reported by NASCAR (rather than track owners) after each race but is rather lumpy and potentially misleading. In 99 of 108 races during the 2007, 2009 and 2009 seasons, attendance figures are rounded to the thousands, e.g., 191,000 or 100,000, which likely introduces measurement error. Furthermore, because NASCAR is a private firm, the reported attendance data might suffer from self-serving measurement errors that make the data less likely to be systematically related to exogenous variables. The Nielsen television ratings reflect the estimated percentage of televisions turned on during the broadcast that were tuned to the NASCAR race; this variable measures the relative demand for the NASCAR broadcast as it depends on what else is on television at the time. The Nielsen television viewership measures the estimated nationwide television audience for the race and measures the absolute level of interest in the broadcast. While Nielsen measures likely suffer from measurement error, it is more likely random and thus expected to only influence estimate precision.[11]

[11] Nielsen defines ratings as the estimated number of TV households tuned to a particular program in the average minute during which the program is on the air. Nielsen calculates the size of the television audience by estimating the percentage of people using television who are tuned to the program during a specific period of time. The Nielsen

We relate three dependent variables to the same set of right-hand side variable in the following estimating equation:

$$DEP_i = \beta_0 + \beta_1 ADJCHURN_i + \beta_2 HHIPTS_i + \beta_3 GASPRICE_i + \beta_4 UNEMP_i + \beta_5 SUNDAY_i + \beta_6 SEVENPM_i + \beta_7 CHASE_i + \beta_8 ROAD_i + \beta_9 CAUTIONS_i + \beta_{10} TVEVENT_i + \beta_{11} TVEVENTxMONTH + \beta_{11} ESPN_i + \beta_{12} ABC_i + \beta_{13} FOX_i + \beta_{14} YR2007_i + \beta_{15} YR2008_i + \varepsilon_i,$$

where the dependent variable, DEP_i, is either attendance, Nielsen ratings, or Nielsen viewership, the β's are parameters to be estimated, and ε is a zero-mean error term. Each variable is defined and summary statistics are listed in Table 1.

Two variables are used to proxy for competitiveness. The first controls for expected competitiveness of the race itself using the average adjusted churn (Mizak, et al., 2007) from the three previous Sprint Cup races held at the same track (*ADJCHURN*). The second controls for season-level competitiveness using the HHI of performance points leading into race *i* (*HHIPTS)*. If improved competitiveness of NASCAR races increases race attendance, or the relative or absolute demand for NASCAR broadcasts, the parameter on *ADJCHURN* will be positive; if attending or watching fans prefer more competitive seasons, the parameter on *HHIPTS* will be negative.

Figure 1 and Figure 2 show time plots for the ADJCHURN and the HHIPTS, respectively. In Figure 1 the adjusted churn tends to follow a cyclical pattern over the course of each season. However, the adjusted churn seems to have been falling over the three seasons investigated here. This is especially true during the 2009 season, the first season during which the so-called "Car of Tomorrow" was used in each race. In other words, the races during the 2009 season were generally not as competitive as the races in the 2007 and 2008 seasons. In Figure 2, the season-level concentration of performance points is also somewhat cyclical over the course of the season. Unlike the race-level measure of competitive balance, it does not seem to be the case that the concentration in performance points was getting worse (larger) during the three seasons included in the sample period.

Variables reflecting the prevailing macroeconomic environment during each NASCAR race are also included in the empirical specification. As many people drive a considerable distance and spend a

ratings do not include Internet and cell-phone streaming data. As a result viewers who record broadcasts for later viewing are not counted, which biases downward the viewership data.

sizeable portion of their disposable income to attend NASCAR events, the average all-grades price of gasoline (*GASPRICE),* as reported by the Energy Information Agency, and the national unemployment rate (*UNEMP),* as reported by the Bureau of Labor Statistics, are included to capture some of the cost of attending a NASCAR event. Higher gasoline prices increase the cost of attending a NASCAR event and are therefore expected to reduce attendance and might be expected to increase television audience (see for example, Caldwell, 2008). On the other hand, if driving and watching a NASCAR race are complementary, then the increase in the price of gasoline would decrease the television audience. Which influence dominates is an empirical question. Higher unemployment might introduce uncertainty about future disposable income and encourage substitution from attending the NASCAR event into either watching it on television or engaging in some other leisure (or labor) endeavor. To the extent that the price of gasoline and unemployment induce substitution away from attending and into watching the event on television, the impact of both variables is expected to be negative in the attendance equation and positive in one or both of the viewership equations.

Variables that describe the characteristics of the NASCAR broadcast and the NASCAR race itself are also included and were collected from NASCAR. To control for possible differences across the four networks that televise NASCAR races, three network-specific dummy variables are included: *ESPN*, *ABC*, and *FOX* (TNT is the reference broadcaster). If the television audience prefers one or more broadcasters, for whatever reason, it is expected that broadcasts on those networks would experience an increase in the level of relative and absolute television viewership. As most, but not all, NASCAR Sprint Cup Races take place on Sunday, a dummy variable that takes a value of one if the race takes place on Sunday (*SUNDAY)* is included. The parameter on this variable will be positive if television audiences are greater on Sunday than otherwise. A dummy variable that takes a value of one if the race was a "night race," i.e., started at seven at night in the Eastern Time Zone (*SEVENPM*) is included. If night racing is more popular with television fans we expect a positive parameter on this variable; however, we do not expect a significant impact of this variable on race attendance.

A dummy variable that takes a value of one if the race is one of the last ten races in the season (*CHASE*), i.e., it is part of the "Chase for the Cup", is included. If Chase races draw a larger television audience, *ceteris paribus*, there will be a positive parameter on *CHASE*. NASCAR races twice a year on road courses that have unique driving and viewing characteristics. A dummy variable for road course races is included to capture the uniqueness of these tracks (*ROAD*). Races that have more cautions flags, whether caused by accidents or mechanical failures, might hold less interest to the television audience. On the other hand, if the marginal television viewer is attracted by the prospect of a crash, races at tracks with a

history of more cautions might draw a larger television audience. To test this theoretical ambiguity, the average number of cautions during the previous three races held at the current track is included (*CAUTIONS).*

NASCAR's propensity to race on either Saturday or Sunday often sets the event and its broadcast against other high-profile sporting events, such as the World Series or the Masters Golf Tournament. When NASCAR races compete with these other events the viewership for the NASCAR broadcast might decrease, notwithstanding the competitiveness and other characteristics of the event. Therefore, a dummy variable is included that takes a value of one if another high-profile sporting event occurred on the same day as the NASCAR race (*TVEVENT*). To the extent that competing sporting events draws individuals away from the NASCAR broadcast, *ceteris paribus*, a negative parameter on the variable *TVEVENT* is expected. To test whether the impact of competing television events changes over the course of the year, the dummy variable *TVEVENT* is interacted with the month of the year where February takes a value of two and November a value of eleven. If there is a smaller impact of competing events later in the NASCAR season a positive parameter is expected on the interaction term.

