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Sports Sentiment and Energy Consumption

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0. Abstract

This paper adds to the existing literature on how mood, specifically induced by the outcome of a sporting event, influences other economic variables. Past research on the subject has found that losses tend to have a greater impact than wins. These findings are consistent with the loss aversion property of prospect theory. I look at NFL game outcomes in the Boston area, where a large portion of the population feels extremely passionately about their home team. This study examines how mood induced by NFL game outcomes impacts energy consumption, a dependent variable that has not yet been used in this area of literature. The energy consumption data comes from smart thermostats, which provide information from hundreds of households in the Boston area alone daily. I primarily focus on target temperature and program override decisions. The results indicate that a win is associated with households' target temperatures being set significantly higher. There is no significant relationship between wins and the probability of an override. The inconsistency in findings between the two dependent variables for wins could be a possible topic for future research to further investigate. Losses are associated with a significant decrease in the probability of an override. Accordingly, there is no significant relationship between losses and target temperature.

1. Introduction

This paper investigates the impact of mood on energy consumption. One way in which mood is affected is through the outcomes of sporting events. Thus, I use the wins and losses of sports games as a means through which to examine the impact of mood. The specific sporting event examined is professional football in the Boston, Massachusetts area. It is believed that wins and losses of sports games can serve to induce a positive or negative mood in individuals.

Football, in particular, is a widely watched sport and creates strong feelings in the United States due to the loyalty of fans. It is the fan's loyalty that determines their emotional reaction to the outcome of a game. When a team that an individual is a fan of loses, it will induce a negative mood including pessimism and lowered self-esteem. When a team that an individual supports wins, however, it will induce an overall positive mood including optimism and higher self-esteem (Gallagher and O'Sullivan, 2011). I will look at whether a win or loss of a local NFL football team in the Boston area will influence thermostat settings in individual homes by presumably impacting mood. This paper looks at two specific types of thermostat settings using smart thermostat data: a household's target temperature and override decisions.

Much past literature has focused on the connection between sporting game outcomes and subsequent stock market returns (Edmans et al., 2007; Gallagher and O'Sullivan, 2011). There is also research on the relationship between sporting event outcomes and family violence (Card and Dahl, 2009). As mentioned, the underlying assumption is that the outcome of a sports game serves to trigger either a positive or negative mood in an individual based on the team that they support. There is additional research to support that sporting events truly impact mood. For example, more positive emotions were seen in tweets following soccer goals of one's home team, while more negative emotions were seen in tweets following the goal of an opponent team (Yu and Wang, 2015). Typically, individuals will support a team that is in geographically close proximity to where they live. Thus, it can be inferred that generally game losses will cause negative emotions in many of the people who live close to the home base of that team.

The past research looking at sporting game outcomes has argued that when researching the relationship between mood and stock market returns, the variable impacting mood must meet three criteria (Edmans et al., 2007; Gallagher and O'Sullivan, 2011). While this paper is not

looking at stock market returns, it is looking at another economic variable that may also be affected by mood. The first criterion is that the mood variable must have a significant and unambiguous effect on mood. Secondly, the variable has to affect a large proportion of the population. Football is arguably the most popular sport in the United States and Boston is particularly loyal to their local football team. Thus, a win or loss of a football game based in Boston would be expected to impact a substantial portion of the Boston population. Finally, The variable must be positively correlated across the majority of the population. I believe that football in the Boston area meet these three criteria. It is a population that is passionate about the sport and has close to homogenous reactions to the outcomes of the games.

Past literature has linked the loss of sporting events with subsequent negative stock market returns. It has not, however, found strong or consistent results relating the wins of games with stock market returns. The majority of this past literature has not found significant results for wins. Past research has additionally found unexpected game losses to be associated with increased rates of family violence, but no such relationship has been found for game wins (Card and Dahl, 2009). Finding weaker results for game wins than game losses is in line with prospect theory, which states that losses have a stronger psychological impact than wins. As such, in the present study, I would expect the losses of football games to have a stronger effect on energy consumption than the wins of football games.

The possible relationship between sports game outcomes and energy consumption would be important for a few reasons. It would indicate that there is a bias present in decision-making related to energy consumption. Extensive literature has revealed that many of our everyday judgments and decisions can be influenced by minor changes in our environment of which we are entirely unaware (Kahneman and Tversky, 2000). For example, people are more likely to

purchase an item (e.g. jam) when there are fewer choices available than when there are more choices available (Iyengar and Lepper, 2000). Additionally, the relationship would indicate that energy consumption could be partially explained by mood variables. In the realm of sports sentiment literature, larger decisions (i.e. as stock market investments) have been investigated. Smaller, everyday economic decisions, such as energy consumption have not yet been examined. With such an everyday decision, there is typically a status quo, and any deviation from the usual setting likely comes from mood. Decisions made regarding thermostat adjustments occur so frequently that they often become habitual. This paper would further expand decision-making literature. While studies have investigated the relationship between sports outcomes and stock market returns or other economic variables, none have looked at sports outcomes in relation to energy consumption.

The present study uses data from hundreds of smart thermostats in the Boston area in January 2014. Two NFL playoff games for a Boston-based team occurred during that month, which serve as winning and losing days. The dependent variables used are target temperature and override decisions. There are number of other weather variables that are controlled for. Findings indicate that a winning is related to a significant increase in same-day target temperature. However, there is no significant relationship between winning and override probability. Losses are associated with a significant decrease in probability of a same-day override. There is no significant relationship found between losses and target temperature.

The next section of this paper will review the main findings from previous related literature. The third section will describe the background of the data that is used in this study. The fourth section will discuss the theoretical framework on which this paper is based and the fifth section will describe the data in detail. The sixth section will present the model that I will

use and the seventh section will present my findings. The eighth and ninth sections will discuss the meaning of the results and ultimately make conclusions about the outcome of this study. Finally, the references can be found in section ten and section eleven contains tables that list the complete findings of this study.

2. Literature Review

2.0 Overview

First, this section will describe the extensive background literature on the relationship between sports outcomes and stock market returns. Secondly, it will discuss sports outcomes in relation to another economic variable, rates of family violence. The third subsection will provide evidence for the relationship between sports outcomes and mood, which is an important basis of the present paper. The fourth subsection will discuss evidence for a relationship between mood and temperature. Finally, I will look at studies connecting mood and consumption, as the present paper looks at the consumption of energy.

