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A Rational Addiction Model**

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THE DEMAND FOR NFL ATTENDANCE:  
A RATIONAL ADDICTION MODEL

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**Abstract:** This paper examines the demand for attendance at National Football League (NFL) games using a rational addiction model to test the hypothesis that professional football displays the properties of a habit-forming good. Rational addiction theory suggests that past and future consumption play a part in determining the current period's consumption for habit-forming goods. A pooled data set is collected using statistics from each NFL team from the 1983 to the 2002 seasons. Current attendance is modeled as a function of team specific variables including past and future attendance, ticket price, and team performance as well as league variables such as the incidence of strikes. The model is estimated using Two-Stage Least Squares (2SLS). It is found that past and future attendance, winning percentage, the age of the stadium in which a team plays, and the occurrence of strikes are significant factors in the determination of attendance at NFL games. The fact that coefficients for past and future attendance are positive and significant in this analysis lends support to the notion that NFL fans display characteristics of rational addiction in their consumption behavior.

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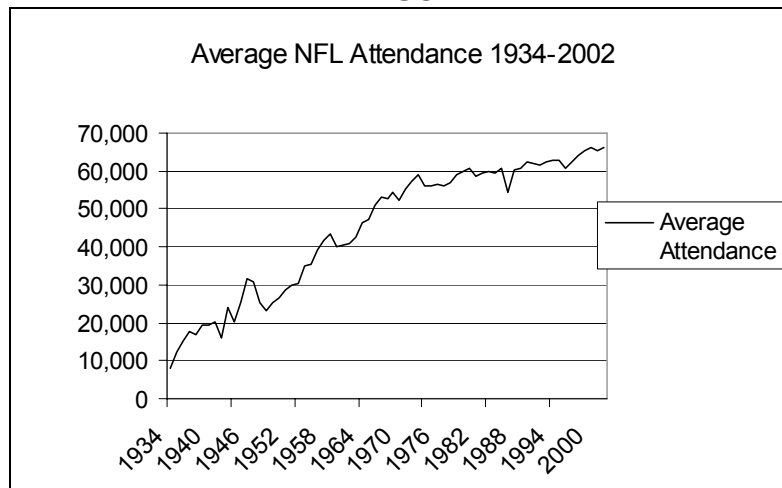
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## INTRODUCTION

In 2002, National Football League (NFL) attendance totaled 16,931,340, with an average attendance per game of 66,138. As illustrated in FIGURE 1.1, attendance figures have been on the rise since these statistics were first made available. In the NFL, ticket revenues account for nearly one-third of all revenues, making attendance quite important to the league.<sup>2</sup> Football fans spend substantial amounts of time and money when they attend an NFL game. According to the Fan Cost Index calculated by *Team Marketing Report*, the average fan spends anywhere from near \$200 in Atlanta to over \$400 in New England when they go to a game. Furthermore, the NFL boasts more fans than any other professional sport in the United States. Over half of all Americans claim to follow the league. Why is it that the NFL is so popular and why is its popularity growing over time? Is it possible that football fans exhibit characteristics of habit-formation in their behavior? This paper will try to answer such questions by examining NFL attendance using a model of rational addiction.

FIGURE 1



SOURCE: *NFL Record and Fact Book*.

<sup>2</sup> Rick Horrow, "The NFL Juggernaut at Postseason, Part I," available from <http://cbs.sportsline.com/general/story/7003559>, accessed February 1, 2004.

While addiction is often used to explain a physical dependency on substances such as alcohol and cigarettes, rational choice theory can explain addictive behavior as it pertains to a much broader array of activities. People can become addicted to any number of things, from food to exercise to work. According to Becker and Murphy (1988), rational addiction theory suggests that people make choices according to their consistent utility maximization plan. This would mean that past consumption and estimated future consumption have an effect on present consumption for addictive goods. If NFL attendance is habit-forming, then it can be shown that past attendance and estimated future attendance are significant factors that affect present attendance at NFL football games. If, on the other hand, past and estimated future attendance do not affect current attendance, then the notion of habit-formation will be called into question.

This paper will proceed as follows. The following section will discuss the relevant literature on the topics of attendance at professional sporting events and the theory of rational addiction. The next section will present the empirical model and methodology. The fourth section will report the results of the regression analysis. The final section will discuss conclusions, along with any caveats encountered, and outline some directions for future research.

## **CURRENT RESEARCH ON ATTENDANCE AND RATIONAL ADDICTION**

There have been a number of studies in the economics literature on factors that influence the consumption of sports, which is generally represented by spectator attendance at sporting events. Economic demand models have been widely used to analyze the factors that determine spectator attendance, and this method has been applied to various sports. A summary of such literature follows. Downward and Dawson (2000) contains an excellent

overview of sports related demand analysis studies.

Baseball attendance has been widely investigated. Kahane and Schmanske (1997) test the proposition that roster turnover has an impact on MLB attendance. Using data from the 1990 through 1992 MLB seasons and an ordinary least squares estimator, they find that turnover does indeed have a significant and negative impact on attendance in MLB. In another study on Major League Baseball attendance, McDonald and Rascher (2000) explore the effects that special promotions have on game day attendance. Using ordinary least squares regression, they find that promotions increase game-day attendance by about 14%. Other studies on demand for baseball attendance include Boyd (2003), which also examines the impact of promotions, Rivers and DeSchriver (2002), which examines the impact of star players, Schmidt and Berri (2002), which examines the impact of strikes, and Schmidt and Berri (2001), which examines how competitive balance influences attendance.

There have also been some studies on attendance at basketball games. Burdekin and Idson (1991) examine the effect that customer discrimination has on attendance for the National Basketball Association (NBA). They find that attendance is significantly affected by the racial composition of the team relative to the racial composition of the market area. Zhang, Pease, Hui, and Michaud (1995) explore the variables that determine whether or not spectators will attend NBA games by developing the Spectator Decision Making Inventory. Using a survey of a random sample of 861 NBA spectators, they find that game promotion, home team, opposing team, and schedule convenience are significantly related to game attendance. Berri, Schmidt, and Brook (2004) examine the impact of star players on NBA attendance, finding that the functional form of the regression equation affects whether or not star players have a significant impact on the demand for attendance.