The television viewership data employed were obtained from Nielsen Ratings Company and reflect the absolute and relative viewership of 108 NASCAR Sprint Cup Series races for the 2007, 2008 and 2009 NASCAR Sprint Cup seasons. The Nielsen data reflect the estimated total number of viewers, which we interpret as an absolute measure of demand, and the percentage of televisions tuned to the NASCAR event, which we interpret as a relative measure of demand. The ability to test the Uncertainty of Outcome Hypothesis in relative terms is an improvement over studies that use attendance or other measures of direct interest in the event.

Table 1 reports the descriptive statistics of the data used in the analysis. Reported attendance and the Nielsen ratings data are available for all 108 races held during the 2007 and 2008 NASCAR seasons; viewership data are available for 105 of the 108 races.[12] The average reported attendance to NASCAR races was approximately 117,000 people, with a minimum of 40,000 and a maximum of 270,000 people. The average rating during this period was 4.35, that is, 4.35% of all televisions turned on during the NASCAR broadcast were tuned to the event, with a minimum of 1.6 and a maximum of 10.2. The estimated average total number of viewers was approximately 6.7 million people, with a minimum of 1.9 million and a maximum of 17.75 million.

[12] Each NASCAR Sprint Cup season is comprised of thirty-six races starting with the Daytona 500 in Daytona, Florida, in early February and ending in Homestead, Florida, in early November.

The average adjusted churn of the 108 races was 0.515 with a minimum of 0.287 and a maximum of 0.738. The average adjusted churn of the previous three races at a particular race's track was 0.523, with a minimum of 0.392 and a maximum of 0.670.[13] The average HHI over the 108 races was 262.28 with a minimum of zero (at the first race of the season) and a maximum of 301.79. Of the macroeconomic variables, the average price of a gallon of gasoline the week of the race was 297 cents, with a minimum of 196 cents and a maximum of 416 cents. The four-week moving average of the price of gasoline over the sample period averaged 292 cents per gallon, with a minimum of 190 and maximum of 410 cents per gallon. The average national unemployment rate during the month of the race was 6.62% with a minimum of 4.40% and a maximum of 10.20%. The four week moving average of the unemployment rate among those workers that qualify for unemployment insurance was 2.83% with a minimum of 1.60% and a maximum of 4.77%. This, in turn, suggests that the unemployment rate among workers who did not qualify for unemployment insurance averaged 3.78%, with a minimum of 2.12% and a maximum of 6.45%.

Of the race characteristics, 80% of the races took place on Sunday, 13% of the races started at night, 36% of the races were broadcast on FOX, 29% were broadcast on ABC, and 18% were broadcast on ESPN, 27% of the races were part of the "Chase for the Cup", and 5% of the races took place on road courses. The average race had 8.98 caution flags (for various reasons), with the maximum being 21 and the minimum being three. The average number of caution flags for the previous three races held at each track was 9.41 with a minimum of 5.66 and a maximum of 17.66 caution flags. Approximately 38% of the races in the sample competed with at least one other high-interest sporting event.

Table 2 lists the dates and high-interest sporting events against which NASCAR broadcasts competed during the sample period. While there are other sporting events broadcast every day a NASCAR broadcast takes place, e.g., a regular PGA tour stop or a regular season basketball game, this variable tracks only high-profile sporting events. *TVEVENT* controls for the increased opportunity costs of watching the NASCAR broadcast when another high-profile sporting event is broadcast during the same day, regardless of when the competing event is actually aired. During the three seasons, 54 races shared the day with at least one other high-interest sporting event such as an NBA Conference Finals or the Masters Golf Tournament.

[13] A higher adjusted churn measure indicates more competitiveness.

5. Empirical Results

Table 3 and Table 4 report the empirical results; the former using contemporaneous values of the adjusted churn, unemployment, the price of gasoline, and the number of caution flags, the latter using the previous three-race average of the adjusted churn and the number of caution flags, and the four-week moving average of unemployment and the price of gasoline. In each table three models are reported, each using a different dependent variable: Model (1) uses reported attendance, Model (2) uses the Nielsen ratings, and Model (3) uses the Nielsen viewership.[14] All specifications apply a Prais-Winsten transformation to control for mild autocorrelation in the data.

Focusing first on the results in Table 3, in Model (1) the only variable significantly related to race attendance to NASCAR races is whether the race is a road race. This is not surprising as road-race courses have less seating capacity than the oval tracks. What is somewhat surprising is that the remaining explanatory variables are all statistically insignificant in explaining the variation of race attendance. While certain variables might be expected to impact television viewership and not attendance, e.g. the dummy variable *TVEVENT*, other variables might be expected to impact attendance and not the television audience, e.g., price of gasoline and the unemployment rate. The general lack of statistically meaningful relationships between attendance and other variables in the model, especially the two variables associated with the macroeconomic situation, might be surprising given that many NASCAR fans travel long distances to attend races and often purchase tickets months in advance.[15]

The difficulty in predicting race attendance is evident from the relatively low R-square of 0.23 in Model (1) in Table 3; the difficulty is also graphically depicted in Figure 3 where the actual and fitted values of attendance are plotted together against time. It is evident that the variation in actual attendance is much greater than the variation in fitted attendance, suggesting that the attendance equation is missing one or more important variables. Nevertheless, it is clear that the variation in attendance was dropping considerably during the sample period with attendance in 2009 seeming to have a smaller variance than in either 2007 or 2008.