2.1 Sports Outcomes and Stock Market Returns

Edmans et al. (2007) investigate how the outcome of various sports games impact the stock market by affecting the mood of investors. Other research has found support for a relationship between mood and stock returns. One example includes positives stock returns around Yom Kippur and St. Patrick's Day but negative stock returns around Rosh Hashanah (Frieder & Subrahmanyam, 2004). Additionally, psychological research supports that the outcomes of sports games affect mood. One example is the finding that fans tend to have a strong positive reaction in response to their team performing well and a negative reaction when their team performs poorly (Wann et al., 1994). An individual's reaction to a sports outcome can also increase or decrease their self-esteem and affect if they feel positively or negatively about life in

general. Because of the impact on general life outlook, Edmans et al. (2007) hypothesized that sports results would affect investor's views on future stock prices. Research has documented that negative outcomes, including increases in heart attacks and crimes, are associated with losses. No such link of a positive magnitude has been found for wins (Carroll et al, 2002; Wann et al., 2001). This lack of effect of wins can potentially be explained by prospect theory, which posits that there is a reference point against which to measure gains and losses. There is evidence that fans exhibit an "allegiance bias", a bias towards their team winning. Thus, a win for their team would be the reference point because that is the outcome that they would expect. Prospect theory also states that losses have a stronger psychological impact than gains of the same magnitude, which is another possible reason that losses may have an effect while wins would not. Additionally, it is possible that a loss may hit harder when it removes a team from a competition entirely (e.g. a playoff game). A win of a playoff game would merely move a team to another round.

The primary sport investigated by Edmans et al. (2007) was soccer, which is the most popular sport in many countries worldwide. Though evidence suggests that sports in general can impact human behavior, soccer in particular seems to be especially important for many countries. International soccer results over the course of more than thirty years were used. The sample included matches played by 39 different countries, with a total of 638 wins and 524 losses. The other sports included in this study were cricket, rugby, ice hockey and basketball. The data for all of the sports other than soccer includes a total of 905 wins and 645 losses from 24 countries. The effect of sports results on stock prices was measured using the return on a broad stock market index on the first trading day after the game. The market indices came from Datastream and returns were computed using a total return index. When the total return index was unavailable, a

price index was used instead. Index returns were measured in terms of the local currency. The null hypothesis was that sports outcomes are not correlated with asset prices. An event study approach was used, which determines the impact of an event on the value of the firm using statistics. An example of when an event study would be frequently used would be in the case of a merger. In the case a merger, one would look at the value of a firm prior to a merger and following a merger because the merger would act as the event. For the study by Edmans et al. (2007) the wins and losses would serve as the events.

A significant "loss effect" was found by Edmans et al. (2007), meaning that a loss of a soccer match for a particular country corresponded with a decline of that country's stock market (as measured the next day). This effect was especially pronounced for more important soccer matches and small stocks, which are mostly held by local investors. The loss effect found could not be explained by rational economic actions of investors. Consistent with prospect theory, such an effect for wins was not found. In looking at other sports, a significant loss effect was documented for cricket and marginal loss effects were found for rugby and basketball. The impact of the loss is not as strong for other sports as for soccer. This finding was to be expected, as soccer is the most popular in most of the countries examined, and therefore should have the greatest impact on mood. For ice hockey, however, no loss effect was found. Consistent with the soccer findings, there is not an impact on the stock market after the winning of a game for the other sports.

Contrary to the above findings, Gallagher and O'Sullivan (2011) did not find an overall loss effect for soccer when conducting a similar study. They did, however, find evidence for a loss effect for soccer and rugby when looking only at knock-out stage games. They focus on

Ireland to explore how investor moods due to the wins or losses of sporting events impact stock market returns. This paper identifies three characteristics that a mood variable must satisfy, which were also used by Edmans et al. (2007). The mood variable must drive mood in a significant and unambiguous way, it must impact a large portion of the population, and finally it must be correlated among the majority of the population of the country. Gallagher and O'Sullivan (2011) argue that Ireland satisfy these criteria. The sample examined includes international soccer, rugby, golf, athletics, boxing, snooker, swimming, and horse-racing events. A continuous variable approach is used to test the link between asset pricing and sports results. There is not a strong relationship found between sport results and stock market results overall, however, when looking at the knock-out stage matches, soccer and rugby losses are found to have a significant negative correlation with stock market return on the trading day after the match. This relationship is slightly stronger for small stocks, just as Edman et al. (2007) found. Consistent with previous research and the loss aversion property of prospect theory, there were no significant findings for stock market returns following the win of a soccer game. There was no data available for rugby wins at the knock-out stage. The intuition behind this finding is that knock-out stages have more significance, thus having a strong enough impact on mood to influence investment behavior. This paper found, however, that when controlling for the stock market rational discounting indirect economic effects on sports related industries, there was no longer a significant relationship, suggesting that there was not in fact a mood effect, but rather that agents were behaving rationally. This finding, is inconsistent with the belief that mood is the linking variable between a win or loss of a game and its impact on the stock market.

Palomino et al. (2009) also looked at soccer game outcomes and the stock market but added betting odds to the equation. They investigated the data of soccer clubs listed on the

London Stock Exchange. Every week, expectations on the games outcomes based on betting odds and the actual outcomes of games are reported. Soccer betting in the UK uses a fixed-odds system, which generates and releases the odds a few days prior to the games. Once put up, the odds will rarely change before the start of a game. Unlike the previously mentioned studies, results from this study show that when a team wins, there is an above average return for three days following the game. After the loss of a game, there is a significantly negative average return for three days following the game. Following a tied game, there are no significant results. When examining if these results could be explained by rational economic actions, it was found that when a team wins, investment actions are in fact primarily due to positive sentiment and overreaction. However, when a team loses, the abnormal stock returns do not appear to be influenced by mood and appear to be the result of rational expectations. This evidence is in contrast to prospect theory and the previously mentioned research supporting that losing tends to have a stronger impact on people's emotions. Because betting odds are good predictors of game outcomes, it would be expected that they too would have an effect on stock prices. However, there appears to be no such connection between the posting of odds and stock prices. There are many possibilities for this, one being that odds are less widely available and seen than game outcomes.

Chang et al. (2012) also investigated the relationship between game outcomes and the stock market, specifically focusing on National Football League (NFL) games. They looked at the stock market returns for Nasdaq firms that were headquartered near NFL teams after games. Results support that the loss of a game would lead to lower market returns the next day for local stocks, while the results for a win were not significant after controlling for necessary variables. The difference between wins and losses, however, was small, making it uneconomical to buy or

sell stocks based on this information. Similarly to past research, this effect was stronger for an unexpected or more important loss. These results support that NFL game outcomes influence investor sentiment and thereby affect the return on local stocks. These results are in line with prospect theory and this is the first study mentioned to focus on the sport of football, which is also the sport used in the present paper.

While some studies have documented evidence that the outcomes of sporting games can subsequently impact the stock market, other studies have found no evidence to support this claim. Vieira (2012) also examined FIFA world cup data, looking at the 2010 world cup in South Africa. Unlike many other studies, this study failed to document any relationship between the outcomes of games and a change in the market. As can be seen, there is not a definitive link between sports outcomes and stock market returns as the results are varied and the samples come from a wide variety of sports and locations. Overall, however, it appears that game losses are associated with negative stock market returns while game wins are not associated with any change in stock market returns. Prospect theory, which states that losses loom larger than gains, would support these findings.

