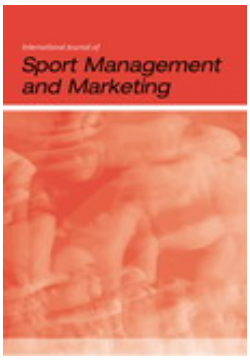

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Consumption determinants in the National Hockey League: the influence of violence in the USA and Canada

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Abstract: The National Hockey League is aligned in such a way that it must present its product to large audiences in two countries. Given the difficulty of such a marketing effort, this study sought to determine the impact that violence, as measured by fighting, has on consumption. Separate demand models were estimated for attendance and viewership in the USA and Canada via Tobit and OLS regression models. Results from the various models indicated that the

promotion of violence should not be considered a viable strategy for increasing consumption. More specifically, while fighting was found to be a positive predictor of attendance in all models, its impact was minimal. From a viewership perspective, fighting was not found to be a significant predictor in either market. Given the evolving nature of consumer preferences, these results are particularly salient to marketers seeking to develop strategies that are relevant to the current marketplace.

Keywords: sport marketing; consumer behaviour; attendance; viewership; National Hockey League; NHL; USA; Canada.

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1 Introduction

Fighting has been a part of the National Hockey League (NHL) lexicon since its inception in 1917. The game itself, however, is perceived differently by the two nations where NHL franchises are located. For Americans, hockey serves as a sense of nationalistic pride and social identity. However, Canadians use hockey as a way to differentiate themselves and their country from the USA (Vincent and Crossman, 2015). Like baseball in the USA, which has long been identified as America's national pastime, hockey is viewed similarly, but perhaps with more fervour, in Canada (Vincent and Crossman, 2015). From a marketing perspective, the National Hockey League (NHL) is charged with satisfying the needs and wants of hockey fans and potential hockey fans in both the Canadian and US markets. This challenge is exasperated in an environment where all sports are faced with fans who are attending and/or tuning in to fewer games while also turning away from games more quickly (Leitch, 2018; Singer, 2017).

Regardless of geographical influence or rule changes designed to elevate the attractiveness of the sport product, the NHL presents a product that entices consumption. Thus, the purpose of the current study was to assess the various factors that impact NHL consumption with particular consideration given to fighting. To present a more holistic review of the factors that influence NHL consumption, two areas were analysed. The first assessed the factors that influence attendance, while the second focused solely on television viewership. Since the NHL must present its product to two distinct audiences, findings were reported separately for the US and Canadian audiences to provide more applicable results.

2 Fighting in the NHL

Fighting has been a part of the lexicon of the NHL since its inception in 1917 when it was comprised of three clubs from the defunct National Hockey Association. Five years later, in 1922, the League introduced its first fighting-specific regulation, Rule 56 – Fisticuffs, which stipulated a five-minute penalty for fighting (Rockerbie, 2012). The creation of this rule truly separated hockey from every other sport in that violence was now regulated and was not grounds for immediate expulsion. The physical nature of the game is what appealed to many spectators and allowed the sport to thrive in its early years.

The Original Six era (1942–1973) ushered in a new stance on fighting, which drew upon the League's origins. While fighting remained prevalent, it now became a tactic for players to prove their worth while also intimidating members of the other team. In 1977 the NHL implemented a new regulation on fighting with the creation of the instigator rule, which levied major and game misconduct penalties on the player who started a fight. In addition, this new rule also disallowed third men into a fight between two players (Fitzpatrick, 2019). In 1992, the NHL imposed an additional two-minute penalty and game misconduct penalty on the individual deemed to have started, or instigated, a fight. Such a provision proved difficult to enforce, however, as most fights are thought to have been started based on a mutual agreement by both parties. Since 1992, the NHL has not introduced any new sanctions on fighting. Rather, they have simply made enforcement a point of emphasis for referees (Fitzpatrick, 2019).

It should also be noted that on-ice violence has the potential to serve as a precursor to fan violence. In recent years, violent crime rates in the USA rose while Canada saw a

decrease in 2020 following five years of steady increases (Federal Bureau of Investigation, 2020; Moreau, 2021). Previous research has also shown that in-game violence can lead to an increase in verbal hostility among fans both within and upon leaving the arena (Harrell, 1981). A more recent study, however, found that fans attending sporting contests where aggressive on field behaviour is either outlawed (e.g., National Football League) or permitted (e.g., National Hockey League) exhibited limited spectator aggression (Roberts and Benjamin, 2000). No studies have provided direct corollaries between hockey violence and general violence. Nevertheless, the potential for violent on-ice incidents to influence violent fan behaviour outside of the rink is a factor that should be considered by the League.