Model (2) in Table 3 uses the Nielsen ratings as the dependent variable. We interpret the market share of the NASCAR broadcast as a measure of relative demand as it reflects the percentage of all televisions

[14] For the attendance model, the dummy variables for which network broadcast the race, *ESPN*, *ABC* and *FOX*, are dropped.
[15] Another explanation is that the reported attendance data are not fully accurate.

turned on during the broadcast. This model yields results more consistent with intuition than the attendance model. The higher the adjusted churn, that is, the more competitive the race, the higher the rating for the race's broadcast. On the other hand, the more concentrated the distribution of season-long performance points, the lower the television ratings. These findings suggest that the relative demand for NASCAR broadcasts does respond positively to an increase in uncertainty: the more competitive the particular event and the entire season, the more interest the television audience displays.

Unlike the attendance model, in the ratings model both the price of gasoline and the unemployment rate are negatively related to television viewership. Perhaps as unemployment increases individuals find other things to do with their time than watch NASCAR events, however, a strong test of this hypothesis is not possible with the data utilized here. Nevertheless, the slight negative relationship between the price of gasoline and viewership might arise if, for some of the NASCAR television audience, driving and watching NASCAR are strong complements. As the price of gasoline increases, and the amount of driving decreases (albeit perhaps only slightly), there might be an associated decline in the NASCAR television audience.

Several of the race characteristics are statistically related to television ratings. Races held on Sunday and races held at night experience greater ratings. On the other hand, races that are part of the Chase for the Cup generally draw a lower rating, which runs counter to one of the reasons NASCAR introduced the Chase in the first place.[16] Road races and races with more cautions do not enjoy statistically different ratings than other races, suggesting that the television audience is not drawn to crashes but are not pushed away by them either. There seem to be no difference in the ratings enjoyed by the various networks that broadcast NASCAR races.

When NASCAR shares the time slot with a high-interest sporting event such as the NBA Finals or the PGA's US Open, ratings suffer a reduction in ratings of 1.1 percentage points. Perhaps for this reason, NASCAR often chooses to not schedule a race when a high-interest event is scheduled. For example, in 2007 (2008) *The Masters* Golf Tournament was held on the weekend of April 7-8 (April 12-13). NASCAR did not race on the Sunday of the Masters in 2007 but did race in Phoenix on the Sunday of the tournament in 2008. In those cases where NASCAR does not compete with a big-time sporting event the marginal viewer seems attracted to the NASCAR event on television. However, the interaction

[16] Interpretation of the parameter on *CHASE* requires a bit of caution. The negative parameter indicates that viewership is less for Chase races than non-Chase races in the sample. However, we do not have the data to test whether the Chase for the Cup has increased viewership of the last ten races relative to the pre-Chase period.

between *TVEVENT* and the month of the year is positive and statistically significant in Model (2), suggesting that later in the season NASCAR events fare about 10% better against competing events.

Somewhat surprising, given the amount of media attention dedicated to falling NASCAR television ratings during the 2009 season, the sample analyzed here suggests that ratings in 2007 were approximately 3 percentage points lower and that ratings in the 2008 season were approximately 1.5 percentage points lower than in the 2009 season, all else held constant. Thus, the ratings decline in 2009 might have been caused by a more nuanced change in the preferences of the television audience than generally appreciated. Indeed, the secular decline in television ratings from the beginning of the season, which starts with the "Super Bowl" of the NASCAR season at the Daytona 500, seems to appear in all three seasons investigated here. This suggests that the trend of declining ratings repeatedly reported on during the 2009 season might have missed the fact that the ratings for the past three years seems to have followed the same general pattern. It is also evident that the specified model is much better at predicting television ratings than race attendance as evidenced with the higher R-square and with the much tighter correlation between the fitted and actual values of television ratings as plotted in Figure 4.

Model (3) in Table 3 reports the estimation results using the estimated number of television viewers of the NASCAR broadcast. This measure of fan interest is interpreted as an absolute measure of demand rather than a relative measure as in the case of the ratings measure. The results are consistent with those in Model (2), suggesting that the absolute demand and the relative demand for NASCAR broadcasts are positively correlated and that NASCAR broadcasts do not necessarily lose relative interest as the overall television audience increases or decreases. All of the variables that are statistically significant in explaining television ratings are also significant in explaining the total television audience for NASCAR broadcasts; the exceptions are the total number of cautions, which is negatively related to total audience, and whether the race is broadcast on ABC or FOX, it is estimated that on average both networks garner 1.1 and 1.4 million more viewers per race, respectively.

Figure 5 depicts the actual and fitted values of the total viewership for the three seasons under investigation. It is apparent that, compared to Figure 1, the model is much better at predicting the level and trend in the size of the television audience. Much like the secular downward trends in ratings depicted in Figure 4, the size of the television audience declines precipitously after the Daytona 500, the first race of the year, and has done so for each of the three seasons investigated. This suggests that concerns about

declining NASCAR television viewership during the 2009 season might have ignored similar trends in the past.

Robustness Check

The three specifications reported in Table 3, provide evidence of segmentation in the NASCAR market to the extent that the variables that help explain television ratings and those that help explain race attendance seem to differ. One obvious reason for segmentation is the physical distance between much of the television audience and where the race takes place. One concern with the specifications in Table 3 is that the models include contemporaneous values for many variables. For instance, in each model in Table 3 the adjusted churn of the actual race is used as a measure of competitive balance. For those who are watching the event on television, the level of competitiveness might be evident and might influence the decision to watch or not watch the event. On the other hand, those who attend the event do not know the level of competitiveness before the race and therefore cannot "undo" their attendance if the race is not very competitive. The same concerns exist in the context of the number of caution flags during the race; those who attend the race in person cannot alter their decision to attend even if there are more caution flags than they prefer.

However, the timing of the decision to attend a NASCAR race is impossible to determine. Many NASCAR tracks market tickets up to a year in advance, which suggests at least some people purchase tickets far in advance of the event. Yet, the decision to purchase a ticket and the decision to actually attend the event are nested but different decisions; personal or macroeconomic conditions near the time of the race might influence the decision to attend, even if a ticket has been purchased long in advance. To accommodate this ambiguity, we use both the contemporaneous measure and the four week moving average of both variables.

The contemporaneous price of gasoline reflects a portion of the immediate costs for those who drive to the event the week of the race. However, anecdotal evidence suggests that the price of gasoline, and the percentage of the household budget spent on gasoline and other energy components, can influence consumption patterns in the future. Therefore, the moving average of the price of gasoline for the four weeks before each race is included to control for this longer-term impact of trends in the energy markets on attendance and television audience.