2.2 Sports Outcomes and Family Violence

While many studies have looked at the relationship between sports sentiment and stock market returns, Card and Dahl (2009) examine the relationship between sports outcomes and family violence. A central part of their study is the role that surprise and unexpected game outcomes play. The main hypothesis of their paper is that negative emotional cues in relation to an expected reference point would cause a breakdown of control to be more likely. This loss of control is what is presumed to be the cause behind a violent episode. This study looks at the data

of police reports of family violence on Sundays during the professional football season. Because many people have a strong emotional attachment to their local NFL teams, professional football games can serve as a good emotional cue. A Poisson regression framework was used to analyze data on police reports from six different states that are home to NFL teams. States with only a single NFL team were used and all reports within that state were included. The effect of the wins and losses of the home team on number of family violence incidents reported was analyzed. The reference point used was the expected probability of a win for a team, which came from betting odds. Location fixed effects, the probability of winning, weather, and the size of the local viewing audience were controlled for. The data set used was the National Incident-Based Reporting System (NIBRS), which includes reports of crimes to individual police agencies that were not necessarily associated with an arrest. It includes the specific date and time of reports, but participation of police agencies is voluntary. The findings revealed that home team losses that were extremely unexpected based on betting odds ("an upset loss"), were related to an increase in at-home male-on-female partner violence for a short period of time after the game ended. This effect was stronger for salient games, such as ones against a major rival. This finding is similar to those of the studies on stock market returns, which found that knock-out stage games produced stronger effects. This evidence suggests that family violence is at least in part due to a loss of control. There was not any effect for female-on-male violence nor violence against children. There was additionally no strong evidence for any effect of a home-team win. This finding is consistent with prospect theory and previously mentioned studies supporting that losses have a stronger impact than wins.

2.3 Sports Outcomes and Mood

An important assumption of research on sports outcomes and economic variables is that

sports outcomes impact mood. As I have mentioned, a win can increase an individual's self-esteem and cause them to feel more positively about life in general. A loss can decrease an individual's self-esteem and cause them to feel more negatively about life in general (Wann et al., 1994). Research has also found increases in heart attacks and homicides to be related to game losses. No similar positive relationships have been found for game wins (Carroll et al, 2002; Wann et al., 2001).

In order to look at the correlation between sporting events and mood, Yu and Wang (2015) looked at tweets by United States soccer fans during the FIFA World Cup games in 2014. While the tweets came from the U.S., the soccer games took place in Brazil. Yu and Wang (2015) examined three games in which the U.S. faced another team and two games in which the U.S. was not playing. The emotions in the tweets were analyzed, particularly after a goal was made by or against the U.S. Sentiment analysis was used, which is a big data approach. Specific words with discrete emotions were counted using a software program. Fear and anger were found to be the most common negative emotions present and increased when the opponent team scored against the U.S., but decreased when the U.S. scored. The positive emotions of joy and anticipation occurred when the U.S. scored a goal. In looking at matches between other teams, there was no clear pattern of emotions detected when goals were scored, as would be expected. There were more positive emotions overall when teams other than the U.S. were playing. This indicates that goals made specifically against a team that one feels an allegiance with (e.g. their "home team") sparks tweets that have more negative emotions. These findings are consistent with disposition theory, which states that enjoyment of a sporting event is based on an individual's disposition and the content of the sporting event. The individual's affective disposition is their feelings or attachment to a particular team, which can be a liking or a

disliking. Individuals tend to enjoy a game more when their team is scoring goals and less when the opponent team is scoring.

End et al. (2009) similarly looked at the impact of the outcome of an individual's favorite teams on mood and relationships. All participants in the study were currently involved in a romantic relationship. Participants were given questions assessing how they perceived the win or loss of their partner's favorite team to impact their partner's mood and their interactions with their partner. The results indicated that individual's perceived their partner to have more negative affect, less positive affect, and increased irritability after the loss of their favorite team compared to a win. These results support that a loss for one's team results in a more negative mood, while a win results in a more positive mood.

2.4 Mood and Temperature

The present study investigates mood and energy consumption, and as such it is important to review literature relating mood and temperature. Wilkowski et al. (2009) explore whether metaphors that connect anger with heat (e.g. one's blood boiling) are grounded in the actual cognitive representations of heat and anger. The findings suggest that in fact, people associate anger with heat. Participants were faster to identify anger-related words when presented with a hot cue (i.e. font suggestive of a hot temperature, campfire background image) than with a cold or neutral cue. This pattern was not found with control words. Additionally, participants estimated temperatures for unfamiliar cities as hotter following anger-related words than following fear-related words or neutral words. In a separate study, participants estimated the current room temperature as being hotter following anger primes than following neutral primes. In terms of identifying faces, participants were quicker to identify angry faces when presented

with heat cues than neutral cues but there was no difference for sad faces. They were also more likely to interpret an ambiguous face as angry when presented on a hot background image than when on a cold background image. Taken together, these findings strongly suggest that people relate anger with heat and potentially suggest that people may physically feel hotter when angry. Because anger is often felt when a game loss occurs, a game loss may also be associated with feeling hotter.

2.5 Mood and Consumption

Mood and energy consumption are a focus of the present study, and past literature relating mood and consumption may also provide valuable insight. Goldstein et al. (2014) studied mood in relation to gambling behavior. In order to do so they recruited regular gamblers. Gambling can be considered a type of consumption, though it may be more influenced by addiction and a "rush" than other types of consumption. For one month, participants were randomly prompted three times each day to report their current mood and whether they had gambled since the last time they had been prompted. About a quarter of the sample met criteria for being considered "problem gamblers". Results showed that a positive mood was related to more time spent gambling, but only for high enhancement motivated gamblers. There was no such relationship found for low enhancement motivated gamblers. High enhancement motives indicate that a gambler's main reason for gambling is that they find it exciting. Thus, for some gamblers, their gambling consumption increased in conjunction with a positive mood.

Collins and Stafford (2015) also looked at mood and consumption, but instead of the consumption of gambling, the consumption of food. Additionally, they manipulated participants' moods rather than measuring existing mood levels. Participants were randomly assigned to have a positive or neutral mood induced. Two different pieces of classical music were used for the

mood induction. Past fMRI results and self-report data had indicated that these music pieces were effective in inducing the desired moods. For the first part of the study, participants were merely asked to come to the lab, given a lunch, and told to eat as much as they desired until they were full. After finishing the lunch, they were asked to schedule a time to return on the same day that was at least two hours later. The participants were asked not to eat or drink anything other than water before they returned. When the participants returned, they were exposed to one of the music pieces and then given three different snacks to "rate". They were told that they could eat as much of each snack as they desired. Their total food intake was later measured. It was found that participants consumed significantly more snacks in the positive mood induction condition than in the neutral mood induction condition. One possible explanation is that individuals who are in a positive mood want to continue feeling positively and consuming food is one means of doing that.