Despite more recent rumblings of an outright ban on fighting in the NHL, there remains a fervent plea to keep fighting a part of hockey due in large part to its entertainment value. In a 2011 poll of NHL players, 98% opposed an outright ban on fighting (Wyshynski, 2012). More recently, in a 2017 poll of 13 players in the NHL, all agreed that fighting had a role in the NHL (Burnside et al., 2017). Regardless of the strategic intentions of the NHL, the League must strike a balance between player safety and entertainment value to ensure its sustainability.

3 Conceptual framework

Professional sport leagues are businesses built upon consumption via attendance and viewership. In the NHL however, this statement is even more relevant given that the NHL holds the smallest TV contract of the four major professional sports in North America with a global worth of $1.2 billion, which accounts for 2.9% of the global sports rights market (Adgate, 2019; Birnie, 2019). This situation forces the NHL to ensure that its marketing efforts are appropriately directed and focused to drive both attendance and viewership. The following variables have been theoretically linked to consumption and thus have formed the foundation for this paper.

3.1 Fighting

In hockey, violent occurrences (e.g., fighting) may entice fans to attend or watch a given contest. While fans are likely to base their consumption on the likelihood of the outcome in relation to their favourite team, previous research has found that fans also consider the fighting potential of the two teams (Jones et al., 1993, 1996; Paul, 2003). Specifically, Jones (1984) found that the ticket demand for a fighting team increased, even if the opponent was not labelled as a fighting team. More recently, Rockerbie (2016) concluded that fighting incidences had a marginally negative effect on attendance. Previous literature related to fighting and viewership has yet to be completed.

3.2 Rivalry

The influence of rivalry on attendance across sports has been heavily researched, especially in recent years. Much of the previous literature has found positive correlations between rivalry matchups and attendance/viewership. While the definition of rivalry varies, this study considered rivalries by the intensity of the competition as reported by

fans of the various teams (Havard et al., 2013). These emotions, if marketed correctly, hold the potential to influence consumption at both a local and national level. To assess this potential, a direct fan assessment was distributed by the researchers consistent with previous rivalry models (e.g., Havard et al., 2013; Tyler et al., 2017).

In addition to the identification of rivalries, the utilisation of proxies including distance between arenas and divisional opponent were considered given the manner in which the NHL is organised. While proximity does not necessarily translate to greater fan intensity it may lead to increases in attendance/viewership based on the formation of geographic or conference rivalries.

3.3 Team quality

To account for team quality in a given matchup, this study utilised the moneyline, which is an odds figure used in sports betting that takes into account various factors before quantifying the relative strength of a team in relation to the opponent. To summarise, the moneyline can be either positive or negative. A negative integer identifies the favourite (e.g., –110), while a positive sign identifies the underdog (e.g., +135). Coates and Humphreys (2011) found that attendance was influenced the most when the home team was a heavy favourite. In addition, attendance was also positively impacted when the home team was a slight underdog due to the potential for an upset. The authors do note that the underdog effect diminished as the status worsened (e.g., the moneyline increased). TV viewership was not a factor considered by Coates and Humphreys (2011).

3.4 Player quality

Superstar effects have been linked to the potential to increase demand and consumption of a sport product based solely on the players' affiliation with a given franchise. Previous literature has produced mixed results regarding the influence of star players on attendance and viewership (Berri and Schmidt, 2006; Berri et al., 2004). Most recently in the NBA, Humphreys and Johnson (2017) found that star players increased attendance both at home and on the road for their respective teams. Similar studies have yet to be conducted for star players in the NHL. Since there is no generally agreed upon metric for measuring star power, this study identified star players as those that finished in the top 100 in terms of total goals scored in the previous season. Since recent NHL rules adjustments have focused on increasing the number of scoring chances, such a metric was deemed appropriate.