The contemporaneous measure of unemployment is the national unemployment rate for the month in which the race takes place as reported by the Bureau of Labor Statistics. The value of this variable is the same for all races that take place in a given month, potentially reducing the precision of the estimation. To increase the variation in unemployment leading up to the various races in the sample, the weekly new and ongoing jobless claims, as reported by the Department of Labor, are employed. Specifically, the weekly data provide an estimate of the active labor force and the total number of unemployed individuals who qualify for new and ongoing unemployment benefits. These data are used to calculate a percentage of the active work force that is unemployed *and* qualifies for unemployment insurance. The difference between the overall unemployment rate and the unemployment rate associated with insured workers is used as a proxy for that portion of the unemployment rate associated with uninsured workers. We include both measures to test whether there are differences in the impact of unemployment of insured and uninsured workers.

To accommodate this lack of perfect information, we replace the adjusted churn of the race itself with the average adjusted churn of the last three Sprint Cup races held at a particular race's track.[17] We use this three-race average as a proxy for the expected competitiveness of the race itself (the correlation between the three-race adjusted churn and the actual adjusted churn is 0.39). We also replace the number of caution flags for a particular race with the average number of caution flags during the previous three races held at a particular track; this is also used as a measure of the expected number of cautions during a particular race.

The results in Table 3 use the price of gasoline the week of the race and the level of national unemployment the month of the race. Either or both of these measures might not take into account the appropriate time frame during which decisions to attend are being made. To address this concern we replace the current month's total unemployment rate with the four-week moving average of the percentage of the workforce that is unemployed and qualifies for unemployment insurance and the four-week moving average of the percentage of the workforce that is unemployed but does not qualify for unemployment insurance.[18] The other explanatory variables remain the same as in the models in Table 3. The results of these models are reported in Table 4.

[17] If less than three races had been held at the track, we take the average adjusted churn of the races that have been held there.

[18] The percentage of the workforce that is unemployed and qualifies for unemployment insurance is directly reported by the Department of Labor on a weekly basis. We measure the percentage of the workforce that is unemployed and does not qualify for unemployment insurance as the difference between the current month's national unemployment rate and the current week's percentage of the workforce that is unemployed and qualifies for unemployment insurance. While it is possible that a small amount of measurement error is introduced in assessing the number of

The results in Table 4 generally mirror those in Table 3. In the case of attendance, Model (1) in Table 4 shows that the greater the three-race adjusted churn and races held on Sunday correlate with greater attendance while road-course races and the three-race average number of caution flags are negatively related to race attendance. The macro-economic related variables remain statistically insignificant suggesting that the lack of a relationship between the state of the economy and race attendance is more nuanced than estimated here or that the relationship is simply not as strong as is commonly believed. The latter conclusion would imply there is something else happening in NASCAR that is changing attendance patterns.

The other two models reported in Table 4 generally confirm the results in Table 3. Unemployment is negatively related to television viewership as is the price of gasoline. However, only the percentage of the workforce unemployed that does not qualify for unemployment insurance is negatively related to television ratings. Unlike the actual number of caution flags during a race, the three-race average number of caution flags is significantly and negatively related to both television ratings and audience.

Overall the empirical evidence suggests that NASCAR attendance is weakly related to uncertainty of outcome, at least at the race level. On the other hand, television ratings and overall viewership are positively related to race uncertainty but negatively related to season-level uncertainty of outcome. However, given the concerns voiced by NASCAR and the media about the patterns of attendance and television audience during the 2009 season there may be concern that there was a structural break between the various measures of fan interest and the variables included in the empirical specification. If this is the case then pooling the three seasons in the same sample would be inappropriate and evidence of a structural break would support the concerns voiced by NASCAR and others.

To test for a structural break, a Chow Test was undertaken in which the restricted model uses the pooled sample of all three seasons and the unrestricted model has the 2007 and 2008 seasons in one sample and the 2009 season in a separate sample. The results of the Chow test are reported in Table 5. For each of the two sets of explanatory variables (those in Table 3 and those in Table 4) and for each of the three dependent variables the Chow test results suggest that it is not possible to reject the null hypothesis that the parameters of the various specifications are constant between the 2007-2008 seasons and the 2009

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the unemployed that do not qualify for unemployment insurance, it seems unlikely that this measurement error is correlated with the model's error term and therefore the only concern would be a loss of efficiency in the parameter estimates.

season. Thus, there seems to be no evidence of a structural break in the attendance, ratings or viewership of NASCAR events.

6. Conclusions

This paper fills a gap in the established literature documenting the impact of outcome uncertainty on fan interest in a number of sports, by applying the hypothesis to NASCAR. Specifically, this paper investigates the impact of two measures of outcome uncertainty, one at the race level and one at the season level, and on three measures of fan interest in NASCAR events: attendance, television ratings, and television viewership. The application of the uncertainty of outcome hypothesis is somewhat unique in the case of NASCAR because there is no "home team". Rather forty-three different teams compete simultaneously during the NASCAR event and throughout the season. In addition, the rank-order reward system of NASCAR suggests that measuring outcome uncertainty is a bit more complicated than in other sports.

In this paper, the uncertainty of outcome for a particular race is measured by using the adjusted churn developed by Mizak, et al (2007). To measure uncertainty of outcome at the season-level, the concentration of season-long performance points reflected by the Herfindahl-Hirschman Index is used. Data describing the 2007, 2008, and 2009 NASCAR Sprint Cup Series seasons are used to estimate various empirical models that relate attendance, television ratings, and television audience to variables describing the macroeconomic environment, the characteristics of the race, and the characteristics of the broadcast.

The empirical evidence suggests that the influence of competitive balance on fan interest in NASCAR events is consistent with the results from other sports. The higher the expected competitiveness of individual NASCAR races, i.e., greater uncertainty of outcome, the higher is fan interest reflected in attendance, television ratings, and television viewership. On the other hand, as the disparity in season-long performance points increases, suggesting less competitive balance over the course of the season, television ratings and viewership fall; attendance is not statistically influenced by season-level competitive balance.

Television ratings and television viewership are reduced when the NASCAR race competes with a high-interest sporting event, but attendance is not. Only viewership is positively related to races held on Sunday and races held at night. Road races are significantly less popular with NASCAR fans, both at the

track and on television. Races with more cautions, and hence less full-speed racing, are less popular with the television audience but not statistically so with the attending audience. This suggests that the television audience and the attending audience in NASCAR are somewhat segmented. We find evidence of greater television audience for races broadcast on ABC and higher ratings for races broadcast on ESPN and ABC.

