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Abstract

Television coverage's impact on college football attendance is a topic of debate. Between 2005 and 2019, annual growth in athletic department revenues for Football Bowl Subdivision (FBS) schools from media rights, postseason football, and National Collegiate Athletic Association (NCAA) conference distributions far exceeded revenue growth in ticket sales revenue. This study re-evaluates the substitution or complementarity of television coverage and stadium attendance in college football with updated data while controlling for selection bias through endogenous treatment regression. Although initial results reveal a positive correlation between television coverage and attendance, national coverage and attendance appear to be substitutes after controlling for selection bias. That said, from an attendance maximizing perspective, national coverage is preferable to lower-tiered coverage if a game is to be televised.

Keywords: endogenous treatment regression, stadium attendance demand, television coverage, college football

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Introduction

Attendance demand has been extensively studied, yet the role television coverage plays in shaping stadium attendance demand is still up for debate. Data from the Knight-Newhouse College Athletics Database shows that between 2005 and 2019, ticket sales made up approximately 20% of total revenues for Football Bowl Subdivision (FBS; the top level of college football, consisting of 130 schools) college athletic departments, the majority of which come from football. However, despite total athletic revenues growing at a 4.4% annual rate over that time period, ticket sales revenue only grew by an average of 1.7% annually, less than the annual United States inflation rate over the same period (approximately two percent). Meanwhile, revenues from the National Collegiate Athletic Association (NCAA) and conference distributions, media rights, and postseason football grew nearly eight percent annually and made up nearly 24% of total revenues. While total revenues are unequivocally benefitted by the growth in television, our focus is on whether growth in broadcasting has come at the expense of live spectator interest.

In the rich empirical literature, there exist several arguments as to whether televised broadcasts function as substitutes for or complements to demand for the stadium product (see discussions in Baimbridge et al., 1996; Falls & Natke, 2017; Kaempfer & Pacey, 1986). Immense growth in television revenues has been accompanied by innovations and improvements in broadcast quality as well as increased viewing options with new premium networks and streaming platforms. As the cost of watching games at home decreases or the quality of the at-home viewing experience improves, the demand for live spectator attendance should be reduced. On the other hand, extensive promotional activities by television networks, such as advance advertising, can increase both television viewership and attendance. Additionally, attending a nationally televised game may hold prestige, as only a limited number of people can attend in-person.

A major concern when estimating the causal relationship between television coverage and attendance is selection bias. Network executives choose to broadcast games that will generate higher viewership, and many of those same attributes that drive live viewership are also likely to spur attendance as well. This, in turn, biases estimates of the effects of television coverage on attendance, likely in the direction of complementary goods.

Numerous studies examining the impact of television coverage on stadium attendance in college football have found a complementary effect yet refrained from controlling for selection bias (Falls & Natke, 2017; Losak et al., 2022). Studies for other leagues and sports (Nalbantis et al., 2022; Storm et al., 2018; Wallrafen et al., 2022a) have shown that, after controlling for selection bias, the estimated effect of television on attendance flips from positive (complements) to negative (substitutes). The purpose of this study is to consider whether a similar trend is observed for college football attendance after controlling for selection bias.

This paper's contributions can be summarized as follows. First, we contribute to the existing literature on college football game attendance factors (e.g., Falls & Natke, 2014, 2017) with updated data over an extended panel period. Second, we are the first paper to control for selection bias when analyzing the impact of television coverage on stadium attendance for college football, highlighting the impact selection bias has on the ability to draw causal inference. Third, we reach conclusions on the complementarity or substitutability of live television coverage on college football attendance demand using more detailed television data than previous college football studies.

Our results reveal a nuanced relationship between television coverage and attendance that varies over time based on the level of coverage. Ordinary least squares (OLS) with school fixed effects highlight a positive correlation between them; attendance is higher when the television network is more prominent and accessible. However, after controlling for selection bias through endogenous treatment regression (ETR), we find that national coverage and attendance are substitutes, not complements. We also uncover a significant trend when examining the results over time. National television coverage acts as a substitute during the first half of the panel period (2000s) but becomes a complementary good during the second half (2010s). This change may be attributed to the evolving baseline option during the sample period. Collectively, we conclude that television is a substitutable good but that national coverage is preferable to lower-tiered coverage if a game is to be televised.

The paper is organized as follows. First, we review relevant literature on television-driven substitution effects on attendance demand, especially for college football. Next, we provide an overview of our panel data set and present our empirical approach. Subsequently, we present empirical results using OLS and fixed effects, followed by ETR. Finally, we conclude with a summary of the findings and suggestions for future research.

Substitution Effects in Sports

We use the standard consumer-theory model to analyze the decision to attend a game, watch it on television, or not watch it at all (Borland & Macdonald, 2003). Consumers face budget constraints—on financial resources and time—that introduce trade-offs. For example, studies consider the impact of substitution on television audiences across sports (Mongeon & Winfree, 2012; Rodríguez et al., 2015), across various levels or leagues of the same sport (Grimshaw et al., 2013; Kang et al. 2018; Nalbantis et al., 2022; Schreyer et al., 2018), and within leagues (Mills et al., 2016; Tainsky et al., 2016). Wallrafen et al. (2022b) showed that scheduling overlaps with local and nonlocal higher division soccer games have a negative impact on demand for German professional handball, basketball, and ice hockey. Wallrafen et al. (2019) showed a similar negative effect on lower-division German soccer games. Whereas these studies consider the extent to which sporting events are substitutes, we focus on the relationship between television coverage and stadium attendance.

The effect of television coverage on stadium attendance has been a topic of concern for decades. North American leagues imposed policies in the mid to late 1900s to mitigate the potential negative impact of broadcasting on attendance, such as limiting the number of broadcasts and implementing blackouts for games that failed to meet attendance targets (Cairns et al., 1986; Hochberg & Horowitz, 1973; Horowitz, 1974; Zuber & Gandar, 1988). Kaempfer and Pacey (1986) found that attendance increased with television coverage, contradicting the notion that telecasts needed to be restricted. That said, Fizel and Bennett (1989) disputed Kaempfer and Pacey's (1986) findings, based on data from the time of the famous Supreme Court case *NCAA v. Board of Regents of the University of Oklahoma*—which ruled that the NCAA's tight control of college football broadcasts violated antitrust law—and concluded that increases in television coverage had a negative impact on attendance.

