RISK TAKING IN NASCAR: AN EXAMINATION OF COMPENSATING BEHAVIOR AND TOURNAMENT THEORY IN RACING

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ABSTRACT

NASCAR racing provides an interesting backdrop to test two theories about incentives and behavior. The compensating behavior theory predicts that if drivers race under safer conditions, they are likely to undertake riskier behavior. Using data from the NEXTEL Cup Series, the paper finds that once drivers were required to wear a new safety device, there was a change in the percentage of miles run under caution. That is, racers drove more aggressive and riskier after October 2001. Tournament theory predicts that non-linear rewards promote more competitive behavior. Starting in 2004, the method for deciding the NEXTEL season champion was changed to encourage racing throughout the season. To compete for the season championship, drivers are motivated to drive safely and stay in each of the first 26 races. After that point only the top ten drivers compete for the series championship, racing to win the non-linear season-ending awards. As a result, we expect racers to drive riskier in the second part of the season. The paper compares NEXTEL driving behavior across three NASCAR series (the other two not competing under the new structure). The results support the theory that NEXTEL Cup Series racers do drive riskier over the last portion of the season. There is not a similar change in the behavior of drivers in the other two series.

INTRODUCTION

In 2001, Dale Earnhardt, seven-time NASCAR driving champion, was killed in a wreck in NASCAR's Daytona 500. The sport of stock car racing has changed in several ways since that date, including improved driver safety and winning strategy. Eleven months after Earnhardt's death, all NASCAR drivers were required to wear a new safety device.[1] Beginning in 2004, NEXTEL became the title sponsor of NASCAR's premier racing series and instituted a "Chase for the

Champion" tournament format for the last 10 races of the season. This paper uses a proxy for risk taking (the percentage of miles run under caution due to accidents) and examines whether NASCAR drivers have responded to the higher level of safety (as predicted by "compensating behavior" models) combined with higher incentives for risk-taking (based on "tournament theory.")

To examine the first question, data for only one NASCAR series are used. The paper asks, "Did racers drive riskier when the new safety requirements were mandated?" To answer the second question, this research takes a unique approach utilizing NASCAR's product structure to examine predictions of driver behavior under rank-order tournaments. In addition to the NEXTEL Cup series, NASCAR sponsors two other racing series, the Busch racing series and the Craftsman Truck Series. Competing with similar equipment (including cars and tracks) and with some common drivers, these second-tier series do not race under the new championship tournament structure. As a result, the difference in risk taking in these two series versus the NEXTEL Cup Series should reflect the impact of the tournament risk-taking behavior - do drivers approach winning differently with more money and prestige up for grabs?

This paper is divided into several sections. First, a short history of NASCAR racing is provided. Next, a literature review addresses previous research regarding compensating behavior and tournament theory. A discussion of the data set follows. Finally, regressions and results are provided.

NASCAR BACKGROUND[2]

The National Association of Stock Car Auto Racing (NASCAR) was founded in 1948 to provide a sanctioning body for several types of car and truck racing. NASCAR is responsible for creating and enforcing the rules under which these races are run, scheduling the races and also for assuring that the winners are paid.[3] This paper focuses on three race series under the NASCAR umbrella: the NEXTEL Cup Series (the premier level of stock car racing); the Busch Series; these cars have lower horsepower and slightly different specifications compared to the NEXTEL series cars; and the Craftsman Truck Series (this series races modified pickup trucks). Many drivers in the NEXTEL Cup Series gain experience by racing in these second-tier classes early in their careers; some drivers continue to race in several series even throughout their careers.

NEXTEL Cup races have been taking place since 1949, while the other two series have been racing since 1982 (Busch Series) and 1993 (Craftsman Truck

Series). NEXTEL refers to the major sponsor of the series. J.R. Reynolds sponsored the series prior to 2004, and the series was called the WINSTON Cup.