3.5 Other determinants

While team quality is a central tenant of demand estimations, additional factors should also be considered. To account for the potential impact that historical franchises have on consumption, a team history variable, measured by the total number of years that the franchise has existed in the current city, was considered. Using attendance and viewership as outcome variables requires that preferences related to geographic region, spectator types, and economic factors be considered. Most commonly, the metropolitan statistical area (MSA) population and average MSA income are considered to standardise market size. Other proxies that were considered included the day of the week and whether or not the contest fell on a holiday. In the NHL specifically, Coates and Humphreys (2011) concluded that attendance was significantly larger for Saturday games

than any other day of the week. Similarly, Tyler et al. (2017) found that weekend games had a significantly positive impact on attendance while holidays were only marginally significant. No information was provided related to their impact on viewership.

4 Theoretical framework

Various theoretical models attempt to explain the relationship between violence and sport consumption (e.g., Bryant et al., 1981). A popularised rationale grounded in entertainment theory and focused on sport's drama aspects will serve as the paper's theoretical foundation. The enjoyment of sports contests is facilitated by the roughness of play by the athletes (Bryant et al., 1981; Comisky et al., 1977). The interpersonal aggression among athletes in sports creates a powerful drama dynamic wherein fans become deeply engaged with athletes' vigorous and violent play. Through this intense effort, athletes prove to the viewers that they are giving maximum effort and are willing to risk sustaining an injury in support of their team, thus creating a more engaging, drama-filled experience. These features are generally considered the most fulfilling aspects of sport of consumption and are proven elements in creating high drama (Bryant et al., 1981; Novak, 1993).

While violence in sport may serve as a primary driver of consumption, the underlying rationale for this preference may not be conventional. Bryant and Zillmann (1983) proposed that fans may be attracted to the violence of sport, "not for the lust of blood, per se, but because the contests' willingness to risk serious injury creates the type of intensity necessary for the maximal enjoyment of the dramatic event" (p.200). Such a notion can easily be applied to the sport of hockey. If players' primary motive were to inflict serious injury on their opponent, the game itself would morph into a different sport altogether. Instead, fighting has become more subtle and serves as a way for players to govern on-ice incidents by standing up for fellow teammates. These violent actions, however, are what create drama for the spectators, thus potentially increasing their enjoyment and consumption of contests.

Few studies have been completed to directly assess the influence of violence on attendance, presenting mixed results. Jones (1984) found that the ticket demand for a fighting team increased, even if the opponent was not labelled as a fighting team. The primary independent variable of interest was penalty minutes, segmented by both violent and non-violent offenses. This study utilised a similar structure. Stewart et al. (1992), who segmented the US and Canadian markets, concluded that violence increases ticket demand for both nations. However, US fans preferred more extreme forms of violence (e.g., game misconducts). The results from Jones et al. (1996) support those of Stewart et al. (1992) in that there are financial incentives for NHL franchises to promote violence. Most recently, Rockerbie (2016) concluded that fighting incidences have a marginally negative effect on attendance. This represents a significant shift from previous research. It was also suggested that a greater emphasis be placed on limiting fighting as it may lead to positive impacts on attendance. Previous literature related to fighting and viewership has yet to be completed.

It is clear that preferences for fighting (e.g., drama) have shifted over time. While violence was once considered a way to promote the sport and increase consumption, it is clear that such conclusions can no longer be considered the standard. The purpose of this study was the further the research in this area and provides more insights into the

influence that violence has on consumption. While previous research has only considered attendance, this study will also assess viewership, which will present new and updated outcomes with the ability to compare results directly. Moreover, given that the NHL has a unique and diverse fanbase with heavy influence in both the USA and Canada, exploration of these markets independently and jointly will provide more detailed results that can drive firm and league-level decisions.

5 Contribution

The purpose of the current study was to provide an assessment of the various factors that impact consumption in the NHL, with a particular consideration given to fighting. Previous studies concerned with this topic have primarily centred their analysis on traditional factors affecting attendance (e.g., economic determinants, franchise history). In addition to attendance, this study also assessed viewership using TV data from the USA and Canada. This allowed for more precise conclusions to be drawn regarding the consumption habits of NHL fans from the different nations. As such, our primary research questions are as follows:

RQ1 What influence does fighting have on attendance in the NHL?

RQ2 What influence does fighting have on national broadcast viewership in the NHL?

