THE NEW STADIUM EFFECT: THE OUTCOMES AND EXTRAPOLATIONS OF NEW STADIA ON TEAMS IN THE NATIONAL FOOTBALL LEAGUE

A THESIS

Presented to

The Faculty of the Department of Economics and Business

The Colorado College

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Arts

By

David Campbell Spatt

May 2011

THE NEW STADIUM EFFECT: THE OUTCOMES AND EXTRAPOLATIONS OF NEW STADIA ON TEAMS IN THE NATIONAL FOOTBALL LEAGUE

David Campbell Spatt

May 2011

Economics

Abstract

When seeking a new home stadium, team owners in the National Football League (NFL) often argue that the addition of a new home field will help to ensure their team's on-field success and generate more wins.[1] Owners argue that a more competitive team will not only provide an increased public benefit, but that a new state-of-the-art stadium will result in a better team – perhaps one that can even contend for a Super Bowl Championship.[2] The public cost of new multimillion-dollar (even billion dollar) stadia accounts for nearly two-thirds of the cost.[3] Do owners have any rationale to prove their claim that new facilities increase their team's success? This study investigates the true effect that a new stadium has on NFL teams' overall regular season win-percentage to see if any statistically significant relationship actually exists.

KEYWORDS: (National Football League, Stadiums in Professional Sports, Stadium Effect on Success in the National Football League, Success Determination in the National Football League)

[1] Kevin G. Quinn, "Do New Digs Mean More Wins? The Relationship Between a New Venue and a Professional Sports Team's Competitive Success," *Journal of Sports Economics*, 4.3 (2003): 168

[2] Gerald Carlino and N. Edward Coulson, "Should Cities Be Ready for Some Football? Assessing the Social Benefits of Hosting an NFL Team," *Federal Reserve Bank of Philadelphia Business Review* (2004): 7-17.

[3] James Quirk and Rodney Fort, *Pay Dirt: The Business of Professional Team Sports* (Princeton, Princeton University Press, 1992).

ACKNOWLEDGEMENTS

First and foremost, thank you Mom. I simply cannot thank you enough for your unconditional love, support, and for providing the means that have allowed me to peruse my education at Colorado College. In no way, shape, or form would this thesis have been possible without you.

Second, thank you to the economics and business department at Colorado College. Especially, Daniel Johnson, my thesis advisor, for his continued assistance and support; Aju Fenn for giving me the opportunity to be a summer research assistant and providing the suggestion to write a paper which ultimately became this thesis; and Pedro d'Araujo, my academic advisor, for a wealth of econometric knowledge and insight, without which this paper would not have been possible. I sincerely hope that I continue to be blessed with educators as honestly dedicated to their students and subject matter as you three are. It has truly been a pleasure to work with each of you.

Third, thank you Jeff Moore, the economic paraprofessional who spent countless hours with me to get this thesis formatted, and somehow always had an answer to a plethora of seemingly impossible thesis-related questions.

Finally, thank you Ashleigh, an unbelievable girlfriend who continually tolerated my shenanigans and was an unwavering source of encouragement throughout the process. Without you, I would have lost all sanity.

"Go confidently in the direction of your dreams! Live the life you've imagined. As you simplify your life, the laws of the universe will seem simpler."

– Henry David Thoreau

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

"Winning the Super Bowl is the ultimate goal…Stadiums and training facilities, however, are a vital element in the success and stability of franchises on both a present and long-term basis. As an organization, you want to assemble the best staff and players, but you also have to provide them with the best facilities and environment in which to achieve success."

– Jeffrey Lurie, Chairman/CEO of the Philadelphia Eagles[1]

The purpose of this study is to uncover and analyze the true effect that a new stadium has on a National Football League (NFL) team's overall regular season win percentage. I hope to find and prove (or disprove) that a statistically significant, positive relationship exists between new stadia and an increase in regular season win-percentage. Regular season win-percentage provides the best estimation of how competitive a given team really is, especially over a span of time. Generally speaking, teams that do well in the regular season have a better chance of contending for a Super Bowl Championship, which is every owner's ultimate goal. While a successful regular season in no way guarantees postseason success, my model will attempt to discover if, and to what extent, new stadiums (holding other variables constant) affect the competitive value of teams in the NFL.

[1] Lincoln Financial Field, Stadium Facts, available from http://www.lincolnfinancialfield.com/stadiuminfo/ (accessed August 2010).

A very important initial question must first be answered – how and why are NFL teams, win-percentage, and stadium effects important? The study of sports economics could easily be regarded as inconsequential, useless, and superficial in the regard that it does not seem to answer more important and pertinent issues of world markets, finance, and consumer behavior. Perhaps analyzing the underlying forces of the current recession would be more scholarly; studying the relationships of football teams and the buildings in which they play might appear pointless. At its very basic level, however, economics seeks to answer relatively simple questions of production, consumption, and the transfer of wealth. In even more simplistic terms, economics is a study of the relationship between individuals and businesses.

One fact must not be overlooked – professional sports leagues are, above anything else, a business. Economists are always looking for naturally occurring social experiments to see how various factors interact and how the system, if changed in some way, reacts. The NFL is undoubtedly the most prominent and widely followed professional sports league in the United States and provides just this opportunity.[2] Professional sports are interesting to study because they represent one of the only industries in which the productivity of labor inputs can be directly measured with player-performance variables.[3] There is a plethora of individual player, team, and league data available that can be used to study and examine desired effects. Studying sports economics can ultimately help to provide a more robust understanding of niche markets, which, in turn, strengthens the field of economics as a the whole. Though, on

[2] Michael Oriard, *Brand NFL: Making & Selling America's Favorite Sport* (Chapel Hill: The University of North Carolina Press, 2007).

[3] Lawrence Hadley et al., "Performance Evaluation of National Football League Teams," *Managerial and Decision Economics*, 21.2 (2000): 63-70.

the surface this study concerns itself with stadiums in the National Football League, I strongly hope and believe that concepts and understanding derived here will enhance my own understanding of economics in general.

Getting back to the initial important question: why are professional sports important? From a business perspective, professional sports teams are important in creating an image for a city. The addition of major league athletics adds credibility and helps to create the perception of a bona fide city center. Growing and expanding cities want to attract new businesses and new streams of revenue. Metropolitan areas with one or more professional teams look more attractive to potential investors.[4]

For local residents, sports are, quite simply, a desired commodity. Teams can help to create loyalty towards a particular city and, though the effects cannot necessarily be shown empirically, sports teams do provide increased public benefit[5] (see literature review for more discussion on this). Professional teams with a successful past and a long standing city affiliation have created a sense of lore for themselves.

From a political viewpoint, teams seeking new stadiums may threaten relocation. Policy makers who fail to keep a team in their present city may lose their jobs on the basis of team relocation alone. In fact, the underlying cause behind many of the problems in professional sports is the:

[4] Quirk and Fort (1992).

[5] Quinn, 168.

> Monopoly power of sports leagues and how leagues exercise that power…The most viable sign of the abuse of power by sports leagues is the widespread use of threats and coercion by teams to blackmail cities into providing elaborate, new, publicly-financed stadiums and arenas, along with lease agreements that saddle state or local taxpayers with the costs of the facilities [under treat of team relocation].[6]

Though the practices by sports leagues may be called into question, they ultimately derive their power from the loyalty of their fan base. For a host of reasons, cities want professional sports; the relation between the two is symbiotic. We must not forget that professional sports leagues are a business.

It goes without saying that stadiums are an integral piece of the puzzle for sports teams. Every professional sports team in the United States, regardless of the league with which they are affiliated with, needs, for business and practical reasons, a home venue of their own. The physical stadium itself is important in creating a culture and loyalty around a particular team: "The true sports fan not only reveres the memory of great players and great teams – he or she can wax poetic about the charms of the great and the not-so-great stadiums of the past as well."[7] Teams demand the most up-to-date venues with modern amenities and technologies. Stadiums provide a physical representation of a team's prowess and have, in recent years, become an important aesthetic component in city skylines.

---

[6] James Quirk and Rodney Fort, *Hard Ball: The Abuse of Power in Pro Team Sports* (Princeton: Princeton University Press, 1999), x.

[7] Quirk and Fort (1992), 125.

Stadium ownership has changed drastically in recent years. At one time, privately owned venues housed teams; now, stadiums are publically owned and largely financed with public funds.[8] This is generally achieved by levying taxes on local citizens. What rationale do owners, teams, and local governments have in raising taxes to build multi-million dollar stadiums, and why should the funding of a new venue be a pertinent issue? The former mayor of Nashville, Phil Bredesen, argues for building a new stadium for the Tennessee Oilers (now the Tennessee Titans):

> First, the economic impact, which does not totally justify the investment but justifies a piece of it. Second, the intangible benefits of having a high-profile NFL team in the community at a time when cities are competing for attention is a positive. Third, it is an amenity that a lot of people want…Fourth, the location of the stadium represents the redevelopment of an industrial area close to downtown, certainly a positive in its own rights and a significant factor in the public mind. Taken together, it makes a very compelling argument for going ahead with this.[9]

Results of an empirical study modeling the effect of a stadium on a NFL team's overall win-percentage could benefit NFL teams looking to justify stadium construction. It could also provide insight for other professional sports leagues curious of the effect. Regardless of the true effect that a new venue actually has on regular season competitiveness, econometric tests may ultimately provide insight to NFL team administration as they seek to maximize wins with the ultimate goal of winning the Super Bowl.[10]

---

[8] Ibid.

[9] Quirk and Fort (1999), 150.

[10] Joseph A. Veres, "Touchdown! The Determinants of Team Success in the National Football League (NFL)" (B.A. Thesis, Colorado College, 2007), 1-3.

An Introduction to the National Football League

The NFL was officially founded on September 17, 1920. Originally known as the American Professional Football Association, the present name was adopted in 1922. The NFL's first president was Jim Thorpe, arguably the best-known athlete in the United States at the time. When it was founded, the league consisted of fourteen teams, two of which remain active today – the Chicago Bears (originally the Decatur Staleys) and the Arizona Cardinals (originally the Chicago Cardinals). As is the case with many professional sports, the NFL faced many years of competition from other professional football organizations, the most prominent being the American Football League (AFL) during the 1960s. The popularity of the two leagues eventually led to a merger between the organizations in 1970 under the name the National Football League. The merged AFL/NFL league consisted of twenty-six teams and has expanded four times, adding six new teams since its inception. Today, the NFL consists of two conferences, the American Football Conference (AFC) and the National Football Conference (NFC). All records from the now-defunct AFL have been incorporated into the new NFL.

The first Super Bowl Championship game was held on January 15, 1967 and was a contest between the champion team of the NFL and the champion team of the AFL, Green Bay Packers and Oakland Raiders, respectively (note, Super Bowl I occurred before the merger of the AFL and the NFL). The first Super Bowl following the merger of the AFL and the NFL was Super Bowl V, held on January 18, 1971 and, as is continued today, featured the champions of the two divisions within the merged NFL.

Throughout its history, there have been two work stoppages in the NFL as a result of tensions between owners and players. The first of these work stoppages occurred in 1982; the other in 1987. Neither was responsible for cancelling an entire season of play. However, both stoppages did have an effect on the length of each season and dramatically altered post-season play.

As the result of a fifty-seven day players' strike in 1982, the playing schedule was reduced from sixteen weeks to nine. Then, at the conclusion of the regular season, the NFL conducted a sixteen-team postseason bracket to determine the Super Bowl winner with seeding based on the truncated regular season standings.

At the start of the 1987 season, the Players' Association of the NFL (NFLPA) went on strike and forced owners to cancel the first game of the season. Though agreement between the NFL and the NFLPA was not reached immediately, the NFL opted not to stop play altogether and instead offered temporary weekly contracts to replacement (referred to at the time as "scab") players for each of the twenty-eight teams. Perhaps the most well remembered aspect of the season, these "scab" players played under the normal coaching staff and in games that counted towards the regular season record. This continued for three weeks before the NFLPA voted to return to work in time to play on the fifth week of the season.

As neither work stoppage cancelled an entire season and, in both cases, the majority of the regular season was played, data from both the 1982 and the 1987 seasons remains included in the analysis that follows.

CHAPTER II

LITERATURE REVIEW

The vast majority of preexisting literature that discusses stadiums is based on Major League Baseball (MLB) data. While the focus of my study aims to discover what effect stadiums have on a NFL team's regular season win-percentage, it is both important and relevant to consider what other studies in the sports economics realm have concluded regardless of the professional sports league on which those studies center. A broad understanding of stadiums can help to provide the most insightful conclusions that can ultimately help to shed light on the NFL and regular season win-percentage question.

Stadiums in Professional Sports Leagues

A paper by Quinn et al. (2003)[1] on the significance of stadiums and team win-percentage found that no statistically significant relationship exists between stadiums and team win-percentage except in the case of Major League Baseball (MLB). This study considered all non-expansion teams of the four major leagues in the United States: MLB, NFL, the National Basketball Association (NBA), and the National Hockey League (NHL). As explained in the study, to include expansion teams, which typically have poor records in their first few seasons of play, would overstate the effect

[1] Kevin G. Quinn et al., "Do New Digs Mean More Wins? The Relationship Between a New Venue and a Professional Sports Team's Competitive Success," *Journal of Sports Economics*, 4.3 (2003): 168

that a new stadium had on their overall performance. To determine the effect of stadiums on teams, the authors used mean win-percentage data three and seven years post and prior to that team receiving a stadium. In response to Scully's (1995)[2] book discussing the cyclical nature of team performance, this study chose to use 1989 as a control year and used ordinary least squares regression to estimate the model. The only variables utilized in both the three-year and seven-year time span included an average win-percentage variable and a dummy variable for new stadiums. Quinn et al. point out that many venues around all sporting leagues tend to be relatively new, in fact, with the exception of the NFL; the median age for stadiums in other professional sporting leagues is around ten years. It is interesting to note that the useful economic life of a stadium is typically twenty-five to thirty years. This helps to explain the current boom in stadium construction. With the exception of the MLB, the authors find that a new stadium has no effect on overall win-percentage and that fans of the NBA, NFL, and NHL should not expect to see an increase in competitive quality following the opening of a new venue.

The study by Quinn et al. (2003) is an expanded study based on the preliminary analysis by Quirk and Fort,[3] who point out that it was not always commonplace for stadiums to be publicly owned. Today however, the majority of stadiums are financed and owned publicly. From 1999 to 2003, twenty-nine new facilities were built throughout the four major sporting leagues in the United States (NHL, NBA, MLB, and the NFL). Taxpayers funded 64% of the total cost of this construction, totaling nearly

---

[2] Gerald Scully, *The Market Structure of Sports* (Chicago: University of Chicago Press, 1995).