Numerous studies have also explored the relationship between televised coverage and stadium attendance outside of North American sports. Baimbridge et al. (1996) was an early investigation of tv's impact on stadium attendance using 1993–1994 English Premier League data, finding that coverage led to lower attendance for Monday games (no significant effects for Sunday). Wallrafen et al. (2022a) reviewed 30 studies on the topic, half of them published since 2008. Of those, all 10 European soccer studies showed either a substitution effect or no effect in England (Buraimo, 2008; Buraimo & Simmons, 2008; Buraimo et al., 2009; Cox, 2012; Cox, 2018), Norway (Solberg & Mehus, 2014), Scotland (Allan & Roy, 2008), and Spain (Buraimo & Simmons, 2009).

Wallrafen et al. (2022a) also identified six studies that focus on college football (Falls & Natke, 2014; Falls & Natke, 2017; Fizel & Bennett, 1989; Kaempfer & Pacey, 1986; Mirabile, 2015; Price & Sen, 2003). Mirabile (2015) found no effect of television coverage on attendance demand for neutral site games. Other recent papers (Falls & Natke, 2014; Falls & Natke, 2017; Price & Sen, 2003) found positive effects of television coverage on stadium attendance for home college football games. Falls and Natke (2017) analyzed video coverage's impact on FBS stadium utilization using panel data from 2007 to 2009, finding an advertising effect that overwhelms any sort of substitution effect. They also found that nationally televised games had higher stadium utilization, while regionalized coverage had no effect and local coverage had mixed results. Losak et al. (2022) exploited the creation of individual conference television networks and highlighted a complementary relationship between coverage and attendance.

Unaddressed in the aforementioned college studies, the endogenous relationship between game attendance and television coverage is a critical concern (Borland & Macdonald, 2003), particularly in college football, where most scheduling decisions are driven by network executives and contractual commitments. After the first month of the season, most game start times are announced just 10–14 days before the game, and the broadcast network is often decided just a week in advance. Many factors of demand that impact spectator interest, such as matchup quality, also impact television viewership (Brown & Salaga, 2018). Typically, the best games are displayed on more prominent networks and attract larger crowds.

Falls and Natke (2017) recognized the endogenous relationship between stadium attendance and television coverage but did not address it in their methodology. The selection bias problem is addressed in Storm et al. (2018), who initially found for Danish men's handball, a complementary effect of appearing on basic tier networks and secondary channels. However, their results were not statistically significant after considering the impact of selection bias and implementing a dyadic model. Wallrafen et al. (2022a) offered a more comprehensive solution, comparing substitution results for German third division soccer with standard OLS and endogenous treatment regression (ETR). They found a complementary effect when using OLS but a substitution effect when using ETR. Nalbantis et al. (2022) focused on the transnational substitution in the United States for European soccer telecasts and found a substantial substitution effect between overlapping Bundesliga and Premier League games. As they lacked an instrument for a Heckman style model that satisfies exclusion restriction, they considered broadcast selection issues using a DMZ model (D'Haultfœuille et al., 2018) and found larger negative coefficients, indicating a stronger substitution effect than under the OLS specification.

We apply the methodology of Wallrafen et al. (2022a) to examine college football attendance, as our specification satisfies the exclusion restriction for selection bias. However, certain factors, such as the behavior difference between season ticket holders and single game buyers (Allan & Roy, 2008; Schreyer et al., 2016) and no-show behaviors (Karg et al., 2021; Schreyer & Torgler, 2021), are not considered due to the lack of disaggregated stadium attendance data (see Schreyer & Ansari, 2022 for a discussion). Our analysis is based on distributed ticket attendance figures.

Empirical Strategy and Data Overview

The sample for this study consists of 12,846 regular season college football games played between 2003 and 2019, featuring home teams from 131 FBS programs across 12 conferences (plus independents). We exclude neutral sites, conference championships, and bowl games (schools qualify for a postseason bowl game by achieving a minimum of six wins in the regular season). The sample is unbalanced due to the unequal number of home games played by each school and schools transitioning to FBS during the sample period.

Estimating Stadium Attendance Demand

Stadium attendance demand factors have been examined extensively across sports and countries, with an emphasis on North American professional leagues and European soccer leagues. Borland and Macdonald (2003) provided a framework for considering factors of attendance demand that include consumer preferences, economic factors, quality of viewing, characteristics of the sporting contest, and supply capacity.

Our focus is on the impact of television coverage on college football attendance demand. Falls and Natke (2014) examined the effect of TV coverage on college football attendance using panel data (2004–2009) and tobit (capacity censoring) or IV regression (endogenous price variable) models. Results indicate increased stadium utilization (percent of stadium capacity filled) for games with better home team quality (measured by season wins, bowl games in the last 10 years, and lifetime win percentage), higher undergraduate enrollment, and rivalry matchups. Lower utilization is seen for games with poor weather, high travel costs, large local populations, conference games, and non-FBS opponents. Similar factors have been analyzed for a neutral site (Mirabile, 2015), FCS (Falls & Natke, 2016), and Division II (Natke, 2019) games.

We analyze stadium attendance demand with the following fixed-effects model,

$$ln(Attendance_{it}) = \alpha + TV_{it}\beta + H_{it}\gamma + E_{it}\delta + Q_{it}\eta + W_{it}\theta + C_{it}\mu + T_t + S_i + \varepsilon_{it}. \quad (1)$$

Our dependent variable, attendance, exhibits a right-skewed distribution; therefore, we apply the natural logarithm. The impact of TV coverage is estimated by focusing on our television coverage (TV_{it}) covariates. Equation 1 also accounts for home stadium characteristics (H_{it}), economic conditions (E_{it}), game-specific attributes (Q_{it}), weather factors (W_{it}), and game substitutes or competition (C_{it}). Season fixed effects (T_t) capture general trends in college football attendance, while school fixed effects (S_i) capture general school attendance levels.

Data on game day attendance, outcome, and venue were sourced from ESPN.com box scores. To fill in gaps in the data, particularly for earlier periods, we utilized archived school media guides. The measurement method for attendance by the NCAA varied during the sample period, and schools were allowed to select their own reporting method in certain years. The results are based on the reported attendance measures, which may introduce bias but are not expected to significantly affect our results.