While the previous study did not look at negative mood, some past studies looking at the link between food consumption and negative mood have found that the results vary based on individual characteristics. Polivy and Herman (1976) found that individuals with clinical depression, and therefore major emotional distress, tended to gain weight as a result of their depression only if they typically restrained their food intake. Those who were normally unrestrained eaters, however, lost weight as a result of depression. Thus, there was not a clear pattern of results for food consumption in relation to negative mood.

2.6 Summary of Past Research

Taken together, there have been mixed results linking sports outcomes and stock returns. Overall, there does appear to be a loss effect, with the loss of one's home-team resulting in a decline in the stock market but no significant results for wins. These results tend to be more

pronounced for more critical games and small stocks, which are largely held by local investors. Similar results have also been found with sports results and violence, with the loss of a game being associated with an increase in violent crime when that loss was unexpected. Prospect theory supports these findings, as it states that losses have a stronger psychological impact than wins of the same magnitude. Studies have also indicated that game losses negatively impact mood while game wins positively impact mood. Additionally, anger, a negative emotion that is likely related with a game loss, appears to be associated with heat. This finding is of interest because the present paper focuses on temperature settings in homes. In terms of studies on mood and consumption, findings veer from those of studies on sports outcomes and stock returns. Positive mood appears to be associated with an increase in consumption while negative mood does not have a clear pattern. These findings are also related to the present paper, as this paper also involves a mood variable and a consumption variable. Though prospect theory and the studies on sports outcomes support that we should expect to find significant results for a game loss but not a game win, the papers on mood and consumption would suggest a possible finding for game wins.

3. Background

The National Football League (NFL) is a professional football league in the United States that is made up of 32 teams. It is the highest professional level of American Football in the world and one of only four major professional sports leagues in America. Many consider football to be the most popular sport in the United States. Every NFL team plays sixteen games during the 17-week long regular season, which runs from the week after Labor Day to the week after Christmas. After the regular season, six teams from each of the two divisions enter the playoffs,

which is a single-elimination tournament. The final game of the playoffs is the Super Bowl, in which the winner of each division competes against one another.

The New England Patriots are an NFL team that is based in the greater Boston area. They play their home games at Gillette Stadium in Foxborough, Massachusetts, which is located approximately 20 miles outside of Boston. Originally the Boston Patriots, the New England Patriots changed their name in 1971 after relocating. The original Boston location may be part of the reason that Bostonians are still so loyal to the team despite the team's new home base being an hour outside of Boston. The team has made it to the Super Bowl eight times and is considered to be one of the most successful NFL teams. Their overall success likely adds to their fan base and the strong ties that people in the Boston area feel towards them. The New England Patriots were chosen as the focus of the present paper. In order to ensure that sports games outcomes had a strong impact on mood, I sought to concentrate a team in the U.S. that had a large fan base in its geographical area. The home base of the team additionally had to have largely homogenous and strong feelings toward the team. Based these criteria, the Patriots are an excellent match. Football as a whole would be considered by many to be the most widely followed sport in the U.S. The Patriots in particular, appear to have an extremely loyal fan base in Bostonians. A large proportion of the greater Boston population actively follows and roots for the Patriots to win. Another reason that the Patriots are so popular in Boston is that there are no other NFL teams in the state of Massachusetts that could detract from the Patriot's fan base.

The thermostat data used in this paper comes from smart thermostats that provide minute-by-minute thermostat and external weather readings for over 60,000 households across the U.S[1]. The thermostats work based on a set point or target temperature, which means that the air-

[1] A small sample of a proprietary dataset from a small thermostat company was provided for use in this study by Professor Qi Ge

conditioning unit automatically turns on to cool the house to the set point during the summer and the heat automatically turns on until the set point is reached during the winter. Programmable smart thermostats can adjust these set points automatically, which allows for users to increase or decrease the set point when they want to save energy but cannot for various reasons such as being asleep or away. Typically the units have different programs for weekdays and weekends. When users are unhappy with the temperature, they can always change or temporarily override the program. My data shows that overrides are quite frequent.

The thermostats are wi-fi enabled and capable of either four or seven unique temperature set points per day. It can be easily programed using web and mobile application, which allow for remote adjustments to be made to the thermostat settings when the user is not home. There is a significant amount of data related to the operation of the remote management platform.

Past research shows that providing users with more information on their usage tends to reduce their demand. Smart thermostats are popular with utility companies as they give them more control for demand side management by reducing energy usage at times of peak demand and help meet federal guidelines. Programs that give users temporal information about their demand reduced long run demand by 7%, though they had little impact in the short-run demand.

4. Conceptual Framework

The present study is based on prospect theory. Prospect theory focuses on preferences over lotteries. It looks at how people choose between different probabilistic alternatives that involve risk, which is perceived in terms of a number of different variables. It is assumed that the probabilities of each of the outcomes is known. The agent's preference admits a utility representation. A utility representation means that numerical values can be attached to each of

the options in a menu (B), which is all of the feasible options from which an agent can choose. The utility of the lottery in prospect theory is defined in terms of losses and gains as opposed to absolute value of the outcome. Additionally, it is assumed that an agent uses "decision weights" when making decisions as opposed to actual probability attached to each of the choices.

There are several important properties of the value function (*v*) in prospect theory. An assumption of the theory is that the curve of *v* is similar for all individuals. The first property is reference dependence, which is that *v* is defined for gains and losses with respect to some underlying reference point and $v(0) = 0$. A reference point means that the starting wealth is important and the relevant outcomes of a gamble are the change with respect to that reference point. The reference point is the current "status quo", or the state that a person has become used to. The referent point in this particular case may be an expected win for one's home-team.

The next property is diminishing sensitivity. For gains, *v* exhibits diminishing marginal utility, while *v* exhibits diminishing marginal disutility for losses. Thus, each additional unit gained does not increase utility as much as the last, whereas each additional unit lost does not decrease utility as much as the last. Loss aversion, the final property, implies that losses loom larger than gains. Thus, a loss will have a greater impact on an individual than a gain of the same amount. As one could intuit, losses will have a negative impact while gains will have a positive one. This property is important because it implies that individual will feel more affected by a loss than a gain of the same magnitude.