Soccer is another sport that has been relatively well studied. Peel and Thomas (1988) investigate the determinants of attendance for professional soccer in England, hypothesizing that games that are not predictable attract bigger crowds. Using data from the 1981-82 season of the English Football League, they find that economic, geographic, and demographic variables play a part in determining attendance at soccer matches. Baimbridge (1997) examines soccer match attendance at the European Championship that was held in England in 1996. He uses ordinary least squares regression and finds that the distance between the team's home city and the tournament site and the quality of the teams are the most important factors that affect tournament attendance. Recent studies on attendance at soccer matches include Hall (2004), which examines the role that television plays in determining attendance, and Szymanski (2001), which examines the relationship between financial parity, competitive balance, and attendance at English soccer matches.

As for football, there have been studies done in recent years on the demand for attendance at collegiate as well as professional football games. In their study of NCAA Division II football, DeSchriver and Jensen (2002) examine the relationship between attendance at college football games and various economic and game variables. Results of the analysis suggest that both the past season and current season winning percentages have an affect on attendance, with the past season's performance becoming relatively less important than the current season's performance as the season progresses. Promotional activities, size of the college, and competition within the market were also found to be significant factors in determining attendance at college football games. A similar study on Division I college football was conducted by Price and Sen (2003). Welki and Zlatoper (1994) examine NFL attendance and the factors that affect it. The regression analysis indicates that the home

team's winning percentage is an important factor in determining attendance. They also suggest that higher ticket prices depress attendance and that the demand for professional football appears to be inelastic.

These studies provide a solid foundation for research on NFL attendance, but none of the studies attempt to account for habit-formation in their models. Economic theory regarding the role that habits play in the demand for goods is a relatively new subject. Alfred Marshall initially mentioned the idea in his 1920 textbook. Marshall notes:

“...whether a commodity conforms to the law of diminishing or increasing return, the increase in consumption resulting from a fall in price is gradual; and, further, habits which have once grown up around the use of a commodity while its price is low are not quickly abandoned when its price rises again.”

Recently, attempts have been made to integrate habit-formation with economic theory. For a comprehensive review of addiction literature see Fenn (1998) and Chaloupka (1988). This study will focus on rational addiction theory as it applies to a demand model for the NFL. It will rely on the work of Fenn (1998), which follows seminal theoretical work by Becker and Murphy (1988) and empirical work by Becker, Grossman, and Murphy (1994).

Rational addiction, according to Becker and Murphy (1988), implies that people make choices according to their consistent utility maximization plan. Their theoretical work outlines the demand model for a habit-forming good, which includes price, past consumption, and expected future consumption. Future empirical work by the likes of Chaloupka (1991), Grossman (1993), Becker, Grossman, and Murphy (1994), and Fenn, Antonovitz, and Schroeter (2001) find support for the rational addiction model in the case of goods with known habit-forming properties such as cigarettes and alcohol.

As for sports attendance and habit-formation, there has been limited investigation. Ahn and Lee (2003) attempt to apply elements of the rational addiction model to sports

consumption in their examination of baseball attendance. The results of their regression analysis indicate that baseball consumption is indeed habitual, but not necessarily addictive in the rational sense (i.e. past consumption influences present consumption but future consumption is insignificant). Byers, Peel, and Thomas (2000) analyze the possibility of rational habit-formation among professional soccer fans in England. The results indicate support for the rational habit-formation model, suggesting that habit may be an important factor that influences spectators at professional sporting events.

Another body of literature accounts for habit-formation by including a measure of “fan loyalty” in the demand equation. While these models are not models of rational addiction, they do consider habit as a factor in the demand for attendance. One such example is found in Dobson and Goddard (1995), which examines attendance in the English Football League. They employ two-stage least squares (2SLS), where attendance and loyalty are endogenous variables, and find that team success, price, and loyalty are significant factors that determine attendance at soccer matches in England.

The present study will fuse elements from the body of literature on attendance at sporting events with the current research on rational addiction. Following the earlier work done on attendance, this study will examine the traditional variables used in predicting spectatorship at sporting events to see how they impact NFL attendance. Estimated past and future consumption are added to the model, according to rational addiction theory. The result will be a model that accounts for habit formation in the demand for attendance at NFL games. The following section will outline this model and discuss the data.



## MODEL AND DATA

The empirical model will be tested using a pooled data set that has been collected from every team in the National Football League for the 1985 through 2002 NFL seasons. There are a total of 32 NFL teams that play 16 games each regular season, which does not include pre-season or playoff games. Due to the requirements of the rational addiction model that will be discussed later in this paper, each team used in the data set had to play at least three seasons to provide sufficient data for one observation.<sup>3</sup> This result is a pooled data set comprised of annual statistics from thirty-one teams. There are three expansion teams in this set that will be discussed in the following subsection. The remaining 28 teams existed for all 17 seasons. This yields a total of 525 observations. Annual data was collected for each team and its respective city. The basic empirical model is displayed in equation 1.

$$\begin{aligned}
 att_t = & \alpha_0 + \alpha_1 * year_t + \alpha_2 * att_{t-1} + \alpha_3 * att_{t+1} + \alpha_4 * tktprc_t \\
 & + \alpha_5 * winpct_t + \alpha_6 * stadage_t + \alpha_7 * income_t + \alpha_8 * allstars_t \\
 & + \alpha_9 * numprotms_t + \alpha_{10} * strike_t + \alpha_{11} * DAFCW + \alpha_{12} * DAFCE \\
 & + \alpha_{13} * DAFCC + \alpha_{14} * DNFCW + \alpha_{15} * DNFCC + e_t
 \end{aligned} \tag{1}$$

TABLE 1 provides a brief description of each of the variables in the regression equation, along with the mean and standard deviation of each of the variables.

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<sup>3</sup> The Houston Texans franchise had to be eliminated from the data set since they were a new expansion team in 2002 and only one season of data was available.