These results will contribute to the growing body of literature concerned with sport consumption and, in particular, the dearth of literature concerned with viewership. Ultimately, these findings will assist in providing a greater understanding and potentially new avenues by which sports leagues can increase their marketability and popularity in an effort to drive consumption.

6 Data and variables

Professional sports leagues are businesses built upon consumption via attendance and viewership. In the NHL, however, this statement is even more relevant given that the NHL holds the smallest TV contract of the four major professional sports in North America with a global worth of $1.2 billion, which accounts for 2.9% of the global sports rights market (Adgate, 2019; Birnie, 2019). This situation forces the NHL to ensure that its marketing efforts are appropriately directed and focused on driving both attendance and viewership.

Home team attendance and national TV ratings for each game served as the dependent variables in the current study. Attendance figures for each regular season game were retrieved from NHL.com. The league only reports aggregated metrics for each game so there was no possibility of segmenting the data by ticket holder type (e.g., season ticket, mini plan, etc.). Across the two seasons under investigation (2014–2015 and 2015–2016), attendance figures were acquired for a total of 2,454 games. Subsequent attendance models investigated US-based teams' home games (N = 1,880) and Canadian-based teams (N = 574) separately. Five games across the two seasons were eliminated from the dataset as they were held at non-traditional facilities during special events (e.g., Winter Classic between Montreal and Boston, held on 1 January 2016, at Gillette Stadium, home of the New England Patriots). A capacity constraint was applied

to each model equal to the listed capacity of each arena. This allowed the censored regression model to account for the varying capacities of each team.

Table 1 Variable definitions and source

Variable	*Definition*	*Source*
Attendance	Total number of people reported to be in attendance to the NHL league office	NHL.com
Viewership	Total number of viewers for the national broadcast of a given game	NBCSports.com and Numeris
Primary tenant	NHL team is the sole, primary tenant in venue. (Yes = 1)	Venue specific sites
Arena capacity	Home venue capacity based on listed venue capacity.	Venue specific sites
Team history	Number of years the home franchise has been in existence	NHL.com
Population	Metropolitan statistical area (MSA) population based on 1 July estimate for the home team based on the season start year (e.g., 2013 for the 2013–2014 season)	Census.gov
Income	MSA median household income for the home team based on 1 July estimates for the season start year (e.g., 2013 for the 2013–2014 season). Canadian values converted into US dollars based on 1 July exchange rate for the stated year	Census.gov and Stacan.gc.ca
Total income area	The product of income and population (income × population) as defined above, created to reduce multicollinearity between these separate measures and outcomes	N/A
Home ML	Closing moneyline for home team. The side listed with a minus (–) sign indicates the favourite, while a plus (+) indicates the underdog	Oddswarehouse.com
Away ML	Closing moneyline for away team. The side listed with a minus (-) sign indicates the favourite, while a plus (+) indicates the underdog	Oddswarehouse.com
Top100 players	Number of players on a given team in the Top 100 based on total goals scored in the previous season	NHL.com
Weekend	Game played on weekend (Friday, Saturday, Sunday) (Yes = 1)	NHL.com
Holiday	Game played on nationally recognised holiday (USA and Canada) (Yes = 1)	NHL.com
Same division	Games featuring teams from same division. (Yes = 1)	NHL.com
Distance	Distance between teams' home venues	Google Maps
Rivalry	Game between rivals as identified by fan responses (Yes = 1)	MTurk Survey using SRFPS (Havard et al., 2013)
Residual penalty minutes	Obtained by fitting a linear regression with penalty minutes as the DV and fighting minutes as the IV, and then obtaining residuals from that model	NHL.com and researchers' analysis
Fighting minutes	Total fighting minutes calculated as a running total for both the home and away teams up to and including the game prior to the contest being measured in the dataset	NHL.com

Additionally, demand estimates were created for TV viewership for Canadian and US viewers separately. US national viewership data was collected via NBCSports.com for all regular season games televised nationally during the 2014–2015 and 2015–2016 seasons (N = 486). Note, these estimates excluded games televised on regional networks. Similarly, viewership data was collected for all regular season games televised in Canada across the same two seasons (N = 208). The Canadian viewership data was purchased from Numeris. Again, only national broadcasts were included in the final dataset. The seasons included in the dataset were chosen based on accessibility and availability of data. A large dataset that included comparative metrics for both countries was not possible to compile for viewership primarily due to the lack of retrieval options for Canadian network viewership data.