We classify television effects based on geographic coverage (regional versus national), following Falls and Natke (2017), but also on the network's prominence and accessibility. Our data collection of broadcast information is from NationalChamps.net, and categorization of networks is based on the network's tier. Our sample includes games televised on broadcast networks, basic tier networks, premium tier networks, regional networks, streaming only/pay-per-view, or not broadcast. Broadcast networks, such as ABC, CBS, FOX, and NBC, are centralized groups that can be watched nationwide with a TV receiver and do not require a cable subscription. Basic tier networks, like ESPN, ESPN2, FS1, NBCSN, and TBS, are widely available in standard cable packages. Premium tier networks, such as ESPNU, ESPNews, CBSSN, BTN, SECN, and PAC12, are nationally available but only through an additional cable subscription or as part of basic cable packages in certain markets. As conference networks have launched over the previous decade, this category has grown significantly. Games not broadcast, available only on regional networks, or through online streaming or pay-per-view (PPV), comprise the remaining games in the sample.

Figure 1 depicts the evolution of college football television coverage over the sample period. In 2003, 43% of games were not televised, while in 2019, less than 0.5% were not broadcast. The change is attributed to the rise of premium options, including conference networks, which accounted for about 25% of all games in 2019 compared to barely existing in 2003. The growth of the online and PPV offerings category has also been significant, increasing from 3% (entirely PPV) in 2003 to nearly 24% (predominantly online streaming) in 2019. Meanwhile, regional networks' share of broadcasts has decreased from 25–30% to less than 13%.

While we opted for the fixed-effects linear regression with logged attendance as the dependent variable, we contemplated the tobit specification with stadium utilization rate (attendance as a percentage of stadium capacity) as the dependent variable and censoring at capacity. Although this approach has been used by others (e.g., Falls & Natke, 2017), we deemed it inappropriate for our analysis. First, certain games have reported attendance figures exceeding stadium capacity, possibly due to temporary seating arrangements for high-attendance games. Utilizing a tobit specification would

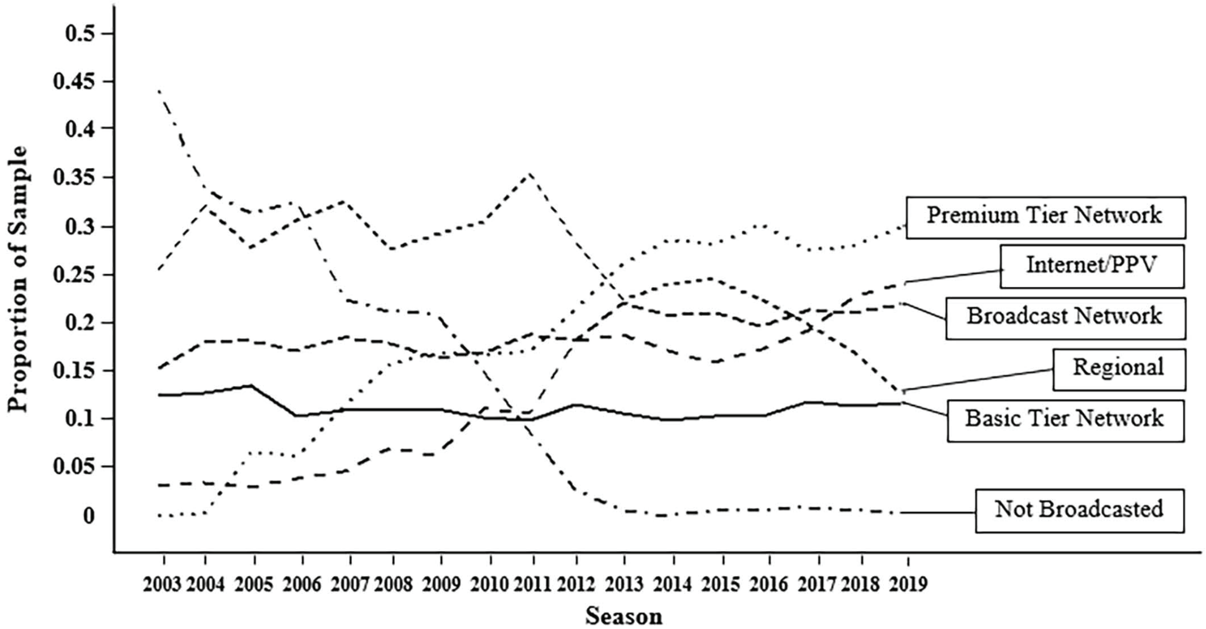

Figure 1. Shifting television coverage over time (in sample)

require a forced censoring of stadium utilization at 100%, which would affect over 17% of our sample observations, including nearly 27% of games hosted by Power 5 (P5) schools. Empirical alternatives are available (two-part models similar to hurdle models, for example) but are complex and entail their own econometric challenges.

Second, the use of panel data in the tobit framework is complicated by the incidental parameters problem resulting from the inclusion of school fixed effects (Greene, 2004), leading to inconsistent estimation of marginal effects and standard errors. Moving to a capacity-inclusive model is not advisable as it would entail sacrificing necessary fixed effects. Random effects are not a suitable alternative as the effects are likely correlated with the independent variables.

Controlling for Additional Factors of Demand

The measures considered in this study account for several factors affecting attendance demand, such as home stadium characteristics, economic conditions, game attributes, weather, and competition. Schreyer and Ansari (2022) provided a comprehensive review of attendance demand literature, covering frequently addressed demand factors and commonly used variables. The specific variables utilized in this study are outlined in Table 1, along with summary statistics in Table 2. Further explanation of select variables is discussed in this section.

In examining college football single-game attendance, many studies have used win percentage or win totals as a measure of team quality (e.g., Falls & Natke, 2014). However, strengths-of-schedule differs significantly, and teams in stronger conferences with fewer wins may be better than teams from weaker conferences with more wins. Thus, relying on record as a control for team quality can be problematic. To address this issue, we include alternative control measures that account for home and opponent affiliation (conference and level), if the game is a conference matchup, recent home team recruiting success, and the relative standing of both schools in relation to the Associated Press (AP) Top 25. Schools are categorized based on their ranking in the Top 5, Top 6–10, or Top 11–25 and whether they are consistently or transiently in any of those groups. The Top 5 teams are considered to be competing for a spot in the National Championship game or College Football Playoff, while the Top 10 teams are striving to reach a major Bowl Championship Series (BCS) bowl game (the most prestigious postseason games besides the playoffs). These categorizations provide insight into how fans and media perceive the competitiveness of a particular team.