In recent years, the NEXTEL Cup Series has scheduled 36 races, the Busch Series has 35 races and the Craftsman Truck series has 25 races. The number of races and locations has varied over the years, although some tracks (like Martinsville, Daytona and Darlington) have been hosting races since the 1940s and 1950s. The races last for different lengths, some 250 miles, others 500, still others are 600 mile races run for over four hours. Depending on the length of the tracks, some races are 50 laps while others are 400. In order to be able to race in a certain race each weekend, cars must "qualify." (The Daytona 500 uses its own system for determining which cars are allowed to race, but it still has a qualifying speed.) Usually the day before the race, the cars race against the clock, with the 43 fastest cars (or 36 trucks) being awarded starting positions, the fastest being awarded "the pole," or the pole position. Over the past 50 years, these pole qualifying speeds have increased. For example, at Darlington, the qualifying speed has risen from 85 miles per hour in the 1950s to 190 miles per hour today. At other courses, the qualifying speed has remained constant; for example Talladega (outside Birmingham, Alabama) has been hosting races for about 35 years and its qualifying speeds have remained about 190 miles per hour. Qualifying speeds for the other series are slightly slower. Average speeds (and changes in average speeds) for all three series are affected by several factors: technology, track design[4], track conditions and risk taking by drivers.

Track conditions and rules can change from season to season due to factors like track paving, the size of restrictor plates, and the installation of safety features like padded walls. These all affect the number of accidents and the number of laps "run under caution." Whenever dangerous conditions occur on the track, an official notifies the cars that the safety car is coming on the track and will set the speed for racing while the conditions are remedied.[5] The safety car slows the speeds and all of the cars must stay behind the safety car and cannot advance their position in the race. These laps "run under caution" are counted as laps in the race. The dangerous condition can arise from cars crashing into one another and leaving crash debris on the track (that is dangerous for other cars to run over) or from cars merely bumping into one another. Non-race related factors can sometimes cause the caution flag to be thrown. The track's paving may produce pebbles or tires may lose their rubber; oil or liquid may be seen on the track; or sometimes cars may stall on the track. While NASCAR races are not run in heavier rain conditions, sometimes laps are run under caution while slight rainfall occurs. In fact, NASCAR cars do not even have headlights or brake lights for driving in rain (glass is a safety concern) – the "lights" on the cars are just stickers (Elliott, 2006). NASCAR provides statistics that note whether a caution lap is due to an accident or due to other track conditions.

To make racing safer, NASCAR requires the following basic safety devices for drivers and/or cars: fire-retardant suit and gloves; helmet and restraint system; a five-point harness system; roll cage; and fuel cell. Most tracks (except road courses) have concrete walls surrounding the track.

Since 1971, sixteen drivers have been killed in the three racing series. Earnhardt was killed when his car slammed into the wall during the Daytona 500. Experts speculated that his death (and some others throughout the years) was caused when his neck was fractured at the base of skull. In essence, the car violently and abruptly stops, while the driver's body is still accelerating. To help address this problem, developers designed a restraint system that attaches a harness to the racer's body and straps the helmet to a collar. It prevents the neck and head from being snapped too violently and causing a similar injury.[6] In October 2001, NASCAR required drivers in these series to use the HANS device or similar ones. No one has died in any NASCAR events since then.[7] In the first half of this paper, we examine whether this change promotes riskier driving.

In 1949, Red Byron won two races and $5800 and was named the NASCAR champion.[8] In 1975, a point system was instituted to reward drivers for winning a race, leading a lap during the race, or leading the most laps. At the end of the season, racers' points were added, and the winner was decided. For example, in 1975 champion Richard Petty won 10 races and $379,000. In 2003, the champion was Matt Kenseth. He won only one race, but still took home over $4 million in winnings. This point system was in place through 2003. One drawback (at least from the spectator viewpoint) of this point system was that by the last few races in the season, the winner had already been decided.

In 2004, NASCAR decided to the change the points system to encourage racing throughout the season.[9] During the season's first 26 races, drivers accumulate points that will qualify them for "the Chase for the Championship" using the existing point system. For the last 10 races of the season, only 10 racers with the most points are actually in a position to win the championship. (The top 10 drivers have their points "reset" higher by 5000 points so that none of the other drivers can catch them. These other drivers are racing to acquire other perks including lower prize money and automatic qualifying for the next season). As result of this new tournament structure, racers are encouraged to stay in the race for the first 26 races, racing safely to accumulate win and lap points. Getting in a wreck during these races and losing the chance to acquire any points, is very costly. The driver may lose the chance to qualify for “the Chase.” The other two series (Busch and Craftsman) are still using the regular point system where no subset of drivers competes for a special award. This feature – two different tournament structures – provides the experiment for the second-half of this paper. We should expect to see the level of risk-taking vary over the three series.

