2021-03-19

Environmental Determinism and Professional Football

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HONORS THESIS

ENVIRONMENTAL DETERMINISM AND PROFESSIONAL FOOTBALL: A STUDY OF HOW CLIMATE AND DEMOGRAPHICS DETERMINE SUCCESS IN THE NFL

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Submitted to Brigham Young University in partial fulfillment of graduation requirements for University Honors

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BRIGHAM YOUNG UNIVERSITY
APRIL 2021

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Acknowledgements

I would like to thank my family for all of the support I've received in gaining my education. I would also like to thank the Geography Department and Honors Program for their assistance and support throughout my college experience.

Abstract

This paper analyzes the impact that geography has through the scope of determinism on professional football within the last 20 years. Fox Sports personality Colin Cowherd suggested the idea of determinism in football in 2017, and this project follows up on the idea that weather and climate specifically will be determinant factors in the success of an NFL franchise. Multiple demographic, economic, and climatic factors were selected to examine which factors are determinant in NFL franchise success. T-Tests were run on each of these variables to provide a P-Value, or an indication of whether or not the relationship between NFL success and these variables was statistically significant. This research finds that there are multiple variables that have an effect on NFL success and that Winter weather can have a significant impact on how successful a given NFL team can be.

Introduction

In 2017, Fox Sports personality Colin Cowherd postulated an interesting theory when he said, “I do not trust warm-weather football teams in the NFL in the playoffs. Of the last 20 Super Bowl winners: Pittsburgh twice, New England five times, Baltimore twice, the Colts once, Seattle once, Denver three times, Green Bay once, and the New York Giants twice. The Saints and Tampa are the only exceptions . . . warm weather reduces productivity.” Cowherd would continue to explain how warm weather areas provide more distractions for players, coaches and staff. Cowherd also stated that there is indeed a geographic difference leading to success that differentiates between cold weather franchises and warm weather franchises (THE HERD 2017). Cowherd’s staff mocked this idea; however, this seems like a theory that could have some validity. Though Cowherd only mentioned temperature as a defining variable, it would make sense that if temperature had an influence on the success of an NFL franchise that there would also be other geographic and demographic factors that may influence that success. There has never been in-depth research as to how certain factors like population, wealth, or any climatic characteristics have in relation to NFL success. It has been shown in other studies that geographic variables can influence the success of business, politics, and technology in a city or region. My hypothesis is that many of these same variables also affect NFL football success. To this end, this research examines variety of geographic variables – demographic, economic, and climatic – and their influence on NFL success. In short, the study demonstrates the statistical significance of numerous geographic factors on NFL Success.

Definitions

Environmental Determinism: A theory that asserts that physical geographic features such as climate and terrain exert a strong and unmediated influence upon human affairs (Meyer and Dylan 2017).

Environmental Possibilism: A theory that suggests that human behavior, and therefore culture, is not merely determined by the environment but by human agency. As a theory, environmental possibilism is directly opposed to environmental determinism (Collins English Dictionary 2021).

The Resource Curse/Paradox of Plenty: A political science theory defined as the adverse effects of a country's natural resource wealth on its economic, social, or political well-being (Ross 2015). Essentially, the paradox of plenty suggests that areas or nations that are home to more resources, like oil in the Darfur region of Sudan or much of the Middle East, tend to have more conflicts and more issues because of those resources.

Literature Review

As there is very little research specifically on environmental determinism and professional football, there were a wide variety of sources of literature concerning this topic. There have been multiple books (Kaplan 2013, Marshall 2015) that describe how certain geographic factors affect politics and culture but not sports specifically, even though sports and entertainment are surely considered a part of any given culture. Further, there have been multiple geographic studies (Kaplan 2013, Marshall 2015) on environmental determinism and

environmental possibilism themselves. These terms are typically catered towards political and cultural geography audiences and some of these ideas have gained traction. In, *'The Revenge of Geography'*, Robert Kaplan explores determinism in its relationship towards conflict in the world. Kaplan discusses how physical geographic factors like mountain ranges and deserts affect how boundaries are created in the world and have changed over time. In summary, Kaplan summarizes how United States intervention in particular areas, specifically the Middle East, will prove worthless as there are certain physical and cultural geographic factors that will prevent long-lasting change (Kaplan 2013).