The empirical evidence suggests that any rules changes on the part of NASCAR that lead to an improvement in race-level competitive balance stand to yield benefits in both attendance and the television audience. Indeed, there was considerable discussion during the 2009 NASCAR season concerning reduced attendance and television audience. It is entirely possible that the recession of 2008 and 2009 encouraged substitution from attending NASCAR races to watching them on television; the amount of additional people watching the event might not be captured by the relatively blunt measures by the Nielsen ratings service. In addition, the way that attendance to NASCAR events is reported might not reveal a dramatic decline in attendance caused by the changing macroeconomic environment. However, the evidence provided here suggests that attendance during the three seasons investigated was not related to the price of gasoline and the unemployment rate, both of which might proxy for direct and indirect costs of attending the race in person.

On the other hand, any rules or structural changes to NASCAR as a sport that reduce competitive balance are expected to reduce both attendance and the television audience. Given the results obtained here, it seems that the common cause of reducing both race attendance and the television audience would be declining competitive balance at the race and season levels. As shown in Figure 1, it seems that competitive balance at the race level during the 2009 season was considerably lower than during the 2007 and 2008 seasons. NASCAR has changed the rules of how the races are run and what is and is not allowed on the cars, epitomized by NASCAR standardizing all cars to the so-called "Car of Tomorrow," introduced intermittently during the 2007 season and which all drivers have used since the 2008 season. If the Car of Tomorrow has significantly reduced the uncertainty of outcome or, perhaps, increased the number of accidents, then the innovation might have had an unintended consequence of reducing fan interest in NASCAR even as it made drivers safer. The actual impact of the "Car of Tomorrow" on competitive balance is an avenue for future research.

In conclusion, we find that the uncertainty of outcome hypothesis pertains to the sport of NASCAR and that the television audience for NASCAR races seems segmented from those who

attend the races in person. While it is entirely possible that the economic slowdown of 2008 and 2009 might have reduced attendance to NASCAR races as suggested by many commentators, the evidence found here is that the price of gasoline and the unemployment rate did not materially impact attendance and therefore either the drop in attendance is not large enough to be detected with standard statistical techniques or the macroeconomic influences that reduced attendance were not correlated with either the price of gasoline or the level of unemployment.

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Table 1: Descriptive Statistics of the Data

Variable	Description	Mean	Std. Dev.	Min	Max
ATTENDANCE	Reported attendance	117,717	40,831	40,000	270,000
RATINGS	Nielsen television ratings (percentage of households)	4.35	1.33	1.66	10.200
VIEWERS [a]	Nielsen television viewership (thousands)	6,739.49	2,479.25	1,994	17,752
ADJCHURN	Adjusted churn of the race	0.515	0.090	0.287	0.738
LAST3ADJCHURN	Average adjusted churn for the previous three races held at the current race track.	0.523	0.061	0.392	0.670
HHI	Herfindahl-Hirschman Index of season level performance points heading into race	262.28	45.36	0	301.79
GASPRICE	All grades average gas price week of race	297.25	57.40	196.3	416.5
GASPRICE4WK	All grades average gas price four weeks before race	291.65	57.77	190.5	410.0
UNEMP	Current month U.S. unemployment rate	6.62	2.11	4.4	10.2
IUNEMP4WK[b]	Average total insured unemployment rate four weeks before race	2.83	1.12	1.6	4.77
UUNEMP4WK	Estimated uninsured unemployment rate (unemp-IUNEMNP4WK)	3.78	1.16	2.12	6.45
SUNDAY	Race occurred on Sunday (1=Yes)	0.80	0.40	1	0
SEVENPM	Race occurred at night (1=Yes)	0.13	0.33	1	0
CHASE	Race is part of the "Chase for the Cup" (1=Yes)	0.27	0.40	1	0
ROAD	Race occurred on a road course (1=Yes)	0.05	0.23	1	0
CAUTIONS	Total caution flags in the race	8.98	3.25	3	21
LAST3CAUTIONS	Average caution flags for last three races at the track.	9.41	2.49	5.66	17.66
ABC	Race broadcast on ABC Network (1=Yes)	0.30	0.46	0	1
ESPN	Race broadcast on ESPN Network (1=Yes)	0.17	0.38	0	1
FOX[c]	Race broadcast on Fox Network (1=Yes)	0.36	0.48	0	1
TVEVENT	Another high-interest sporting event held on day of race (1=Yes)	0.38	0.48	0	1
TVEVENTMONTH	TVEVENT times month of the year	2.19	3.08	0	11

Notes: Sample is comprised of 108 observations from the 2007, 2008, and 2009 NASCAR seasons.

[a] Based on 105 observations as three races have unreported data.

[b] The reported weekly claims for employment insurance as reported by the Bureau of Labor Statistics (not seasonally adjusted). The measure is calculated by taking total applications (new plus ongoing) as a percentage of the reported covered portion of the labor force. [c] The omitted network is TNT which accounted for 16% of all broadcasts.

Table 2: High-Interest Sporting Events in Competition with NASCAR Broadcasts (2007, 2008 and 2009 Seasons)