There are also properties of the probability weighting function (ρ). The first is that for every $0 \leq \alpha \leq 1$, there is $0 \leq \rho(\alpha) \leq 1$. Thus, for every decision weight corresponding to α is a number $\rho(\alpha)$ between 0 and 1. $\rho(\alpha)$ increases strictly with α. Another key property is that small probabilities are overweighted and large ones are underweighted. This means $\rho(\alpha)$

$> \alpha$ for small α and $\rho(\alpha) < \alpha$ for large α. Studies that have tried to estimate the weighting function have found that $\rho(\alpha) = \alpha$ when α is approximately 1/3. Because of the inconsistency in weighting, people believe that outcomes attached to small probabilities are more likely to happen than they actually are, while they believe that outcomes attached to large probabilities are less likely to happen than they actually are. This leads to the following pattern of risk attitudes: people are risk-averse for gains in large-probability lotteries but risk-loving for losses in large-probability lotteries. For small-probability lotteries, however, the pattern is reversed with people being risk-loving for gains and risk-averse for losses.

Because of loss aversion, framing effects come into play in prospect theory. Framing refers to the manner in which a choice is presented and framing options in terms of gains or losses can affect what an agent chooses. The domain refers to whether an action is perceived to occur in the realm of gains or losses. Depending on the context, the domain can either be relatively objective or relatively subjective. In some cases, whether something is a win or a loss in unclear. Additionally, the same outcome can often be framed to seem as though it is a win or reworded to seem as though it is a loss. In my study, this type of ambiguity is not present and it is always clear whether we are dealing with a "win" or a "loss" of a game.

The most important piece of prospect theory for the current study is loss aversion. As mentioned previously, because of the construction of the value function (v), losses will loom larger psychologically than gains. Thus, for the current study, I would expect losses of games to have a greater impact than wins of games. Accordingly, the loss of a sporting event should affect an individual's mood more than the win of a sporting event and subsequently also have a greater impact on the changing of the thermoset. As past literature has shown, anger tends to be

associated with heat. As such, I would expect the loss of a game to be associated with feeling warmer, which I expect to have ramifications for temperature settings.

Hypotheses:

1) Losing a sporting event would have a negative impact on ones mood and likely cause anger. As such, I hypothesize that there will be a decrease in thermostat settings (to make the temperature cooler) following the loss of a sporting event. Thus, I expect there to be a negative relationship between the target temperature and loss of a game.
2) Based on prospect theory and past literature, I do not expect wins to have enough of an effect on mood to result in any significant change in thermostat settings. I do not expect a relationship between target temperature and the win of a game.
3) Because I believe that a loss would cause an individual to be more angry and therefore feel warmer, I expect that it would also cause them to override the smart thermostat. Thus, I hypothesize that there will be a positive relationship between override decisions and losses.
4) As stated previously, according to prospect theory a win will not have as strong of a psychological impact as a loss. Therefore, I hypothesize that there will not be a relationship between override decisions and wins.

5. Data

5.0 Background of Data

A panel data set is used in this study. Panel data sets observe a sample of individuals over a period of time, which provides multiple data points for each individual. Advantages to using panel data sets include that you can control individual heterogeneity and you can identify

individual and time effects. The data primarily comes from smart thermostats for the entire month of January 2014. The data set was narrowed down to look solely at homes in the greater Boston area. There were a total of 851 homes included in this sample making for 26,383 total observations. There is data for each day in January for each household present in the data set. As has been mentioned previously, the majority of people living in the Boston area should be fans of the local sports teams. The local National Football League team for Bostonians is the New England Patriots. Outcomes of New England Patriots football games were added to the data set, which came from the National Football League website (http://www.nfl.com). Two specific New England Patriots games were used, both of which were playoff games. A loss of either game would have resulted in elimination and ended the season for the New England Patriots. As such, playoffs make for higher stakes games. Much of the past research on sports outcomes and economic variables has found that the effect of the sports outcomes is substantially greater when a game is critical (e.g. a loss will result in elimination) or the result is unexpected. This is thought to be because there is a greater impact on mood. I chose to examine these two playoff games, which would be considered more important than a regular season game, because I am aiming to measure games that have a strong impact on mood. The first game occurred on January 11th at the home stadium in Foxborough, Massachusetts against the Indianapolis Colts and was a win. The second game occurred on January 19th at the Denver, Colorado stadium against the Denver Broncos and resulted in a loss. Because the entire month of January is used, the majority of the days in the data set are days on which no game was played.

5.1 Description of Variables

The dependent variables that will be looked at are target temperature and override decisions. For all of the variables, *i* will be equal to household and *t* will be equal to day. The

$Target_{it}$ is the average daily temperature at which the thermostat is set in degrees Fahrenheit of the i^{th} household at the t^{th} time. $Override_{it}$ is a dummy variable, which is equal to one if the i^{th} household has overridden the programmed thermostat settings at least once on the t^{th} day. The main independent variables that will be looked at are winning and losing. Both winning and losing are dummy variables. $Winning_{it}$ is equal to one if there is a win on a particular day. $Losing_{it}$ is equal to one if there is a loss on a particular day. The control variables that are used in each of my four models vary. A number of weather control variables that are thought to likely have an impact on thermostat settings are used. They include $L.Target_{it}$, $Outdoor_{it}$, $L.Outdoor_{it}$, $Precipitation_{it}$, $Snowfall_{it}$, $Ambient_{it}$, $Windspeed_{it}$, $L.Override_{it}$, $Outdoorfreq_{it}$ and $Ambientrange_{it}$. $L.Target_{it}$ is a lag variable, which is the measurement of $Target_{it}$ one day prior. $Outdoor_{it}$ is the average daily outdoor temperature measured in degrees Fahrenheit. $L.Outdoor_{it}$ is a lag variable, which is the measurement of the $Outdoor_{it}$ one day prior. $Precipitation_{it}$ is the average daily amount of rainfall measured in millimeters. $Snowfall_{it}$ is the average daily amount of snowfall measured in millimeters. $Ambient_{it}$ is the average daily indoor temperature. $Windspeed_{it}$ is the average daily wind speed. $L.Override_{it}$ is lag variable, which is a measurement of $Override_{it}$ one day prior. $Outdoorfreq_{it}$ is the daily number of changes in the outdoor temperature. Finally, $Ambientrange_{it}$ is the daily range of ambient temperatures.

5.2 Descriptive Statistics

The descriptive statistics for all of the variables in the sample can be seen in Table 1. Valuable insights about the data set can be drawn from the descriptive statistics. $Target_{it}$ has an average of 63.61 degrees and a relatively small variance, indicating that people tend to have a comfort level that falls within a narrow range. This also suggests people are not changing the

target temperature to widely varying temperatures. The mean of $Override_{it}$ indicates that on average, 62% of the sample overrides the program a day. Thus, program overrides occur quite frequently. There is considerable variation in the results, as the standard deviation is also relatively high. The majority of the days in the sample were days that did not have a game and thus the mean for both winning and losing is relatively low. Based on the means for $Winning_{it}$ and $Losing_{it}$, it can be seen that only 3% of the sample is a win and only 3% is a loss. The average outdoor temperature ($Outdoor_{it}$) is 25.48 degrees and the variance is relatively low. The mean outdoor temperature is substantially lower than the mean target temperature, indicating that people used a considerable amount of heat.