Tim Marshall follows a similar format to Kaplan's work in showing how environmental determinism has made the current world the way it is (Marshall, 2015). Marshall moves continent to continent and shows how geographic factors are typically unreported when it comes to political affairs. Marshall argues that rivers, mountains, deserts, oceans, and seas have a massive impact on political affairs and that geopolitics is a very undervalued form of political study. Both Marshall and Kaplan acknowledge the presence of environmental determinism, and they conclude that there are certain events and happenings that are strictly determined by geography. Therefore, environmental determinism plays a much larger role in the world than typically recognized (Marshall 2015). Both Kaplan and Marshall provide excellent insight environmental determinism and its impact on the world.

To gain a better understanding about the modern NFL, there were also numerous sources consulted (Maraniss 2000, O'Connor 2019). The majority of NFL writing has to do with specific individuals and teams rather than looking at statistical relationships between them. However, there are multiple sources (Maraniss 2000, O'Connor 2019) that discuss how coaches like Bill Belichick and Vince Lombardi were grateful to coach in cold weather areas

(Foxborough, Massachusetts and Green Bay, Wisconsin respectively). Many coaches have discussed the importance of practicing in poor weather and non-ideal conditions with snow, rain, and below-average temperatures. as it provides an opportunity to be more prepared than their opponents (Maraniss 2000). Simply put, the more frequently a team can practice in the snow or rain, the better able and acclimated they are to play a game in the snow or rain. There are multiple NFL teams in cold-weather areas that have indoor practice facilities. These teams will often forego using the indoor practice facilities in harsh conditions to better prepare their players to actually play a game in those conditions (O'Connor 2019).

There are limited academic resources concerning geography and sports but there is existing literature that links geography and sports. There certainly are links between geography when it comes to tourism (Ilies, Dehoorne, Wendt, Kozma 2014) as well as areas in which exceptional athletes are produced at their particular source (Ilies, Dehoorne, Wendt, Kozma 2014) There is also existing research on how sports can create a sense of identity and contribute to the perception of certain locations (Bale 2010). John Bale, known as the primary researcher for the intersection between sports and geography would acknowledge a link between the two, specifically illustrating the power that sports have to change a given landscape (Bale 2010). This could be anything from the actual changes made to a physical landscape by building stadiums, fields, or any other facilities as well as simply people in one area flying a flag representing a certain sports team. Continued research found that the environment had been somewhat ignored when concerned with sports success and sports culture in general, but there certainly is a link between the two and has been coined 'neo-determinism' (Meyer and Guss 2018). However, there has never been research as to which factors statistically influence sports success. The following research is unique and will further the study of sports geography within the NFL.

Methods

The first step in this research was determining an adequate scope. There are four major professional sports leagues in the United States with enough data to run some sort of statistical analysis: the NFL, MLB, NBA, and NHL. Any one of these leagues could have worked for this project based on economic and population studies. However, both the NBA and NHL are primarily played indoors, and their games are not subject to the conditions of given city's climate. MLB would also work for the majority of factors and most of its teams play outdoors. However, MLB's season (April – October) does not have the seasonal weather variances that the NFL's season has (September – January). Further, MLB does not have a salary cap, so richer teams – usually associated with large markets – can simply recruit and pay for better players. Conversely, the NFL does have a cap salary, which helps to increase parity throughout its 32 teams – regardless of market size. Thus, the only professional league in the United States that could provide the basis to examine sport success and geographic variables is the NFL. College sports were also eliminated from this research as there are significantly more teams and multiple conferences and divisions that provide numerous different levels of competition. For example, it wouldn't be fair to run a geographic study on the success of the University of Alabama (Division 1) in comparison to North Dakota State University (Division 2) even though they are both successful because the level of play varies greatly between divisions.

The NFL was established in the mid-1900's. However, this study was conducted on the modern NFL using recent economic, population, and climatic variables. This was decided because it is important to provide the best snapshot of how geography affects the NFL currently as the last 20 seasons (not including the 2020-2021 NFL season) include all recent expansion

teams. Therefore, this study will only examine the 2000-2001 to 2019-2020 NFL seasons, but more expansive research on other NFL eras would be plausible through continued research.