Competing Event	2007 Date	2008 Date	2009 Date
NBA All-Star Game	2/18/2007 Sunday	2/17/2008 Sunday	2/15/2009 Sunday
NCAA Basketball Tournament	3/18/2007 Sunday		3/22/2009 Sunday
World Baseball Classic Semifinals involving U.S. Team			3/22/2009 Sunday
MLB Opening Weekend	4/15/2007 Sunday	4/6/2008 Sunday	4/5/2009 Sunday
PGA Masters		4/12/2008 Saturday	
NHL Conference Quarterfinals	4/15/2007 Sunday 4/21/2007 Saturday	4/12/2008 Saturday	4/18/2009 Saturday 4/26/2009 Sunday
NBA Conference Quarterfinals	4/21/2007 Saturday 4/29/2007 Sunday	4/27/2008 Sunday	4/18/2009 Saturday 4/26/2009 Sunday 5/2/2009 Saturday
NHL Conference Semifinals	5/6/2007 Sunday	5/3/2008 Saturday	5/2/2009 Saturday 5/9/2009 Saturday
NBA Conference Semifinals	5/6/2007 Sunday	5/3/2008 Saturday 5/10/2008 Saturday	5/9/2009 Saturday
NHL Conference Finals	5/13/2007 Sunday	5/10/2008 Saturday	5/24/2009 Sunday
NBA Conference Finals	5/10/2007 Sunday	5/25/2008 Sunday 6/8/2008 Sunday	5/24/2009 Sunday
NHL Finals	6/4/2007 Sunday		5/31/2009 Sunday
NBA Finals	6/10/2007 Sunday	6/15/2008 Sunday	6/7/2009 Sunday 6/14/2009 Sunday
PGA US Open	6/17/2007 Sunday	6/15/2008 Sunday	6/21/2009 Sunday
1st NFL Preseason Game		8/17/2008 Sunday	
Beijing Olympics		8/23/2008 Saturday	
NFL Opening Weekend		9/7/2008 Sunday	
US Open Tennis	9/8/2007 Saturday	8/31/2008 Sunday 9/7/2008 Sunday	9/12/2009 Saturday
MLB American League Championship Series (Game 2)			10/17/2009 Sunday
MLB World Series (Game 4)			11/1/2009 Sunday

Table 3: Estimation Results using Contemporaneous Values

	(1) ATTENDANCE	(2) RATINGS	(3) VIEWERS
ADJCHURN	59,682.511	2.527***	5,908.902***
	(39,527.211)	(0.810)	(1,341.793)
HHI	-61.888	-0.015***	-27.742***
	(53.290)	(0.002)	(2.833)
GASPRICE	43.022	-0.006***	-13.063***
	(78.175)	(0.002)	(3.780)
UNEMP	367.772	-0.758***	-1,474.728***
	(7,643.796)	(0.233)	(439.152)
SUNDAY	16,035.318	0.817***	1,032.305***
	(9,924.677)	(0.298)	(368.749)
SEVENPM	6,527.238	0.587*	841.067**
	(11,618.221)	(0.303)	(379.248)
CHASE	-10,232.245	-0.851**	-1,064.355*
	(9,649.138)	(0.375)	(543.525)
ROAD	-51,852.212***	-0.094	-139.806
	(12,677.341)	(0.348)	(472.237)
CAUTIONS	-2,021.905*	-0.031	-77.213**
	(1,024.434)	(0.019)	(32.332)
TVEVENT	5,924.861	-1.177***	-2,108.621***
	(15,316.127)	(0.419)	(655.354)
TVEVENTMONTH	-1,998.450	0.119*	226.127**
	(2,562.524)	(0.064)	(91.391)
YR2007	9,910.965	-3.020***	-6,063.132***
	(36,941.541)	(1.128)	(2,155.905)
YR2008	5,234.125	-1.513*	-3,092.975*
	(30,846.723)	(0.822)	(1,557.706)
ESPN		-0.229	-424.618
		(0.346)	(474.182)
ABC		0.299	1,104.382*
		(0.367)	(566.110)
FOX		0.491	1,462.590***
		(0.302)	(529.033)
CONSTANT	95,233.990	15.226***	27,284.494***
	(80,972.250)	(2.344)	(4,361.640)
Observations	108	108	105
R-squared	0.235	0.789	0.851

Notes: Variables are defined in Table 1. A Prais-Winsten estimator was applied in each specification. For three races reported viewership is missing. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4: Estimation Results Using Lagged Values

	(1) ATTENDANCE	(2) RATINGS	(3) VIEWERS
LAST3ADJCHURN	139,171.433*** (43,076.663)	2.050* (1.074)	3,393.224* (1,835.671)
HHI	-77.337 (50.326)	-0.016*** (0.002)	-28.893*** (2.638)
GASPRICE4WK	155.722 (126.135)	-0.006 (0.004)	-16.908*** (6.226)
IUNEMP4WK	17,158.277 (15,541.764)	-0.488 (0.595)	-1,778.586* (995.309)
UUNEMP4WK	-2,205.072 (7,239.651)	-0.698*** (0.234)	-1,316.196*** (459.448)
SUNDAY	18,049.077* (10,347.771)	0.832*** (0.300)	995.544*** (375.602)
SEVENPM	8,244.532 (11,166.558)	0.717** (0.336)	848.343* (464.408)
CHASE	-3,505.671 (11,050.491)	-0.805** (0.394)	-1,048.673 (662.381)
ROAD	-51,968.472*** (12,947.395)	-0.087 (0.339)	-23.686 (432.697)
LAST3CAUTIONS	-2,171.654** (1,038.633)	-0.088*** (0.025)	-129.994*** (46.242)
TVEVENT	3,044.891 (16,223.220)	-1.374*** (0.385)	-2,218.848*** (653.213)
TVEVENTMONTH	-873.499 (2,638.757)	0.138** (0.057)	226.554** (90.512)
YR2007	43,885.157 (43,492.636)	-2.017 (1.665)	-5,846.516* (3,045.409)
YR2008	19,952.537 (32,920.907)	-0.808 (1.150)	-2,867.810 (2,143.483)
ESPN		-0.209 (0.349)	-343.510 (492.577)
ABC		0.352 (0.382)	973.781 (624.064)
FOX		0.651* (0.332)	1,697.647*** (586.542)
Constant	-32,347.392 (103,196.263)	14.421*** (4.076)	30,556.486*** (6,693.206)
Observations	108	108	105
R-squared	0.264	0.797	0.834

Notes: Variables are defined in Table 1. A Prais-Winsten estimator was applied in each specification. For three races reported viewership is missing. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5: Chow Tests for Parameter Constancy between 2007/2008 and 2009

H_0: Parameter Constancy between 2007/2008 and 2009 Seasons	**ATTENDANCE**	**RATINGS**	**VIEWERS**
From Table 3	0.215	0.804	0.940
From Table 4	0.437	1.682	1.696

Notes: The Chow (1960) test for parameter constancy is calculated as

$$CHOW = \frac{(RSS_{2007,2008,2009} - (RSS_{2007,2008} + RSS_{2009}))/m}{RSS_{2007,2008,2009}/(N-2k-2)} \sim F[m,N\text{-}2k\text{-}2],$$

where $RSS_{2007, 2008, 2009}$ is the residual sum of squares from the regression using all observations, $RSS_{2007, 2008}$ is the residual sum of squares from the regression using 2007 and 2008 season, and RSS_{2009} is the residual sum of squares from the regression using only the 2009 season, *m* is the number of parameters in each specification (13 for attendance and 16 or 17 for ratings and viewers), and N-2k-2 are the degrees of freedom in the unrestricted model. The critical values for each test differ because there are varying degrees of freedom for the six different specifications tested. The degrees of freedom for the statistics corresponding to the first row are [13, 80], [16, 74] and [16, 71], with critical values at the 5% level of 1.844, 1.782, 1.788, respectively. The degrees of freedom for the statistics corresponding to the second row are [14, 78], [17, 75], and [17, 69], with critical value at the 5% level of 1.820, 1.766, 1.772, respectively.