[3] James Quirk and Rodney Fort, *Pay Dirt: The Business of Professional Team Sports* (Princeton, Princeton University Press, 1992).

nine billion dollars.[4] The change in the stadium market from a primarily private to public market is among the most important factors that improved team profitability. After World War II, most professional football teams played in multi-purpose venues, most notably baseball parks – the vast majority of which were privately owned. Then, between 1950 and 1980 the switch from private to public ownership began to occur; median stadium capacities increased steadily as well. This can be generally attributed to local governments who started funding stadium refurbishments and replacements in order to keep teams from relocating. Stadiums are important to teams and leagues as they increase attendance, which, in turn, increases revenue and profit. Quirk and Fort found that, on average, MLB teams that received a new stadium saw an increase in attendance of 62% (this equates to an additional 600,000 fans annually) during the first five years after construction. Much of the attendance increase can be attributed directly to the stadium itself and fan curiosity to see and experience a new venue. More importantly, the prolonged increase in attendance was also due to an increase of team win-percentage after acquiring a new stadium. The authors discovered that from 1960-1982, MLB teams that received new venues experienced an improved win/loss record over a five-year period of thirty-five points (winning five and one-half more games per year in the new stadium – which increased division standing by at least one spot). A sound argument can be made to support this notion:

[4] Gerald Carlino and N. Edward Coulson, "Should Cities Be Ready for Some Football? Assessing the Social Benefits of Hosting an NFL Team," *Federal Reserve Bank of Philadelphia Business Review* (2004): 7-17.

> A new stadium will tend to improve the drawing potential for a team, for a given roster of players. As makes sense intuitively (and from economic theory), the stronger drawing potential of a team, the more profit-maximizing team finds it worthwhile to spend in improving the caliber of the team. [Therefore,] the profit incentives this creates lead predictably to the team's acquiring higher-quality players, producing a better performance on the playing field.[5]

This effect was seen by both new expansion teams (who would be expected to get better as a direct result of the draft) and well established franchises across MLB.

Clapp and Hakes (2005)[6] suggest that fans of Major League Baseball teams will attend a new stadium after the construction of that stadium regardless of a given team's win percentage; this is, essentially, a honeymoon period. The authors determine that attendance in the honeymoon raises about 35% in the first season following construction; this increase lasts only two seasons for parks built from 1960-1974 but lasts from six to ten seasons for newer venues. It has been shown that the major determinant that generates attendance at home games is a given team's competitive nature. Essentially, better teams garner more fans, although teams that are too dominant eventually lose fans. That is, fans want a competitive team that can win against other competitive teams. However, the fact persists that a new stadium itself can increase attendance by casual fans who want to see the new venue and enjoy its amenities. While this study is specific to MLB, the authors believe that the same effect could be observed for all the major sporting leagues as there is no obvious reason that demand preferences of fans toward on-field action and stadium amenities would differ in structure between sports. There are also a large number of fans that follow multiple professional sports

---

[5] Ibid, 139.

[6] Christophor Clapp and Jahn Hakes, "How Long a Honeymoon? The Effect of New Stadium on Attendance in Major League Baseball," *Journal of Sports Economics*, 6.3 (2005).

teams. Other relevant questions such as optimal construction timing, optimal stadium size, attendance, and cost remain unanswered. Finally, the authors find that there is no interaction between new venues and team performance on attendance or stadium revenue. This means that owners would not be inclined to use a new stadium's revenue stream to increase team quality of play.

In his paper studying the effect of capital structure and team performance within Major League Baseball, O'Roark (2001)[7] discovers that evidence exists which suggests that publicly owned stadiums negatively affect the winning percentage of the team that plays in it. This argument is based on the premise that team owners are less likely to have incentives to field competitive teams in publicly owned stadiums. Using his model, O'Roark finds that when the win-percentage increases for a team playing in a publicly owned stadium so too does the probability of that venue becoming privately owned. When team owners decide to invest in a team by buying publicly owned stadiums from a city, they take on an even greater financial burden and "with a private residual claimancy of a stadium, a team owner will be determined to push his players to get the most out of them."[8] Essentially, owners with more financial stake in a team will be more inclined to hire staff and players that keep a team at its competitive best.

Tu (2005)[9] discusses the effect that stadiums have on housing prices in a given Metropolitan Statistical Area (MSA). Between 1999 and 2005, thirty new professional

---

[7] Brian O'Roark, "Capital Structure and Team Performance in Professional Baseball," *Journal of Sports Economics*, 2.2 (2001): 168-180.

[8] Ibid. 177.

[9] Charles Tu, "How Does a New Sports Stadium Affect Housing Values? The Case of FedEx Field," *Land Economics* 81.3 (2005): 379-395.

stadiums were built, and now nearly two-thirds of the major league teams in the United States have built or are planning on building new venues. Opponents of stadium building argue that stadiums only bring increased traffic, pollution, and undesirable crowds; this paper addresses this concern by examining the true effect on housing prices. If Not-In-My-Backyard (NIMBY) activists are correct, then a stadium should ultimately decrease property values in the immediate area. This specific study looked at the effect of FedEx Field, home of the Washington Redskins (located in Landover, Maryland). This paper finds that before and during construction of a new venue, housing prices near the site are sold at a discount but the price difference was significantly narrowed after completion of the stadium. In the end, new stadiums positively affect housing values in the surrounding area. In the case of FedEx Field, the aggregate increase in property values totaled $42 million (for houses located in a 2.5 mile radius of the field) after the stadium was completed. It is believed that these effects are a result of improved infrastructure (to allow fans to attend games), additional jobs, and additional recreational outlets, which ultimately benefit residents. In the end, the positive effects greatly outweigh the short-lived negative effects.

Miller (2007)[10] examines the effect on major league franchise values as a result of receiving a new stadium. The study finds that, regardless of how a venue was financed, it positively benefits a team's value. Major league sports in the United States have seen a boom in stadium construction in recent years, the majority of the cost of the venues being financed in some way by the public. Perhaps most interesting is the abundance of academic literature which finds that, on average, sports teams and their

[10] Phillip Miller, "Private Financing and Sports Franchise Values: The Case of Major League Baseball," *Journal of Sports Economics* 8.5 (2007): 449-467.

stadiums have no significant impacts on local or regional economies regardless of team owners that suggest otherwise. The major justification for the claim by academics is that spending on sports teams within a MSA is simply a redistribution of money that would have been spent in the economy anyway. There have even been cases when a team or stadium has actually decreased employment and earnings in an MSA. In the end, neither the existence of a professional sports team nor stadium construction provides a catalyst for economic development. Regardless of the actual effect on local economies, however, Miller finds that, assuming marginal costs are less than marginal revenues, franchise values of teams moving into new stadiums will be higher as a result of the move. Teams that play in privately funded and owned stadiums see an increase in franchise value over time whereas teams, playing in publicly financed stadiums see a decrease (all things being equal) in franchise value. Though franchise values rise as a result of stadium construction, regardless of where the stadium funding comes from, the increase in team value does not offset the cost of construction.

Bouiler et al. (2006)[11] examine the efficiency of the NFL's betting market. They discuss various factors that influence one's decision to bet on a particular team based on home field advantage and fan support. The authors find that stadium factors such as playing surface, whether the stadium is enclosed, and overall attendance combine to give a home-team a statistical advantage in their chance of winning. While the authors caution on betting on these factors alone (as in practice they find it to be unprofitable), it is interesting in that it provides evidence that stadiums can, in fact, play an important role in a team's overall success. An owner about to spend and petition a city for

[11] Bryan Boulier et al., "Testing the Efficiency of the National Football League Betting Market," *Applied Economics* 38.3 (2006): 270-284.

millions of dollars would be able to carefully craft a new venue that enhances the team's probability of winning in that building.

On-Field Performance Determinants in the National Football League

Hofler and Payne's (1996)[12] study discusses how efficient NFL teams are in living up to their offensive potential. While it is common for fans to compare teams based on their season-to-season win percentage, coaches are more concerned with teams playing to their ultimate potential given their specific performance inputs. Hofler and Payne make no comment about which team is more talented or even which team wins more games. Instead, they explore how well each team lives up to its offensive potential given its talent. The authors discover that NFL teams are excellent in exploiting the talent they have and therefore, given inputs, play to their expected offensive potential nearly 96% of the time.

A paper by Hadley et al. (2000)[13] measures the performance of NFL teams and head coaches based on player production – more generally, the number of games won. They find that better teams have better inputs but that many of the differences between winning and losing teams are relatively small. So while input (player performance) is the key ingredient, coaches can make all the difference when it comes to winning the game. As the central decision-maker on every NFL team is the head coach, it makes sense to determine what, if any, effect they have on their team's overall success. The study finds that the most consistently efficient coaches (that is, those who are able to

---

[12] Richard Hofler and James Payne, "How Close to Their Offensive Potential Do National Football League Teams Play?," *Applied Economics Letters* 3.11 (1996): 743-747.

[13] Lawrence Hadley et al., "Performance Evaluation of National Football League Teams," *Managerial and Decision Economics*, 21.2 (2000): 63-70.

win the most games) are the ones with the most experience in the league. The study concludes that an experienced head coach can gain three to four additional victories for his team over the course of a single season. Coaching experience is a major determinant in the overall success of a team in a given season and should be considered alongside offensive and defensive statistics.

Hendricks et al. (2003)[14] study the NFL draft and the effect that it ultimately has on team performance. The NFL draft system is unique in the fact that, unlike all other major sporting leagues, there is no minor league system. While other football leagues do exist, the major stepping-stone in reaching the NFL is the collegiate system (specifically the National Collegiate Athletic Association [NCAA]). A successful college career is the basis upon which professional teams recruit talent. The NFL draft does not allow potential players to choose teams; instead, teams choose them based on their previous season's performance. This means that there is an increased likelihood that talented players will be matched with teams that give that player a greater opportunity for a successful career. Very few markets have comparable information regarding pre-employment experience. Thus, the NFL draft is in essence a hiring market based on statistical discrimination. While this can be very beneficial for some teams – e.g. teams that draft well – it is also shown that the draft decisions may have little or no impact on win-maximization.

[14] Wallace Hendricks et al., "Uncertainty, Hiring, and Subsequent Performance: The NFL Draft," *Journal of Labor Economics* 21.4 (2003): 857-886.

Joseph Veres[15] analyzes various factors that impact the winning percentages of teams in the NFL. This study regresses both general management decisions with team statistics in an attempt to discern the factors that positively and significantly affect success in a given season. Analyzing all current teams between 2002-2006, Veres discovers that it is very difficult if not impossible to determine the most important factors of success season to season. In one year, defense statistics seem to win more games while in another season, general management decisions appear more significant. During the 2002 season, on-field performance statistics proved to provide the best indicators for success – notably the number of plays by the offense. In 2003, defense statistics (especially total number of points allowed and number of first downs surrendered) proved statistically significant. General management decisions regarding head coaches and their level of experience in the 2004 season aided in team success. This echoes findings by Hadley et al. (2000).[16] Special teams with the best extra point percentage led their teams to victory in 2005. Finally, the 2006 season presented no statistically significant variables contributing to team win-percentage. With personnel changes both on and off the field, coupled with normal team fluctuation, the "results of the five models make it difficult to assess properly the determining factor of winning percentage for an NFL team over the course of a given year…the determinants are constantly changing from year to year."[17]

---

[15] Joseph A. Veres, "Touchdown! The Determinants of Team Success in the National Football League (NFL)" (B.A. Thesis, Colorado College, 2007), 1-3.

[16] Hadley et al.

[17] Ibid.

CHAPTER III

METHODOLOGY

Before this study can begin, an extremely important question must first be answered: what constitutes a new stadium? It seems logical to collect data on teams that have played in a single permanent home venue for a series of years before a move to another permanent home stadium. Then, analysis on win percentages could attempt to explain the difference that moving from an old to a new venue has. However, there are numerous instances throughout the NFL when a team will play in multiple venues, occasionally over multiple seasons prior to receiving their own permanent home field. Is it not also accurate, then, to consider teams that had no previous home venue and moved into a new stadium of their own?

Therefore, in attempting to discern the most accurate estimation that a new stadium has on a team's overall regular season win percentage, one must also consider teams moving from a non-permanent home field situation to a facility of their own. Clearly, two types of teams seek new stadiums. There are teams and owners that want a new stadium because their old field is past its prime, and there are teams that need new stadiums because they simply do not have a home field of their own.

What kind of effect could these different considerations make on the final analysis? These different situations must be considered to see, if in fact, they have any difference on the final outcome. Two approaches to data analysis develop. An original

approach will only consider teams that move from an old permanent home stadium to a new permanent home stadium, playing enough seasons in both stadiums to build a symmetrical spread of data. An alternate approach will disregard where a team played (as long as they did play – no expansion teams are included in either approach) before receiving a permanent home field. The alternate approach spread will also be built symmetrically around the team's acquisition of a new stadium.

To further elaborate, here are some pertinent examples. The Seattle Seahawks moved into their new home stadium, Quest Field, at the start of the 2002 regular season. However, in the eight years prior to moving into Quest Field, the Seahawks played the entirety of the 2000 and 2001 seasons at Husky Stadium (traditionally considered the home of the Washington Huskies of the National Collegiate Athletic Association [NCAA]) as repairs were made to Kingdome – the previous home stadium of the team. The original approach would disregard the Seahawks data, as the team did not have a permanent home field in the eight years prior to moving into Quest Field. However, for teams such as the Seahawks (and a few others, all of which are accounted for in detail later), what if the lack of an NFL quality stadium actually weakened the competitiveness of the team during those years? Is it not also accurate to include the teams (the most notable being the Seattle Seahawks, New York Giants, Oakland Raiders, and the Tennessee Titans) that moved into a permanent home stadium after a significant period of time moving from venue to venue?

Furthermore, in taking the alternate approach in considering new stadiums, there are cases where the actual years in the spread of applicable data changes. One example is the Chicago Bears. According to the stipulations of the original approach, data would

be considered like this: though Soldier Field was officially opened on October 9, 1924, the Chicago Bears did not actually begin to use the facility until the 1971 season. Before the team moved into this new facility, they played their home games at Wrigley Field (traditionally recognized as the home of the Chicago Cubs – a Major League Baseball team). It is therefore easy to draw a line between new and old home venues and analyze the effect that the move from Wrigley Field to Soldier Field had on the team and data in this approach begins at the outset of the 1961 season.

However, using the alternate approach yields different years of applicable data; though the Chicago Bears had been playing in Soldier Field since 1971, the team left after the 2001 season. After playing the 2002 season at Memorial Stadium (traditionally considered the home of the University of Illinois' Fighting Illini Football team located in Champaign, Illinois), the team returned in 2003 to Soldier Field after the building had undergone a twenty-month, $632 million extensive renovation. This, of course, raises the issue of renovations to existing structures. However, being that the total cost of renovations to Soldier Field in 2001 could have instead purchased a brand new facility, perhaps it is actually more accurate to consider the Chicago Bears as receiving a "new" stadium in the 2003 season.