Table 1. Variable Descriptions

Variable	Source	Description and Notes
Stadium Age	Media guides and online news articles	One is subtracted from stadium age to allow for a demand discontinuity effect between the first season and subsequent seasons of a new stadium.
New, Temp, Big Stadium Renovations	Media guides and online news articles	Indicators if the school is playing in the first season of a new stadium, playing in a temporary facility, or playing in the first season in a stadium following significant renovation efforts.
Pop, Income ($)	BEA[a]	Population and income measured in the school's metropolitan statistical area (MSA).
Temp, Humidity, Wind, Precip	Weather Underground	Weather conditions are within an hour of kickoff. Results are robust to the time horizon of the weather conditions (measures within three hours of kickoff and weather that morning).
Max Competing Ratings (2012+)	Sports Media Watch	The highest rating among games starting between two hours before and four hours after kickoff.
Better Games Scheduled	AP (Associated Press) Rankings	Inverted points (25 points to top ranked) are rewarded based on AP rankings. Per matchup, schools' points are added, plus 25 if both schools are ranked. The number of better games scheduled is the number of games with higher point totals on a given day.
National Event, Nearby Opening (2012+)	Various Sources	Indicators if there is a major national event taking place or if a pro team in the same MSA has their opening game scheduled. National events include the World Series, first rounds of the US Open, Major League Soccer (MLS) Cup Finals, Ryder Cup, and presidential debates.
FBS, P5, Conf Opponent	Various Sources	Indicators if a school's opponent is a Football Bowl Subdivision school, Power-5 school, or conference opponent.
Team Ranking Variables	AP Rankings	Indicator if both schools are in the AP Top 25 or if the home and away schools, respectively, are consistently in the Top 5, Top 10, and Top 25. "Consistent" requires being in that bucket in at least 14 of the previous 20 polls (10-of-20 for Top 5). Non-consistent ranked schools are labeled "transient."
Recruiting Last2	247Sports	Average composite score ratings over the last two recruiting classes. Composite scores are calculated by 247Sports.
Day-of-Week and Timeslot	ESPN	Indicators for Thursday, Friday, Saturday early (12:00–2:30 pm), Saturday afternoon (3:00–5:30 pm), Saturday evening (after 6:00 pm), and other.
Month	ESPN	Indicators for August, September, October, November, and December games.
Opening Kickoff, Home Opener	ESPN	Indicators if this is the team's first game of the season and if this is the team's first home game of the season, respectively.
Game Spread (2007+)	SBR[b]	Indicators if the home team is a big (> 10 points) or small (< 10 points) favorite or underdog.
Pt Total (2007+)	SBR[b]	Vegas expected point total, an ex-ante measure of total scoring.
Distance	Google Maps	Straight line mileage between the stadiums of the schools.

Note. [a] Bureau of Economic Analysis. [b] sportsbookreviewsonline.com.

We capture alternative options to watching a college football game by controlling for (1) the quality of the next best option (max competing ratings) and (2) competition from national events (such as the World Series) and local professional sports (such as opening day). As demonstrated by Berkowitz et al. (2011), for example, high-profile sporting events can have a negative impact on demand for other sports telecasts, such as NASCAR. The availability of substitution variables for this analysis begins in 2012.

Data on betting in sports, dating back to 2007, provide insight into the demand for scoring and the impact of uncertainty of outcome on viewership. The uncertainty of outcome hypothesis (UOH), first proposed by Rottenberg (1956), has been widely investigated in the sport demand literature, with relevant studies including Forrest and Simmons (2002) and Buraimo and Simmons (2008). Loss aversion is an alternative motive as an attendance demand factor (Coates et al., 2014). Our data also include the distance between school football stadiums, which captures information on travel costs and geographic rivalries.

Table 2. Summary Statistics (*n* = 12,846)

Variable	Mean	*SD*	Min	Max
Attendance	44,487	26,381	1,111	115,109
Better Games Scheduled	15.661	6.0380	0	24
Recruiting Last2	163.39	61.348	0	319.61
Vegas Point Total	55.269	8.1232	27	90
MSA Population (10,000)	181.61	296.20	3.0050	1,934.6
MSA Income ($1,000)	41,299	11,011	20.851	114.08
Distance (100 Miles)	5.5466	5.4212	0.0164	50.143
Max Competing Ratings	3.2825	1.7514	0	10.1
Stadium Age (Yrs – 1)	58.023	27.844	0	110
Temperature (°F)	66.917	15.489	0	107
Humidity (%)	54.226	20.216	0	100
Wind Speed (MPH)	8.7472	5.2886	0	40
Precipitation (in)	0.0034	0.0314	0	1.1
FBS Opponent	0.8552	0.3519	0	1
P5 Opponent	0.3896	0.4877	0	1
Conf Opponent	0.6265	0.4838	0	1
Both Ranked	0.0481	0.2140	0	1
Home Opener	0.1541	0.3610	0	1
Opening Kickoff	0.0953	0.2936	0	1
Nearby Opening	0.0053	0.0729	0	1
National Event	0.0402	0.1964	0	1
New Stadium	0.0051	0.0715	0	1
Temp Stadium	0.0012	0.0353	0	1
Renovations	0.0030	0.0550	0	1
T5 Consis (Home/Away)	0.0213 / 0.0152	0.1445 / 0.1223	0 / 0	1 / 1
T5 Trans (Home/Away)	0.0208 / 0.0163	0.1427 / 0.1265	0 / 0	1 / 1
T10 Consis (Home/Away)	0.0178 / 0.0128	0.1323 / 0.1126	0 / 0	1 / 1
T10 Trans (Home/Away)	0.0246 / 0.0189	0.1549 / 0.1362	0 / 0	1 / 1
T25 Consis (Home/Away)	0.0726 / 0.0551	0.2594 / 0.2282	0 / 0	1 / 1
T25 Trans (Home/Away)	0.0529 / 0.0443	0.2238 / 0.2058	0 / 0	1 / 1
Big Home Fav	0.3839	0.4864	0	1
Small Home Fav	0.2699	0.4439	0	1
Small Home Dog	0.2129	0.4094	0	1
Big Home Dog	0.1253	0.3311	0	1
Saturday Midday	0.2907	0.4541	0	1
Saturday Afternoon	0.3062	0.4609	0	1
Saturday Evening	0.2853	0.4516	0	1
Thursday	0.0463	0.2102	0	1
Friday	0.0469	0.2114	0	1
Other Day	0.0247	0.1551	0	1

One key omitted variable is game price. Given game heterogeneity in price levels, proprietary pricing strategies, and heterogeneous ticket buyers in attendance—such as season ticket holders, groups, and premium seat purchasers—controlling for price in this setting is neither practical nor possible without more data. This could introduce endogeneity, as improved game quality could lead to higher demand, leading to increased prices, and a decrease in quantity demanded. However, the price setting and broadcast decisions are made by separate stakeholders, suggesting that price endogeneity is unlikely to affect our television variables.