Comparing means reveals that there is an average $Target_{it}$ of 63.61 degrees on days that there is no game. The mean $Target_{it}$ is higher when there is a win at 63.87 degrees. Mean $Target_{it}$ is lowest when there is a loss at 63.42 degrees. The average target temperature being lower on days that there is a loss compared to days that there is no game is consistent with my hypothesis that a game loss will lead to individuals feeling warmer and subsequently turning down the temperature on their thermostat. The higher average target temperature on days with a win is not consistent of my hypothesis that there would be no difference. Although these differences are small, $Target_{it}$ has a small variance, meaning that small differences can be significant. For $Override_{it}$, the average was 0.62 on a day with no game. The mean $Override_{it}$ is lower at 0.49 for a loss. My hypothesis was that override decisions would increase on loss days as the result of adjusting thermostat settings rather than decrease. However, the means reveal that on a day with no game, there is a 62% probability of an override, while on the day of a loss, there is only a 49% probability of an override. On win days, $Override_{it}$ was only slightly lower than

on a day with no game at 0.60. This is consistent with the hypothesis that a win would not have a strong enough psychological impact to affect override decisions.

6. Empirical Model

There are a total of four regression functions conducted using fixed effects models with robust standard errors. A fixed effects model assumes that the individual specific effect is correlated to the independent variable. The dependent variables used are target temperature and override decisions. Two of the functions are baseline regression functions for target temperature and override decisions. Additional control variables are added to the two initial baseline regression functions for extended versions of the target temperature and override decisions regression functions.

The first regression is the $Target_{it}$ baseline regression function:

$$Target_{it} = \beta_0 + \beta_1 Winning_{it} + \beta_2 Losing_{it} + \beta_3 L.Target_{it} + \beta_4 Outdoor_{it} + \beta_5 L.Outdoor_{it} + \gamma_{it} + \varepsilon_{it}$$

The main variables of interest are $Winning_{it}$ and $Losing_{it}$. It is expected that β_1 will not have a strong enough impact on mood to be correlated with $Target_{it}$, and thus will not have a significant outcome. β_2, however, is expected to have a negative sign, with the loss of a game being related to a decrease in the target temperature that is set. Anger is related to heat and as such the loss of a game is expected to be related to a decrease in target temperature because individuals are expected to feel warmer after a loss and want to cool down by lowering target temperature. The other variables in this regression function serve as control variables. β_3, is expected to be positively correlated with $Target_{it}$. β_4 is expected to be negatively correlated with

$Target_{it}$, as a decrease in β_4 would likely lead to an increase in the heat, and thereby an increase in $Target_{it}$. β_5 is similarly expected to have a negative coefficient.

The extended $Target_{it}$ regression function is as follows:

$$Target_{it} = \beta_0 + \beta_1 Winning_{it} + \beta_2 Losing_{it} + \beta_3 L.Target_{it} + \beta_4 Outdoor_{it} + \beta_5 L.Outdoor_{it} + \beta_6 Precipitation_{it} + \beta_7 Snowfall_{it} + \beta_8 Ambient_{it} + \beta_9 L.Windspeed_{it} + \gamma_{it} + \varepsilon_{it}$$

The signs of the independent variables already contained in the $Target_{it}$ baseline regression function are expected to remain the same. It is unknown whether β_6, β_7, and β_9 will have a positive or negative coefficient. β_8 is expected to have a positive coefficient.

The next regression function is the $Override_{it}$ baseline:

$$Override_{it} = \beta_0 + \beta_1 Winning_{it} + \beta_2 Losing_{it} + \beta_3 L.Override_{it} + \beta_4 Target_{it} + \beta_5 L.Target_{it} + \beta_6 Outdoor_{it} + \beta_7 L.Outdoor_{it} + \gamma_{it} + \varepsilon_{it}$$

The variables that I am focusing on are once again $Winning_{it}$ and $Losing_{it}$. I expect that β_2 will have a positive sign, while β_1 will not be significant. For the control variables, it is expected that β_3 will have a positive sign. It is unclear whether β_4 and β_5 would have a negative or positive sign. β_6 will likely have negative sign, as a lower temperature would likely be related to more overrides in an attempt to increase the heat. Similary, β_7 is also expected to have a negative sign.

The final regression function includes additional control variables to the $Override_{it}$ baseline function and is the $Override_{it}$ extended regression function:

$$Override_{it} = \beta_0 + \beta_1 Winning_{it} + \beta_2 Losing_{it} + \beta_3 L.Override_{it} + \beta_4 Target_{it} + \beta_5 L.Target_{it} + \beta_6 Outdoor_{it} + \beta_7 L.Outdoor_{it} + \beta_8 Snowfall_{it} + \beta_9 Ambient_{it} + \beta_{10} Windspeed_{it} + \beta_{11} Precipitation_{it} + \beta_{12} Outdoorfreq_{it} + \beta_{13} Ambientrange_{it} + \gamma_{it} + \varepsilon_{it}$$

For the overlapping variables between the baseline $Override_{it}$ function and the extended version, the signs of the coefficients are expected to remain the same. For the added variables, the expected outcomes are as follows. It is unknown what the sign for β_8, β_{10}, and, β_{11} will be. It is additionally unknown if β_9 is expected to have a positive or negative sign. β_{13} is expected to have a positive sign, as a larger range of temperature would indicate more of a changing temperature. β_{12} is expected to is expected to have a positive sign, as more changes would likely impact the need to override a system more.

7. Results

The overall baseline $Target_{it}$ regression was significant at the 1% level. The results can be observed in Table 2. Contrary to my hypothesis, there was not a significant relationship between $Losing_{it}$ and $Target_{it}$. Surprisingly, however, there was a significant positive coefficient for $Winning_{it}$ at the 1% level. These results indicate that target temperature would be expected to be increase by 0.30 degrees on the day of a win. $L.Target_{it}$ had a positive significant coefficient at the 1% level. One would expect target temperature yesterday and target temperature today to be highly related. A 1 degree increase in yesterday's target temperature would be associated with a 0.60 degree increase in today's target temperature. $Outdoor_{it}$ had a significant negative coefficient at the 1% level, as expected, but $L.Outdoor_{it}$ did not have a significant coefficient. A 0.01 degree decrease in target temperature is associated with an outdoor temperature increase in 1 degree. This is a relatively small magnitude, but as the outdoor temperature decreases, people appear to overcompensate by increasing the target temperature.