These are some preliminary examples of how the perception of "new" can actually effect what years of data are used for teams in this analysis. While the majority of teams remain unaffected by this, the effect must be separately analyzed.

I have decided that because an arbitrary line must be drawn on the amount spent on renovations to determine whether or not they belong in the data set, renovations to pre-existing structures will be disregarded save for two special cases – The Oakland

Raiders and the Chicago Bears – as in both cases renovations to an old venue essentially created an entirely new complex that remained located on the original footprint. However, note that renovations to previous stadiums are discarded from the original approach and will only be considered in the alternate approach.

To determine the effect that stadiums have on team success, regular season win percentages will be analyzed in three different time windows to see if an effect exists and, if so, for how long. These different time windows will be symmetrically based around the season in which a team receives its new stadium. The periods of time analyzed in this study include six-year (three years before and after receiving stadium), ten-year (five years before and after receiving stadium), and twenty-year (ten years before and after receiving stadium) windows. Only teams with sufficient data for each period of time will be used in each window of time. Any peculiarities (as well as years of applicable data) have been accounted for. This means that the NFL's newest expansion teams and the organizations that have only played in a single home stadium are not applicable to this study and have not been included. Teams that did not have enough data to be included in the data set have been accounted for.

Generally speaking, most new NFL stadiums are ready in time for the beginning of a fresh season; however, there are occasionally exceptions when a team moves into a stadium mid-season. As it is nearly impossible to factor in the contribution that the addition of receiving a new stadium mid-year has on win percentage for that entire season, new stadiums have only been considered in their first full season of use throughout the data set.

It is not uncommon for teams to be relocated, sold to new owners, or to have their preexisting home venues change name. Many of these name changes have been accounted for in the detailed write-ups of each league. However, for simplicity, in the data set itself, only the most current name of venue or team (where applicable) has been used.

Additionally, there are a few instances when an old franchise receives a new stadium but does not have enough information playing in that new stadium to be included in the study. In those relevant cases, data from the team's previously new and old stadiums has been used instead. All cases are accounted for in chapter five.

Rarely, instances also occur when a team will move into a permanent home stadium but the structure itself is preexisting. That is, the building is new for the team but the building itself was previously erected. This is most notable in the case of the Chicago Bears. Though unusual, these instances still constitute a new permanent home stadium and have been considered in the data.

It is important to note that while the entire NFL regular season is played during a single calendar year, the Super Bowl is not held until January or February of the following year. Therefore, in the context of this study it is more accurate to consider a Super Bowl winning team the champion of the year before the Super Bowl game is actually played. This has been accounted for and "corrected" within the data set. For example, the entire regular season that determined the league champion of the NFL and AFL for the first Super Bowl (held in 1967) was played, in its entirety, in 1966. Therefore, for the purposes of data collection and analysis, I have considered the Super

Bowl winner the champion of the season prior to when the Super Bowl was actually played.

Of course, new stadiums are not and cannot be considered the only determinant of a team's overall success measured in regular season win-percentage. While this study's primary aim seeks to discover what relationship between venues and competitive-nature exists, many other explanatory variables must be considered and will be included in the model. These other variables include data on metropolitan statistical area (MSA) population, MSA median income, and the number of other professional sports franchises located in that MSA. Additionally, the model includes on-field performance statistics including the number of offensive plays in a season, number of defensive points surrendered, extra point percentage (points after touchdown), and head coaching experience. It is extremely important to include these other variables in an attempt to build the most accurate model. I am focusing on the effect of two specific variables: in this case, win-percentage and new stadiums. By using MSA and performance measures as control variables, I will create a more accurate model and ensure that the effect of a new stadium is not unfairly exaggerated as a determinant (or deterrent) of success on the gridiron.

CHAPTER IV

MODELS

For a more in-depth discussion of the variables discussed in the four models below – as well as any notable exceptions – please refer to chapter five.

FIGURE 4.1

THE NEW STADIUM EFFECT MODEL

$$Y(WINPERCENTAGE) = \beta_0 + \beta_1(NEWSTADIUM) + \beta_2(CAPACITY) + \beta_3(PROTEAMPERPOPULATION) + \beta_4(MEDIANINCOMEMSA) + \beta_5(HEADCOACHEXPYEARS) + \beta_6(NUMBEROFFENSIVEPLAYS) + \beta_7(DEFENSIVEPOINTSALLOWED) + \beta_8(EXTRAPOINTPERCENTAGE) + u.$$

TABLE 4.1

DEPENDENT VARIABLE IN THE NEW STADIUM EFFECT MODEL

Variable	**Definition**
WINPERCENTAGE	The regular season win-percentage (the win/loss record) for a given team in a given year.

TABLE 4.2

INDEPENDENT VARIABLES IN THE NEW STADIUM EFFECT MODEL

Variable	**Definition**
NEWSTADIUM	Bernoulli variable indicating whether or not a team, for a given season, is playing in a new permanent home stadium. Recorded as 0 if stadium is not new (defined by the stipulations of the original or alternate analysis) or 1 if stadium is new.
CAPACITY	Capacity of a stadium, for a given team, in a given season.
PROTEAMPERPOPULATION	Number of professional sports teams per capita in a given metropolitan statistical area (MSA). This measure only includes teams from the following professional leagues: Major League Baseball (MLB), the National Basketball Association (NBA), and the National Hockey League (NHL). This measure also includes any additional NFL teams in an MSA.
MEDIANINCOMEMSA	Median income of residents in a given MSA and based on year. This variable is recorded in ten-year windows as reported by the United States Census Bureau.
HEADCOACHEXPYRS	The number of years of total experience in the NFL of the head coach, of a given team, for a given season. Only years when a head coach position was held are included in this measure.
NUMBEROFFENSIVEPLAYS	The total number of offensive plays attempted by a given team in a given season. This measure includes pass attempts, rush attempts, and times quarterback is sacked.
DEFENSEIVEPOINTSALLOWED	The total number of point surrendered by a given team in a given season.
EXTRAPOINTPERCENTAGE	The percentage of successful points after touchdown (PAT), for a given team, in a given season.
β_0	Intercept term.
u	Error term.

Expectations of the New Stadium Effect Model

I believe that results from the New Stadium Effect Model will fail to yield a statistically significant value of the NEWSTADIUM variable in the case of the original analysis. However, I expect that I will find NEWSTADIUM to be statistically significant when considering data in the alternate approach on the premise that teams moving from venue to venue before receiving a permanent home stadium of their own are at a competitive disadvantage. Once these teams finally have the benefit of permanent facilities, they should perform better on the field. Additionally, I expect that the effect of the NEWSTADIUM variable will be more prominent in the ten and twenty year window of the alternate approach.

It is reasonable to expect on-field performance measures – that is, the NUMBEROFFENSIVEPLAY, DEFENSIVEPOINTSALLOWED, and EXTRAPOINTPERCENTAGE variables – to be statistically significant in all time windows and in both approaches. The reasoning behind this expectation is simple: the better a team is on the field, the more games they will win. This should hold regardless of the building in which a team plays. Additionally, I expect HEADCOACHEXPYEARS to be statistically significant in all cases for both approaches due to the study by Hadley et al. (2000).[1]

I do not believe that I will find a statistically significant effect of the CAPACITY, MEDIANINCOMEMSA or PROTEAMPERPOPULATION variables. Residents of an MSA have no ability to organize a team (these decisions are left to general management and team owners). While city populations may be a proxy for

---

[1] Lawrence Hadley et al., "Performance Evaluation of National Football League Teams," *Managerial and Decision Economics*, 21.2 (2000): 63-70.

money or support for a team I do not think that its effect will have any effect on a team's overall regular season win-percentage.

FIGURE 4.2

THE PROLONGED STADIUM EFFECT MODEL

$$Y\ (WINPERCENTAGE) = \beta_0 + \beta_1(PROLONGEDSTADIUMEFFECT) + \beta_2(CAPACITY) + \beta_3(PROTEAMPERPOPULATION) + \beta_4(MEDIANINCOMEMSA) + \beta_5(HEADCOACHEXPYEARS) + \beta_6(NUMBEROFFENSIVEPLAYS) + \beta_7(DEFENSIVEPOINTSALLOWED) + \beta_8(EXTRAPOINTPERCENTAGE) + u.$$

TABLE 4.3

DEPENDENT VARIABLE IN THE PROLONGED STADIUM EFFECT MODEL

Variable	**Definition**
PROLONGEDSTADIUMEFFECT	This variable measures the number of regular seasons before and after a new stadium is acquired for a given team. For the first season a new stadium is used, this variable is recorded as 0 and moves in both a positive and negative direction as applicable.

Independent Variables in the Prolonged Stadium Effect Model

The Prolonged Stadium Effect Model regresses all of the same variables used in the New Stadium Effect Model. However, the Prolonged Stadium Effect Model regresses the PROLONGEDSTADIUMEFFECT variable (see table 4.3 for description) in place of the NEWSTADIUM variable. With the exception of the NEWSTADIUM variable, this model utilizes the same dependent and independent variables as the New

Stadium Effect Model. Please refer to variable descriptions listed under New Stadium Effect Model in Table 4.2 for a full description of these variables.

Expectations of the Prolonged Stadium Effect Model

With the Prolonged Stadium Effect Model, I expect to have the same results that I predicted with the New Stadium Effect Model (please see "Expectations of the New Stadium Effect Model" for discussion).

The NEWSTADIUM variable measures whether or not a stadium is "new" or "old". In this model, NEWSTADIUM is replaced with PROLONGEDSTADIUMEFFECT, which is a variation of the NEWSTADIUM variable as it measures the age of a stadium (both new and old). As both variables are similar, I believe the model will yield similar results to those expected in the New Stadium Effect Model. Under that assumption, I anticipate that for all time windows in the original approach, PROLONGEDSTADIUM EFFECT will fail to yield statistically significant results. However, I believe that when the stipulations of the alternate analysis are applied, the PROLONGEDSTADIUMEFFECT variable will be statistically significant in the ten and twenty year time windows.

FIGURE 4.3

THE WINNING DIVISION CHAMPIONSHIP MODEL

$$Y(DIVISIONCHAMPION) = \beta_0 + \beta_1(NEWSTADIUM) + \beta_2(CAPACITY) + \beta_3(PROTEAMPERPOPULATION) + \beta_4(MEDIANINCOMEMSA) + \beta_5(HEADCOACHEXPYEARS) + \beta_6(NUMBEROFFENSIVEPLAYS) + \beta_7(DEFENSIVEPOINTSALLOWED) + \beta_8(EXTRAPOINTPERCENTAGE) + u.$$

TABLE 4.4

DEPENDENT VARIABLE IN THE WINNING DIVISION CHAMPIONSHIP MODEL

Variable	**Definition**
DIVISIONCHAMPION	0 if team was not division champion, 1 if team was division champion and therefore played in the championship game.

Independent Variables in the Winning Division Championship Model

The Winning Division Championship Model regresses many of the same variables used in the New Stadium Effect Model. The Winning Division Championship Model once again regresses the NEWSTADIUM variable against the dependent variable; the PROLONGEDSTADIUMEFFECT variable has been excluded. The Winning Division Championship Model utilizes the same dependent and independent variables as the New Stadium Effect Model. Please refer to variable descriptions listed under New Stadium Effect Model in Table 4.2 for a full description of these variables.

Expectations of the Winning Division Championship Model

With the Winning Division Championship Model, I expect to have the same results that I predicted with the New Stadium Effect Model (please see "Expectations of the New Stadium Effect Model" for discussion) with the exception of the NEWSTADIUM variable. While I do expect to see this variable to have statistical significance for data in the alternate analysis in the New Stadium Model and the Prolonged Stadium Effect Model, I do not believe that it will make any difference in a team's ability to win a division championship. While a team may see an increase in regular season win-percentage there is no guarantee of post-season success. Playoff games in the NFL are a best-of-one contest. While the stadium effect may be seen over the course of a season, I do not think it is reasonable to expect a team's new venue to have a significant difference on a single game in the post season.

FIGURE 4.4

THE WINNING LEAGUE CHAMPIONSHIP MODEL

$$Y(\text{LEAGUECHAMPION}) = \beta_0 + \beta_1(\text{NEWSTADIUM}) + \beta_2(\text{CAPACITY}) + \beta_3(\text{PROTEAMPERPOPULATION}) + \beta_4(\text{MEDIANINCOMEMSA}) + \beta_5(\text{HEADCOACHEXPYEARS}) + \beta_6(\text{NUMBEROFFENSIVEPLAYS}) + \beta_7(\text{DEFENSIVEPOINTSALLOWED}) + \beta_8(\text{EXTRAPOINTPERCENTAGE}) + u.$$

TABLE 4.5

DEPENDENT VARIABLE IN THE WINNING LEAGUE CHAMPIONSHIP MODEL

Variable	Definition
LEAGUECHAMPION	0 if team did not win the league championship, 1 if team did win league championship.

Independent Variables in the Winning League Championship Model

The Winning League Championship Model regresses many of the same variables used in the New Stadium Effect Model. The Winning League Championship Model once again regresses the NEWSTADIUM variable against the dependent variable; the PROLONGEDSTADIUMEFFECT variable has been excluded. The Winning League Championship Model utilizes the same dependent and independent variables as the New Stadium Effect Model. Please refer to variable descriptions listed under New Stadium Effect Model in Table 4.2 for a full description of these variables.

Expectations of the Winning League Championship Model

As with the Winning Division Championship Model, I expect to have the same results that I predicted with the New Stadium Effect Model (please see "Expectations of the New Stadium Model" for discussion) with the exception of the NEWSTADIUM variable. While I do expect to see this variable to have statistical significance for data in the alternate analysis, I do not believe that it will make any difference in a team's ability to win a league championship.

As of 2010, the host city's team has never won a Super Bowl. In fact, thirty-eight Super Bowls have been held in an NFL stadium and never has the home team

been involved. No Super Bowl host stadium has even had a team reach the league championship. Furthermore, "only five would-be Super Bowl hosts have even made the playoffs."[2]

While a team may see an increase in regular season win-percentage after receiving a new stadium, this does not guarantee post-season success. Playoff and championship games in the NFL are a best-of-one contest. While the stadium effect may be seen over the course of a season, I do not think it is reasonable to expect a team's new venue to have a significant difference on a single game – most especially the championship game.

[2] Associated Press, "Super Bowl Host Without a Hometown Champion in 37 Tries," National Football League, http://www.nfl.com/news/story/09000d5d8a612 1d/article/super-bowl-host-without-a-hometown-champion-in-37-tries (accessed February 7, 2011).

CHAPTER V

IN-DEPTH DISCUSSION OF TEAM DATA AND MODEL VARIABLES

In-depth Discussion of Team Data

Original Analysis Methodology by Team

This approach considers teams that moved from an old permanent home venue to a new permanent home field. Additionally, I have attempted to use the most current team data available that is relevant in the context of this study.