Figure 1

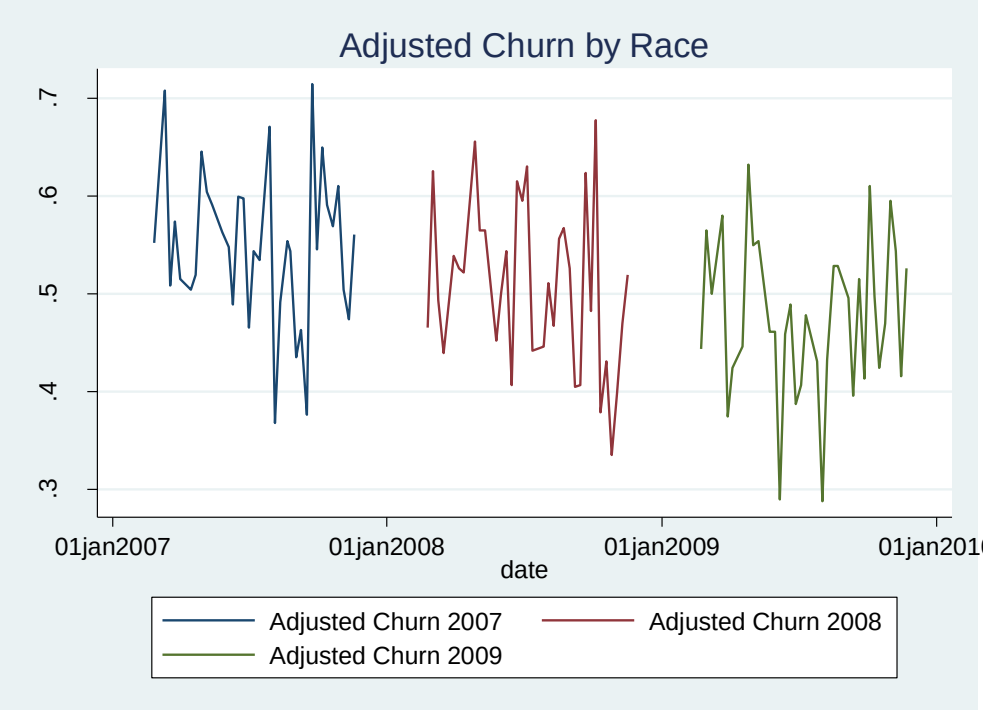


Figure 2

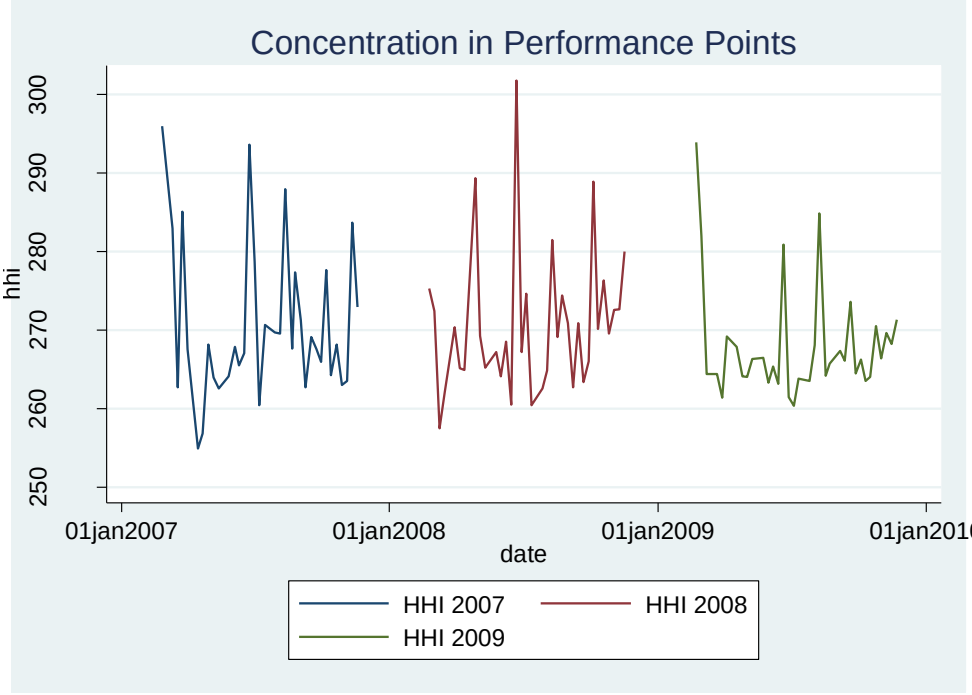


Figure 3

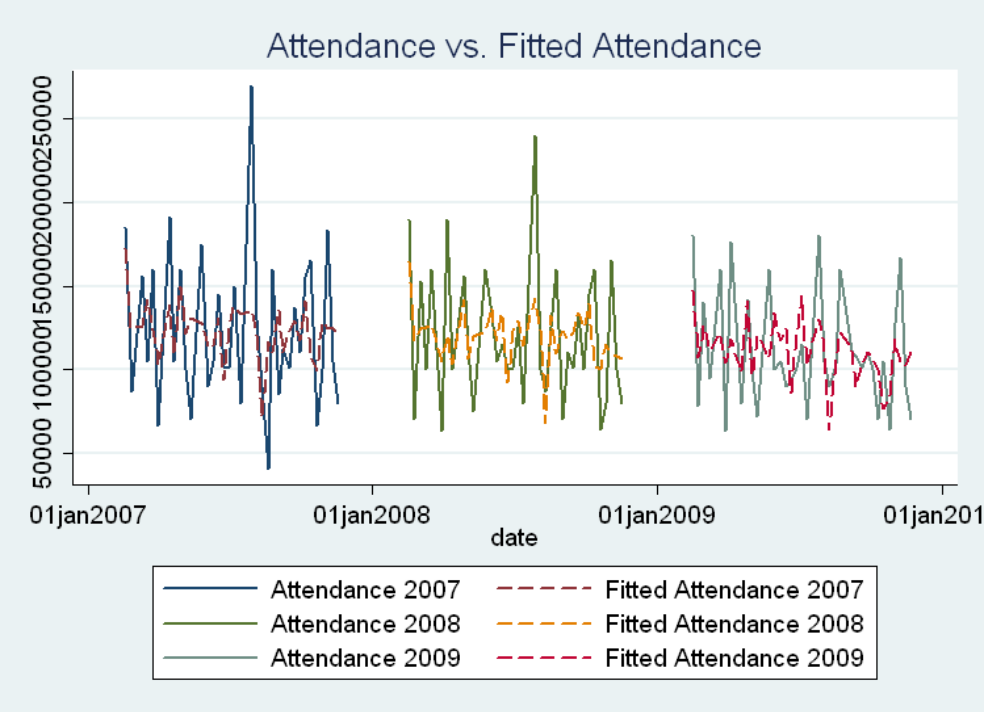


Figure 4

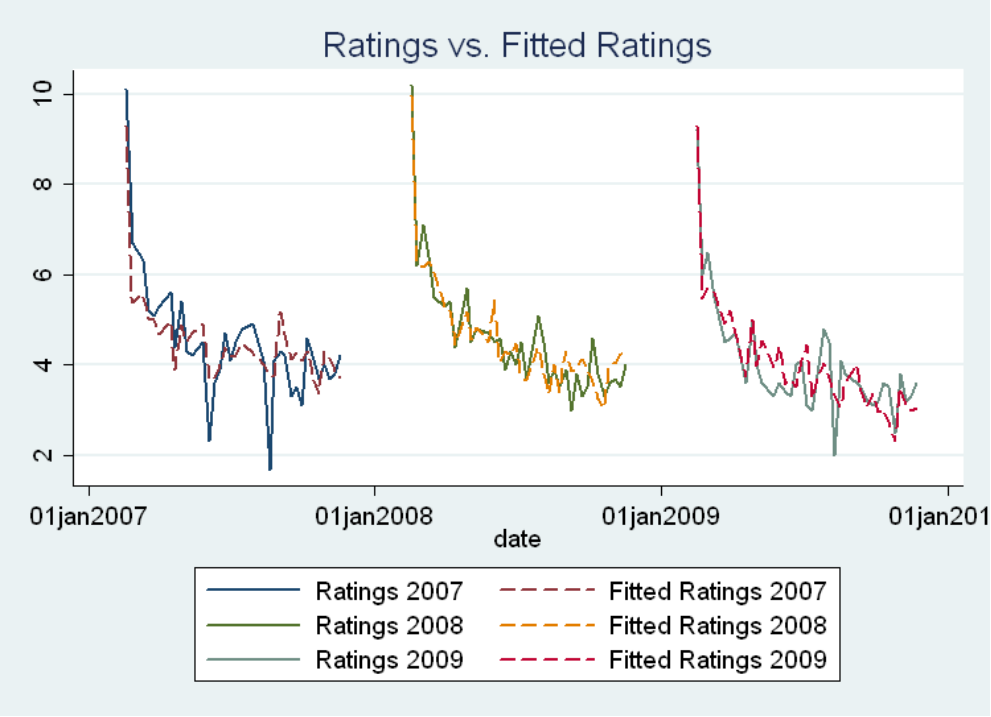