LITERATURE REVIEW

Two different theories and their impact on risk-taking behavior are addressed in this paper. Both theories, compensating behavior and tournament schemes, predict that agents will engage in more risky behavior the lower the cost of errors and the higher the payoff.

Addressing the compensating behavior literature, Peltzman (1975) initiated discussion in this arena by predicting that increased safety devices in automobiles should lead drivers to undertake riskier behavior. Eponymously called the Peltzman Effect, his results showed that the number of injuries and fatalities increased after the federal government required manufacturers to install seat belts in cars. Subsequent research highlighted the problems of trying to isolate the effects of driving conditions, driver ability and preferences, law enforcement, road conditions, etc. from the effects of drivers’ using seat belts. For example, Singh and Thayer (1992) examine individual behavior and find that the predictions of compensating behavior hold only when drivers are “not strongly risk averse” – quite an understatement of NASCAR drivers’ personalities. When analyzing responses to auto safety features, Lave and Weber (1970) and Blomquist (1991), specify a cost/benefit analysis and find that people do respond to “changes in the net benefit” by undertaking more risk. Blomquist also included child seats and motorcycle helmets in his analysis. Traynor (2003) notes the difference between regulations to reduce the losses caused by accidents (i.e. death) versus regulations to actually reduce the number of accidents. As expected, he finds that there are increases in “externalities” or accidents as a result of the former. Analogous to this result, we expect to find that NEXTEL Series drivers engaging in more risky behavior, exhibited by closer and faster driving that results in more miles run under caution due to accidents.

That might be the end of the story except for the fact that NASCAR changed risk-taking incentives again in 2004. Lazear and Rosen (1981) introduce the idea that rank-order tournaments are an efficient way to promote optimal behavior especially when differences in ability are hard to determine or luck is involved. In addition to using tournament theory to explain executive compensation, the theory has been applied to sports as well. Given that the prize money is determined prior to the tournament (or race or championship) and that the purse is not evenly split among participants (a non-linear reward system), there is motivation to be more competitive. For example, Ehrenberg and Boganno (1990) find that golfers played better as prize money increased. Von Allmen (2001) questioned the efficiency of NASCAR's point system using data from 1998-1999. He noted that the *point* system used for individual races was linear. Given that a rank-order tournament would have been more appropriate, he rationalized that NASCAR's point system supported the profit-maximizing function of teams and the need to control "excessively aggressive behavior."[11] In changing the structure of the point system, the new "Chase" keeps the linear point system in each race, but changes the motivation for risk-taking after the twenty-sixth race. At that point, drivers face a different environment. Results from only 10 races matter – the need to acquire points becomes immediate and drivers cannot afford to fall behind.

To summarize, the two questions this paper examines are: 1) given the compensation behavior theory, do we see NEXTEL Cup drivers driving riskier as a result of using the HANS device; and 2) given tournament theory, do we see NEXTEL Cup racers driving safer over the first 26 races, but more risky over the last 10 when the champion is decided. Given data constraints, we consider only NEXTEL Cup data to answer the first question. We use data for all NEXTEL, Busch and Craftsman Truck series to answer the second question

DATA

This paper uses NASCAR data using race reports that include (among others) pole speeds, average speeds, cars in accidents, and laps run under caution.[12] The paper uses 10 years of NEXTEL Cup data (1997-2006) and three years of data for the Busch and Craftsman Truck Series (2004-2006). We chose these years for the NEXTEL Cup data because changes in cars and technology were fairly consistent and comparable. Specific data for laps under caution (i.e. numbers of cars and reason for the cautions) were only available from 2004 forward for the Busch and Craftsman Truck Series.

To proxy for risk-taking[13], this paper uses the ratio (ACCMILES):

$$\frac{\text{miles run under caution due to accidents}}{\text{total miles in the race.}}$$

By considering the miles under caution due to accidents, we capture drivers' risk taking. We assume the more aggressive and risky drivers race, the closer they race, the more accidents occur and the more caution laps run. According to the compensating behavior story, we should see NEXTEL drivers taking more risk from October 2001 forward. If drivers believe there is a smaller risk of dying while wearing the HANS device, there should be more evidence of riskier driving (a change in the percentage of miles under caution).