The following are peculiarities and exceptions contained within the National Football League data – listed by modern-day conference and division. Unless otherwise noted, a total of twenty years of data per team has been included in the data set. Stadium renovations are ignored in this approach. Twenty-five teams are included.

AFC East

The New England Patriots moved into their new stadium, Gillette Stadium, at the beginning of the 2002 regular season. Therefore, only sixteen years worth of data has been included in the set.

AFC North

The modern day Baltimore Ravens were moved from Cleveland, Ohio (where they were known as the Cleveland Browns) by their owner Art Modell after the 1995 season. However, as negotiated in the deal by the NFL, the team was allowed to move

but would be forced to leave behind their history and former name for a planned expansion team, the "reincarnated" Cleveland Browns, in 1999. This meant that when the Ravens started their first season in Baltimore beginning in 1996 they were, in essence, a brand new team (even though some of the staff and players moved from Cleveland) Due to this, and because the Ravens did not move into their new stadium, M&T Bank Stadium until 1998, data from the team has been excluded.

As discussed above, the Cleveland Browns were moved to Baltimore after the 1995 regular season yet their records remained in Cleveland. The team was then reestablished at the beginning of the 1999 season. While the team experienced a three-year hiatus, they eventually reentered the league and began playing at their new, current venue, Cleveland Brown Stadium. Due to the NFL's stipulations that all records associated with the Browns franchise were to remain in Cleveland, the data from the team, both prior to moving and post-reestablishment are included in the data set. The three years of inactivity has simply been skipped over, but the relevant data remains included.

The Pittsburgh Steelers moved into their current venue, Heinz Field, at the start of the 2001 season. Therefore, only a total of eighteen years of data from the team has been included in the set.

AFC South

The Houston Texans joined the NFL in time for the 2002 season, the same year that they began playing at their current venue, Reliant Park. Data that can be analyzed in the context of this study is not yet available regarding the Texans playing in their new stadium. Therefore, data from the team has been excluded from the set.

The Indianapolis Colts' new stadium, Lucas Oil Stadium, was opened at the beginning of the 2008 stadium. As this stadium is so new, sufficient data that can be analyzed in the context of this study is not currently available. However, the Colts have a long and storied history (becoming a franchise on January 23, 1953) playing in the NFL. Originally the team played in Baltimore (as the Baltimore Colts) at Memorial Stadium, then moved to Indianapolis at the start of the 1984 season playing at the RCA Dome. Data from the team's previous two venues have been used instead (1974-1993), and, where applicable, data from the Baltimore Colts has been used.

The Jacksonville Jaguars joined the NFL at the start of the 1995 season, the same year that they began playing at their current home venue, Jacksonville Municipal Stadium. Not enough data that can be analyzed in the context of this study is currently available. Therefore, no data from the team has been included in the set.

The Tennessee Titans moved from Houston, Texas (where they were known as the Houston Oilers) after the 1996 season. For the first two seasons in Tennessee the team was known as the Tennessee Oilers and played their home games at the Liberty Bowl and at Vanderbilt Stadium until moving into their own venue, LP Field, in 1999. At that time the team was also rechristened the Tennessee Titans. As the team did not have a permanent home field for a significant period of time after moving from Houston, data from the team has been excluded from the original approach.

AFC West

The Denver Broncos moved into their current home stadium, Invesco Field at Mile High Stadium, at the beginning of the 2001 regular season. Therefore, a total of only eighteen years of data has been included in the set.

In 1960, Lamar Hunt, a co-founder of the AFL, established a new team, the Dallas Texans in Dallas, Texas. After winning an AFL title, the team moved to Kansas City and became the Kansas City Chiefs. As the team moved into a new stadium when they moved to Kansas City, Missouri (Kansas City Municipal Stadium), then received a newer home venue in 1972 (Arrow Stadium – the team's current home field), a total of only eighteen years of data have been recorded. No data from the predecessor team has been recorded.

The Oakland Raiders, originally charted in 1960, were moved by their owner, Al Davis, to Los Angeles for the beginning of the 1982 season (where they were known as the Los Angeles Raiders). After thirteen seasons, Davis decided to move the team back to Oakland where they remain today. During the team's first stint in Oakland, they played at the Oakland-Alameda County Coliseum and when they returned to the city they also returned to the same stadium (while playing in Los Angeles the team played at Los Angeles Memorial Coliseum). The original analysis will use data from when the Raiders moved from Oakland to Los Angeles in 1982 as this move provided the team with a new permanent home facility.

The San Diego Chargers were chartered in 1960 and moved into their current venue, Qualcomm Stadium, in 1967. Therefore, only twelve years of data has been included in the data set.

NFC East

The Dallas Cowboy's new stadium, Cowboys Stadium, was opened in time to host the team for the entirety of the 2009 season. However, as this move is so recent, sufficient win percentage data concerning this new field does not yet exist. As the

Dallas Cowboys officially became a franchise on January 28, 1960 and have a long and storied history, data from the seasons in which the Cowboys played at their former fields, Texas Stadium and the Cotton Bowl, has been used instead (1961-1980).

Beginning in 1956, the New York Giants played their home games in Yankee Stadium (traditionally considered the home of Major League Baseball's New York Yankees). Before the start of the 1973 NFL season, New York City officials announced a two-year renovation of Yankee stadium. The Giants were granted two final home games at Yankee stadium before moving out. The team played the remainder of the 1973 season and the entirety of the 1974 season at the Yale Bowl stadium in New Haven, Connecticut. Then, at the beginning of the1975 season, the Giants returned to New York to play their home games at Shea Stadium (traditionally considered the home of Major League Baseball's New York Mets). Finally, in 1976, Giants Stadium in East Rutherford, New Jersey was opened. It remained the home of the Giants until the conclusion of the 2009 season. At the start of the 2010 season, the New York Giants moved stadiums once again to New Meadowlands Stadium (also located in East Rutherford New Jersey), a joint venue with the New York Jets. As there was no permanent home field for the New York Giants for three seasons, data from the team cannot be analyzed in the context of the original approach. Therefore, any data pertaining to the team has been excluded from the original approach.

As the Philadelphia Eagles did not begin playing at their current facility, Lincoln Financial Field, until the 2003 season, a total of only fourteen years of data has been included in the set.

NFC North

Though Soldier Field was officially opened on October 9, 1924, the Chicago Bears did not actually begin to use the facility until the 1971 season. Before the team moved into this new facility, they played their home games at Wrigley Field (traditionally recognized as the home of the Chicago Cubs – a Major League Baseball team from Chicago). Data collected on the Bears begins at the outset of the 1961 season.

As the Detroit Lions did not begin playing at their current facility, Ford Field, until the 2002 season, a total of only fourteen years of data has been included in the set.

NFC South

The Carolina Panthers' first season was in 1995, and the following season the team moved into its current home venue, Bank Of America Stadium in Charlotte, Carolina. Therefore, no data has been recorded.

The New Orleans Saints' first season was in 1967 and in 1975 the team moved into its current home venue, the Louisiana Superdome in New Orleans, Louisiana. Therefore, only sixteen years of data are included in the set.

NFC West

The Arizona Cardinals moved into their new home stadium, University of Phoenix Stadium, at the start of the 2006 regular season. Therefore, a total of only eight years worth of data has been included in the set.

The Seattle Seahawks moved into their new home stadium, Quest Field, at the start of the 2002 regular season. However, in the eight years prior to moving into Quest

field, the Seahawks played both the entirety of the 2000 and 2001 in Husky Stadium (traditionally considered the home of the Washington Huskies of the NCAA) as repairs were made to Kingdome – the previous stadium of the team. As such, data from the Seahawks has been excluded from the data set in the original approach, as the team had no permanent home field in the eight years prior to moving into Quest Field.

The St. Louis Rams moved from Los Angeles after the 1994 season and applicable data from the predecessor team has been used. Because the St. Louis Rams did not move into their current home venue, Edward Jones Dome, until November of the 1995 regular season, the stadium has not been considered "new" until the 1996 season.

Alternate Analysis Methodology by Team

This approach considers teams that played in multiple venues before moving to a new permanent home field of their own. Additionally, I have attempted to use the most current team data available that is relevant in the context of this study.

The following are peculiarities and exceptions contained within the National Football League data – listed by modern-day conference and division. Unless otherwise noted, a total of twenty years of data per team has been included in the data set. With the exception of the Chicago Bears and the Oakland Raiders, stadium renovations are otherwise ignored in this approach. Twenty-eight teams are included.

Some teams remain excluded from the data set. The Baltimore Ravens, Houston Texans, Jacksonville Jaguars, and Carolina Panthers are not included because they are all expansion teams and have not played in stadiums relevant to this study.

The following teams were excluded from the original analysis. However, for the reasons listed below, they are included in the alternate analysis. They are listed by their modern-day league and conference. Unless otherwise noted, the years of data used remains the same for teams as listed in the original analysis above.

AFC South

The Tennessee Titans (known as the Tennessee Oilers until 1999) are included in the alternate analysis. The team moved into LP Field at the start of the 1999 season after a number of seasons without a permanent home stadium.

AFC West

Chartered in 1960, the Oakland Raiders were moved by their owner, Al Davis, to Los Angeles for the beginning of the 1982 season (where they were known as the Los Angeles Raiders). After thirteen seasons, Davis decided to move the team back to Oakland where they remain today. During the team's first stint in Oakland, they played at the Oakland-Alameda County Coliseum and, when they returned to the city in 1995, they also returned to the same stadium. While playing in Los Angeles the team played at Los Angeles Memorial Coliseum. While the franchise did not technically receive a brand new stadium after they relocated to Oakland, the stadium did undergo a $120 million renovation. One of Davis' motivations for leaving Oakland initially was the lack of an appropriate facility for his team. When the city finally renovated the stadium, Davis was convinced to return his team to Oakland. As the lack of a new stadium provided enough motivation to leave, and the renovations eventually prompted the team's return, it is relevant to keep the team included. $120 million in upgrades, though

not as extensive as the repairs to Soldier Field (below), proved enough to persuade Davis to relocate to Oakland. Therefore, though the team did not technically receive a new stadium, data from the Oakland Raiders has been included in the alternate analysis data set. The alternate approach analyzes the new stadium in 1995.

NFC East

The New York Giants are included in the alternate analysis. The team moved into Giants Stadium at the start of the 1976 season after a number of seasons without a permanent home stadium.

NFC North

Though the Chicago Bears had been playing in Soldier Field since the 1971 season, the team temporarily left the venue after the 2001 season as it underwent extensive renovations. After playing the 2002 season at Memorial Stadium, the team returned in 2003 to Soldier Field after the building had undergone a twenty-month, $632 million extensive renovation. As the cost of renovation was so immense (nearly the same price as purchasing a brand new stadium), the Bears represent one of two examples in the alternate approach where renovations were considered relevant. While the original approach in the study analyzes the Chicago Bear's new stadium change in 1971, this approach analyzes the new stadium in 2003. Only fourteen years of data are included in the set.

NFC West

The Seattle Seahawks are included in the alternate analysis. The team moved into Quest Field at the start of the 2002 season after a number of seasons without a permanent home venue. Only sixteen years of data are included in the in the set.

In-depth Discussion of Variables

CAPACITY

This variable measures the stadium capacity of a given team in a given year. Due to small stadium renovations and the changing of safety regulations over time, this variable may not be completely accurate on a season-to-season basis. I have attempted to include the most accurate estimate using official NFL record and fact books.[1] [2] [3] [4] The significance of this variable should not be overlooked; however, it should be considered in a broad sense.

MSA Population (Used in the PROTEAMPERPOPULATION Variable)

This measure is included in ten-year time windows – as reported by the United States Census Bureau. It is reported based on a given team's stadium location, with a few exceptions: Sterling Heights, Michigan was used instead of Pontiac Michigan;

---

[1] National Football League, *Official 1984 National Football League Record and Fact Book* (New York: Workman Publishing Co., 1983).

[2] National Football League, *The Official National Football League 1992 Record and Fact Book: 73rd Season* (New York: Workman Publishing Co., 1991).

[3] National Football League, *NFL 2000 Record and Fact Book: 81st Season* (New York: Workman Publishing Co., 1999).

[4] National Football League, *The Official Record and Fact Book 2010: 91st Season* (New York: Workman Publishing Co., 2009).

Milwaukee Wisconsin instead of Green Bay, Wisconsin; St. Paul Minnesota instead of Bloomington, Minnesota; Boston, Massachusetts instead of Foxborough, Massachusetts; Jersey City, New Jersey instead of East Rutherford, New Jersey; and Baltimore, Maryland instead of Landover, Maryland.

MSAMEDIANINCOME

In the context of this study, using median income as opposed to mean income as a measurement of wealth is a better estimation because, unlike a mean measure, the median is less affected by outliers.

Estimates were taken in ten-year time windows as reported by the United States Census Bureau. It must be noted that finding median income data on an MSA level over the entire span of NFL data collected (1947-2009) is extremely difficult. The first time the Census collected income data in the decennial census was in 1940. Median income data does not exist on an MSA level in a comparable format before 1959 (1960 Census). I have included the best estimate possible in all cases though many proxy variables exist throughout the data set. The following list comprises all proxy variables and exceptions used throughout the data set. All values have been converted into 2009 constant dollars.

In an attempt to remain consistent, data pertaining to MSA median income correlates with the corresponding location used in the MSA population measure. However, due to available median income data, the following exceptions were made: Instead of using median income data from Sterling Heights, Michigan (which is used as a population proxy for Pontiac, Michigan) data was included from Detroit, Michigan; Phoenix, Arizona instead of Tempe/Glendale, Arizona; Chicago, Illinois instead of Champaign, Illinois; and Memphis, Tennessee instead of Nashville, Tennessee.

The following exceptions were also made: the median income data from Oakland, California was not reported in years that correlated with years of team data collected from 1972-1979; therefore, median income data from 1979 was used instead. Median income data from San Francisco, California was not reported in years that correlated with years of team data collected from 1961-1978; therefore, median income data from 1979 was used instead. Median income data from Miami, Florida was not reported in years that correlated with year of team data collected from 1979-1988; therefore, median income data from an average of 1989 and 1969 values was used instead. As median income data is not reported by the Census before 1959 (explained above), the 1959 median income value serves as a proxy for data pertaining to the Green Bay Packers in the years 1947-1958. Median income data from the 1999 Census was not reported for Cincinnati, Ohio; therefore, data from Columbus, Ohio has been included instead. Median income data from the 1999 Census was not reported for Denver, Colorado; therefore, data from Greeley, Colorado has been included instead.

HEADCOACHEXPYEARS

The head coach variable measures the total experience of the coach for a given team in years. Years are measured in total NFL experience and not based on years with a particular team. For coaches who experience a break between jobs, the non-active years have simply been skipped over. In instances where a coach was replaced or resigned mid-season, the coach who finished that season has remained included. A coach in his initial season at the head coaching position has been considered with “zero” years of experience and no consideration to previous assistant-coach or team coordinator roles were taken into account.