TABLE 1  
Variable Definitions and Descriptive Statistics

<b>Variable</b>	<b>Description</b>	<b>Mean</b>	<b>Standard Deviation</b>
att <sub>t</sub>	Total annual attendance for each NFL team from the NFL Record and Fact Book	477996.34	84816.88
year <sub>t</sub>	Index variable for each year from 1985-2002	1993.66	4.644
tktprc <sub>t</sub>	Weighted average annual ticket price for each team each year	21.59	5.924
winpct <sub>t</sub>	Team winning percentage for each season	0.50	0.185
stadage <sub>t</sub>	Age of the facility in which the team plays in years	17.80	10.046
income <sub>t</sub>	Annual per capita metropolitan statistical area income	17375.06	2795.469
allstars <sub>t</sub>	Number of Pro Bowl players on a team each season	2.95	2.273
numprotms <sub>t</sub>	Number of major professional sports teams (NBA, NFL, MLB, NHL) in each NFL city	3.55	1.987
strike <sub>t</sub>	Dummy variable that equals 1 in each year that there was a strike (1987)	0.06	0.239

### ***Relocation and Expansion Teams***

Some of the teams included in the data set are expansion teams that entered the league at some point during the 1985 through 2002 period. Both the Carolina Panthers and the Jacksonville Jaguars entered the NFL in 1995. Also, the Cleveland Browns left Cleveland to become the Baltimore Ravens in 1996. Then, in 1999, Cleveland was granted an expansion team, still called the Browns, to replace the Browns that had left town three years before. These three teams are the only examples of expansion teams that entered the league during the time period that is being studied. Since the data is broken down by team and by year, the fact that these teams did not exist for the entire data set was not problematic

econometrically. The expansion teams were simply included in the data set as any other team, except for the fact that significantly fewer observations were available for these three teams.

There were also a number of teams that relocated during the time period of interest. The Oakland Raiders, who began playing in Oakland in 1970, relocated to Los Angeles in 1982. The franchise then packed up and moved back to Oakland in 1995. Also, the Titans that now play in Tennessee called Houston home from 1970 through 1996. The Rams have been playing in St. Louis since 1995, after they followed the Raiders lead and left the City of Angels. Also, as previously discussed, the Ravens that now play in Baltimore were the Cleveland Browns until 1996. In calculating the demographic variables such as income and city-specific variables such as number of professional teams, great care had to be taken to ensure that the information was being calculated for the correct cities when teams relocated.

### ***Dependent Variable***

The dependent variable,  $att_t$  from equation 1, in the empirical model will be attendance. This is measured for each NFL team for each season as total paid attendance. The data was collected from the *NFL Record and Fact Book*, published for every season from 1985 through 2002.<sup>4</sup>

### ***Independent Variables***

The independent variables that will be used are mostly team-specific variables. The only exception is the strike variable,  $strike_t$  in equation 1. This variable affects the whole league and is a dummy variable that takes on a value of one in the years when there was a labor strike or lockout in the NFL and a value of zero in all other years. The only year

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<sup>4</sup> A special thank you is owed to Kenn Tomasch, Rod Fort, and Alexander Hinojos for their work to help ensure the integrity and accuracy of this data set.

included in the data set during which there was a strike is the 1987 season. The *NFL Record and Fact Book* provided this information.

Strikes are expected to negatively affect demand, especially since they often shorten the season, reducing the total potential attendance for every team. Schmidt and Berri (2002) found that strikes do indeed reduce attendance at Major League Baseball games.

The first team-specific explanatory variable is ticket price,  $tktprc_t$  from equation 1, which is defined as the average ticket price for each team for each year. The ticket price used is a weighted average, attained by accounting for the number of seats at each specific ticket price in calculating the average price for each team in a given year. This data was also collected from Rod Fort's Sports Business Data Pages and then deflated by the Consumer Price Index to generate real prices.<sup>5</sup> Ticket price, according to the law of demand, should be negatively related to the quantity demanded of NFL games. Depending upon the elasticity of demand for the good, demand may be more or less sensitive to changes in price, but price is expected to have some negative impact.

The next explanatory variable is winning percentage,  $winpct_t$  in equation 1, which is the winning percentage of each team for each season included in the data set. This is calculated by dividing the total number of regular season wins by the total number of regular season games. In the event of a tie, which is a possibility in the NFL, each team was given one-half of a win. Winning percentage was calculated using statistics from *Total football II: The encyclopedia of the national football league*. According to past studies, such as Welki and Zlatoper (1994), DeSchriver and Jensen (2002), and Price and Sen (2003), winning percentage is expected to have a positive effect on attendance. It seems that winning teams

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<sup>5</sup> The Consumer Price Index was taken from the U.S. Department of Labor. All values were calculated in terms of 1983 dollars.

tend to create greater interest and draw in bigger crowds in most cases.

Stadium age,  $stadage_t$  in equation 1, is another variable that appears on the right-hand side of the regression equation. This is the age, in years, of the facility in which each NFL team plays in any given season. When a new stadium is built or an old stadium is significantly renovated, the stadium age variable will have the value of one for the first season during which the stadium is used. The stadium age variable will take on a value of two in the following season, three in the next, and so on until the team moves to a new stadium or the old one is substantially renovated. Then, the variable starts over at one. These ages were calculated using information from the *NFL Record and Fact Books*. The age of the facility in which the team plays is expected to impact the demand for attendance negatively. Previous studies, such as Howard and Cromton (2003) and Kahane and Schmanske (1997), have explored the stadium novelty effect, finding that newer stadiums tend to boost attendance. Empirical evidence suggests that although the novelty effect loses much of its power after the first year or two with attendances often falling in subsequent years, the overall impact is still seen for many years afterward since attendances rarely drop below the figures seen before the stadium was built. Thus, older stadiums are expected to be associated with lower attendance figures.

Income, displayed as  $income_t$  in equation 1, is also a variable that is used to explain attendance. In the empirical model, per capita income for the Metropolitan Statistical Area is used. These data were obtained from the website of the Bureau of Economic Analysis and are also adjusted for inflation by dividing the series by the Consumer Price Index for all urban consumers series whose base year is 1983. As was noted in a previous sub-section, certain NFL teams have not played in the same city each year. Care had to be taken in

matching the correct Metropolitan Statistical Area with the correct team for each season. Per capita income figures were gathered for the city in which the team played in any given season, even when it was not the same city that hosted the team the previous season. Income is an important factor in the demand for any good, with higher income causing increased consumption for normal goods. However, it is unclear whether or not professional sporting events are normal goods with some studies, such as Noll (1974) and Welki and Zlatoper (1994), finding the impact of increased income to be negative or insignificant. Therefore, the expected sign and perhaps the significance of the income coefficient are uncertain.

The number of professional sports teams in each city that houses an NFL team was also expected to have some impact on the attendance of professional football games in that city. Therefore, the total number of professional football, basketball, hockey, and baseball teams that are in an NFL city is included as an explanatory variable. This variable is named  $numprotms_t$  in equation 1. It was constructed using team information that is included on each league's website. The number of other professional sports teams in the city could have a negative impact on attendance, since they could be seen as substitutes for NFL teams. Noll (1974) found this to be the case for professional baseball. However, the other teams could also be viewed as complementary goods and could thus increase the demand for NFL attendance. The sign of this variable is ambiguous.