We use the same proxy for risk taking when examining all three series and whether the new tournament structure affects the NEXTEL drivers but not drivers from the other two series.

In all cases, we use other variables to explain the number of miles under caution. These include the length of the track. "Short tracks" (less than a mile in length) compress the cars into tighter racing packs. Restrictor-plate races encourage cars to also run in packs to enjoy the benefits of aerodynamics and drafting.[14] Pole speeds provide an idea of how fast cars can go on the track. Average race speeds reflect the track design and also the number of crashes – the more miles under caution, the lower the average speed. Data for the total race purse is also provided. This data is deflated using the Consumer Price Index. To capture the fact that less experienced drivers may cause accidents, the number of rookie drivers finishing NEXTEL Series Cup races is used. Rookie classification is determined using NASCAR rules. Another factor that can impact the number of miles under caution is the number of cars on the track. NASCAR race reports provide the reasons that cars do not finish each race, the main reasons being accidents or engine trouble.

REGRESSIONS AND RESULTS

To examine whether NASCAR drivers respond as these theories predict, we estimate two sets of regressions. In one set, we use 10 years of NEXTEL Cup Series data to determine whether drivers compensate in response to wearing the HANS devices. In another set, we rearrange the data and use three years of NEXTEL Cup, Busch and Craftsman Truck Series data and examine whether changes in the tournament prize money structure elicit a change in driving behavior.

Using ACCMILES as a proxy for risk taking, a Chow test is used to determine whether there is a change in coefficients after the new safety rule was imposed. With data from 1997 through 2006, we estimate:

$$ACCMILES_t = c + \beta LEFT_t + \gamma SPEED_t + \delta ROOKIE_t + \eta PLATE_t + \theta SHORT_t + \rho POLE_t + \lambda RPURSE_t + e_t \quad (1)$$

for 328 races. To explain why the number of accident miles may vary by race, we consider:

- the percentage of cars (that started the race) LEFT racing by the race's end. It's assumed the more cars on the track, the greater the chance for accidents;
- the log of the average SPEED of the race. The faster the cars go, the more accidents they should get in or cause;
- the number of ROOKIES that finish the race. A greater number of inexperienced drivers should cause more accidents;
- PLATE is a dummy variable that is 1 when cars are required to use restrictor plates and 0 otherwise. Tighter racing conditions in restrictor plate races increase the chance for accidents;
- SHORT is dummy variable that is 1 when the track is shorter than one mile (causing tight racing conditions) and 0 otherwise;
- the log of POLE is the winning qualifying speed for the pole position and reflects the true speed attainable on the track. It makes sense that the faster the cars go, the greater the chance is for an accident;
- RPURSE is the log of the total race's purse converted into natural logs. It is assumes that drivers are motivated by winning more prize money; and
- an error term that is assumed to be normally distributed with mean 0.

The race data were divided into two segments:[15]
No HANS required - race one in 1997 through the race 28 in 2001; and
HANS required – race 29 in 2001 through the last race in 2006.

Results from this initial regression indicated two adjustments needed to be made. White's test for heteroskedasticity is significant, and the coefficient on SPEED is negative. As cars get in accidents due to high speeds, ACCMILES increases, but when the pace car comes out to slow the race so the track can be cleaned, SPEED decreases. That is, an increase in ACCMILES can cause a decrease in SPEED. To correct for both of these problems, the regression is re-estimated using instrumental variables and MAC2 (a TSP-version of a Chow Test that corrects for heteroskedasticity based on Thursby (1993)).

Results for a corrected equation 1 appear in Table 1. Focusing on the Chow test result, note that the p-value of 0.49 shows that drivers are not driving riskier – there doesn't appear to be compensating behavior in response to the new HANS safety device required in October 2001.