There are some unique peculiarities in the data set. The Green Bay Packers officially had co-coaches in the 1953 season (Hugh Devore and Ray McLean) and is the only team with such an instance the data set.[5] For the purposes of data collection this unique situation will be considered as "zero" years of experience. It should be noted, however, that Ray McLean did return for a season as the sole head coach of the Packers for the 1958 season – in which he was considered to have one year of prior coaching experience. There is another notable exception in the data set: Mike Holovak officially became the head coach for the New York Jets for only the last game of the 1976 season after Lou Holtz resigned. Mike Holovak was also the head coach for the Boston Patriots (now the New England Patriots) from 1961 to 1968.[6] For purposes of data collection, coaches who entered the position as mid-year replacements were considered the sole head coach for that year. This one instance, however, was disregarded. Though coach Holovak had prior experience coaching in the NFL, including his experience for that single game as "eight years" could unfairly bias the variable because he only served for one game in 1976.

NUMBEROFFENSIVEPLAYS, DEFENSIVEPLAYSALLOWED, and EXTRAPOINTPERCENTAGE

These variables measure the on-field performance statistics for a given team in a given season. Based on Veres'[7] study, these indicators represent an offensive, defensive, and special teams measure and were the most statistically significant

---

[5] Database Football, "NFL Coaching Records," http://databasefootball.com/coaches /coachlist. htm (accessed October 2010).

[6] Ibid.

[7] Joseph A. Veres, "Touchdown! The Determinants of Team Success in the National Football League (NFL)" (B.A. Thesis, Colorado College, 2007), 1-3.

variables in the seasons that he studied. While a plethora of on-field performance statistics could be included, they would all likely be highly correlated with the aforementioned variables.

Teams with more offensive plays in a given season are more likely to score. It goes without saying that scoring more points increases the likelihood of winning more games. Measures such as fourth down conversion rate, quarterback passing percentage, rush statistics, and number of touchdowns are directly associated with the total number of plays executed. The more plays that an offense runs, the more opportunity they have to score. Defenses that allow more points are, quite simply, hurting their team's chance to win. Other defensive statistics are highly correlated with this measure. Special team variables, measured in extra point percentage rate (points after touchdown – abbreviated PAT), are also included. Teams that have a more productive offense will have more chances to attempt a PAT. Higher PAT-percentage will help to ensure more wins in a season.

These on-field statistics are better measures than, for instance, the total number of Pro Bowl players on a team or the number of players inducted into the Professional Football Hall of Fame. These other measures may be biased – teams with bigger fan bases might send more players to the Pro Bowl or certain politics may be involved with players chosen for enshrinement into the Hall of Fame.[8]

[8] James Quirk and Rodney Fort, *Pay Dirt: The Business of Professional Team Sports* (Princeton, Princeton University Press, 1992).

CHAPTER VI

THEORY AND ECONOMETRIC PROCEDURES

Tobit Regression Versus Ordinary Least Squares Regression

Theoretically, because the dependent variable in this study is win-percentage, which takes a value between zero and one, it makes sense to estimate using a Tobit regression. A Tobit model attempts to rationalize censored dependent-variable data – that is, data that falls outside of the permissible 0-100% range in a way comparable with uncensored data. For data in the uncensored range, a Tobit model simply runs a standard ordinary least squares (OLS) regression. There are no instances in my data set, in any time window for either analysis, of censored data. While the theoretical reason behind running a Tobit model is sound, there is absolutely no difference between the resulting coefficients and T-values given by OLS estimation. Therefore, for all time windows used in the New Stadium Effect Model and the Prolonged Stadium Effect Model, an OLS regression has been utilized.

Ordinary Least Squares Estimation

An Ordinary Least Squares (OLS) estimation model will be used to estimate the effect of explanatory variables on regular season win-percentage with close consideration being paid to the effect of a new stadium.

An OLS regression minimizes the sum of the squared vertical distances from the line of best fit to the actually observed points. That is, OLS estimation minimizes the

sum of squared residuals. When applied to a model that is linear in parameters, a basic OLS multiple linear regression equation looks like this:

FIGURE 6.1

OLS MULTIPLE LINEAR REGRESSION EQUATION

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + u$$

Where Y represents a dependent variable, β_0 represents the intercept, β_1 through β_k represent the coefficient value associate with a given explanatory variable, denoted: X_1 through X_k. Finally, the term denoted "u" represents an error term. This error is the difference between observed points (denoted y_1 through y_k) and points estimated by the model (denoted $\hat{y}_1$ through $\hat{y}_k$). An OLS regression will model the impact and the statistical significance of each independent variable against the dependent variable.

It is impossible to construct a model that perfectly describes the dependent variable; econometric models do, however, provide a sensible estimation. For simplicity, the model assumptions include:

1. Y and each X (the dependent and each independent variable) are linear in parameters. That is, a linear model of the sample data represents a true representation of the population.
2. Each individual observation comes from a random sample.
3. There is variability among each chosen explanatory variable.
4. Homoskedasticity (constant variance) among residuals exists.

5. There is a lack multicollinearity (high correlation among independent variables). When followed and, if necessary, corrected for, an OLS model provides the best linear unbiased estimation.

A violation of any of these OLS assumptions will bias the model and provide inaccurate results. In the case of homoskedasticity and multicollinearity, tests can be run to check for violations. If necessary, any issue of homoskedasticity and multicollinearity will be corrected.

Finally, an OLS model is capable of predicting values of win-percentage that are below 0% or above 100%. When using this model for predictive purposes, one must be careful and reasonable in the values of all independent variables. For estimation purposes, a table of the minimum and maximum values for each variable collected is included.

TABLE 6.1

MINIMUM, MAXIMUM, AND MEAN VALUES OF THE ORIGINAL APPROACH

Variable Name	**Minimum**	**Maximum**	**Mean**
WINPERCENTAGE	0%	100%	49.45%
CAPACITY	34000	92488	67157
PROTEAMPERPOPULATION	7.60E-07	3.40E-05	6.28E-06
MEDIANINCOMEMSA	$34,047	$90,348	$61,701
HEADCOACHEXPYRS	0	40	6.5
NUMBEROFFENSIVEPLAYS	582	1199	960
DEFENSIVEPOINTSALLOWED	131	533	316
EXTRXPOINTPERCENTAGE	80%	100%	96.63%

Data Range (years): 1947 - 2009
Total Number of Observations: 454

TABLE 6.2

MINIMUM, MAXIMUM, AND MEAN VALUES OF THE ALTERNATE APPROACH

Variable Name	**Minimum**	**Maximum**	**Mean**
WINPERCENTAGE	0%	100%	48.75%
CAPACITY	34000	92491	67656
PROTEAMPERPOPULATION	3.45E-07	7.41E-05	6.08E-06
MEDIANINCOMEMSA	$34,047	$91,826	$62,955
HEADCOACHEXPYRS	0	32	5.9
NUMBEROFFENSIVEPLAYS	599	1199	968
DEFENSIVEPOINTSALLOWED	131	533	320
EXTRXPOINTPERCENTAGE	80%	100%	97.02%

Data Range (years): 1947 - 2009
Total Number of Observations: 504

Probit Restriction

For the Winning Division Champion Model and Winning League Champion Model, a probit restriction was imposed as the dependent variables are, in both cases, Bernoulli variables (coded “0” for failure to win or “1” for success).

Multicollinearity

By constructing a correlogram (correlation matrix) I was able to eliminate any variables that were overly correlated with another. Including two or more variables that are highly correlated with each other will bias the model by over exaggerating the variables’ effect (see point number five above in the “Ordinary Least Squares Estimation” section). Generally speaking, I eliminated any variable that exhibited 30% correlation or higher (in either a positive or negative direction) with another variable.

FIGURE 6.2

CORRELOGRAM: ORIGINAL ANALYSIS, SIX-YEAR WINDOW

Variable	NEW…	CAP…	PRO…	MED…	HEA…	NUM…	DEF…	EXT…
NEWSTADIUM	1.0000							
CAPACITY	**0.3121**	1.0000						
PROTEAMPERPOPULATION	0.0399	0.2471	1.0000					
MEDIANINCOMEMSA	-0.0109	0.0435	0.2360	1.0000				
HEADCOACHEXPYRS	-0.1092	-0.2932	-0.1323	-0.0079	1.0000			
NUMBEROFFENSIVEPLAYS	-0.0084	0.1504	**0.3620**	**0.3930**	0.0944	1.0000		
DEFENSIVEPOINTSALLOWED	0.0627	-0.0096	0.2234	0.2281	-0.0582	**0.3571**	1.0000	
EXTRAPOINTPERCENTAGE	0.1038	0.0974	0.0436	0.1751	0.0715	0.0130	-0.0420	1.0000

Variables that are correlated above this 30% threshold remain in the final model. Included above is the correlogram for the six-year time window of the original analysis. Any variables that remain in the model and exhibit above 30% or more correlation with another variable appear in bold font.

While I have only included one correlogram for the sake of brevity, a correlogram exists for each individual time windows in both the original and alternate analysis. All of these additional correlograms appeared similar, if not exactly the same, as the six-year window from the original analysis above. Many of the variables discussed above appear correlated above a 30% level in the other correlograms; the variables remain included for the reasons previously discussed. It is worth noting that for every time window in either analysis there is never a set of variables correlated above 40%.

It makes some intuitive sense that the NEWSTADIUM and CAPACITY variable are correlated. Stadium architects work to build a stadium to specific needs and wants of a team owner. While correlated above 30%, the two variables are not tremendously over-correlated. As such, they remain included.

It is surprising that PROTEAMPERPOPULATION and NUMBEROFFENSIVE plays are highly correlated. While my model does consider the number of professional teams in an MSA to have an effect on a given team's overall win-percentage, it makes no intuitive sense why more teams per-capita is more strongly correlated with the number of offensive plays by an NFL team in a season. Therefore, the variables, though correlated at a level above 30%, remain included.

It is equally surprising that MEDIANINCOMEMSA and NUMBEROFFENSIVEPLAYS are correlated above 30%. Again, there is no clear intuitive reason why the amount that individuals living in a particular MSA make and the number of offensive plays that associated team has in a season. As such, the variables remain included.

NUMBEROFFENSIVEPLAYS and DEFENSIVEPOINTSALLOWED are also correlated above 30%. There is some intuition behind this – the more time a team is playing offense the less time they have to play defense and vice-versa. While these variables are correlated above 30%, both variables are strongly significant when it comes to explaining regular season win-percentages, division championships won, and league championships won. As these variables are extremely theoretically important, their slightly high correlation factor will be accepted as unavoidable.

TABLE 6.3

VARIABLES ORIGINALLY CONSIDERED BUT EXCLUDED BECAUSE OF AN OVERLY HIGH CORRELATION WITH ANOTHER VARIABLE

Variable	Definition
ADDPROTEAMMSA	The number of additional professional sports teams playing in the same MSA as a given NFL team, based on year. This variable only includes teams from Major League Baseball (MLB), the National Basketball Association (NBA), the National Hockey League (NHL), and any other NFL teams playing in a similar MSA. This variable was highly correlated with the POPULATIONMSA variable.
POPULATIONMSA	The population of the metropolitan statistical area (MSA) for which a given team plays. Recorded in ten-year windows as reported by the United States Census. This variable was highly correlated with the ADDPROTEAMMSA variable.
YEAR	The year in which a given team played a given season. This variable was highly correlated with the ADDPROTEAMMSA, MEDIANINCOMEMSA, NUMBEROFFENSIVEPLAYS, and the DEFENSIVEPOINTSALLOWED variables.

Other Variables Considered but Excluded

The following variables were originally considered but were excluded, in all cases, because of an overly high correlation to other variables in the model. It must be noted that the PROTEAMPERPOPULATIONMSA variable was constructed to capture the effect of POPULATIONMSA and ADDPROTEAMMSA on regular season win-percentage. The PROTEAMPERPOPULATIONMSA variable eliminated a problem of multicollinearity among the aforementioned variables

Homoskedasticity and Normally Distributed Errors (Normality)

One assumption of OLS estimation (as discussed above) is homoskedasticity, the violation of which is called heteroskedasticity. Heteroskedasticty exists when there is a non-constant variance of the error term. To test for heteroskedasticity, the Breusch-Pagan and Cook-Weisberg test was employed.

In all cases, I failed to reject the null hypothesis of homoskedasicity in favor of the alternative hypothesis of heteroskedasticity at 5% confidence level. There are, however, a few examples when homoskedasticity does not hold true at a 10% confidence level. In these cases (included by model), robust standard errors were used to fix the problem. I retested any of the models using robust standard errors for heteroskedasticy and, in all cases, I failed to reject the null hypothesis of homoskedasticy at a 5% and a 10% confidence interval. Normality of errors was tested using a skewness and kurtosis test in all time windows and for every model. I failed to reject the null hypothesis of normality in favor of the alternative hypothesis of non-normality at both a 5% and 10% confidence level.

CHAPTER VII

RESULTS AND ANALYSIS

The following section includes results and a discussion of the results from all of the models presented in chapter four. Two tables, one for the original and one for the alternate approach, precede the analysis in each case.

