Capacity Utilization Rates Across NFL Stadiums

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Attendance at NFL games has steadily increased for the past half-decade. Teams and the league as a whole have a direct interest in learning what brings fans to the games. This research studies the economic/demographic factors and team/performance characteristics that affect stadium capacity utilization rates of NFL teams over the period from 2012 to 2016. Among the economic/demographic factors, we find that the more populated is the city where a team is located, the higher is the team's stadium capacity utilization rate. Among the team/performance characteristics, our results indicate that having a new stadium, having more professional teams in a city, and the team's winning percentage all affect the stadium capacity utilization rate.

I. Introduction

Sports play a vital role in the lives of many and are a big part of American culture and society. The NFL has been in the top tier of the entertainment industry for quite some time. It is valued at upwards of $62 billion and this value translates to the influence the NFL has on the public (Stewart, 2015). Even though the league has experienced exponential growth in the past, it is facing some challenges that could make or break its future success.

While attendance at each stadium varies based on capacity and fan loyalty, we study capacity utilization because of its ability to measure relative attendance. Studying capacity utilization could potentially allow upper level management of NFL teams to understand the main drivers leading fans to attend regular season games. This understanding would influence managers to make more informed economic decisions on factors like personnel and facilities.

In the first section of our paper, we review the current literature relating to our topic. The literature gave us a solid base for developing our research and provides examples of the factors that may influence stadium capacity utilization. The second section of the paper links the information and background of the literature to variables that we hypothesize influence stadium capacity utilization. Once we have discussed each variable, we then discuss the theoretical effects we expect each variable to have on capacity utilization. The third section of our paper explains the results and data with regards to our regression. The final section provides a summary of our research.

II. Literature Review

Research on factors that impact attendance at NFL games is limited, but there is broader research that looks at attendance for professional sports across many leagues. Literature can be found discussing the theory behind the drivers of attendance, the effects of a new stadium on attendance, and an explanation of attendance in a rational addiction model. Using a number of variables drawn from the literature we found, and devising some of our own based on our experience as fans, we came up with ten different variables that we believe contribute the most to the capacity utilization of teams in the NFL.

Spenner, Fenn, and Crooker (2004) studied NFL game day attendance using a rational addiction model to test the hypothesis that professional football is a habit-forming good. Their research used a pooled data set. While some of their variables were a bit too complex for use, the paper indicates attendance should be modeled as a function of past attendance, ticket price, and team performance.

Zlatoper and Wlki (1999) studied the theoretical determinants of game-day attendance. Their analysis focused on team quality, expected score, weather, ticket price, and indoor versus outdoor stadiums. Their research is limited, focusing only on the 1986-1987 seasons. Their study gave solid theoretical reasonings for us to include variables that measured team quality and cost of attendance.

Quirk and Fort (1992) addressed the impact that new stadiums can have on attendance in Major League Baseball. They found there was an average increase in attendance of about 62% during the first five years a baseball team plays in a new stadium. We control for new stadium effects on NFL capacity utilization in our research.

III. Theory and Model

To develop a model of capacity utilization for NFL teams, we used ten variables, four of which were grouped into economic/demographic variables, and six of which were grouped as team/performance variables. Equation (1) presents our model:

$$UTIL = f(\text{Economic/Demographic Characteristics, Team/Performance Characteristics}) \quad (1)$$

Table 1 shows a detailed outline of these categories. Both the dependent and explanatory variables are defined and explained in Table 1. The sign of our hypothesized regression coefficients were determined by the variable's perceived ability to increase or decrease the capacity utilization rate.

We classified INC, POP, PRO, and FCI as economic/demographic variables. This category controls for the influence of location and wealth of fans in the area. As per capita income rises, so does disposable income. This leads to an increase in the amount of money people can budget towards entertainment, such as NFL games. For this reason, the regression coefficient for INC was hypothesized to be positive. An increase in population, increases the size of a team's potential fan base. Teams with larger fan bases have more people attending their games and so we hypothesized POP's regression coefficient to be positive. The regression coefficient for PRO was hypothesized to be negative because in the midst of substitutes, the demand for attending an NFL game will decrease.