Next, it was necessary to select a wide and extensive number of variables to conduct statistical analysis. When it comes to NFL football, there are a variety of ways to measure of success including win percentage, win percentage in winter months, Super Bowl appearances, Super Bowl wins, division titles, and many other. For this research, win percentage, Super Bowl appearances, and Super Bowl wins were selected. Division titles were not selected because teams within one division are typically near one another geographically, thus sharing similar climatic conditions. The other variables do not lump certain teams together geographically and will be more effective in this research.

Climatic variables in this research include precipitation totals, mean high and low temperatures month to month, and composite winter weather scores used by the National Weather Service to determine which cities are more conducive to harsh winter conditions. These variables will test my hypothesis, based on the theory of Colin Cowherd, that warm-weather teams are less successful during the winter playoff months. Demographic variables included in this research are population and mean GDP per capita of each NFL city as that data is readily available and will be a fair indication as to whether or not larger markets have an impact on NFL success.

Once these variables were gathered, significance between variables was determined with multiple T-Tests by separating areas into two different groups. For example, to test for the statistical significance between winning percentage and moisture levels, NFL franchise locations were required to be determined as either an area with high moisture content or an area with low moisture content. These splits were not always equally down the middle, but adequately

separated each group into the most useful category and will make it possible to run this sort of analysis. P-values are presented for each t-test which is a preliminary statistic concerning probability. Lower P-values indicate higher probabilities or show a greater relationship between two variables and higher P-values indicate lower probabilities and a likelihood that two given values and less significant to one another.

Climatic data were collected from the National Weather Service, and demographic data were collected from the United States Census Bureau. NFL data were compiled from footballreference.com.

Limitations

There are numerous limiting factors that come with this sort of research. The first limitation is that the idea of environmental determinism essentially eliminates the possibility of human agency based on their geography. Determinism eliminates extraordinary performers and puts each player on a level playing field, making them equal. However, though this research will show that there are certain determinant factors, the approach of environmental possibilism should be considered and reviewed. Possibilism would provide value for extraordinary performers in not-so-appealing geographic areas. For example, based on Cowherd's theory, a city like San Antonio would not be conducive to long-term success, however, factors that are not relevant in deterministic studies (like hall of fame center Tim Duncan and coach Gregg Popovich), could lead to success. Further, based on certain coach and player movement, it is becoming more and more possible to create success for a team regardless of geographic location. For example, the Jacksonville Jaguars just hired head coach Urban Meyer and will likely draft a

generational talent in Trevor Lawrence at quarterback. This may set Jacksonville up for a successful future, even though Jacksonville doesn't meet the conditions of success according to Cowherd's argument. Perfect storms do happen on occasion, but by taking a sample of twenty NFL seasons, outliers should not significantly alter this statistical analysis.

The other primary limitation in this research is only using twenty seasons. This could place unfair emphasis on certain teams that have been successful within only that period. However, there are dynasties throughout each decade of NFL history, so one decade would probably not work any better than another decade.

Results

Elevation

The Denver Broncos are home to 'Mile High Stadium' as they are the only NFL team with a stadium even remotely near 5,280 feet in elevation. Less oxygen in the air at higher elevations makes it more difficult to breathe - especially upon exertion. Therefore, it could be assumed that NFL teams at higher elevations are more successful. Teams located in Miami and Carolina become acclimated practicing and living at lower elevations, so the jump up to such an extreme elevation could negatively affect their performance. However, does this jump in elevation affect performance at the individual basis or on a team as a whole? To determine if teams at higher elevations had higher levels of success a T-Test was calculated based on elevation where teams were split into two groups: high elevation including all teams above 500 feet average elevation, and low elevation including all teams below 500 feet in average elevation.