TABLE 7.1

RESULTS: THE NEW STADIUM EFFECT MODEL (ORIGINAL APPROACH)

	SIX-YEAR		TEN-YEAR		TWENTY-YEAR	
Variable Name:	**Coefficient**	**T-score**	**Coefficient**	**T-score**	**Coefficient**	**T-score**
NEWSTADIUM	1.91E-02	(0.84)	1.09E-02	(0.62)	-2.08E-01	(-1.29)
CAPACITY	1.79E-06	(1.73)*	1.01E-06	(1.29)	1.13E-06	(1.67)*
PROTEAMPERPOPULATION	9.87E+02	(0.43)	1.60E+03	(0.83)	1.70E+03	(0.88)
MEDIANINCOMEMSA	-2.51E-07	(-0.25)	-8.84E-07	(-1.21)	-8.35E-07	(-1.23)
HEADCOACHEXPYRS	1.75E-03	(1.14)	1.61E-03	(1.39)	1.08E-03	(1.16)
NUMBEROFFENSIVEPLAYS	7.19E-04	(5.99)***	7.29E-04	(7.66)***	6.73E-04	(8.18)***
DEFENSIVEPOINTSALLOWED	-2.37E-03	(-14.33)***	-2.37E-03	(-18.00)***	-2.28E-03	(-21.02)***
EXTRAPOINTPERCENTAGE	-1.75E-01	(-0.58)	3.20E-01	(1.52)	2.83E-01	(1.70)*
Constant	5.94E-01	(1.95)**	1.94E-01	(0.90)	2.60E-01	(1.51)
	N = 150		N = 240		N = 320	
	Adj R^2 = 0.6002		Adj R^2 = 0.6064		Adj R^2 = 0.5997	
	F-Stat = 28.96		F-Stat = 47.02		F-Stat = 60.73	

* Statistically Significant 10% Level

** Statistically Significant 5% Level

*** Statistically Significant 1% Level Or Higher

TABLE 7.2

RESULTS: THE NEW STADIUM EFFECT MODEL (ALTERNATE APPROACH)

	SIX-YEAR		TEN-YEAR		TWENTY-YEAR	
Variable Name:	**Coefficient**	**T-score**	**Coefficient**	**T-score**	**Coefficient**	**T-score**
NEWSTADIUM	1.34E-02	(0.67)	1.41E-02	(0.91)	-5.78E-05	(-0.00)
CAPACITY	5.54E-07	(0.59)	3.09E-07	(0.40)	7.51E-07	(1.14)
PROTEAMPERPOPULATION	-3.80E+02	(-0.26)	-2.45E+02	(-0.29)	-5.13E+03	(-2.74)***
MEDIANINCOMEMSA	-2.38E-07	(-0.26)	-5.94E-07	(-0.93)	-3.10E-07	(-0.51)
HEADCOACHEXPYRS	5.35E-03	(3.03)***	5.21E-03	(4.49)***	3.17E-03	(2.96)***
NUMBEROFFENSIVEPLAYS	7.60E-04	(6.14)***	7.17E-04	(6.72)***	7.18E-04	(8.83)***
DEFENSIVEPOINTSALLOWED	-2.21E-03	(-14.80)***	-2.29E-03	(-19.13)***	-2.14E-03	(-20.63)***
EXTRAPOINTPERCENTAGE	1.53E-01	(0.53)	5.25E-01	(2.31)**	4.96E-01	(2.95)***
Constant	2.51E-01	(0.89)	-2.68E-03	(-0.01)	-2.90E-02	(-0.17)
	N = 168		N = 270		N = 340	
	Adj R^2 = 0.5993		R^2 = 0.6207		Adj R^2 = 0.5974	
	F-Stat = 32.22		F-Stat = 59.68		F-Stat = 63.89	

* Statistically Significant 10% Level

** Statistically Significant 5% Level

*** Statistically Significant 1% Level Or Higher

In the ten-year time window, the Breusch-Pagan and Cook-Weisberg test for heteroskedasticity provided a chi^2 value of 3.05. Therefore, robust standard errors were used in the regression. This marks the only instance in the New Stadium Effect Model when robust standard errors are employed in the OLS regression.

New Stadium Effect Model Analysis

Not once, in either the original or alternate analysis, does a new stadium seem to have any statistically significant effect on the regular season win-percentage for teams in the National Football League. While I had anticipated significant results in the alternate analysis (for reasons described earlier), at its most basic level, winning games is about what happens on the field. It should not make any difference where the field is or how the stadium is constructed. Two teams play on the same surface and both are subject to the same benefits and disadvantages (with the exception of home-field crowd) inherent to that venue. While I had hoped to show that a new stadium could make a significant, positive effect on a team's ability to win games, there is no evidence to support that claim.

When comparing the results from the original and alternate approach, it is certainly no surprise that the number of offensive plays and number of defensive points allowed are, in every time window, statistically significant at a 1% level. Clearly, on-field performance statistics play the most significant role in determining a team's overall regular season win-percentage. The more offensive plays a team is able to run, the more chances to score, and the less time an opposing team can play offense. Likewise, a team that can limit the number of points it surrenders to opposing teams will have a better chance at winning games. The number of points allowed on defense is the most significant variable, given by its extremely high T-statistic. This does not suggest that defense plays a more crucial rule than offense in determining overall-season win percentage. However, we can be very confident that it does affect win percentage in a negative manner. Though the impact of a single extra offensive play or

one extra point allowed is minimal – suggested by the coefficient value of each variable – the aggregate's effect on the dependent variable is undeniable. The data reflects logic: a team that wishes to increase their number of wins should run more offensive plays and allow fewer points to be scored against them.

The other measure of on-field performance (extra point percentage) seems to have more of an effect in the alternate analysis. There is no clear intuition behind this. However, this variable only becomes statistically significant in the ten-year window. This suggests that investing in a quality kicker is good in the long run but that a few missed PATs in a single season probably will not drastically affect a team's ability to win games.

A stadium's capacity seems somewhat significant at a six and twenty year time interval but only in the original analysis. While statistically significant in these intervals, the coefficient value shows that the effect of one or even one thousand extra seats in a stadium has an almost immeasurable effect. This suggests that owners and architects need to think carefully about the number of seats in a venue as it might actually have an effect on how a team performs. Players might be fueled by the home crowd and have incentive to make big plays. Capacity in the alternate analysis does not seem to have a statistically significant effect on regular season win-percentages.

The number of years of head coaching experience plays an extremely important role in determining wins in the alternate analysis. In all time windows the variable is highly statistically significant and the coefficient is positive. This is not surprising given the study by Hadley et al. (2000)[1]. With a coefficient value near $5E^{-3}$ (equivalent to

[1] Lawrence Hadley et al., "Performance Evaluation of National Football League Teams," *Managerial and Decision Economics*, 21.2 (2000): 63-70.

0.005) in the six and ten year windows of the alternate analysis, we see that a coach with experience can contribute substantially to a team's success. Holding other variables constant, a coach with ten years of experience can contribute 0.05% and a coach with twenty years experience can contribute 1% to a team's overall win-percentage with experience alone. However, it is interesting that not once is the head coach experience variable statistically significant in the original analysis. There is no obvious explanation for this.

The number of professional teams per-capita is significant in the twenty-year window of the alternate analysis in a negative direction. This is very surprising. It is difficult to describe why the number of professional teams negatively effects NFL regular season win-percentages, especially when this is not something that current team owners can do anything about. It is merely contingent on the other professional leagues and where teams are already placed. This does, however, suggest that new expansion teams may not want to locate in cities that already have established sports franchises as it may hinder their success in the long run. Though the PROTEAMPERPOPULATION variable is statistically significant at a 10% confidence interval in the original approach, its effect is neglegable evidenced by the extremely small coefficient.

TABLE 7.3

RESULTS: THE PROLONGED STADIUM EFFECT MODEL (ORIGINAL APPROACH)

	SIX-YEAR		TEN-YEAR		TWENTY-YEAR	
Variable Name	**Coefficient**	**T-score**	**Coefficient**	**T-score**	**Coefficient**	**T-score**
PROLONGEDSTADIUMEFFECT	4.11E-03	(0.63)	1.67E-03	(0.57)	-2.55E-03	(-1.85)*
CAPACITY	1.88E-06	(1.83)*	1.05E-06	(1.27)	1.19E-06	(1.79)*
PROTEAMPERPOPULATION	9.87E+02	(0.43)	1.62E+03	(0.84)	1.81E+03	(0.94)
MEDIANINCOMEMSA	-2.67E-07	(-0.27)	-8.96E-07	(-1.27)	-7.26E-07	(-1.07)
HEADCOACHEXPYEARS	1.74E-03	(1.13)	1.61E-03	(1.30)	1.16E-03	(1.25)
NUMBEROFFENSIVEPLAYS	7.13E-04	(5.94)***	7.25E-04	(5.70)***	6.80E-04	(8.27)***
DEFENSIVEPOINTSALLOWED	-2.37E-03	(-14.30)***	-2.36E-03	(-18.45)***	-2.28E-03	(-21.12)***
EXTRAPOINTPERCENTAGE	-1.63E-01	(-0.54)	3.25E-01	(1.59)	2.80E-01	(1.69)*
Constant	5.94E-01	(1.94)**	1.96E-01	(0.88)	2.33E-01	(1.35)
	N = 150		N = 240		N = 320	
	Adj R^2 = 0.5993		R^2 = 0.6194		Adj R^2 = 0.6019	
	F-Stat = 28.85		F-Stat = 56.21		F-Stat = 61.30	

* Statistically Significant 10% Level

** Statistically Significant 5% Level

*** Statistically Significant 1% Level Or Higher

In the ten-year time window, the Breusch-Pagan and Cook-Weisberg test for heteroskedasticity provided a chi^2 value of 2.06. Therefore, robust standard errors were used in the regression. This marks the first of two instances in the Prolonged Stadium Effect Model when robust standard errors are employed in the OLS regression

TABLE 7.4

RESULTS: THE PROLONGED STADIUM EFFECT MODEL (ALTERNATE APPROACH)

	SIX-YEAR		TEN-YEAR		TWENTY-YEAR	
Variable Name	**Coefficient**	**T-score**	**Coefficient**	**T-score**	**Coefficient**	**T-score**
PROLONGEDSTADIUMEFFECT	5.20E-03	(0.89)	3.47E-03	(1.26)	-6.18E-04	(-0.48)
CAPACITY	5.23E-07	(0.57)	2.81E-07	(0.37)	8.01E-07	(1.22)
PROTEAMPERPOPULATION	-3.62E+02	(-0.25)	-2.43E+02	(-0.29)	-4.97E+03	(-2.65)***
MEDIANINCOMEMSA	-2.47E-07	(-0.27)	-6.24E-07	(-0.98)	-2.53E-07	(-0.41)
HEADCOACHEXPYEARS	5.33E-03	(3.03)***	5.19E-03	(4.50)***	3.16E-03	(2.96) ***
NUMBEROFFENSIVEPLAYS	7.56E-04	(6.11)***	7.11E-04	(6.57)***	7.21E-04	(8.86) ***
DEFENSIVEPOINTSALLOWED	-2.22E-03	(-14.83)***	-2.29E-03	(-19.12)***	-2.14E-03	(-20.68) ***
EXTRAPOINTPERCENTAGE	1.61E-01	(0.56)	5.28E-01	(2.32)**	5.01E-01	(2.99) ***
Constant	2.59E-01	(0.92)	1.17E-02	(0.05)	-4.35E-02	(-0.25)
	N = 168		N = 270		N = 340	
	Adj R^2 = 0.6002		R^2 = 0.6219		Adj R^2 = 0.5977	
	F-Stat = 32.33		F-Stat = 60.93		F-Stat = 63.96	

* Statistically Significant 10% Level
** Statistically Significant 5% Level
*** Statistically Significant 1% Level Or Higher

In the ten-year time window, the Breusch-Pagan and Cook-Weisberg test for heteroskedasticity provided a chi^2 value of 2.83. Therefore, robust standard errors were used in the regression. This marks the second instance in the Prolonged Stadium Effect Model when robust standard errors are employed in the OLS regression

Prolonged Stadium Effect Model Analysis

With one exception, the variable measuring the prolonged stadium effect is insignificant. In the original analysis at a twenty-year time interval, the variable is significant at a 10% level. However, the coefficient of the variable is negative. This implies that old stadiums (coded as negative numbers) actually have a positive effect on win-percentage. This is not what I had anticipated. Though the effect is statistically significant, it is minimal due to the small coefficient value associated with the variable. It appears that new stadiums, holding other variables constant, have a negative effect on the dependent variable. The PROLONGEDSTADIUMEFFECT variable replaced NEWSTADIUM in this model. Given that these two measures are similar, it is not surprising that they yield similar results. While I had predicted that new stadiums would contribute significantly and positively to overall win-percentage in the alternate approach, there is no data to support this claim. According to both the New Stadium Effect Model and the Prolonged Stadium Effect Model, there is no evidence supporting the claim that new stadiums are catalyst for success in the NFL.

Concurrent with findings in the New Stadium Effect Model, it is not surprising that on-field performance statistics are vital aspects of team success. The total number of offensive plays and number of defensive points surrendered are statistically significant at a high level in both the original and alternative approach in the Prolonged Stadium Effect Model. Once again, the number of defensive points allowed appears more statistically significant. For reasons discussed in the New Stadium Effect Model Analysis, these on-field performance measures are the best estimators of regular season-win percentage. As only the NEWSTADIUM variable in this model changed from the

New Stadium Effect Model, it would be cause for concern if the on-field performance variables yielded drastically different results. Results from both models allow us to conclude that a team's performance on the field is by far the most important determinant of success in a season.

Kickers are more vital in the ten and twenty year windows of the alternate analysis, seen in their high significance level; they also appear statistically significant in the twenty-year window of the original approach. As seen in the previous model, kickers appear more important in the long run and do not seem make much of a difference on a game-to-game basis in a single season.

The capacity variable is statistically significant in the six and twenty-year windows in the original approach – this is similar to findings of the New Stadium Effect Model. Once again, the coefficient value shows that the effect, though significant, is minimal. Again, the stadium capacity measure in the alternate approach does not have a statistically significant effect on regular season win-percentage. Considering results from both models, we can say that capacity in the Prolonged Stadium Effect Model is only significant in the original analysis in the short (six-year) and long (twenty-year) term. When building a new stadium, owners should be cognizant that the total number of seats available may help their team. However, they should not make this their primary concern when looking to build a successful franchise.

Once again, the total number of professional teams per-capita seems only statistically significant in the twenty-year window of the alternate analysis. However, the coefficient of the variable is negative (as it was in the New Stadium Effect Model). While this outcome was not expected, it is consistent between both models. Both the

New Stadium Effect Model and the Prolonged Stadium Effect model provide evidence suggesting that the number of professional teams per capita, in a twenty-year time interval in the alternate approach, may detract from an NFL team's regular season win-percentage.

The number of years of head coaching experience is again statistically significant in all intervals in the alternate analysis, yet never proves significant in the original approach. There is no clear logical reasoning behind why coaches are more important if considered in an alternate analysis. However, as the data demonstrates, this does appear to be the case in both the New Stadium Effect and Prolonged Stadium Effect models. It appears imperative that teams moving into a new stadium in the alternate analysis also need an experienced head coach in order to achieve success.

Finally, both the New Stadium Effect and the Prolonged Stadium Effect models demonstrate that MSA median income is not statistically significant in either approach or for any time window. This is not surprising, as even the most dedicated fans have no ability to affect their team's performance on the field. It does not seem to matter how affluent an NFL team's home city is in regards to regular season win-percentage.