The number of marquis players on a team is included as a variable that may have an effect on the attendance for that team and is shown as  $allstars_t$  in equation 1. The number of players that a team sends to the Pro Bowl in a given season is used as a proxy for such talent. Pro Bowl rosters for each year were found at [pro-football-reference.com](http://pro-football-reference.com). The number of Pro Bowl players is expected to have a positive impact on attendance, since big-name superstars

often attract crowds. However, Rivers and DeSchrive (2002) found that star players only seemed to increase attendance at Major League Baseball games when their presence on the team was accompanied by an improvement in team performance. It is unclear whether or not this variable will be significant.

### ***Dummy Variables***

There will also be variations in attendance specific to certain divisions. The NFL is separated into two conferences, the American Football Conference (AFC) and the National Football Conference (NFC). Each of these conferences contains three divisions.<sup>6</sup> There are an East, a West, and a Central division in each conference, totaling six divisions in the NFL. The divisions each contain five or six teams. Every division may have specific variations in attendance due to the competitiveness of a certain division or the level of rivalry among the teams in that division. To account for these division-specific effects, five dummy variables were created, one for each division except for the NFC West.<sup>7</sup> For example, the dummy variable for the AFC East Division takes on a value of one for every team that is in that division and a value of zero otherwise. The team division dummies were created using the NFL divisions as outlined in *Total football II: The encyclopedia of the national football league*. The signs of the coefficients on the divisional dummy variables are unknown and could vary according to the division.

### ***Past and Future Attendance***

Also appearing on the right-hand side of regression equation 1 are past and future

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<sup>6</sup> The conferences were realigned in 2002 to include four divisions, but for the time period included in this study, there were three divisions per conference.

<sup>7</sup> An attempt was made to include team-specific dummies in the regression model. However, this resulted in near multicollinearity.

attendance variables,  $att_{t-1}$  and  $att_{t+1}$ , respectively. According to rational addiction theory, past and expected future consumption have an impact on present consumption for habit-forming goods. Thus, if the NFL is indeed habit-forming, then the coefficients associated with past and future attendance should be positive and significant. A complete derivation of the demand function for a good with habit-forming properties can be found in the appendix, providing justification for the inclusion of past and future attendance in the regression model.

### ***Estimation Procedures***

To estimate the demand for NFL attendance, fixed-effects two-stage least squares (FE2SLS) will be employed. This estimation procedure was chosen due to the fact that actual figures for past and future attendance,  $att_t$  and  $att_t$  in equation 1, are endogenous in the regression equation because they would each depend on present attendance according to the model. The method of FE2SLS involves using instrumental variables to run a first stage of regressions with past and future attendance as dependent variables. The predicted values obtained from this first stage of regressions for past and future attendance are then used in the second stage as independent variables to explain the current period's attendance,  $att_t$  in equation 1. Using the predicted values instead of actual values remedies the econometric problems associated with having independent variables that are correlated with the error term. The instrumental variables that were used in the first stage of regressions are presented in TABLE 2.



TABLE 2  
Two-Stage Least Squares Instrumental Variables and Definitions

Variable Name	Description
$tktprc_{t-1}$	Weighted average annual ticket price for each team during the previous season
$tktprc_{t+1}$	Weighted average annual ticket price for each team during the following season
$winpct_{t-1}$	Team winning percentage for the previous season
$winpct_{t+1}$	Team winning percentage for the following season
$stadage_{t-1}$	Age of the facility in which the team played in the previous season in years
$stadage_{t+1}$	Age of the facility in which the team played in the following season in years
$income_{t-1}$	Annual per capita metropolitan statistical area income for the previous year
$income_{t+1}$	Annual per capita metropolitan statistical area income for the following year

## REGRESSION RESULTS

TABLE 3 summarizes the results of the regression analyses from the two models that were estimated using the two-stage least squares procedure. The t-statistics are displayed in parentheses below the reported coefficients. The difference between the two models lies only in the fact that one is completely linear while the other uses logarithmic transformations of the price and attendance variables. A blank cell indicates that the variable was omitted from the regression.

TABLE 3  
Two-Stage Least Squares Regression Results

Variable	Dependent Variable - ATT	Dependent Variable - LOG(ATT)
C	1807445 (2.2664)**	5.0112 (2.5370)**
YEAR	-914.5879 (-2.2674)**	-0.0027 (-2.6610)*
ATT <sub>t-1</sub>	0.4791 (24.9088)*	- -
LOG(ATT <sub>t-1</sub> )	- -	0.4657 (23.7089)*
ATT <sub>t+1</sub>	0.5304 (26.6753)*	- -
LOG(ATT <sub>t+1</sub> )	- -	0.5615 (26.5583)*
TKTPRC	314.0091 (1.0898)	- -
LOG(TKTPRC)	- -	0.0225 (1.2933)
WINPCT	29659.14 (3.1869)*	0.0630 (2.7401)*
STADAGE	-221.0191 (-2.0778)**	-0.0055 (-2.1350)
INCOME	0.0456 (0.1044)	6.31E-08 (0.0585)
ALLSTARS	-760.6668 (-1.1361)	-0.0019 (-1.1517)
NUMPROTMS	-596.8834 (-1.0500)	-0.0014 (-1.0321)
STRIKE	-61106.15 (-9.3769)*	-0.1573 (-9.7968)*
DAFCE	-1434.679 (-0.4258)	-0.0026 (-0.3143)
DAFCW	-1518.751 (-0.4585)	-0.0029 (-0.3505)
DAFCC	224.2667 (0.0642)	0.0021 (0.2371)
DNFCW	-1681.916 (-0.1358)	-0.0029 (-0.4105)

TABLE 3, continued

Variable	Dependent Variable - ATT	Dependent Variable - LOG(ATT)
DAFCC	224.2667 (0.0642)	0.0021 (0.2371)
DNFCW	-1681.916 (-0.1358)	-0.0029 (-0.4105)
DNFCC	-474.3118 (-0.1358)	-0.00086 (-0.0986)
AR(1)	-0.5864 (-15.0714)*	-0.5723 (-14.9082)*
R-squared	0.8824	0.8666
Adjusted R-squared	0.8778	0.8615
F-statistic	194.1048	168.1571
Durbin's <i>h</i>	-1.29	-1.13

t-statistics in parenthesis

\*indicates significance at the 99% confidence level

\*\*indicates significance at the 95% confidence level

Heteroscedasticity was detected using the White test. This problem was corrected using White's (1980) correction for standard errors. Serial correlation was also detected in the original model. Therefore, a correction for serial correlation, originally proposed by Fair (1970), is employed. This involves the use of autoregressive models that take into account how much persistence is present in terms of the dependent variable. Once the autoregressive term is incorporated, one can fail to reject the null hypothesis of no serial correlation according to both the Durbin-Watson test and Durbin's *h* test.<sup>8</sup>

The results of the two models show that the same variables are significant and are also consistent in the signs of the variables. The constant term is positive and significant in both models. The year trend variable is negative and significant, suggesting that there is some season-specific variation in the attendance at NFL games.