Higher Elevations	Lower Elevations
Green Bay Packers	Miami Dolphins
Chicago Bears	Jacksonville Jaguars
Tennessee Titans	New Orleans Saints
Buffalo Bills	New York Giants
Cleveland Browns	New York Jets
Detroit Lions	Philadelphia Eagles
Indianapolis Colts	Oakland Raiders
Carolina Panthers	Tampa Bay Buccaneers
Minnesota Vikings	San Francisco 49ers
Kansas City Chiefs	Houston Texans
Atlanta Falcons	Seattle Seahawks
Arizona Cardinals	Los Angeles Chargers/San Diego Chargers
Pittsburgh Steelers	Los Angeles Rams (Current)
Denver Broncos	New England Patriots
	Washington Football Team
	Dallas Cowboys
	St. Louis Rams (2000-2015)
	Baltimore Ravens
	Cincinnati Bengals

This research is being under a 95% confidence level, meaning that for any T-Test, a result of less than .05 would be necessary to indicate a significant result.

Elevation	Overall Win %	Super Bowl Appearances	Super Bowl Wins
P-value	.356	.283	.209

As seen from these T-Test scores, we fail to reject the null hypothesis as there was no significant result indicating that elevation influences the success NFL teams. None of these numbers are even close to the .05 threshold and though it seems likely that individual athletes may struggle when moving to higher elevations, elevation is not an environmental determinant

for success by the metrics of win percentage, Super Bowl Appearances, and Super Bowls wins. There are several reasons as to why this could be the case. For example, are certain tools that professional trainers give their athletes to use to simulate training at high elevations including special masks that help approximate reduced oxygen levels. Also, restricted airflow has been a training tool for many NFL athletes, and this can simulate the oxygen content in air at higher elevations (Levine 2016).

Moisture

Precipitation was selected as a variable because it modifies how the game of football is played. In the rain or a snow, the ball becomes slippery, and this may alter a game's outcome. Therefore, it would make sense that teams that play in low moisture areas would struggle when forced to play in the rain or snow. For each moisture variable, teams were split into two groups indicating higher and lower measurements, all teams with less than 60' of annual moisture (rain and snow primarily) and all teams with more than 60' of annual precipitation, and placed in a T-Test.

Higher Moisture	Lower Moisture
Washington Football Team	Arizona Cardinals
Jacksonville Jaguars	Los Angeles Rams (Current)
Cincinnati Bengals	San Francisco 49ers
Baltimore Ravens	Miami Dolphins
Indianapolis Colts	St. Louis Rams (2000-2015)
Kansas City Chiefs	Dallas Cowboys
Detroit Lions	Los Angeles Chargers/San Diego Chargers
Pittsburgh Steelers	Seattle Seahawks
Chicago Bears	Carolina Panthers
New York Giants	New Orleans Saints
Denver Broncos	Oakland Raiders

Green Bay Packers	New York Jets
Cleveland Browns	Tampa Bay Buccaneers
Minnesota Vikings	Philadelphia Eagles
New England Patriots	Houston Texans
Buffalo Bills	Atlanta Falcons
	Tennessee Titans

There are also seasonal changes from Fall to Winter in any given NFL season, so for the purpose of this research, fall winning percentages include all games in September and October and winter winning percentages include all games in November, December, and January (including playoffs).

Moisture	Fall Win %	Winter Win %	Super Bowl Appearances	Super Bowl Wins
P-value	.168	.182	.131	.085

From these tests, no significant results were found. However, upon further analysis, there were some additions to this data that needed to be removed. There are multiple NFL teams that play under a dome roof, meaning that they can eliminate any moisture that would possibly affect gameplay. So, the samples from teams with domes were removed, and the tests were run again.

	Fall Win %	Winter Win %	Super Bowl Appearances	Super Bowl Wins
With Dome	.168	.182	.131	.085
W/O Dome	.207	.025	.101	.048

Once ‘The Dome Effect’ is removed, a much different picture is presented. In terms of Winter winning percentages and Super Bowl Wins, we can now reject the null hypothesis. This

illustrates that moisture, specifically in the winter (primarily snow), is a determining factor in NFL success.

Temperature

Extreme hot and extreme cold temperatures could affect the outcome of a football game. This may occur when warm-weather football teams like Arizona or Atlanta travel to cold-weather Buffalo or Green Bay during the winter months. These warm-weather teams are likely not as prepared to play in the colder temperatures.