TABLE 7.5

RESULTS: THE WINNING DIVISION CHAMPIONSHIP MODEL (ORIGINAL APPROACH)

	SIX-YEAR		TEN-YEAR		TWENTY-YEAR	
Variable Name	**Coefficient**	**Z-score**	**Coefficient**	**Z-score**	**Coefficient**	**Z-score**
NEWSTADIUM	-3.30E-02	(-0.11)	-1.28E-01	(-0.48)	-5.32E-02	(-0.21)
CAPACITY	-1.35E-05	(-0.79)	-9.27E-07	(-0.08)	-4.49E-06	(-0.43)
PROTEAMPERPOPULATION	1.37E+04	(0.44)	-1.52E+04	(-0.48)	-1.79E+04	(-0.54)
MEDIANINCOMEMSA	-2.51E-06	(-0.18)	-1.85E-05	(-1.51)	-2.03E-05	(-1.55)*
HEADCOACHEXPYEARS	7.54E-04	(0.04)	-4.10E-03	(-0.27)	-8.46E-03	(-0.69)
NUMBEROFFENSIVEPLAYS	4.15E-03	(2.63)***	3.15E-03	(2.87)***	3.45E-03	(3.45)***
DEFENSIVEPOINTSALLOWED	-8.92E-03	(-3.29)***	-1.40E-02	(-6.71)***	-1.62E-02	(-6.95)***
EXTRAPOINTPERCENTAGE	3.20E+00	(0.78)	2.97E+00	(1.00)	2.44E+00	(0.91)
Constant	-4.77E+00	(-1.10)	-1.77E+00	(-0.55)	-8.14E-01	(-0.31)
	N = 150		N = 240		N = 320	
	Wald chi^2 = 17.31**		Wald chi^2 = 53.04***		Wald chi^2 = 56.49***	
	Pseudo R^2 = 0.1526		Pseudo R^2 = 0.2609		Pseudo R^2 = 0.3397	

* Statistically Significant 10% Level
** Statistically Significant 5% Level
*** Statistically Significant 1% Level Or Higher

Robust standard errors were employed in case heteroskedasticity exists. Even if the model exhibits homoskedasticity, correcting by using robust standard errors has the same effect on each variable. In no way is the estimation altered by correcting for a non-existent problem – in the case it does exist however, it has been corrected for.

TABLE 7.6

RESULTS: THE WINNING DIVISION CHAMPIONSHIP MODEL (ALTERNATE APPROACH)

	SIX-YEAR		TEN-YEAR		TWENTY-YEAR	
Variable Name	**Coefficient**	**Z-score**	**Coefficient**	**Z-score**	**Coefficient**	**Z-score**
NEWSTADIUM	2.76E-02	(0.09)	4.26E-02	(0.16)	1.82E-01	(0.66)
CAPACITY	-2.03E-05	(-1.30)	-1.05E-05	(-0.90)	-1.79E-05	(-1.45)
PROTEAMPERPOPULATION	-1.30E+04	(-0.66)	-6.79E+04	(-1.46)	-8.50E+04	(-2.45)***
MEDIANINCOMEMSA	-4.30E-06	(-0.34)	-1.33E-05	(-1.24)	-1.47E-05	(-1.29)
HEADCOACHEXPYEARS	3.51E-02	(1.42)	2.41E-02	(1.24)	-6.61E-04	(-0.04)
NUMBEROFFENSIVEPLAYS	2.90E-03	(1.90)**	2.52E-03	(2.13)**	3.02E-03	(2.87)***
DEFENSIVEPOINTSALLOWED	-7.36E-03	(-2.50)***	-1.28E-02	(-6.19)***	-1.73E-02	(-6.25)***
EXTRAPOINTPERCENTAGE	6.80E+00	(1.36)	5.83E+00	(1.74)*	4.32E+00	(1.37)
Constant	-7.21E+00	(-1.30)	-4.02E+00	(-1.12)	-1.30E+00	(-0.42)
	N = 168		N = 270		N = 340	
	Wald chi^2 = 16.27**		Wald chi^2 = 50.83***		Wald chi^2 = 49.82***	
	Pseudo R^2 = 0.1687		Pseudo R^2 = 0.2745		Pseudo R^2 = 0.3913	

* Statistically Significant 10% Level
** Statistically Significant 5% Level
*** Statistically Significant 1% Level Or Higher

Robust standard errors were employed in case heteroskedasticity exists. Even if the model exhibits homoskedasticity, correcting by using robust standard errors has the same effect on each variable. In no way is the estimation altered by correcting for a non-existent problem – in the case it does exist however, it has been corrected for.

Winning Division Championship Model Analysis

It is important to keep in mind that regular season statistics are being used to estimate post-season success in the Winning Division Championship model. There is no guarantee that teams with a high win-percentage at the end of the regular season will continue to play well in the post-season. In football, this is commonly referred to as the "any given Sunday" principle. In the NFL, only one game is played to determine the winner of the NFC and the AFC. A team's regular season performance may set a precedent for their success in the playoffs; additionally, they may be awarded a higher seed. However, regular season performance matters less in determining or predicting the team that will eventually win a division championship. When looking at the results from this model, we should expect to see that the highly significant variables (namely on field performance variables) from the New Stadium Effect and Prolonged Stadium Effect models are less significant in the Winning Division Championship model.

Given the associated Z-scores on the NEWSTADIUM variable, we see that new stadiums have no significant effect in predicting teams that win a division championship in the NFL. This holds true for all time windows and in both the original and alternate approach. While it would be very interesting if this variable had appeared significant here, it is not surprising given the findings in the New Stadium Effect and Prolonged Stadium Effect models. As new stadiums fail to yield a statistically significant result in terms of regular season win-percentage, it should not be expected that they would affect a team's ability to win in the post-season.

As predicted, on-field performance statistics from the regular season are still statistically significant, but to a lesser extent. As explained above, this is logical, as

regular-season precedents are less likely to translate to post-season success – especially in a single game. Once again, the variable measuring the number of defensive points allowed is more highly significant than number of offense plays in all time windows and in both the original and alternate approach. With confidence, I can predict that teams with a potent offense and strong defense in the regular season will have success in the division championship game – assuming they make it to that point.

Unlike findings from the New Stadium Effect and Prolonged Stadium Effect models, the number of years of coaching experiences does not have a statistically significant affect on a team's ability to win a division championship. This marks the first time that the HEADCOAHCEXPYEARS variable is not significant in any window or in either approach. This suggests that while an experienced coach may be able to lead his team into the playoffs, he cannot guarantee a division championship and a trip to the Super Bowl.

As seen in the twenty-year window of the alternate approach of the New Stadium Effect and the Prolonged Stadium Effect model, the number of professional teams per-capita is once again statistically significant and negative in the Winning Division Championship model. The number of additional teams in the same city may impede an NFL team's ability to win the division championship in the long run after receiving a new stadium.

The CAPACITY variable is not significant for any time windows in either approach. While a team may play at home in the division championship game, they cannot rely solely on their fans to push them to victory.

Data from the Winning Division Championship model yields some very unique results, most notably the MEDIANINCOMEMSA variable in the twenty-year window of the original approach and EXTRAPOINTPERCENTAGE variable in the ten-year interval of the alternate analysis. This is the first time that median income of an MSA has appeared statistically significant in any model. While the median income of a team's host city does not appear to make a difference in the regular season, it does have an effect on that team's ability to win a division championship (ten-year, original approach). What is most intriguing is the negative coefficient of the variable. This suggests that, the higher the median income is for a city, the more they will impede their team from winning a division championship. While peculiar, I do not think too much weight should be placed on this specific result as a number of proxy values were used to estimate median MSA income (see chapter five for a discussion of this). It is also very interesting that a kicker's PAT percentage from the regular season is statistically significant in the post-season (ten-year window, alternate approach). This marks the first time that EXTRAPOINTPERCENTAGE appears statistically significant in a ten-year time window in the original approach.

TABLE 7.7

RESULTS: THE WINNING LEAGUE CHAMPIONSHIP MODEL (ORIGINAL APPROACH)

	SIX-YEAR		TEN-YEAR		TWENTY-YEAR	
Variable Name	**Coefficient**	**Z-score**	**Coefficient**	**Z-score**	**Coefficient**	**Z-score**
NEWSTADIUM	3.87E-02	(0.10)	1.56E-01	(0.52)	2.12E-01	(0.80)
CAPACITY	-1.40E-07	(-0.01)	-2.01E-05	(-1.39)	-1.66E-05	(-1.53)
PROTEAMPERPOPULATION	3.87E+04	(1.30)	4.05E+04	(1.89)**	-1.42E+04	(-0.36)
MEDIANINCOMEMSA	2.68E-05	(1.61)*	7.47E-06	(0.64)	-8.37E-06	(-.055)
HEADCOACHEXPYEARS	1.84E-02	(0.83)	-3.08E-02	(-1.34)	-2.90E-02	(-1.92)**
NUMBEROFFENSIVEPLAYS	6.53E-03	(3.49)***	3.31E-03	(2.58)***	2.87E-03	(2.85)***
DEFENSIVEPOINTSALLOWED	-1.48E-02	(-4.03)***	-1.29E-02	(-5.65)***	-1.31E-02	(-5.46)***
EXTRAPOINTPERCENTAGE	4.30E+00	(0.71)	5.51E+00	(1.34)	3.27E+00	(1.08)
Constant	-1.01E+01	(-1.67)*	-5.70E+00	(-1.19)	-2.18E+00	(-0.78)
	N = 150		N = 240		N = 320	
	Wald chi^2 = 22.66***		Wald chi^2= 40.20***		Wald chi^2 = 39.97***	
	Pseudo R^2 = 0.2953		Pseudo R^2 = 0.2337		Pseudo R^2 = 0.2835	

* Statistically Significant 10% Level
** Statistically Significant 5% Level
*** Statistically Significant 1% Level Or Higher

Robust standard errors were employed in case heteroskedasticity exists. Even if the model exhibits homoskedasticity, correcting by using robust standard errors has the same effect on each variable. In no way is the estimation altered by correcting for a non-existent problem – in the case it does exist however, it has been corrected for.

TABLE 7.8

RESULTS: THE WINNING LEAGUE CHAMPIONSHIP MODEL (ALTERNATE APPROACH)

	SIX-YEAR		TEN-YEAR		TWENTY-YEAR	
Variable Name	**Coefficient**	**Z-score**	**Coefficient**	**Z-score**	**Coefficient**	**Z-score**
NEWSTADIUM	-1.71E-01	(-0.39)	9.73E-02	(0.29)	7.78E-01	(2.22)**
CAPACITY	-3.76E-06	(-0.26)	-2.02E-05	(-1.33)	-5.97E-05	(-3.78)***
PROTEAMPERPOPULATION	-2.14E+04	(-1.82)*	-8.24E+03	(-0.67)	-2.01E+05	(-2.54)***
MEDIANINCOMEMSA	3.26E-05	(1.69)*	5.04E-06	(0.41)	-3.17E-06	(-0.17)
HEADCOACHEXPYEARS	9.74E-02	(1.64)*	-7.25E-03	(-0.27)	-4.39E-02	(-1.51)
NUMBEROFFENSIVEPLAYS	7.05E-03	(2.36)***	2.62E-03	(1.76)***	1.79E-03	(1.46)
DEFENSIVEPOINTSALLOWED	-1.82E-02	(-2.77)***	-1.34E-02	(-5.20)***	-1.89E-02	(-4.65)***
EXTRAPOINTPERCENTAGE	1.98E+01	(1.69)*	8.67E+00	(1.56)	8.35E+00	(1.61)*
Constant	-2.57E+01	(-2.07)	-7.86E+00	(-1.21)	-2.00E+00	(-0.47)
	N = 168		N = 270		N = 340	
	Wald chi^2 = 12.77*		Wald chi^2 = 34.23***		Wald chi^2 = 30.55***	
	Pseudo R^2 = 0.4008		Pseudo R^2 = 0.2608		Pseudo R^2 = 0.4670	

* Statistically Significant 10% Level
** Statistically Significant 5% Level
*** Statistically Significant 1% Level Or Higher

Robust standard errors were employed in case heteroskedasticity exists. Even if the model exhibits homoskedasticity, correcting by using robust standard errors has the same effect on each variable. In no way is the estimation altered by correcting for a non-existent problem – in the case it does exist however, it has been corrected for.

Winning League Championship Model Analysis

As with the division championship, the league champion of the NFL is decided in a single game. Again, while a team's regular season performance may set a precedent for their success in the playoffs, regular season performance matters less in determining or predicting the team that will eventually win the league championship. When looking at the results we should expect to see that highly significant variables (namely on field performance variables) from the New Stadium Effect and Prolonged Stadium Effect models are less significant in the Winning League Championship model.

In looking at only data in the original approach, we see that new stadiums appear to have no statistically significant effect on a team's ability to win a league championship. Again, it would be very interesting if this variable had appeared significant here; it is not surprising, however, given the findings in the New Stadium Effect, Prolonged Stadium Effect, and Winning Division Championship models. As new stadiums failed to yield a statistically significant result in the regular season or division championship game, it should not be expected that new stadiums would assist a team in winning the league championship game.

Interestingly enough, the number of years of head coaching experience is significant in a twenty-year interval of the original approach, but the coefficient of the variable is negative. This suggests that in a twenty-year window, experienced coaches may actually negatively-effect a team's ability to win the championship game. This marks the only time that the HEADCOACHEXPYEARS variable is both significant and negative.

Additionally, it is not surprising that the CAPACITY variable is not statistically significant in any time-window in the original approach in this model. This is logical, as no host city's team has ever played in the championship game.[2]

Continuing to look only at the results of the original analysis, there are a few variables other than the number of regular season defensive points allowed and the number of offensive plays in the regular season that appear statistically significant in Winning League Championship model. The occurrence of these statistically significant variables is somewhat random. Median income of an MSA is significant in a six-year window. However, for the first time in all models, the variable is positive. In the short run, a higher median income of a city might actually help their team win a championship. We can hypothesize that fans from wealthier cities have more ability to travel to the championship game to cheer on their team. However, this variable only appears significant in the six-year window. If teams plan to use their host city's median income to their advantage, they need to get the championship game in the short term.

The number of professional teams per-capita is statistically significant in a ten-year window in the original approach. This marks the only time in any model that the PROTEAMSPERPOPULATION variable is both statistically significant and positive. There is no clear intuition why, in a ten-year window, having more teams in an MSA can positively influence an NFL's team's ability to win the championship, especially since the variable had a negative coefficient in the New Stadium Effect and Prolonged Stadium Effect models.

[2] Associated Press, "Super Bowl Host Without a Hometown Champion in 37 Tries," National Football League, http://www.nfl.com/news/story/09000d5d8a612 1d/article/super-bowl-host-without-a-hometown-champion-in-37-tries (accessed February 7, 2011).

Looking at results from the alternate analysis presents an entirely different picture. The new stadium variable appears, for the first and only time in any model, positive and statistically significant. This means that in the alternate approach, teams that receive new stadiums are more likely than their peers to win a Super Bowl championship within ten years after receiving the new venue – the NEWSTADIUM variable is also highly significant.

Once again, the MEDIANINCOME variable is statistically significant and positive in only the six-year window of the alternate analysis – this echoes findings in the original approach of the Winning League Championship Model. The number of years of head coaching experience is also significant in this approach, but only at a six-year interval. Unlike the findings in the original approach, experienced coaches may be able to help their teams win the championship game in the short term in the alternate analysis. The EXTRAPOINTPERCENTAGE variable is also statistically significant in the six and twenty-year window of the alternate approach. This suggests that kickers with a high PAT percentage in the regular season will be a major benefit to their teams when it comes to winning the championship game in the short and long term.