Initially, we replaced the ticket price with the FCI because the ticket price was not statistically significant in the early stages of our research. We thought that replacing it with the FCI would be a better representation and explain more of the variation in our model because it

looks at the aggregate costs of attending a game instead of just a single ticket. This factor not only includes ticket prices, but also food, memorabilia, and parking to give a more accurate estimate on a fans total cost for attending a game. The FCI is a metric that's been calculated and tracked by Team Marketing Report since 1991 as a way to estimate the cost for a family of four to attend a live sporting event. According to Scibetti (2017), the specific details vary a little over the years based on the availability of data, but the FCI considers the following items; two adult average price tickets, two child average price tickets, four small soft drinks, two small beers, four hot dogs, two programs, two adult-size caps, and parking. The law of demand states that as prices rise, the quantity demanded falls. As a result, we hypothesized FCI's regression coefficient to be negative.

The team/performance characteristics category is comprised of NEW, GMS, RAM, WIN, PLAY, and CHAMP. Team/performance variables show how successful the product a team puts on the field is, along with some logistics that relate to stadiums and specific NFL teams. We hypothesized NEW's regression coefficient to be positive because a new stadium would enhance the gameday experience for the fans and generate more interest around the team. We set the parameter of this variable at 3 years or less because the luster of a new stadium would depreciate rapidly. The regression coefficient for GMS was hypothesized as positive. We concluded that the more a team plays at home, the more opportunity a franchise has to build a stable fan base. RAMS' regression coefficient was expected to have a negative correlation with capacity utilization because the LA Coliseum is larger than any other NFL stadium, which is therefore harder to fill. The team moved to a new market, which produces disruption within the fan base. WIN's regression coefficient was hypothesized to be positive. The more a team wins, the more

invested fans are in their team. The regression coefficients for PLAY and CHAMP were hypothesized to be positive. Fans get excited to associate themselves with the success of a playoff/championship team and it leads to a positive outlook on the team's success in the upcoming season.

IV. Results & Discussion

We opted to use paneled data for our model. There were a total of 160 observations that we collected over the years between 2012 and 2016. We obtained the data for our model through ESPN, Pro-Football Reference, NFL Team Marketing Reports, and FRED. We used an ordinary least squares regression model to run a regression using observed data from the above sources and estimated the following equation and results:

Table 2	Capacity Utilization Regression, Unbalanced Panel Least Squares			
	Version 1		Version 2	
Variable	Coefficient	T-stat	Coefficient	T-stat
C	76.13078***	(14.14389)	75.21570***	(14.06996)
INC	-4.14E-05	(-1.058830)		
POP	4.23E-07*	(1.4875505)	4.44E-07**	(1.561460)
PRO	-0.541784*	(-1.355961)	-0.537756*	(-1.344979)
FCI	0.009375	(1.631902)	0.007543	(1.456299)
NEW	7.674692***	(3.866969)	6.783019***	(3.680452)
GMS	1.844457***	(2.697690)	1.798715***	(2.631025)
RAM	-8.480179***	(-3.257377)	-8.457757***	(-3.246108)
WIN	4.652298***	(2.357041)	4.782972***	(2.423655)
PLAY	1.602598***	(1.958646)	1.751564***	(2.182284
CHAMP	2.306884	(1.121838)		

Adjusted R^2	.353256	.351907	

(*,**,***) Statistically different from zero at (0.10,0.05,0.01) level of significance, one-tailed test

After adjusting for degrees of freedom, the model explained approximately 35.3% of the variation in capacity utilization. Using a one-tailed test on each of the explanatory variables, NEW, GMS, RAM, WIN, and PLAY were significant at the 1% level, while POP and PRO were significant at the 10% level. Though FCI was not statistically significant due to a sign reversal, we argue that the variable is theoretically significant. These eight determinants were isolated in a second model to test for robustness. Adjusting for degrees of freedom, the second model explained approximately 35.2% of the variation in capacity utilization.

The model lost minimal explanatory power - only about 0.13% - after removing the statistically insignificant factors from the list, a total of two variables. This supports the notion that the two removed variables, INC and CHAMP, were truly irrelevant. In addition, the remaining eight variables retained significance as well as their sign. NEW, GMS, RAMS, WIN, and PLAY remained significant at the 1% level, while PRO remained significant at the 10% level. POP became more statistically significant, jumping from the 10% to the 5% level.

Though the theory used in this paper asserted that ten variables were potentially affecting team's capacity utilization, the empirical results provide evidence supporting a model in which the capacity utilization can be explained by eight factors. While these results do not indicate that the eight are the only factors that could explain variation in capacity utilization, they do provide evidence that they are significant in determining capacity utilization.