Lower Average Temperature	Higher Average Temperature
Minnesota Vikings	Carolina Panthers
Green Bay Packers	New York Giants
Denver Broncos	New York Jets
Chicago Bears	Tennessee Titans
New England Patriots	Washington Football Team
Detroit Lions	Seattle Seahawks
Buffalo Bills	Atlanta Falcons
Indianapolis Colts	Dallas Cowboys
Pittsburgh Steelers	Jacksonville Jaguars
Cincinnati Bengals	Oakland Raiders
Cleveland Browns	Arizona Cardinals
Kansas City Chiefs	Houston Texans
St. Louis Rams (2000-2015)	New Orleans Saints
Baltimore Ravens	San Francisco 49ers
Philadelphia Eagles	Los Angeles Chargers/San Diego Chargers
	Los Angeles Rams (Current)
	Tampa Bay Buccaneers
	Miami Dolphins

To examine this, one group of teams with above average temperatures or warm temperatures (a winter average temperature above 35 degrees Fahrenheit) and another group of teams with below

average temperature or cold temperatures (a winter average temperature below 34 degrees Fahrenheit) were selected.

	Overall Win %	Winter Win %	Super Bowl Appearances	Super Bowl Wins
T Test Score	.16	.317	.211	.125

With just these tests, we fail to reject the null hypothesis and conclude that temperature is not a determinant for NFL success. However, as with moisture, 'The Dome Effect' must be taken into account. Domes are able to control the temperature within the dome, meaning that there is no variation in temperature in the dome and the game is unaffected by temperature. Another test was run the 'The Dome Effect' in mind.

	Overall Win %	Winter Win %	Super Bowl Appearances	Super Bowl Wins
With Dome	.16	.317	.211	.125
Without Dome	.103	.037	.174	.042

Once the dome teams are removed, the p-value for each variable became lower and thus more significant. The null hypothesis can now be rejected for both winter winning percentage and for Super Bowl wins, meaning that temperature is a variable that can determine how successful teams are during the winter months and winning the Super Bowl.

Composite Winter Weather

To fully determine whether winter weather is a determinant of NFL success, there was a need for a composite score to determine how certain places compared to others in terms of winter harshness. The National Weather Service creates a list of cities and how they are ranked within their Winter Weather Severity Index (WWSI).

Harsher Winter	Milder Winter
Minnesota Vikings	St. Louis Rams (2000-2015)
New England Patriots	Tennessee Titans
Green Bay Packers	New Orleans Saints
Buffalo Bills	Washington Football Team
Denver Broncos	Carolina Panthers
Chicago Bears	Atlanta Falcons
Cleveland Browns	Houston Texans
Detroit Lions	Seattle Seahawks
Pittsburgh Steelers	Jacksonville Jaguars
Indianapolis Colts	Miami Dolphins
New York Giants	Dallas Cowboys
New York Jets	Oakland Raiders
Cincinnati Bengals	San Francisco 49ers
Baltimore Ravens	Tampa Bay Buccaneers
Kansas City Chiefs	Arizona Cardinals
Philadelphia Eagles	Los Angeles Chargers/San Diego Chargers
	Los Angeles Rams (Current)

All of the NFL franchises were listed from least severe to most severe and then split in half to create two groups one indicating a harsher winter and another indicating a milder winter. A T-Test was run both with dome teams and without dome teams.

	Overall Win %	Winter Win %	Super Bowl Appearances	Super Bowl Wins
With Dome	.079	.156	.081	.018

Without Dome	.043	.113	.069	.011

Each metric of winning became more significant when the dome teams were removed. This demonstrates that winter weather is a determining factor in the general success of an NFL franchise.

There are a variety of reasons as to why cold weather is a determinant in franchise success. One such reason may be the Paradox of Plenty which suggests that areas with more resources will tend to have more issues as far as geopolitics are concerned (Ross 2015). In this case, warm weather cities are conducive to a variety of resources not as present in other areas. For example, clubs, bars, parties, and other activities are more plentiful in areas with warmer weather. This provides distractions for players, staff, and personal and could be a factor as to why colder weather teams tend to be more successful.

Population

Another possible determinant to NFL success is population or the size of a city hosting an NFL team. Cities with larger populations are typically larger market areas. These areas have the opportunity to attract better more free agents because of the market size and the available financial benefits (Mengle 2019).