Introducing Selection Bias to the Model

Selection bias affects the estimation of the causal relationship between TV coverage and attendance demand. This occurs because more prominent networks prioritize the display of high-quality games, which tend to attract larger crowds. To address this bias, Wallrafen et al. (2022a) employed an endogenous treatment regression (ETR), as introduced by Heckman (1978), to analyze third division soccer in Germany. ETRs integrate a nonlinear model to calculate selection into the treatment group and a linear model to measure the outcome variable of interest. We use the *etregress* command in Stata to estimate a probit regression in the first stage to determine the probability of a game being selected for national television broadcast and a linear regression in the second stage to model logged attendance.

The binary endogenous variable is the selection of a game for national television coverage. Unlike with the OLS specification, where we included variables for each of the different tiers of television coverage, we strictly identify if the game is nationally televised, as the treatment variable in ETR must be binary. The linear and probit regressions include slightly different variable specifications to meet the exclusion restriction requirement. First, to account for conference contracts with specific networks, the home team fixed effects are replaced with conference dummy variables in the probit model. Second, a "better games scheduled" variable is included in the probit regression (see Table 1) to reflect the game inventory selection for national coverage. Third, Saturday start times are removed from the probit model and combined in the day-of-the-week control variable to reflect that game dates are determined before the season while game start times are determined predominantly by television networks. Fourth, the major national event and max competing ratings variable are excluded from the probit. A major national event should impact all broadcasts and thus should not uniquely impact specific games. The max competing ratings variable is replaced in the probit, with the more holistic better games variable to consider the entire array of viewing options. Finally, stadium characteristics and weather variables are also omitted from the probit, as they are irrelevant to the broadcast selection decision. The linear model includes the same variables as previously described.

Econometric Results

Table 3 provides results for the full sample period (2003–2019) excluding substitute and betting variables (Columns 1 and 4), the partial sample period (2007–2019) including betting variables (Columns 2 and 5), and the partial sample period (2012–2019) including betting and substitution variables (Columns 3 and 6). Results are separated by coverage classifications, with a "not televised" reference group (Columns 1–3) and "not nationally televised" reference group (Columns 4–6), keeping just the nationally televised variables. School clustered standard errors are excluded from the table, along with school and time controls, for brevity.

Matchup quality variables produce predictable results. Games against P5 opponents, especially non-conference P5 opponents, have greater attendance. Attendance demand increases with opponent quality, especially for teams ranked in the Top 25. The home team experiences a rise in attendance as a result of being ranked in the Top 25, with a greater impact observed for teams transiently in the Top 25 or Top 10 compared to consistently in the Top 25 or Top 10. This may illustrate a "hype" factor surrounding recent success and unfamiliar territory into a different part of the rankings. The combined impact of both home and away teams being ranked is not purely additive, with a diminishing effect observed. Finally, our measure of recent recruiting performance indicates a positive and statistically significant effect on attendance.

We also consider the results from our other control variables. Relative to early Saturday afternoon kickoffs, attendance is statistically significantly lower for Thursday games and higher for Saturday night games. The home opener game sees an attendance increase, but no evidence supports additional attendance for being the school's first game of the season. Of the economic variables, only population returned statistically significant, with no effect for local income. There is some

Table 3. Fixed Effects Model of College Football Attendance

OLS, Dependent Variable: Ln(Attendance)						
Sample Start	**2003**	**2007**	**2012**	**2003**	**2007**	**2012**
Variables Excluded	**Bet, Subs**	**Subs**	**None**	**Bet, Subs**	**Subs**	**None**
Broadcast Network	0.149***	0.179***	0.085**	0.083***	0.089***	0.091***
Basic Tier Network	0.141***	0.169***	0.063*	0.075***	0.079***	0.068***
Premium Tier Network	0.100***	0.128***	0.033	0.034***	0.041***	0.043***
Regional Coverage	0.083***	0.105***	0.012			
Internet or PPV Stream	0.058***	0.071***	-0.045			
FBS Opponent	0.006	-0.016	-0.012	0.012	-0.012	-0.009
P5 Opponent	0.057***	0.069***	0.077***	0.061***	0.073***	0.079***
Conference Game	-0.116***	-0.118***	-0.115***	-0.112***	-0.117***	-0.115***
P5 Opp X Conf	0.081***	0.077***	0.070***	0.076***	0.073***	0.066***
Away T5 Consis	0.077***	0.136***	0.110***	0.082***	0.138***	0.107***
Away Top 5 Trans	0.079***	0.124***	0.103***	0.084***	0.125***	0.102***
Away T10 Consis	0.083***	0.112***	0.093***	0.088***	0.114***	0.091***
Away T10 Trans	0.064***	0.093***	0.074***	0.069***	0.097***	0.073***
Away T25 Consis	0.065***	0.094***	0.089***	0.069***	0.096***	0.088***
Away T25 Trans	0.035***	0.051***	0.037***	0.040***	0.054***	0.038***
Home T5 Consis	0.099***	0.084***	0.062***	0.101***	0.086***	0.062***
Home T5 Trans	0.078***	0.069***	0.055***	0.082***	0.072***	0.055***
Home T10 Consis	0.070***	0.067***	0.044***	0.073***	0.070***	0.045***
Home T10 Trans	0.082***	0.070***	0.054***	0.084***	0.072***	0.054***
Home T25 Consis	0.078***	0.072***	0.058***	0.081***	0.074***	0.058***
Home T25 Trans	0.107***	0.090***	0.084***	0.109***	0.094***	0.084***
Both Ranked	-0.060***	-0.077***	-0.067***	-0.064***	-0.080***	-0.068***
Recruiting Last2	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
Vegas Point Total		0.001	0.000		0.000	0.001
Big Home Fav		0.009	0.001		0.008	0.001
Small Home Dog		-0.015**	-0.008		-0.014*	-0.007
Big Home Dog		-0.067***	-0.057***		-0.067***	-0.057***
Thursday	-0.035**	-0.062***	-0.065***	-0.033**	-0.061***	-0.064***
Friday	-0.017	-0.033**	-0.038**	-0.017	-0.033**	-0.040**
Other Day	-0.088**	-0.138***	-0.170***	-0.081**	-0.128***	-0.159***
Sat Mid Afternoon	0.009	0.008	0.011	0.007	0.005	0.008
Sat Evening	0.031***	0.027***	0.029***	0.027***	0.023***	0.025***
Home Opener	0.037***	0.031**	0.030*	0.037***	0.030**	0.030*
Opening Kickoff Week	-0.007	0.001	0.008	-0.006	0.001	0.008
MSA Pop (10,000)	0.001**	0.001	0.001*	0.001**	0.001	0.001*
MSA Income ($1,000)	-0.001	-0.002	-0.001	-0.001	-0.002	-0.001
Distance (100 miles)	-0.010***	-0.008***	-0.008***	-0.010***	-0.009***	-0.008***
Distance (100 miles) Sq	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Nearby Opening Day			-0.026			-0.029
Major National Event			-0.016			-0.017
Max Comp Ratings			0.001			0.000
Stadium Age	-0.003	-0.002	-0.007**	-0.003	-0.002	-0.007**
Stadium Age Squared	0.000	0.000	0.000	0.000	0.000	0.000