The marginal effects of each significant variable range from 4.44E-07 for POP to about -8.46 for RAM. This means that each additional person in the metro-population increases

capacity utilization by 4.44E-07%, while the L.A. Rams are expected to have 8.46% less capacity utilization due to their substantially larger stadium. Another variable that is shown to have a negative impact on capacity utilization PRO. We expect each additional professional team in the metro area to decrease capacity utilization by approximately .5%.

The three remaining significant team/performance variables have positive anticipated effects on capacity utilization. Having a new stadium (NEW) in the past three years increases capacity utilization by 5.78%, while a $1 increase in the FCI will increase utilization by .007%, and each additional game (GMS) increases utilization by about 1.8%. The two significant team/performance variables of WIN and PLAY matched our expectations of having a positive impact on capacity utilization. A 1% increase in win percentage the previous season will increase capacity utilization by approximately 4.78%, and a previous season playoff appearance will increase a team's capacity utilization by about 1.75%.

V. Conclusion

Using economic/demographic, professional/competitive, and team performance data for 32 NFL teams, we estimate that 8 factors are significant in explaining the capacity utilization in the NFL. The elements that proved to be significant were the population, professional teams in the same city, fan cost index, new stadium, the number of home games, rams, winning percentage, and playoffs.

After making adjustments to our model, we were able to eliminate some of the problems we ran into last semester. Substituting the FCI for the ticket price was fruitful in the sense that the variable was significant, but it had a positive sign, which contradicted our hypothesis. In light of this, we felt that this could be contributed to the fact that more successful teams are going to

have a higher demand for tickets and so they have the leverage to charge higher prices for their tickets, concessions, and merchandise. Furthermore, the addition of the Rams variable accounted for the skewed capacity data from the team's move from St. Louis to a substantially larger stadium in Los Angeles.

When considering the implications of these results, it is clear that NFL executives main focus should be on their team's performance. That being said, the key to filling stadiums is predominantly correlated with the quality of play that teams put on the field.

VI. References

Crooker, J., Fenn, A. J., & Spenner, E. L. (2004). The Demand for NFL Attendance: A Rational Addiction Model. *Colorado College Economics and Business Working Paper,* 4(1).

Federal Reserve Economic Data | FRED | St. Louis Fed. (n.d.). Retrieved December 13, 2017, from https://fred.stlouisfed.org/

Fort, R. D., Quirk, J. (1992). *Pay Dirt: The Business of Professional Team Sports*. Princeton, NJ: Princeton University Press.

NFL Attendance. (n.d.). Retrieved December 13, 2017, from http://www.espn.com/nfl/attendance

Pro Football Statistics and History. (n.d.). Retrieved December 13, 2017, from https://www.pro-football-reference.com/

Team Marketing Report. (2012-2016). Retrieved December 13, 2017, from https://www.teammarketing.com/

Welki, A., Zlatoper, T., (1999). U.S. Professional Football Game-day Attendance. *Atlantic Economic Journal*, 27(3), 285-298.

Table 1
Variable Specification Breakdown

Variable	Definition
Dependent Variable	
Capacity Utilization	Measures the percentage of each stadium's capacity that is filled during each season's home games by taking the home attendance divided by the stadium capacity and multiplying it by 100.
Explanatory Variables	
Economic/Demographic	
Income → INC	Measures the per capita real income within each team's metro population.
Population → POP	Measures the metro area population for each team.
Professional teams in the same city → PRO	Measures how many other teams from the NFL, MLB, NBA, and NHL are in the same metro-area. This variable is representing the substitutes in the vicinity.
Fan Cost Index → FCI	Estimate of the cost for a family of four to attend an NFL game.
Team/Performance	
New stadium → NEW	This is a dummy variable that measures whether or not a team has inhabited a new stadium within the last three years.
Number of games played → GMS	Measures how many times each team plays at home in a given season.
LA Rams → RAM	Dummy variable that shows as 1 for the rams and 0 for every other team.
Winning percentage → WIN	Measures the percentage of games that a team wins in a given regular season.
Playoffs → PLAY	Dummy variable that measures whether or not a team made the playoffs in the previous year.
Championship → CHAMP	Dummy variable that measures whether or not a team won the Super Bowl in the previous year.