Table 1: NEXTEL Cup Series Chow Test for Compensating Behavior, 1997-2006
Dependent Variable: $ACCMILES_t$

	1997-2006	HANS not required	HANS required
C	.81 (0.00)**	.61 (0.00)**	.61 (0.00)**
LEFT	-.0006 (0.55)	-.005 (0.00)**	-.003 (0.02)*
SPEED	-.59 (0.00)**	-.25 (0.00)**	-.35 (0.00)**
ROOKIE	-.002 (0.17)	-.002 (0.26)	.00 (0.99)
PLATE	.06 (0.00)**	.008 (0.49)	.03 (0.00)**
SHORT	-.02 (0.12)	.01 (0.28)	.009 (0.30)
POLE	.44 (0.00)**	.16 (0.01)**	.23 (0.00)**
RPURSE	-.005 (0.74)	.002 (0.50)	.002 (0.65)
	R^2 = 0.55 Chow (p-value)= 0.49	R^2 = 0.64	R^2 = 0.68

** indicates a p-value significant at the 1% level; * indicates significant at the 5% level.

However, this result could be clouded due to the introduction of 2004's "Chase for the Champion." We suspect that drivers' motivation to compete over the season changed. Therefore, there are conflicting incentives facing drivers: drive riskier because it's safer versus drive safer to accumulate points throughout the season and compete in the "Chase."

To disentangle these effects, we re-estimate equation 1 using data through 2003. These results are presented in Table 2. The Chow test results show that drivers are driving riskier. The p-value (0.00) for the Chow test is significant; the coefficients over the two periods differ. As predicted by the compensating behavior theory, racers drive riskier in response to the HANS device being required. That is, when the penalty for taking risks falls, racers compensate by driving more aggressively.

Table 2: NEXTEL Cup Series Chow Test for Compensating Behavior, 1997-2003
Dependent Variable: $ACCMILES_t$

	1997-2003	HANS not required	HANS required
c	.69 (0.00)**	.61 (0.00)**	.39 (0.00)**
LEFT	.0005 (0.99)	.06 (0.51)	-.07 (0.43)
SPEED	-.66 (0.00)**	-.77 (0.00)**	-.47 (0.00)**
ROOKIE	-.003 (0.11)	-.004 (0.12)	-.0005 (0.83)
PLATE	.07 (0.00)**	.08 (0.00)**	.05 (0.00)**
SHORT	-.02 (0.12)	-.04 (0.09)	.007 (0.69)
POLE	.50 (0.00)**	.58 (0.00)**	.36 (0.00)**
RPURSE	-.00006 (0.98)	.005 (0.32)	.006 (0.49)
	R^2 = 0.51 Chow (p-value)= 0.00	R^2 = 0.42	R^2 = 0.68

** indicates a p-value significant at the 1% level; * indicates significant at the 5% level.

The next section of this paper focuses on the tournament theory. We propose that NEXTEL Cup drivers will behave differently over the race season. During the first 26 races, drivers have an incentive to stay in the race, accumulate points and be one of the top-ten drivers. For the last ten races, only these drivers are competing to be named the series champion and collect the monetary award. Given the non-linearity of this tournament reward, we expect drivers to take on more risk over this period. That is, for NEXTEL Cup Series there should a difference between the miles run under caution over the first 26 races versus the last ten (or 28 percent of the season). Because the Busch Series and the Craftsman Truck Series did not compete using a similar re-structuring, we don't expect the number of miles run under caution to change over the season. (These series are still racing under the tournament structure described by von Allmen (2001) that promotes less aggressive driving.)

We re-organize the NEXTEL data stacking the first 26 races for each year for 2004, 2005 and 2006; and then stack the last 10 of each year (108 races). We organize the data for the other two series (Busch and CTS) using the same format save one difference. Because the other two series have fewer races, we divide the season based on the same ratio of races that NEXTEL uses: Busch Series (72/28) and Craftsman Truck (55/20). We estimate a similar regression as in the first part of the paper:

$$ACCMILES_t = c + \beta LEFT_t + \gamma SPEED_t + \eta PLATE_t + \theta SHORT_t + \rho POLE_t + \lambda RPURSE_t + e_t . \qquad (2)$$

The only difference is the omission of the ROOKIE variable. The two second-tier series are expected to have less-experienced drivers, and the definition of "rookie" in those series is harder to pinpoint. Because we want to compare the three series on the same basis, we omit ROOKIE from the NEXTEL regression. Given that its coefficient was insignificant in the earlier regression, we do not feel that meaningful information has been lost. The results from these regressions are presented in Tables 3, 4 and 5. (The estimates have also been made using the MAC2 program and instrumental variables.)