Table continues

Table 3. Fixed Effects Model of College Football Attendance *Continued*

OLS, Dependent Variable: Ln(Attendance)						
Sample Start	**2003**	**2007**	**2012**	**2003**	**2007**	**2012**
Variables Excluded	**Bet, Subs**	**Subs**	**None**	**Bet, Subs**	**Subs**	**None**
New Stadium	0.078**	0.073	0.024	0.071**	0.057	0.017
Temp Stadium	-0.193**	-0.159*	-0.122	-0.212**	-0.179*	-0.110
Big Renovations	0.085*	0.077*	0.120**	0.077	0.063	0.117**
Temperature (F)	0.004***	0.005***	0.005***	0.005***	0.005***	0.005***
Temperature (F) Sq	-0.000***	-0.000**	-0.000***	-0.000***	-0.000**	-0.000***
Humidity	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
Wind Speed (MPH)	-0.001**	-0.001	-0.001	-0.001**	-0.001	-0.001
Precipitation (in)	-0.201***	-0.186**	-0.217**	-0.204***	-0.188**	-0.224**
Constant	10.317***	10.196***	10.171***	10.358***	10.282***	10.146***
Sample Size	12,846	9,159	5,792	12,846	9,159	5,792
R Squared	0.901	0.915	0.924	0.900	0.914	0.924

Note. Home school clustered standard errors are used to calculate *p*-values, although they are excluded from this table for brevity. Home school, month, and season dummy variable coefficients are not included in the table for brevity but can be made available upon request. All models were estimated in Stata. Statistical significance is defined at the * 10%, ** 5%, and *** 1% levels.

evidence of a honeymoon effect for new stadiums or following major renovations and a sizeable penalty for teams playing in temporary facilities. Population, income, and stadium age exhibit significant multicollinearity due to insufficient within-school variation during the sample period (variable inflation factor results available upon request; these were the only variables showing troubling signs of multicollinearity). The distance between schools negatively impacts attendance, though there is a statistically significant positive coefficient for the quadratic term. Climate preference for optimal attendance includes warmer temperatures (high 80°F) with low humidity, less wind, and no precipitation.

Betting market variables are accessible in our sample starting in 2007. Although the impact of points scored was not statistically significant, it showed a positive trend, consistent with attendance demand findings that suggest a preference for high-scoring games (Paul et al., 2012). Lower attendance was observed for teams that are both big and small underdogs, supporting the notion of loss aversion over outcome uncertainty (Coates et al., 2014). None of the substitution variables, available in our sample from 2012, were found to be statistically significant.

The remaining results focus on the impact of TV coverage on attendance, showing the greatest rise in attendance is for games on broadcast networks, followed by basic tier networks and premium tier networks. Attendance also appears to be greater for games appearing on regional television stations than games only available via an online stream or PPV. Focusing on Column 4, attendance increases by approximately 8.6% when a game is available on a broadcast network, 7.8% when a game is available on a basic tier network, and 3.5% when a game is available on a premium tier network, all in comparison to games not nationally televised. More prominent coverage leading to higher attendance supports the advertising effect hypothesized by Falls and Natke (2017).

Table 4 displays the results from the ETR models. Columns 1–3 characterize the nationally televised endogenous binary regressor covering all games on broadcast, basic, and premium tier networks. Columns 4–6 only include games on broadcast and basic tier networks. Wald tests reject the null hypothesis of no correlation between the error terms of the probit and linear models, indicating the presence of selection bias and the necessity for ETRs.

First, we analyze the probit results. Increased availability of better game options leads to a decrease in the probability of being nationally televised. Higher-quality matchups, particularly those against Power 5 opponents, have a higher likelihood of being nationally televised. Our results indicate that television networks prioritize maximizing outcome uncertainty, with a lower probability of national coverage when the home team is a heavy favorite or underdog. Games played on days other than Saturday are more likely to be nationally televised. Matchups involving closer proximity schools have