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<sup>8</sup> William H. Greene, *Econometric Analysis*, Third Edition, Upper Saddle River, New Jersey: Prentice Hall: 1997.

As expected, the coefficients on past and future attendance are positive and significant. This is consistent with rational addiction theory, which supports the notion that NFL fans display characteristics of rational addiction. This implies that as past and expected future attendance rise, attendance in the current season rises as well.

The coefficient for the team's winning percentage is also positive and significant. This is in accordance with other research, since nearly all studies that examine the demand for attendance at professional sporting events include some measure of team performance in the equation, which is usually found to positively affect attendance. Welki and Zlatoper (1994) find that the home team record is a significant factor in determining game day attendance. Berri, Schmidt, and Brook (2004) also find that team performance is an important factor in determining attendance with wins, playoff wins, and championships all turning out to be significant and positive in their analysis of attendance at NBA games. This suggests that a team that wins more games tends to attract more fans.

The age of the stadium has a negative impact on attendance, which concurs with previous research on the topic. The stadium novelty effect appears to be a factor in determining NFL attendance, since results indicate that older stadiums have lower attendance than newer stadiums. Each additional year that a stadium has been open decreases attendance, *ceteris paribus*.

Strikes also depress attendance significantly. This is understandable since the only strike year that was included in this NFL data set was in 1987, and it reduced the season to 15 games instead of the 16 games that are played in a normal, strike-free season. This reduced the total potential attendance for each team during the 1987 season. Also, replacement players were employed during this NFL strike and played for three games, which attracted

significantly smaller audiences than the superstars that fans had become accustomed to seeing. Results from the linear model indicate that teams can expect to see a decrease of over 60,000 fans attending games during a strike year. This is also consistent with findings in Major League Baseball studies that find that strikes tend to depress baseball attendance.

The autoregressive term is negative and significant. As previously discussed, this term was included to correct for serial correlation and the fact that it is negative and significant indicates that there is a very strong level of persistence in attendance from season to season.

Ticket price, number of Pro Bowl players, number of other professional sports teams, and income were all found to be insignificant. While price is always expected to be significant in determining demand, this is not always the case in studies of attendance at professional sporting events. Rivers and DeSchriver (2002) find price to be insignificant in their study of major league baseball and they mention that other studies have had similar findings. The number of Pro Bowl players on a team may not matter too much to NFL fans, either. Perhaps this is because it is winning that matters, and all-star players only matter when they help a team win. Rivers and DeSchriver (2002) find that all-star baseball players only help increase attendance for winning teams. Berri, Schmidt, and Brook (2004) also find support for this theory in their study of the NBA. It could be that fans care mostly about winning, regardless of whether it is big name Pro Bowl players on the field or just a good team made up of average players. The number of professional sports leagues in a city is not seen to have a significant impact on attendance, which could be due to the fact that fans do not consider the other sports leagues to be substitutes for the NFL. Another explanation for this is the possibility previously discussed that the number of professional sports teams a city

has is usually representative of the city's population. Cities with many teams often have large populations to support these teams. A large population can boost attendance, which may cancel out the fact that there are a greater number of sports teams competing for the sports fan's dollar in these large cities. These two conflicting ideas may be causing the insignificance in this variable. Also, the fact that the seasons for the other three major professional sports do not perfectly overlap with the NFL season. The NFL season starts in the fall and ends with the Superbowl at the end of January. The Major League Baseball season goes through the spring and summer, ending in the fall and the NBA and NHL both start up later in the fall and play into the early summer. The NFL season is quite condensed and ends when the other leagues are not in key parts of their season. This may help protect the NFL from the competition of other professional sports leagues that they might face if their seasons followed similar schedules. As for the division-specific effects, none of the divisional dummy variables proved to be significant factors in determining attendance at NFL football games.

The R-Squared and adjusted R-Squared statistics are well above .80 for each of the models, approaching .90 with the linear model. This means that the model explains nearly 90% of the variation in attendance, which is comparable to attendance demand models in previous studies.

## **CONCLUSIONS**

This study has attempted to answer questions about attendance at National Football League games by estimating the demand for tickets to these games and examining fan behavior. In the past, rational addiction theory, pioneered by Becker and Murphy (1988), has been used to explain the demand for habit-forming goods. Rational addiction theory

suggests that people make choices according to their consistent utility maximization plan, implying that past and expected future consumption of a habit-forming good would likely impact the present consumption of that good for addicted consumers. The purpose of this paper was to test for characteristics of rational addiction among fans of the National Football League.

While there have been many studies that have attempted to explain attendance at various sporting events, there have been relatively few attendance studies that have examined the NFL. There have also been a number of studies that have tested rational addiction theory, but none of them have examined this theory in the context of professional football. This paper has summarized the main findings of previous research and extended it by combining the theories found in the two bodies of literature.

Previous work on attendance provides various models with many variables that have been hypothesized to have an impact on attendance at professional sporting events. These variables include, but are not limited to, team-specific variables such as winning percentage and the number of marquis players on a given team's roster, and league-specific variables such as the incidence of strikes and measures of competitive balance. Also, key economic demand determinants such as ticket price and income, are included in traditional attendance demand models. The innovation of this research is the inclusion of past and future attendance in the demand equation. This comes from the derivation of the demand curve for habit-forming goods that is outlined in detail in the appendix. Testing for significance of these two variables in the demand function explores the possibility of habit-formation among the consumers, who are, in this case, NFL fans.

To test the rational addiction model empirically, data was collected for the 1985 through 2002 NFL seasons. The data set is a pooled set comprised of statistics from each NFL team for each season that is played during the period included in the study. The results are very consistent among the models, showing the same variables to be significant with uniformity in the signs and magnitudes of coefficients. Past and future attendance, winning percentage, stadium age, and strike years were found to be significant factors in explaining attendance at NFL games. These findings are consistent with the theory. However there are some caveats that merit discussion.