CAPACITY and PROTEAMPERPOPULATION appear statistically significant but negative in the alternate approach, both in the twenty-year time window. The number of professional teams in an MSA also appears significant in a six-year window. While this is surprising, these results should be interpreted loosely for reasons explained above – namely, the use of proxy values for population data and no home team ever playing in their own venue for the championship game.

CHAPTER VIII

CONCLUSION

At the outset of this thesis, I included a statement by Jeffrey Lurie the Chairman and CEO of the Philadelphia Eagles. Mr. Lurie argues that new stadiums are an integral part to a team's success on the field. He asserts that for the teams and general management interested in winning Super Bowls – the "ultimate goal" – new stadiums should top the agenda. While owning a team in any professional sports league is, above anything else, a business, the reasons behind an owner's desire for a new venue are multi-faceted. There is no doubt that new stadiums attract new fans (and their revenue) while also helping to create a specific brand in a niche market. Yes, owners care about the success of their team, but they also care about keeping fans interested in their product.

Wrapping up a multitude of business related interests into the excuse of "increased team success" plays to the desires of fans – after all, they will be responsible for funding a substantial amount towards construction. However, this thesis does not deal with the financial or logistical implications of building stadiums. Rather, it asks whether there is an impact on the field. Do team owners have any evidence to suggest that their team will perform better as a direct result of multi-million dollar stadium construction?

According to Quinn et al. (2003)[1] the answer is simple: no, stadium construction in the National Football League cannot be justified in terms of an increased win-percentage. Results of the original approach in this study agree with those findings. According to data taken from 1947-2009 from twenty-five teams in the NFL, never is the variable measuring a new stadium both statistically significant and positive. In fact, there is even evidence (in the Prolonged Stadium Effect Model – twenty year window) to suggest that old stadiums may be actually be more beneficial to a team's success. The most telling results given by original approach analysis are obvious – players win games in the NFL. A high regular season win-percentage is a direct result of the number of offensive plays executed and the productivity of the defense. Ultimately, there is no data given by the original approach of this study to support the claim that a new stadium will increase a team's regular season win-percentage or the ability to win a Super Bowl.

Mr. Laurie, you may be disheartened by the findings of the original approach. I do, however, have some promising news for you. According to data in the alternate approach, also taken from 1947-2009 from twenty-eight teams in the NFL, you can expect a new stadium to aid in the pursuit of a Super Bowl championship. That may seem counterintuitive being that you cannot also expect your team to see an increase in their regular-season win percentage. However, data at the twenty-year interval suggests that building a new stadium does have an effect on winning the championship game. That assertion comes with some assumptions. First and foremost, you must to be willing to accept the stipulations and exceptions of my alternate analysis. Again, you cannot expect not to see any significant increase of win-percentage throughout the regular

[1] Kevin G. Quinn et al., "Do New Digs Mean More Wins? The Relationship Between a New Venue and a Professional Sports Team's Competitive Success," *Journal of Sports Economics*, 4.3 (2003): 168

season. However, if your team can play well enough to make the playoffs, then the addition of a new home stadium may be the final missing variable that your team needs to win the Super Bowl.

I believe both the original and alternate approach to be accurate representations modeling regular season win-percentage in the National Football League. However, neither approach in this study can support the claim that building a new stadium has a direct effect on increasing the regular season win-percentage of teams in the National Football League. It does not matter how new stadiums are considered. Teams that move from an old to a new permanent home stadium are not expected to see an increase in their win-percentage as a direct result of the new venue. Likewise, teams without a home stadium of their own before receiving a permanent area are not expected to have an increased regular season win-percentage.

However, new stadium construction can be shown to have either a positive or a negligible effect on an NFL team's ability to win the Super Bowl. The original approach suggests that new stadiums cannot aid a team trying to win the league championship; the alternate analysis says otherwise. I cannot say which approach is the most accurate; they simply represent different ways to consider the acquisition of a new stadium. In pursuit of the "ultimate goal," it appears that owners do have some justification to build a new stadium. Of course, the relationship between new stadiums and championship victories is not a guarantee. There is strong evidence, however, supporting a correlation between the two at a twenty-year interval of the alternate approach. Fans and owners may need to be patient before they see the benefits of a new stadium construction.

So, Mr. Lurie, if you want my suggestion, look beyond the stadium: make sure you have one of the best defenses in the league, give successful kickers long term contracts, and hire an experienced coach. There is no single ingredient that guarantees wins in the National Football League – that recipe seems as multi-faceted as an owner's desire to build a new stadium.

SOURCES CONSULTED

Associated Press. *Super Bowl Host Without A Hometown Champion In 37 Tries.* Available online at: http://www.nfl.com/news/story/09000d5d81a6121d/article/super-bowl-host-without-a-hometown-champion-in-37-tries.

Ballparks.com. *Robert F. Kennedy Memorial Stadium.* Available online at: http://www.ballpa rks.com/baseball/american/rfksta.htm.

BallparksOfBaseball.com. *Atlanta Fulton County Stadium.* Available online at: http://www.ballparksofbaseball.com/past/AtlantaStadium.htm.

Boulier, Bryan L., H. O. Stekler, and Sarah Amundson. "Testing the Efficiency of the National Football League Betting Market." *Applied Economics* 38, no. 3 (2006): 279-284.

Brannas, Kurt and Thomas Laitila. "Heteroskedasticity in the Tobit Model". *Statistical Papers* 30 (1989): 185.

Buffalo Bills. *Stadium Facts and Figures.* Available online at: http://www.buffalobills .com/tickets/stadium/facts-and-figures.html.

Carlino, Gerald A. and N. E. Coulson. "Should Cities Be Ready for Some Football? Assessing the Social Benefits of Hosting and NFL Team." *Federal Reserve Bank of Philadelphia Business Review*, no. 2 (2004): 7-17.

Carolina Panthers. *Stadium: Facts.* Available online at: http://www.panthers.com/sta dium/facts.html.

Clapp, Christopher M. and Jahn K. Hakes. "How Long a Honeymoon? The Effect of New Stadiums on Attendance in Major League Baseball." *Journal of Sports Economics* 6, no. 3 (2005): 237-263.

Cleveland Browns. *About the Stadium.* Available online at: http://www.clevelandbrown s.com/stadium/about-the-stadium.html.

Creamer, Chris. *National Hockey League Logos.* Available online at: http://www.sports logos.net/league.php?id=1.

————. *National Basketball Association Logos.* Available online at: http://www.sportslogos.net/league.php?id=6.

Database Football. *Coaches.* Available online at: http://www.databasefootball.com/coaches/coachlist.htm.

Detroit Lions. *Ford Field Facts & History: General Information.* Available online at: http: //www.detroitlions.com/ford-field/facts-history.html.

Gibson, Campbell and Kay Jung. *Historical Census Statistics on Population Totals by Race, 1790 to 1990, and by Hispanic Origin, 1970 to 1990, For Large Cities and Other Urban Places in the United States.* Available online at: http://www.census.gov/population/www/documentation/twps0076/twps0076.html.

Gibson, Campbell. *U.S. Census Bureau Population of the 100 Largest Cities and Other Urban Places in the United States: 1790 to 1990.* Available online at: http:// www.census.gov/population/www/documentation/twps0027/twps0027.html.

Gillette Stadium. *Gillette Stadium Quick Facts.* Available online at: http://www.gillettestadium.com/stadium_information/index.cfm?ac=quick_facts.

Hadley, Lawrence, Marc Poitras, John Ruggiero, and Scott Knowles. "Performance Evaluation of National Football League Teams." *Managerial and Decision Economics* 21, no. 2 (2000): 63-70.

Hendricks, Wallace, Lawrence DeBrock, and Roger Koenker. "Uncertainty, Hiring, and Subsequent Performance: The NFL Draft." *Journal of Labor Economics* 21, no. 4 (2003): 857-886.

Hofler, Richard A., James E. Payne. "How Close to Their Offensive Potential Do National Football League Teams Play?" *Applied Economics Letters* 3, no. 11 (1996): 743-747.

Invesco Field at Mile High. *Stadium Introduction History & Facts Page.* Available online at: http://www.invescofieldatmilehigh.com/stadium_info/intro.

Kansas City Chiefs. *Stadium History.* Available online at: http://www.kcchiefscom/ arrowhead/history.html.

Lambeau Field. *Stadium Info/History: Hallowed Ground.* Available online at: http://www.lambeaufield.com/stadium_info/history/.

Lincoln Financial Field. *Stadium Facts.* Available online at: http://www.lincolnfiancialfield.com/stadiuminfo/.

Louisiana Superdome. *Timeline.* Available online at: http://www.superdome.com/time.

Matheson, Victor A. “Contrary Evidence on the Economic Effect of the Super Bowl on the Victorious City.” *Journal of Sports Economics* 6, no. 4 (2005): 420-428.

Miller, Phillip. “Private Financing and Sports Franchise Values: The Case of Major League Baseball.” *Journal of Sports Economics* 8, no. 5 (2007): 449-467.

Minnesota Vikings. *Stadium: Mall of America Field at the H.H.H. Metrodome Information.* Available online at: http://www.vikings.com/stadium/metrodome.html

National Football League. *The Official Record and Fact Book 2010: 91st Season.* New York: Workman Publishing Co., 2009.

————. *NFL 2000 Record and Fact Book: 81st Season.* New York: Workman Publishing Co., 1999.

————. *The Official National Football League 1992 Record and Fact Book: 73rd Season.* New York: Workman Publishing Co., 1991.

————. *Official 1984 National Football League Record and Fact Book.* New York: Workman Publishing Co., 1983.

————. *History: Super Bowl V.* Available online at: http://www.nfl.com/superbowl/history/recap/sbv.

————. *History: Super Bowl I.* Available online at: http://www.nfl.com/superbowl/history/recap/sbi.

————. *History.* Available online at: http://www.nfl.com/history.

————. *NFL Standings.* Available online at: http://www.nfl.com/standings?category=league.

————. *NFL Tiebreaking Prodecures.* Available online at: http://www.nfl.com/standings/tiebreakingprocedures.

New York Giants. *The giants stadiums: Where the Giants have Called Home From Their Inception in 1925 to the Present.* Available online at: http://www.giants.com/history/TheGiantsStadiums.asp.

NFLTeamHistory.com. *Washington Redskins - FedEx Field.*Internet on-line. Available online at: http://www.nflteamhistory.com/nfl_teams/washington_redskins/stadium.html.

Oracle Arena & Oakland-Alameda County Coliseum. *History*. Available online at: http://www.coliseum.com/info/history.php.

Oriard, Michael. *Brand NFL : Making and Selling America's Favorite Sport.* Chapel Hill: University of North Carolina Press, 2007.

O'Roark, J. B. "Capital Structure and Team Performance in Professional Baseball." *Journal of Sports Economics* 2, no. 2 (2001): 168-180.

Pasquarelli, Len. *Lengthy Strike Has Mostly Been Forgotten.* Available online at: http://sports.espn.go.com/nfl/columns/story?columnist=pasquarelli_len&id=3030311.

Pittsburgh Steelers. *Heinz Field Stadium Information.* Available online at: http://news.steelers.com/heinzfield/stadiuminfo.

Pro-Football-Reference. *Franchise Encyclopedias*. Available online at: http://www.pro-football-reference.com/teams/.

QuickMBA. *Central Tendency.* Available online at: http://www.quickmba.com/stats/centralten/.

Quinn, Kevin G. "Do New Digs Mean More Wins? The Relationship Between a New Venue and a Professional Sports Team's Competitive Success." *Journal of Sports Economics* 4, no. 3 (2003): 167-182.

Quirk, James P. and Rodney D. Fort. *Hard Ball : The Abuse of Power in Pro Team Sports.* Princeton: Princeton University Press, 1999.

————. *Pay Dirt : The Business of Professional Team Sports.* Princeton: Princeton University Press, 1992.

Reliant Park. *Facts.* Available online at: http://www.reliantpark.com/facts/.

Scully, Gerald W. *The Market Structure of Sports.* Chicago: University of Chicago Press, 1995.

Shmoop XLV. *Labor and History of the NFL: Looking at the Past Through the Lens of Labor.* Available online at: http://www.shmoop.com/nfl-history/labor.html.

Soldier Field. *Stadium History.* Available online at: http://www.soldierfield.net/content/stadium-history.

SportsEncyclopedia.com. *Baltimore Ravens: Historical Moments.* Available online at: http://www.sportsecyclopedia.com/nfl/baltrav/ravens.html.

Stadiums of Pro Football. *Past NFL Stadiums.* Available online at: http://www.stadiumofprofootball.com/past.htm.

Texas State Historical Association. *Cotton Bowl.* Available online at: http://www.tshaonline.org/handbook/online/articles/xxc01.

The Professional Football Hall of Fame. *Team-by-Team-Histories.* Available online at: http://www.profootballhof.com/history/teams.aspx.

————. *Sept. 17, 1920 - The Founding of the NFL.* Available online at: http://www.profootballhof.com/history/release.aspx?release_id =98.

Tu, Charles C. "How Does a New Sports Stadium Affect Housing Values? The Case of FedEx Field." *Land Economics* 81, no. 3 (2005): 379-395.

United States Census Bureau. *Consumer Price Index Series.* United States Census Bureau, 2009.

————. *U.S. Census Bureau, American Fact Finder: Detailed Tables P77. Median Family Income in 1999 (dollars) - Universe: Families.* Available online at: http://factfinder.census.gov/servlet/DTTable?_bm=d&context=dt&ds_name=DEC_2000_SF3_U&mt_name=DEC_2000_SF3_U_P077&CONTEXT=dt&tree_id=403&all_geo_types=N&geo_id=38000US0040&geo_id=38000US0060&geo_id=38000US0120&geo_id=38000US0160&geo_id=38000US0200&geo_id=38000US0220&-geo_id=38000US0240&-geo_id=38000US0280&-geo_id=38000US0320&-geo_id=38000US0380&-search_results=01000US&-format=&-_lang=en.

————. *U.S. Census Bureau Income Table 2. Median Family Income by Metropolitan Statistical Areas (MSA): 1969, 1979, and 1989.* Available online at: http://www.census.gov/hhes/www/income/data/historical/metro/msa2.html.

————. *State and County Quick Facts.* Available online at: http://quickfacts.census.gov/qfd/index.html.

United States Department of Labor. *Bureau of Labor Statistics: CPI Inflation Calculator.* Available online at: http://www.bls.gov/data/inflation_calculator.htm.

Veres, Joseph A. 2007. *Touchdown! The Determinants of Team Success in the National Football League (NFL).* B.A. Thesis, Colorado College, 2007.

Wegryn, Jim. *Major League Baseball Team Names and Franchise Histories.* Available online at: http://www.jimwegryn.com/Names/BaseballTeams.htm.