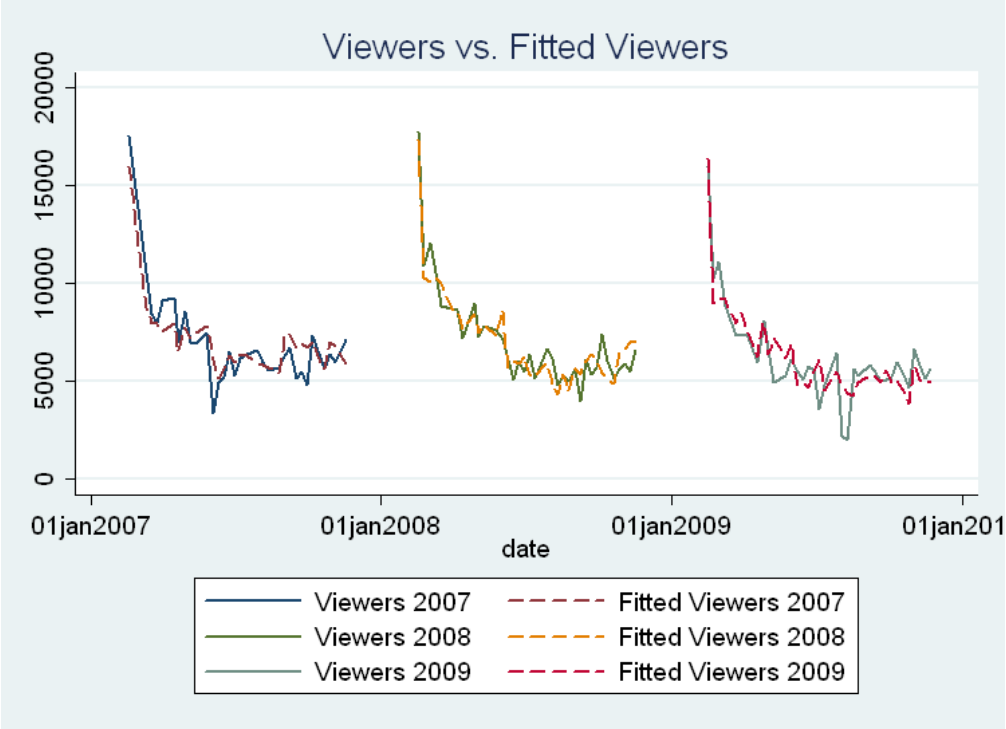


Figure 5


Viewers vs. Fitted Viewers
0
5000
10000
15000
20000
01jan2007
01jan2008
01jan2009
01jan201
date
Viewers 2007
Viewers 2008
Viewers 2009
Fitted Viewers 2007
Fitted Viewers 2008
Fitted Viewers 2009