First of all, NFL games sell out on a regular basis, which creates econometric difficulties when one is trying to estimate demand. A simultaneous Tobit estimation might be more appropriate with the truncated dependent variable. Also, to better test for habit formation, it would be beneficial to know whether or not the same people are attending games. Such data are not available for attendance at NFL games due to the lack of panel data. These problems motivate the suggestions for future research.

### ***Future Research***

It would be interesting to employ the rational addiction model to test television viewership in the NFL, using data from Nielsen ratings to test for habit-formation among fans that watch professional football from their own homes. This would remedy the problem that excess attendance demand may cause, since there is not a fixed stadium capacity when it comes to television broadcasts. The excess demand, evidenced by sellouts, causes a truncated dependent variable. This can cause econometric problems if the model is not estimated correctly. The econometric problems that arise from improper estimation include



nonsensical predicted values, biased regression coefficients, error terms that are not normally distributed, and heteroscedasticity.

Another benefit of using Nielsen ratings is that viewership could be tracked to see if it is indeed the same households that are tuning in game after game, which would provide more compelling evidence for habit-formation. Furthermore, the utility function in the optimization problem is assumed to be quadratic. This does not model rational addicts correctly since it implies that if there is any deviation from the steady state of consumption, the addict will either quit consuming altogether or increase consumption infinitely. This is not the case according to rational addiction theory, which suggests that there are actually several steady states of consumption to which addicts can move. Using a Cobb-Douglas function or some other functional form would provide innovation in rational addiction literature. However, using these functions in the optimization problem may make it impossible to solve. These are simply suggestions to keep in mind for further research that is beyond the scope of the current study.

### ***Implications***

This research provides some insights into the habit-formation aspects of the demand for NFL football that have not been included in earlier studies. Calculating the elasticity of demand with respect to winning percentage provides one interesting insight. When these elasticities are calculated, the impact of winning percentage on attendance is not found to be as significant as one might expect. Using the basic linear FE2SLS regression model, the elasticity of demand with respect to winning percentage for the entire league was found to be 0.03. Also, the sample was broken down by team for Denver, Cincinnati, Tampa Bay, and Dallas and the elasticities were calculated for the individual teams. Again, the elasticity of

demand with respect was found to be approximately 0.03 for each one of the teams for which it was calculated. This implies that for every one percent increase in winning percentage, attendance increases by 0.03 percent. For the four teams tested, a rise in attendance of that magnitude translates into between 12,700 and 17,500 more fans attending games in a given year.

This study has some important implications, especially for those that set ticket prices for the NFL. Researchers in the field of sports economics have been puzzled by the fact that analyses of attendance demand at professional sporting events consistently find that tickets for games are priced in the elastic range of the demand curve. This is contradictory to microeconomic theories that state that optimal prices, which are those that maximize profits, are set in the inelastic portion of the demand curve. Estimates of price elasticity in studies by Noll (1974) and Fort (2003) suggest that prices are not set at this optimal point. Allowing for habit-formation provides a possible explanation for this puzzling phenomenon. Owners may be aware of the effect that habitual behavior has on demand and they may price tickets accordingly, hoping to increase current attendance in order to increase their future profits by getting more people “hooked” on the sport. This study supports such a notion and suggests that by continuing to price in the elastic portion of the demand curve, the NFL can hope to increase the demand for attendance at their games in the long run.

In conclusion, this study provides support for the rational addiction model for the consumption behavior of NFL fans. The results suggest that the consumption of NFL games, at least in attendance at NFL games, is indeed habit forming. This study provides a starting point for the examination of habit-formation in professional sports.

## APPENDIX

The purpose of this Appendix is to derive the demand function for an addictive good. This will follow the derivation that was already outlined in Chapter Three, but will go over the details that were not included in the text.

The derivation depends on the assumed utility function for a rational agent and the equation for the addictive stock that a habit-forming good accumulates. These concepts are discussed in detail in Chapter Three.

Utility Function:

$$U_t = U(Y_t, C_t, A_t, e_t) \quad (\text{a.1})$$

Addictive Stock:

$$A_t = (1 - \delta)C_{t-1} + (1 - \delta)A_{t-1} \quad (\text{a.2})$$

It is assumed that the rate of decay of the addictive stock is 100%, which implies that  $\delta$  is equal to one in the coefficient of the  $A_{t-1}$  term. This leaves the following equation for the addictive stock constraint:

$$A_t = (1 - \delta)C_{t-1} \quad (\text{a.3})$$

Now, the addictive stock constraint can be substituted into the utility function, leaving a function that represents utility in terms of consumption of the addictive good and consumption of all other goods:

$$U_t = U(Y_t, C_t, (1 - \delta)C_{t-1}, e_t) \quad (\text{a.4})$$

Assuming that an agent lives to time  $T$  and discounts their utility according to the market rate of interest,  $r$ , lifetime utility,  $U$ , can be represented as follows, where  $\beta$  represents the discount factor  $\frac{1}{1+r}$ :

$$U = \sum_{t=1}^T \beta^{t-1} U(Y_t, C_t, (1 - \delta)C_{t-1}, e_t) \quad (\text{a.5})$$

The lifetime budget constraint is represented as follows, where  $W$  represents the present value of lifetime wealth,  $Y_t$  is the numeraire good,  $P_t$  is the price of the addictive good in time

$t$  and  $C_t$  is the quantity consumed of the addictive good in time  $t$  and  $\beta$  is again the consumer's discount factor  $\frac{1}{1+r}$ :

$$W = \sum_{t=1}^T \beta^{t-1} (Y_t + P_t * C_t) \quad (\text{a.6})$$

### Solving for First Order Conditions

The objective is to maximize lifetime utility,  $U$ , subject to the budget constraint,  $W$ . It is necessary to set up a simple Lagrangian optimization problem, as follows:

$$L = \sum_{t=1}^T \beta^{t-1} U(Y_t, C_t, (1-\delta)C_{t-1}, e_t) + \lambda [W - \sum_{t=1}^T \beta^{t-1} (Y_t + P_t * C_t)] \quad (\text{a.7})$$

The first step is to take a partial derivative of equation a.7 with respect to  $Y_t$  and set it equal to zero, yielding the following:

$$\frac{\partial L}{\partial Y_t} = \beta^{t-1} U_{Y_t}(Y_t, C_t, (1-\delta)C_{t-1}, e_t) - \lambda \beta^{t-1} = 0 \quad (\text{a.8})$$