Higher Population	Lower Population
Seattle Seahawks	Green Bay Packers
Carolina Panthers	Buffalo Bills
Indianapolis Colts	Pittsburgh Steelers
San Francisco 49ers	Cincinnati Bengals
Jacksonville Jaguars	St. Louis Rams (2000-2015)
Dallas Cowboys	Cleveland Browns
Philadelphia Eagles	New Orleans Saints

Arizona Cardinals	Minnesota Vikings
Houston Texans	Oakland Raiders
Chicago Bears	Miami Dolphins
Tampa Bay Buccaneers	Kansas City Chiefs
Los Angeles Chargers/San Diego Chargers	Atlanta Falcons
Los Angeles Rams (Current)	Baltimore Ravens
New York Giants	Denver Broncos
New York Jets	Detroit Lions
	Tennessee Titans
	New England Patriots
	Washington Football Team

In this analysis, teams were split up into groups of over 750,000 people in a city and under 750,000 people in a city, and T-Tests were run for the same measures of success.

Total Population	Overall Win %	Super Bowl Appearances	Super Bowl Wins
P-value	.451	.364	.127

Though the Super Bowl win category is approaching statistical significance, we still fail to reject the null hypothesis as there is no statistical significance indicating that the overall population of a city is determinant in NFL team success. These teams are typically higher in total revenue generated, but that doesn't necessarily translate to team success. Through this test, we can see that population is not a good indicator of how successful a given NFL team can be.

GDP Per Capita

Per capita GDP is an indicator that values the wealth of a given location rather than just the number of people. The wealth of a city can also be an attractive aspect of a city to acquire better talent.

Higher GDP	Lower GDP
Indianapolis Colts	Tampa Bay Buccaneers
Tennessee Titans	Arizona Cardinals
Chicago Bears	Miami Dolphins
New England Patriots	Buffalo Bills
Houston Texans	Minnesota Vikings
Pittsburgh Steelers	Los Angeles Chargers/San Diego Chargers
Denver Broncos	New York Giants
Dallas Cowboys	Detroit Lions
Kansas City Chiefs	Green Bay Packers
Los Angeles Rams (Current)	Jacksonville Jaguars
Washington Football Team	Cincinnati Bengals
Oakland Raiders	St. Louis Rams (2000-2015)
New York Jets	Atlanta Falcons
New Orleans Saints	Carolina Panthers
Seattle Seahawks	Cleveland Browns
San Francisco 49ers	Baltimore Ravens
Philadelphia Eagles	

In this analysis, teams were split up into two groups of per capita GDP above and below 60,000. Multiple measures of success were used as a part of this T-Test.

GDP/Capita	Overall Win %	Super Bowl Appearances	Super Bowl Wins
P-value	.024	.076	.136

GDP is a significant factor in overall win percentage. Super Bowl appearances, though not significant, is near significant along with the significant value of overall win percentage, meaning that per capita GDP is a factor of determining NFL success.

Though these T Tests do show significant results, there are other issues that need to be addressed. For example, when splitting samples into two groups during a T Test, that split is determined to the researcher's best judgment and is arbitrarily determined. Further, a T Test can determine whether or not something is significant, but it does not show the extent of that significance. Though there are significant results as presented in this project, much more in-depth research is necessary to determine the extent certain variables affect NFL team success. Finally, it is important to note that the data used are not independent as when one team wins, another team loses. This makes certain other statistical methods impossible, so independent data would be necessary as well to continue this project. This would likely mean looking more at home and away winning percentages based on certain times of conditions. By analyzing success on a game-to-game basis, we would be able to have win percentages for any given team in any given type of weather, making it possible to test the differences in how teams play in certain weather conditions in comparison to normal.

Conclusion

Preliminary research indicates that there are certain geographic factors impact on NFL team success. Specifically, as Cowherd suggested, it appears that winter weather conditions are more conducive to NFL success in comparison to traits associated with warm weather. There is now a statistical basis for further research concerning this phenomena and continued research is

necessary. Geography affects other cultural aspects of everyday life and though more research is needed, it can be stated that geography also has an impact on how well our favorite sports teams perform. There were statistical limitations with this project, but with additional research, more descriptive results would be possible. Though not perfect, it can be seen that geography has some effect, but that effect is difficult to define at this point. However, as with other areas of culture, sports, specifically the NFL, are at least somewhat affected by geography and environmental determinism.

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