The results for the extended $Target_{it}$ regression function can be seen in Table 2. The results for the main variables of interest remained the same. The overall regression remained significant at the 1% level. Once again, there was not a significant coefficient for $Losing_{it}$, but there was a positively significant coefficient for $Winning_{it}$ at the 1% level. The magnitude of the effect decreased slightly with an expected target temperature increase of 0.21 degrees on the day of a win. The coefficient for $L.Target_{it}$ remained positive and significant at the 1% level. There was a noticeable decrease in the magnitude with an increase in 1 degree in yesterday's target temperature being associated with an increase of 0.26 in today's target temperature. The decline in magnitude was most likely due to the introduction of the $Ambient_{it}$ variable. $Outdoor_{it}$ again had a significant negative coefficient at the 1% level. The magnitude increased with a 1 degree increase in outdoor temperature associated with a 0.03 degree decline in target temperature. Unlike the previous regression, $L.Outdoor_{it}$ also had a significant negative coefficient at the 1% level. A 1 degree increase in yesterday's outdoor temperature was associated with a 0.01 degree decrease in today's target temperature. Of the added control variables, $Windspeed_{it}$ and $Precipitation_{it}$ did not have significant coefficients. $Snowfall_{it}$ had a positive significant coefficient at the 5% level with a 1 millimeter increase in snowfall being associated with a 0.0006 increase in target temperature. $Ambient_{it}$ had a positive significant coefficient at the 1% level with a 1 degree increase in ambient temperature associated with a 0.62 degree increase in target temperature

The complete results for the baseline $Override_{it}$ regression are presented in Table 3. The overall regression was significant at the 1% level. In this equation, the coefficient for $Winning_{it}$ was not significant, however, $Losing_{it}$ had a negative significant coefficient at the 1%

level. A loss is associated with an 11% decline in the probability of an override. I had hypothesized that $Winning_{it}$ would not have a significant coefficient, however, my prediction for the relationship between a game loss and overrides was the opposite of what is found here. The coefficient of $L.Override_{it}$ was positive and significant at the 1% level. Thus, an override yesterday is associated with a 16% increase in override probability today. The coefficient of $Target_{it}$ was significant and positive at the 1% level, but the coefficient of $L.Target_{it}$ was significant and negative at the 1% level. A 1 degree increase in target temperature is associated with a 3% increase in the probability of an override. However, a 1 degree increase in the target temperature yesterday is associated with an expected 0.5% decrease in the probability of an override today. It is unknown why there is a difference in signs for the coefficients of $Target_{it}$ and $L.Target_{it}$. $Outdoor_{it}$ had a significantly negative coefficient at the 1% level. A 1 degree increase in outdoor temperature is associated with a 0.2% decrease in the probability of an override. The coefficient of $L.Outdoor_{it}$ was not significant.

The results for the $Override_{it}$ regression function with additional control variables are listed in Table 3. Once again, the overall regression was significant at the 1% level. Again, the coefficient of $Winning_{it}$ was not significant, but $Losing_{it}$ had a significantly negative coefficient at the 1% level. A loss is associated with an 8% decrease in probability of an override, which is slightly lower than the baseline model. The $L.Override_{it}$ coefficient was again positively significant at the 1% level. An override yesterday is associated with a 12% increase in the probability of an override today. The $Target_{it}$ coefficient was again significantly positive at the 1% level and the $L.Target_{it}$ coefficient was significantly negative at the 1% level. A 1 degree increase in target temperature is associated with a 1% increase in the probability of an override.

A 1 degree increase in target temperature yesterday is associated with a 0.7 degree decrease in the probability of an override today. The coefficient of $Outdoor_{it}$ is also once again significant and negative at the 1% level. A 1 degree increase in outdoor temperature is related to a 0.1 degree decrease in target temperature. Of the added control variables, the coefficients of $Precipitation_{it}$ and $Outdoorfreq_{it}$ were not significant. The coefficients of $Snowfall_{it}$ and $Ambient_{it}$ were significant and positive at the 1% level and the coefficient of $Windspeed_{it}$ was significant and negative at the 1% level. A 1 millimeter increase in snowfall is associated with a 0.02% increase in the probability of an override. A 1 unit increase in wind speed is associated with an 0.05 decrease in the probability of an override. A 1 degree increase in ambient temperature is associated with a 2% increase in the probability of an override. $Ambientrange_{it}$ also had a significant positive coefficient at the 1% level. A 1 degree increase in the range of ambient temperatures is associated with a 3% increase probability of overrides.

8. Discussion

My findings on target temperature were very much in contrast to prospect theory and previous studies involving sports outcomes and other economic variables. I had expected that a loss would have a greater impact than a win based on past evidence. This, however, was not what I found with regards to the target temperature. Winning was a significant predictor of target temperature, while losing was not. Previous studies have found little evidence of game wins being related to stock market returns. The discrepancy from the previous studies likely emerged due to the different dependent variables used. While much of the past literature focused on stock returns, the present study focused on energy consumption. Fundamental differences in the variables may have caused the different results. The linking variable in the studies on stock

market returns and the present study is assumed to be mood induced by the win or loss of a game. It appears that a positive or negative mood may differentially impact stock market returns and energy consumptions. Buying or selling stocks could be considered a larger and more influential decision to make than adjusting energy consumption. Energy consumption is a smaller economic decision that people make every day, while stock market investments are larger decisions made on a less frequent basis. When decisions are made daily, people tend develop a comfort level and form habits. Any variation in a small decision, such as energy consumption, likely comes from changes in mood. A decision to change target temperature would more so be a breaking of habitual behavior than a stock market decision.

I have found evidence to suggest that when a game is won, the target temperature is increased compared to baseline. While literature has suggested that anger is associated with heat (Wilkowski et al., 2009), I have not found any literature to suggest a relationship between temperature and positive emotions. Individuals are presumably excited and joyful after the win of a game, and my findings suggest that these emotions are linked to setting a higher thermostat temperature. One possible explanation is that in celebration individuals want to splurge on energy and decide to set the temperature higher after a win. My dataset comes from winter months when the outdoor temperatures are lower and therefore experiencing warmer temperatures could be considered a luxury.

Previously mentioned studies on mood and consumption may further illuminate inconsistencies between my hypotheses and results related to target temperature. Polivy and Herman (1976) found that inducing a positive mood lead to a higher consumption of food. Increasing a target temperature in the winter means that an individual is turning up the heat and therefore increasing spending, another type of consumption. Additionally, Goldstein et al. (2014)

found that for some gamblers, positive mood was associated with more time spent gambling. Thus, positive moods may be linked to greater consumption of various types of goods. While studies on stock markets did not find significant results for wins, it is possible that buying stocks may be less exciting and celebratory than other types of consumption. Buying of stocks tends to be a more thoughtful process than changing thermostat settings. As mentioned, buying stocks is done on a less frequent basis than setting the thermostat and as such different decision strategies may be used. Mood may therefore impact decisions related to stock market and thermostats differently.