Table 4. ETR of College Football Attendance

Linear Regression with Endogenous Treatment Effects, Dependent Variable: Ln(Attendance)						
Sample Start	**2003**	**2007**	**2012**	**2003**	**2007**	**2012**
Premium Included	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**
Variables Excluded	**Bet, Subs**	**Subs**	**None**	**Bet, Subs**	**Subs**	**None**
National Coverage	-0.163***	-0.026	0.014	-0.241***	-0.217***	0.238***
FBS Opponent	0.036***	-0.010	-0.008	0.021**	-0.025**	0.000
P5 Opponent	0.131***	0.102***	0.093***	0.157***	0.159***	0.032*
Conference Game	-0.106***	-0.114***	-0.113***	-0.098***	-0.102***	-0.126***
P5 Opp X Conf	0.037*	0.059***	0.060***	0.046**	0.042**	0.076***
Away T5 Consis	0.172***	0.181***	0.137***	0.229***	0.283***	0.013
Away Top 5 Trans	0.164***	0.159***	0.126***	0.217***	0.245***	0.022
Away T10 Consis	0.167***	0.150***	0.117***	0.222***	0.240***	0.004
Away T10 Trans	0.136***	0.127***	0.096***	0.181***	0.201***	0.000
Away T25 Consis	0.123***	0.119***	0.104***	0.159***	0.179***	0.031*
Away T25 Trans	0.093***	0.074***	0.048***	0.110***	0.115***	0.001
Home T5 Consis	0.148***	0.115***	0.078***	0.168***	0.172***	0.009
Home T5 Trans	0.125***	0.096***	0.069***	0.150***	0.149***	0.012
Home T10 Consis	0.114***	0.090***	0.060***	0.136***	0.138***	0.001
Home T10 Trans	0.121***	0.091***	0.068***	0.147***	0.140***	0.002
Home T25 Consis	0.114***	0.092***	0.069***	0.135***	0.136***	0.016
Home T25 Trans	0.145***	0.113***	0.093***	0.157***	0.150***	0.054***
Both Ranked	-0.070***	-0.086***	-0.070***	-0.060***	-0.098***	-0.043***
Recruiting Last2	0.001***	0.001***	0.001***	0.002***	0.001***	0.001**
Vegas Point Total		0.000	0.001		0.000	0.001
Big Home Fav		0.000	-0.003		-0.016**	0.012
Small Home Dog		-0.012*	-0.006		-0.014*	-0.003
Big Home Dog		-0.070***	-0.057***		-0.084***	-0.046***
Thursday	0.045*	-0.026	-0.052***	0.062***	0.033*	-0.113***
Friday	0.079***	0.006	-0.024	0.113***	0.083***	-0.104***
Other Day	0.062	-0.059	-0.129***	0.110***	0.067	-0.247***
Sat Mid Afternoon	0.008	0.006	0.009	0.014**	0.010*	0.007
Sat Evening	0.025***	0.021***	0.023***	0.031***	0.026***	0.027***
Home Opener	0.034***	0.030**	0.030*	0.036***	0.028**	0.034**
Opening Kickoff Week	-0.007	-0.001	0.006	-0.009	0.001	0.006
MSA Pop (10,000)	0.001**	0.001	0.001*	0.001**	0.001	0.001*
MSA Income ($1,000)	-0.001	-0.002	-0.001	-0.002	-0.003	-0.001
Distance (100 miles)	-0.009***	-0.008***	-0.008***	-0.008***	-0.007***	-0.009***
Distance (100 miles) Sq	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Nearby Opening Day			-0.032			-0.010
Major National Event			-0.017			-0.019
Max Comp Ratings			0.000			0.000
Stadium Age	-0.003	-0.002	-0.007**	-0.003	-0.002	-0.006**
Stadium Age Squared	0.000	0.000	0.000	0.000	0.000	0.000
New Stadium	0.070**	0.056	0.015	0.062*	0.054	0.035
Temp Stadium	-0.205**	-0.193**	-0.112	-0.203**	-0.150*	-0.133
Big Renovations	0.070	0.058	0.116***	0.074	0.065	0.122**
Temperature (F)	0.005***	0.005***	0.005***	0.004***	0.004***	0.005***

Table continues

Table 4. ETR of College Football Attendance *Continued*

Linear Regression with Endogenous Treatment Effects, Dependent Variable: Ln(Attendance)						
Sample Start	**2003**	**2007**	**2012**	**2003**	**2007**	**2012**
Premium Included	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**
Variables Excluded	**Bet, Subs**	**Subs**	**None**	**Bet, Subs**	**Subs**	**None**
Temperature (F) Sq	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
Humidity	-0.001***	-0.001***	-0.001***	-0.001***	0.000***	-0.001***
Wind Speed (MPH)	-0.001**	-0.001*	-0.001	-0.001**	-0.001	-0.001
Precipitation (in)	-0.184***	-0.172**	-0.209**	-0.184***	-0.181**	-0.244**
Constant	10.291***	10.270***	10.150***	10.312***	10.282***	10.197***
National Coverage (Probit Regression)						
Better Gms Scheduled	-0.009*	-0.007	-0.011	-0.010**	-0.006	-0.026***
FBS Opponent	0.493***	0.298***	0.516***	0.276***	-0.099	-0.141*
P5 Opponent	1.066***	1.139***	1.121***	1.086***	1.066***	1.118***
Conference Game	0.154*	0.028	0.047	0.252***	0.271***	0.335***
P5 Opp X Conf	-0.785***	-0.685***	-0.619***	-0.552***	-0.560***	-0.663***
Away T5 Consis	1.383***	1.532***	2.074***	1.331***	1.435***	1.481***
Away Top 5 Trans	1.307***	1.172***	1.548***	1.213***	1.151***	1.229***
Away T10 Consis	1.185***	1.279***	6.286***	1.190***	1.226***	1.898***
Away T10 Trans	0.855***	0.789***	1.190***	1.038***	1.043***	0.995***
Away T25 Consis	0.675***	0.662***	0.798***	0.799***	0.794***	0.712***
Away T25 Trans	0.726***	0.657***	0.687***	0.649***	0.566***	0.358***
Home T5 Consis	0.433***	0.773***	0.645***	0.468***	0.808***	0.546***
Home T5 Trans	0.488***	0.743***	0.736***	0.523***	0.728***	0.400**
Home T10 Consis	0.482***	0.470***	0.500	0.470***	0.642***	0.482***
Home T10 Trans	0.456***	0.558***	0.684**	0.569***	0.724***	0.686***
Home T25 Consis	0.404***	0.529***	0.483***	0.472***	0.644***	0.544***
Home T25 Trans	0.506***	0.689***	0.609***	0.516***	0.667***	0.400***
Both Ranked	0.142	0.061	-0.290	-0.035	-0.212**	-0.019
Recruiting Last2	0.004***	0.005***	0.008***	0.006***	0.006***	0.008***
Vegas Point Total		0.001	-0.001		-0.004*	-0.002
Big Home Fav		-0.219***	-0.170**		-0.317***	-0.318***
Small Home Dog		0.088	0.144*		-0.005	0.003
Big Home Dog		-0.056	0.086		-0.147**	-0.107
Thursday	1.419***	1.646***	1.692***	1.125***	1.183***	1.350***
Friday	1.774***	1.745***	1.731***	1.545***	1.477***	1.459***
Other Day	2.347***	2.729***	2.422***	2.688***	3.304***	3.285***
MSA Pop (10,000)	0.000	0.000	0.000	0.000	0.000	-0.000
MSA Income ($1,000)	0.005	0.003	-0.003	-0.004	-0.006**	-0.008**
Distance (100 miles)	0.018**	0.020**	0.023*	0.031***	0.021***	0.017**
Distance (100 miles) Sq	-0.001***	-0.000*	-0.001**	-0.001***	-0.001*	-0.000
Nearby Opening Day			0.262			-0.506*
Constant	-2.955***	-3.014***	-3.353***	-2.813***	-2.461***	-2.570***

Note. Home school clustered standard errors are used to calculate p-values, although they are excluded from this table for brevity. The top part of the table includes the linear regression results, while the bottom part of the table includes the probit results. Home school, conference, month, and season dummy variable coefficients are not included in the table for brevity but can be made available upon request. All models were estimated in Stata. Statistical significance is defined at the * 10%, ** 5%, and *** 1% levels.

a higher probability of national coverage; this likely captures that networks are more likely to broadcast rivalry games. Finally, the probability of a national broadcast, especially on broadcast or basic tier networks, decreases when a nearby major professional team has its opening day.