These results tend to confirm the predictions of tournament theory. Using the NEXTEL data set results shown in Table 3, the Chow test (with a p-value of 0.08) provides evidence that a change occurs in ACCMILES across the two periods. Drivers took more risks and drove more aggressively once the "Chase" started. A telling change occurs in the RPURSE; it becomes positive and significant over the "Chase" period. It appears that drivers take more risk to win these races.

Table 3: NEXTEL Cup Series Chow Test for Tournament Theory, 2004-2006
Dependent Variable: $ACCMILES_t$

	2004-2006	First 26 Races	Last 10 Races
c	.69 (0.01)**	.73 (0.02)*	-1.49 (0.07)
LEFT	.06 (0.39)	.12 (0.21)	-.12 (0.24)
SPEED	-.71 (0.00)**	-.71 (0.00)**	-.69 (0.00)**
ROOKIE	.0008 (0.72)	.002 (0.41)	-.008 (0.11)
PLATE	.07 (0.00)**	.07 (0.00)**	.09 (0.02)*
SHORT	-.02 (0.21)	-.03 (0.19)	-.02 (0.55)
POLE	.54 (0.00)**	.53 (0.00)**	.43 (0.00)**
RPURSE	-.002 (0.85)	.002 (0.81)	.10 (0.01)**
	R^2 = 0.60 Chow (p-value)= 0.08	R^2 = 0.59	R^2 = 0.74

** indicates a p-value significant at the 1% level; * indicates significant at the 5% level.

Table 4: Busch Series Chow Test for Tournament Theory, 2004-2006 Dependent Variable: $ACCMILES_t$			
	2004-2006	72 races	28 races
c	1.12 (0.02)*	1.42 (0.01)**	-3.85 (0.32)
LEFT	.01 (0.89)	.18 (0.21)	-.10 (0.45)
SPEED	-.75 (0.00)**	-.89 (0.00)**	-.48 (0.00)**
LENGTH[a]	.09 (0.00)**	.11 (0.00)**	-.16 (0.41)
SHORT	-.02 (0.22)	-.07 (0.03)*	.05 (0.20)
POLE	.43 (0.00)**	.48 (0.00)**	.73 (0.05)*
RPURSE	.02 (0.44)	.01 (0.72)	.21 (0.19)
	R^2 = 0.69 Chow (p-value)= 0.24	R^2 = 0.61	R^2 = 0.78

a = the variable LENGTH is used in place of PLATE in this set of regressions. There are no races using restrictor plates in the second half of the series. Because the restrictor plate races are on the longer tracks, LENGTH of track is used.

Table 5: Craftsman Truck Series – Chow Test for Tournament Theory; 2004-2006

Dependent Variable: $ACCMILES_t$

	2004-2006	55 races	20 races
c	.11 (0.77)	.34 (0.47)	.90 (0.29)
LEFT	.20 (0.07)	.27 (0.03)*	-.22 (0.35)
SPEED	-.82 (0.00)**	-.81 (0.00)**	-.50 (0.00)**
PLATE	.13 (0.00)**	.17 (0.00)**	.05 (0.35)
SHORT	-.04 (0.01)**	-.07 (0.02)*	.003 (0.88)
POLE	.67 (0.00)**	.65 (0.00)**	.34 (0.05)*
RPURSE	.04 (0.42)	.009 (0.87)	.006 (0.98)
	R^2 = 0.65 Chow (p-value)= 0.31	R^2 = 0.67	R^2 = 0.74

** indicates a p-value significant at the 1% level; * indicates significant at the 5% level.

Results for the Busch and Craftsman Truck series show that there is not a significant change in the coefficients. The p-values for the Chow tests are 0.24 and 0.31. Drivers do not appear to change their risk taking during the season. The existing tournament structure does not promote more aggressive driving over the season-ending races.

CONCLUSIONS

The compensating behavior theory predicts that if drivers race under safer conditions, they should undertake riskier behavior. Regression analysis lends evidence in support of this theory. Starting in October 2001, drivers were required to wear a HANS device. Using NEXTEL Cup Series from 1997 through 2003, there is a change in the number of miles run under caution due to accidents. A Chow test verifies that a break occurs in October 2001.