Upon simplification, the following first order condition is obtained:

$$U_{Y_t}(Y_t, C_t, (1-\delta)C_{t-1}, e_t) = \lambda \quad (\text{a.9})$$

The next step involves taking the partial derivative of equation a.7 with respect to  $C_t$  and setting it equal to zero. However, the Lagrangian problem from equation a.7 must be expanded due to the fact that the variable of interest,  $C_t$ , is present in the summation not only at time  $t$ , but also at time  $t+1$ . This makes it necessary to have four separate terms in the Lagrangian equation for four distinct scenarios. A term is needed for time  $1$  to  $t-1$ , plus a term for time  $t$ , another term for time  $t+1$ , and a final term for time  $t+2$  to  $T$  in order to explain the four possibilities and isolate the scenarios at time  $t$  and time  $t+1$ , which will be the times that  $C_t$  remains in the equation. The resulting Lagrangian is presented in equation a.10:

$$\begin{aligned} L = & \sum_{t=1}^{t-1} \beta^{t-1} U(Y_t, C_t, (1-\delta)C_{t-1}, e_t) + \beta^{t-1} U(Y_t, C_t, (1-\delta)C_{t-1}, e_t) \\ & + \beta^t U(Y_{t+1}, C_{t+1}, (1-\delta)C_t, e_{t+1}) + \sum_{t=t+2}^T \beta^{t-1} U(Y_t, C_t, (1-\delta)C_{t-1}, e_t) \\ & + \lambda [W - \sum_{t=1}^T \beta^{t-1} (Y_t + P_t * C_t)] \end{aligned} \quad (\text{a.10})$$

The partial derivative with respect to  $C_t$  can now be taken, producing the following equation, which has been set equal to zero:

$$\begin{aligned} \frac{\partial L}{\partial C_t} &= \beta^{t-1} U_{C_t}(Y_t, C_t, (1-\delta)C_{t-1}, e_t) \\ &+ \beta^t U_{C_t}(Y_{t+1}, C_{t+1}, (1-\delta)C_t, e_{t+1}) * (1-\delta) - \lambda \beta^{t-1} P_t = 0 \end{aligned} \quad (\text{a.11})$$

Some simplification yields the following, which is the second of the first order conditions:

$$\begin{aligned} &U_{C_t}(Y_t, C_t, (1-\delta)C_{t-1}, e_t) + \beta U_{C_t}(Y_{t+1}, C_{t+1}, (1-\delta)C_t, e_{t+1}) * (1-\delta) \\ &= \lambda P_t \end{aligned} \quad (\text{a.12})$$

### ***Deriving the Demand Function***

In keeping with Becker et al. (1994)<sup>9</sup> and Fenn (1998),<sup>10</sup> the utility function is assumed to be quadratic in the current period's consumption of the addictive good, the composite good, the addictive stock, and the other unobservable events that impact utility. These variables are denoted by  $C_t$ ,  $Y_t$ ,  $A_t$ , and  $e_t$ , respectively. Just as before, a substitution is made for  $A_t$ , according to the addictive stock constraint from equation a.3. The result is the following utility function, first outlined in Becker and Murphy (1988):

$$\begin{aligned} U_t &= U_1 C_t + U_2 (1-\delta)C_{t-1} + U_Y Y_t + U_e e_t + \frac{U_{11}}{2} C_t^2 + \frac{U_{22}}{2} (1-\delta)^2 C_{t-1}^2 \\ &+ \frac{U_{YY}}{2} Y_t^2 + \frac{U_{ee}}{2} e_t^2 + U_{12} C_t (1-\delta)C_{t-1} + U_{1Y} C_t Y_t + U_{1e} C_t e_t \\ &+ U_{2Y} (1-\delta)C_{t-1} Y_t + U_{2e} (1-\delta)C_{t-1} e_t + U_{Ye} Y_t e_t \end{aligned} \quad (\text{a.13})$$

Taking the partial derivative of the exact utility function in equation a.13 with respect to  $Y_t$  and setting it equal to  $\lambda$  produces the exact form of the first order condition, given in equation a.14:

$$\frac{\partial U_t}{\partial Y_t} = U_Y + U_{YY} Y_t + U_{1Y} C_t + U_{2Y} (1-\delta)C_{t-1} + U_{Ye} e_t = \lambda \quad (\text{a.14})$$

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<sup>9</sup> Gary Becker, Michael Grossman, and Kevin Murphy, "An Empirical Analysis of Cigarette Addiction," *The American Economic Review*, Volume 84, Number 3, 1994: 396-418.

<sup>10</sup> Aju Fenn, "The impact of addiction information on cigarette consumption," Ph.D. Dissertation, Iowa State University, 1998.

Now, equation a.14 can be solved for  $Y_t$ :

$$Y_t = \frac{\lambda - U_Y - U_{1Y}C_t - U_{2Y}(1-\delta)C_{t-1} - U_{Ye}e_t}{U_{YY}} \quad (\text{a.15})$$

Similarly, taking the partial derivative of the exact utility function with respect to  $C_t$ , and setting it equal to  $\lambda$  can obtain the exact form of the second of the first order conditions.

$$\begin{aligned} & [U_1 + U_{11}C_t + U_{12}(1-\delta)C_{t-1} + U_{1Y}Y_t + U_{1e}e_t] + \beta[U_2(1-\delta) \\ & + U_{22}(1-\delta)^2C_t + U_{12}(1-\delta)C_{t-1} + U_{2Y}(1-\delta)Y_{t+1} + U_{2e}(1-\delta)e_{t+1}] \quad (\text{a.16}) \\ & = \lambda P_t \end{aligned}$$

Next, equation a.15 will be used to substitute for  $Y_t$  and  $Y_{t+1}$  in equation a.16 in order to get the marginal utility function for the addictive good completely in terms of  $C_t$  and exogenous variables:

$$\begin{aligned} & [U_1 + U_{11}C_t + U_{12}(1-\delta)C_{t-1} + U_{1Y} \left[ \frac{\lambda - U_Y - U_{1Y}C_t - U_{2Y}(1-\delta)C_{t-1} - U_{Ye}e_t}{U_{YY}} \right] \\ & + U_{1e}e_t] + \beta[U_2(1-\delta) + U_{22}(1-\delta)^2C_t + U_{12}(1-\delta)C_{t-1} \quad (\text{a.17}) \\ & + U_{2Y}(1-\delta) \left[ \frac{\lambda - U_Y - U_{1Y}C_{t+1} - U_{2Y}(1-\delta)C_t - U_{Ye}e_{t+1}}{U_{YY}} \right] + U_{2e}(1-\delta)e_{t+1}] \\ & = \lambda P_t \end{aligned}$$