Next, we examine the linear model results. Notably, the results for the betting variables reveal a disparity between the factors that influence TV viewership and spectator interest. Fans of the home team exhibit loss aversion behavior, whereas match uncertainty is favored for nationally televised games. The other covariates exhibit similar signs as in the OLS model.

The focal variable is the national coverage treatment variable. A substitution effect between stadium attendance and coverage is evident when considering broadcast and basic tier games only. The average treatment effect on attendance, when appearing on either a broadcast or basic tier network, is -21.4% (95% CI: -25.1% to -17.5%) using the full 2003–2019 sample. Inclusion of premium tier games in the national coverage variable reduces the marginal effect to -15.1%. Using the 2012+ sample, and including betting and competition variables, the marginal effect switches signs to 26.9% (95% CI: 17.4% to 37.1%) without premium games and is not statistically different from zero when including premium games.

To determine if the sign switch in Column 6 of Table 4 results from including betting and substitution variables or limiting data to 2012 onwards, we re-examine the specification in Column 4 of Table 4 across various time frames. Table 5 displays ETR estimates for the national coverage variable, in which we specify the regression using data from only the years listed. Coefficient estimates for the first half of the sample period (2000s) indicate a substitution effect between national TV coverage and stadium attendance, while estimates for the latter half of the sample period (2010s) suggest a complementary relationship.

Table 5. ETR of College Football Attendance by Time Period

Linear Regression with Endogenous Treatment Effects (National Coverage = Broadcast and Basic Tier)				95% Confidence Interval	
	Sample	**Estimate**	**SE**	**2.5%**	**97.5%**
National Coverage, 2003–2006	2,767	-0.250***	0.026	-0.302	-0.199
National Coverage, 2007–2010	2,966	-0.206***	0.029	-0.262	-0.150
National Coverage, 2011–2014	3,088	0.245***	0.038	0.172	0.318
National Coverage, 2015–2019	4,025	0.199***	0.035	0.130	0.268

Note. Each row shows the linear national coverage coefficient from a different ETR specification, where the ETR specification is split into different time periods. Standard errors are clustered at the school level. Renovations and temporary stadiums had incredibly small samples in certain splits of the data, so they are removed from this model. We only use variables that were available during the entire sample period (excluded betting and substitution variables). All models were estimated in Stata. Full model results are available upon request. Statistical significance is defined at the * 10%, ** 5%, and *** 1% levels.

Did consumer preferences shift over the nearly 20-year sample? One possible explanation for our results lies in the nature of the next best alternative when evaluating the effect of appearing on national television. The data show a decrease in the proportion of non-televised games in the sample around the turn of the 2010s. During the 2000s, ETR results suggest that appearing on national television, compared to the outside option, led to lower attendance. During that period, the outside option heavily included not appearing on television at all. However, during the 2010s, nearly all games in the sample were broadcast. Our results imply that while no television is preferable to national television from an attendance maximizing perspective, there are benefits to being nationally televised compared to lower tier broadcasting options, potentially due to advertising and prestige effects.

Discussion and Conclusion

The proliferation of television, combined with the decline in college football attendance, has led many to question if a causal relationship between the two exists. Results from OLS with fixed effects indicate that nationally televised games have higher attendance. However, this is due to selection bias of better matchups being chosen for national coverage. Controlling for selection bias using ETR, the study finds that being on a national network, particularly a broadcast or basic tier network, decreases attendance. This contradicts previous suggestions that national television serves as a complement (Falls & Natke, 2017; Losak et al., 2022) but does confirm some elements of that story. Specifically, being broadcast on national television enhances stadium attendance compared to lower-tier options.

None of these results are meant to suggest that schools should limit television exposure or prioritize stadium attendance. The exposure and financial benefits that come with playing on national television almost surely dwarf the financial losses from reduced or stagnant ticket and related in-stadium revenues such as concessions, parking, and merchandise, especially for P5 schools.

This paper highlights the significance of controlling for selection bias in estimating the impact of television on stadium attendance demand. Results revealed that, prior to the implementation of the ETR models, television was viewed as a complement. However, after controlling for selection bias, television was found to be a substitutable good. Additionally, nationally televised games benefited from increased advertising and prestige compared to lower tiered networks. Selection bias is especially important to control for when analyzing college football since flex scheduling is a widely used practice and could explain the divergence from similar studies in European soccer, which generally found that television coverage and stadium attendance are substitutable goods.

Of note, we did not control for price endogeneity as was done in Falls and Natke (2017). Despite this, our fixed effects results produced similar television parameter estimates. This suggests one of three possibilities: (1) Variables in the model (including school fixed effects) capture much of the information contained in prices, (2) price endogeneity has limited impact on statistical inference in this setting, or (3) Falls and Natke's (2017) instrument may not effectively correct for price endogeneity. Further evaluation of their approach is beyond the scope of this paper.

The impact of substitution effects on attendance for P5 and non-P5 home games (in addition to other levels of college football) is an area of future interest. This study primarily disregards the impact of stadium capacity constraints, which is justified in the empirical section. However, it is worth exploring if substitution effects would be more pronounced in situations where games do not sell out. Ideally, measuring marginal willingness to pay would provide a more accurate demand-side measure, eliminating concerns about price endogeneity. Short of that, examining the effects of television on non-sellout games, especially for non-P5 schools, would be valuable.

Further research is needed, both empirical and theoretical, to generalize our findings to diverse consumer segments. Consumer heterogeneity leads to varying substitution mechanisms in purchasing decisions. For instance, season ticket holders often make their purchases prior to the start of the season, thus the impact of individual-game television factors on ticket purchasing may be limited. (However, it could affect their secondary market behaviors). Additionally, television substitution may impact "no-show" behaviors (Karg et al., 2021; Schreyer & Torgler, 2021), which were not considered in the current study.

What is clear, however, is that causal effect estimation of television coverage on stadium attendance demand must address coverage selection bias to avoid biased estimates in television coverage variables toward complementary goods. It is also important for researchers to acknowledge the temporal nature of television coverage, which is prevalent in other sports.

Our results, while backward-looking, have practical implications for sport managers. As television proliferation increases, consumers face a choice between watching at home and attending live. To mitigate attendance declines, sport managers may leverage the prestige effect while increasing advertising and exposure of live events. Further research is needed to evaluate the effectiveness of these interventions in combating television-induced attendance decline.

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