Von Allmen (2001) asserts that the rank-order tournament used during the NASCAR season prior to 2004 is linear and does not promote appropriate competitive behavior. Starting in 2004, the structure was changed to encourage racing throughout the season. To compete for the season championship, drivers now have a motivation to drive safely and stay in each of the first 26 races. After that point only the top ten drivers compete for the series championship, racing to win the non-linear season-ending awards. As a result, we expect drivers to drive riskier in the second part of the season Neither of the other two NASCAR series, Busch and Craftsman Truck race under the new structure. Therefore, we would not expect their driving behavior to change over the race season. Results support the theory. A Chow test shows a change in the percent of miles run under caution for the NEXTEL Cup Series, while the Chow test does not show any evidence of a break in the ACCMILES variable for the other two series.

ENDNOTES

[1] In their *New York Times*' article "How Many Lives Did Dale Earnhardt Save?," Dubner and Levitt (2006) discuss evidence showing that drivers are responding by driving more safely – there has been a decrease in the number of predicted crashes.

[2] Several sources are used for this material including www.nascar.com, www.nascarmedia.com and www.racing-reference.info.

[3] One problem in the early days of car racing was that promoters organized the race, but had left town by the time the race was over, taking the entrance fee money for himself. While the cars are referred to as "stock" (i.e., off the dealership floor), there is actually very little in common today with any car that you might buy from your Ford, Chevrolet or Toyota dealer and a NEXTEL car.

[4] Some speedway tracks are ovals (with four turns), and some are tri-ovals (three turns); other tracks are road courses. Due to the track design at Daytona and Talladega superspeedways, cars are required to use "restrictor plates" that purposely slow down the cars. We omit data from road courses in this study because these tracks are substantially different from the speedways.

[5] In early years of racing, a race official "threw out the yellow flag," the signal that the track was under caution and the safety car entered the track. While the yellow caution flag is still used, teams also notify their drivers that they are racing under caution using radios.

[6] The HANS (head and neck support) is the most popular restraint product, but not the only one. Drivers were allowed to wear one of several models, but starting in 2005 only the HANS was approved.

[7] One other safety development has also taken place during the same period. To soften the blow on impact, developers have designed padded walls to replace small sections of the concrete walls that surround the tracks. These walls have only been installed at a few turns at Lowe's Motor Speedway and Indianapolis. While several other safety features have been added over the years, it was only after the addition of the HANS device that deaths have (so far) ended.

[8] The following information deals with the NEXTEL Cup series and its predecessors.

[9] It is no coincidence that "The Chase" starts at the same time as the NFL season begins. The NFL is considered NASCAR's biggest competitor for fans and viewership.

[10] Answering Traynor's second question is not something as important to NASCAR. Race fans like the accidents. No research has been undertaken to discover the "optimal" number of accidents in a race...yet.

[11] A Washington Post article (2007) cited data from Joyce Julius Associates (a firm that collects advertising statistics) claiming that "Home Depot's logo received 29 minutes and 51 seconds of airtime" when Tony Stewart drove the Home Depot car to a fifth-place finish in the 2006 Daytona 500. The firm calculated that this exposure plus Home Depot's name being said during the race's broadcast was worth $8.3 million. Joyce Julius estimates that the Home Depot's NASCAR media exposure for the entire season was worth $98.6 million.

[12] I appreciate the access to NASCAR's media website for this data.

[13] Dubner and Levitt (2006) use the number of crashes to measure risk-taking. The number of crashes though doesn't reflect the severity of the wrecks or the number of cars involved. The number of miles run under better represents the risk-taking by drivers. The riskier the driving, the more complicated the wrecks and the more clean-up time required all lead to more miles run under caution.

[14] David Ronfeldt (2002) notes the game theory tactics that drivers must use under these conditions. Given the aerodynamics, drivers must race in columns to benefit from lower air resistance. This "drafting" allows the cars to go faster, but also provokes crashes.

[15] Given that some drivers might have started wearing the HANS device sooner after Earnhardt's death, a Chow test was performed at several earlier points in the 2001 season. None were significant.

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