Now, the function can be solved for  $C_t$ :

$$\begin{aligned} & U_{11}C_t - \frac{U_{1Y}^2C_t}{U_{YY}} + \beta U_{22}(1-\delta)^2C_t - \frac{\beta U_{2Y}^2(1-\delta)^2C_t}{U_{YY}} \\ & = \lambda P_t - U_1 - U_{12}(1-\delta)C_{t-1} - \frac{U_{1Y}\lambda}{U_{YY}} + \frac{U_{1Y}U_Y}{U_{YY}} + \frac{U_{1Y}U_{2Y}(1-\delta)C_{t-1}}{U_{YY}} \\ & + \frac{U_{1Y}U_{Ye}e_t}{U_{YY}} - U_{1e}e_t - \beta U_2(1-\delta) - \beta U_{12}(1-\delta)C_{t-1} - \beta U_{2Y}(1-\delta)\lambda \quad (\text{a.18}) \\ & + \frac{\beta U_{2Y}(1-\delta)U_Y}{U_{YY}} + \frac{\beta U_{2Y}(1-\delta)U_{1Y}C_{t-1}}{U_{YY}} + \frac{\beta U_{2Y}(1-\delta)U_{Ye}e_{t+1}}{U_{YY}} \\ & - \beta U_{2e}(1-\delta)e_{t+1} \end{aligned}$$

In the left-hand side of the equation,  $C_t$  can be factored out. Let the remaining pieces be equal to  $\Omega$ .

$$\begin{aligned}
C_t \left[ U_{11} - \frac{U_{1Y}^2}{U_{YY}} + \beta U_{22} (1-\delta)^2 - \frac{\beta U_{2Y}^2 (1-\delta)^2}{U_{YY}} \right] &= P_t - U_1 - U_{12} (1-\delta) C_{t-1} \\
- \frac{U_{1Y} \lambda}{U_{YY}} + \frac{U_{1Y} U_Y}{U_{YY}} + \frac{U_{1Y} U_{2Y} (1-\delta) C_{t-1}}{U_{YY}} + \frac{U_{1Y} U_{Ye} e_t}{U_{YY}} - U_{1e} e_t - \beta U_2 (1-\delta) & \\
- \beta U_{12} (1-\delta) C_{t-1} - \beta U_{2Y} (1-\delta) \lambda + \frac{\beta U_{2Y} (1-\delta) U_Y}{U_{YY}} + \frac{\beta U_{2Y} (1-\delta) U_{1Y} C_{t-1}}{U_{YY}} & \\
+ \frac{\beta U_{2Y} (1-\delta) U_{Ye} e_{t+1}}{U_{YY}} - \beta U_{2e} (1-\delta) e_{t+1} &
\end{aligned} \tag{a.19}$$

$$\Omega = \left[ U_{11} - \frac{U_{1Y}^2}{U_{YY}} + \beta U_{22} (1-\delta)^2 - \frac{\beta U_{2Y}^2 (1-\delta)^2}{U_{YY}} \right] \tag{a.20}$$

Both sides of the equation will then be divided by  $\Omega$ , leaving  $C_t$  alone on the left-hand side. The remaining terms on the right-hand side can now be reduced and terms can be collected to find coefficients for the intercept,  $C_{t-1}$ ,  $C_{t+1}$ ,  $P_t$ ,  $e_t$ , and  $e_{t+1}$ :

$$\begin{aligned}
C_t &= \frac{\left[ -U_1 - U_{1Y} \frac{(\lambda - U_Y)}{U_{YY}} - \beta U_2 (1-\delta) - \beta U_{2Y} \frac{(1-\delta)(\lambda - U_Y)}{U_{YY}} \right]}{\Omega} \\
&+ \frac{1}{\Omega} \left[ -U_{12} (1-\delta) + \frac{U_{1Y} U_{2Y} (1-\delta)}{U_{YY}} \right] (C_{t-1}) + \frac{1}{\Omega} \left[ -\beta U_{12} (1-\delta) + \frac{\beta U_{1Y} U_{2Y} (1-\delta)}{U_{YY}} \right] (C_{t+1}) \\
&+ \frac{\lambda}{\Omega} (P_t) + \frac{1}{\Omega} \left[ \frac{U_{1Y} U_{1e}}{U_{YY}} - U_{1e} \right] (e_t) + \frac{1}{\Omega} \left[ \frac{\beta U_{2Y} U_{Ye} (1-\delta)}{U_{YY}} - \beta U_{2e} (1-\delta) \right] (e_{t+1})
\end{aligned}$$

The demand equation for the addictive good,  $C_t$ , can easily be seen if the terms that make up the coefficients are renamed as  $\alpha$  terms:

$$\alpha_0 = \frac{\left[ -U_1 - U_{1Y} \frac{(\lambda - U_Y)}{U_{YY}} - \beta U_2 (1-\delta) - \beta U_{2Y} \frac{(1-\delta)(\lambda - U_Y)}{U_{YY}} \right]}{\Omega} \tag{a.22}$$

$$\alpha_1 = \frac{1}{\Omega} \left[ -U_{12} (1-\delta) + \frac{U_{1Y} U_{2Y} (1-\delta)}{U_{YY}} \right] \tag{a.23}$$

$$\alpha_2 = \frac{1}{\Omega} \left[ -\beta U_{12} (1-\delta) + \frac{\beta U_{1Y} U_{2Y} (1-\delta)}{U_{YY}} \right] \quad (\text{a.24})$$

$$\alpha_3 = \frac{\lambda}{\Omega} \quad (\text{a.25})$$

$$\alpha_4 = \frac{1}{\Omega} \left[ \frac{U_{1Y} U_{1e}}{U_{YY}} - U_{1e} \right] \quad (\text{a.26})$$

$$\alpha_5 = \frac{1}{\Omega} \left[ \frac{\beta U_{2Y} U_{Ye} (1-\delta)}{U_{YY}} - \beta U_{2e} (1-\delta) \right] \quad (\text{a.27})$$

Thus, the demand equation is as follows:

$$C_t = \alpha_0 + \alpha_1 C_{t-1} + \alpha_2 C_{t+1} + \alpha_3 P_t + \alpha_4 e_t + \alpha_5 e_{t+1} \quad (\text{a.28})$$

Notice that the current period's price is included in the demand for the addictive good, as well as past and expected future consumption of the good. This is the key to the rational addiction model.



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