The results for the second variable of interest in this paper, override decisions, were more in line with my hypotheses. Winning was not significant, as would be predicted by prospect theory, which states that a loss would have a greater impact than a win of the same magnitude. Although winning was predictive of a higher target temperature, it was not associated override decisions. Losing was significant, but not in the direction that I expected. The loss of a game was associated with a decrease in the probability of overrides. I had expected that a loss and therefore negative mood would lead individuals to decrease the target temperature more by overriding the program. This ended up not being the case, though a game loss still had an impact on the number of overrides. The finding that a game loss is associated with a decreased probability of overrides may be explained by a general lack of motivation due to negative mood after the loss of a game.

Because there was a significantly positive relationship between target temperature and winning, I would have expected there to also be a positive relationship between override decisions and winning. I have assumed that the win of a game induces positive mood and therefore alters consumption behavior. In order to increase the target temperature settings, it would be anticipated that an individual would be more likely to override the preprogrammed

thermostat settings following a win. Therefore, the results for winning regarding target temperature and override decisions were inconsistent. The results between target temperature and override for losses, however, were more consistent. There was not a significant relationship between target temperature and the loss of a game, and therefore I would have expected there to also be no relationship between losses and override decisions or a negative relationship between losses and override decisions. I found the latter, with the likelihood of an override decreasing when a game loss occurred. This is consistent with a home not altering their target temperature following the loss of a game.

One drawback of the current study is that only two games were used, limiting the generalizability of the findings. Additionally, the win was a home game, while the loss was an away game. This could be considered a confounding factor, and it would be beneficial to do future research including more games. It should be noted that based on past research, I do not believe that whether a game was home or away would significantly affect the findings. Much of the past research on sporting games has looked at fans who presumably did not view the game in person. The assumption is that many people are loyal to their local team and will view it on television or by another means regardless of the physical location. Thus, whether a game occurred at home or away should not impact its affect on the mood of fans of the playing team. The two games were also played against two different opponents. Past studies have indicated that outcomes that were more unexpected or games against a team's "rival" can have a stronger impact on mood. A larger sample with more opponent teams and more wins and losses would control for these factors.

The present study also did not investigate the role that surprise results may play. As shown by Goldstein et al.(2014), unexpected game outcomes based on betting odds yield

stronger results. Card and Dahl (2009) also only found a significant relationship between sports outcomes and family violence for game losses that were not expected. Looking at the role of a surprise would be another direction for future research, as surprise could serve to further explain the relationship between sports sentiment and energy consumption. It should be noted that a small sample size was used in the present study and the methodology would have been better applied to a larger sample with more time periods. The discrepancy found between the results for target temperature and override decisions could very well be a result of a small sample size problem. This would be another worthwhile consideration of future research. This remains the first study investigating the relationship between mood induced by sports games outcomes and energy consumption and as such there is much left to be researched on the topic.

9. Conclusion

This paper looks at the relationship between mood and energy consumption. In order to investigate mood, I look at the outcomes of sports games, which can serve to induce a positive or negative mood. Specifically, I examine two NFL playoff games and related thermostat settings in the Boston area. The two dependent variables looked at are the probability of overrides and target temperature. The findings show that a win is associated with an increase in target temperature but is not significantly related to probability of overrides. The inconsistency between target temperature and probability of overrides found for wins may be due to the small sample in the present study and should be a consideration for future research. A loss of a game is associated with a decrease in the probability of an override but not significantly related to target temperature. This study is the first to look at the relationship between mood and energy consumption and shows that changes in mood can impact small, everyday decisions such as setting a thermostat.

The results of the current study highlight that outcomes of sporting games may differentially impact various economic variables. Past research on sports outcomes and other economic variables and prospect theory are not entirely aligned with the present findings. The loss of a game was not associated with any change in target temperature, but the win of a game was related to an increase in target temperature. Additionally, the probability of overrides was decreased by the loss of a game but not affected by the win of a game. The underlying assumption is that the loss of a game induces a negative mood, which therefore decreases probability of overrides. By the same token, the win of game induces a positive mood, which leads to an increase in the target temperature set by households. It would be beneficial for future research to investigate more economic variables as they relate to the outcomes of sporting games. Additionally, examining other sports and locations in similar studies could serve to expand the scope of this literature. As mentioned earlier, the role that surprise and unexpected game outcomes play may be important in the relationship between mood and energy consumption and as such should be considered in the future. Field studies examining the relationship between mood and energy consumption would also be beneficial. There are no clear theories on the link between mood and energy consumption and developing some would provide more of a basis on which to conduct future research.

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11. Tables

Table 1

Variable	Observations	Mean	Std. Dev.
Target	26,383	63.61	6.41
Override	26,383	0.62	0.49
Winning	26,383	0.03	0.18
Losing	26,383	0.03	0.18
Outdoor	26,383	25.48	12.21
Ambient	26,383	64.23	6.19
Outdoor Frequency	26,383	46.80	84.40
Windspeed	26,383	53.06	17.82
Ambient Range	26,383	6.86	4.19
Snowfall	26,383	17.96	53.48

Table 2

	Base Model	Extended Model
Target Temperature		
Constant	25.95*** (1.24)	8.59*** (1.71)
L.Target	0.60*** (0.02)	0.26*** (0.06)
Outdoor	-0.01*** (0.002)	-0.03*** (0.003)
L.Outdoor	-0.002 (0.002)	-0.01*** (0.002)
Winning	0.30*** (0.10)	0.21*** (0.07)
Losing	-0.10 (0.09)	0.03 (0.08)
Precipitation		0.0001 (0.002)
Snowfall		0.0006** (0.0003)
Ambient		0.62*** (0.07)
Windspeed		0.0005 (0.0007)

All robust standard errors are in parentheses

* indicates significance at the 10% level of significance

** indicates significance at the 5% level of significance

*** indicates significance at the 1% level of significance

Table 3

	Base Model	Extended Model
Overrides		
Constant	-1.12*** (0.14)	-1.41*** (0.12)
L.Override	0.16*** (0.01)	0.12*** (0.01)
Target	0.03*** (0.002)	0.01*** (0.003)
L.Target	-0.005*** (0.002)	-0.007*** (0.001)
Outdoor	-0.002*** (0.0003)	-0.001*** (0.0003)
L.Outdoor	0.0002 (0.0003)	-0.0001 (0.0003)
Winning	-0.009 (0.01)	-0.004 (0.01)
Losing	-0.11*** (0.01)	-0.08*** (0.01)
Snowfall		0.0002*** (0.00004)
Ambient		0.02*** (0.003)
Windspeed		-0.0005*** (0.0001)
Precipitation		-0.0006 (0.0005)
Outdoor Frequency		-8.17e-06 (0.00002)
Ambient Range		0.03*** (0.002)

All robust standard errors are in parentheses

* indicates significance at the 10% level of significance

** indicates significance at the 5% level of significance

*** indicates significance at the 1% level of significance