Table 2 Summary Statistics

Variable		*Min*	*Median*	*Mean*	*Max*	*SD*
Attendance		7,311	18,044	17,459	22,247	2,522
Viewership	USA	129,000	303,500	498,511	3,500,000	487,545
	CAN	4,480	352,280	460,183	2,286,740	383,739
Between club variables						
Arena capacity		15,294	18,506	18,480	22,428	1,480
Team history		4	37	43	99	27
Population		783,000	4,019,3000	5,880,060	20,118,063	5,673,355
Income		$39,758	$55,082	$61,594	$104,530	17,990
Total income area		4.97e10	1.91e11	3.48e11	1.30e12	3.41e11
Individual game variables						
Home moneyline		–550	–129	–82	322	135
Away moneyline		–370	116	52	460	140
Top100 players		1	3	3	7	1.3
Weekend		0	0	.44	1	.497
Holiday		0	0	.03	1	.177
Same division		0	0	.360	1	.480
Distance		6	1,100	1,244	3,414	825
Rivalry		0	0	.180	1	.385
Residual penalty minutes		–904	–48	9.07e-14	1,408	269
Fighting minutes		0	265	270	740	159

A complete listing of the explanatory variables used in the study can be found in Table 1 along with their source and the scale upon which they were measured. Summary statistics of the data can be found in Table 2. A total of 17 explanatory variables were included in the models estimating attendance whereas the models estimating viewership contained 16 explanatory variables.

The rivalry variable for each contest was coded based on the results from an MTurk survey, distributed by the researchers, targeted toward fans of each team. The structure of the survey followed that of the sport rivalry fan perception scale (SRFPS) (Havard et al., 2013). The primary outcome of interest was the fans' identification of the franchises

which they perceived to be their teams biggest and second biggest rival. In total, 313 completed surveys were collected and analysed. The average number of completed surveys per team was 10, which provided a representative sample on which to base the rivalry classifications. Matchups in the dataset were then coded based on these responses as either a rivalry (1) or not a rivalry (0). Note that both primary and secondary rivalries were coded. In other words, if at least one respondent indicated that a team was a rival (either primary or secondary) then that team was coded to be a rival of the respondent's favourite team. Direct understanding of fans' perceptions of their rivals provided a more accurate measure than selecting rivalries based on pundit commentary or franchise history given the evolving nature of the NHL.

As noted by DeSchriver et al. (2016), the inclusion of ticket price in demand estimates has traditionally provided little to no predictive or explanatory information when estimating attendance. Therefore, following the work of Tyler et al. (2017) and DeSchriver et al. (2016), the current study also did not include ticket price into the demand models.

The current study was specifically interested in better understanding the impact fighting has on attendance and viewership. Therefore, two variables were included to measure the impact of rough play and fighting on attendance and viewership. The penalty minutes variable included the running number of penalty minutes the two teams playing had accumulated within the given season up until the time of the game as data was analysed at the individual game level. Likewise, the fighting minutes variable included the number of fighting major penalty minutes the two teams had also collectively accumulated that given season up until the time of the game. Note, figures for both variables were tallied for the home and away team separately. Further, fighting minutes were not included in the overall penalty minutes variable in an effort to mitigate multicollinearity.

Even after separating fighting minutes from other penalty minutes, we found that these two variables remained collinear (VIF > 10 for both). This is likely due to the fact that games that feature more rough play will likely also feature more fighting, and vice versa. To account for this, we retained fighting minutes as specified, and used residual penalty minutes as our predictor for non-fighting penalty minutes. This measure was obtained by fitting a linear regression with penalty minutes as the DV and fighting minutes as the IV, and then obtaining residuals from that model. By construction, the penalty minutes variable then represented the variation in penalty minutes not explained by fighting. This eliminated the collinearity issue, and the residual approach was used in all models.

7 Methods

Similar to the work of Tyler et al. (2017), several demand models were created to measure and compare the impacts of penalties and fighting penalties on spectatorship and TV viewership of NHL games in Canada and the USA for the 2014–2015 and 2015–2016 seasons. Models were created based on the previously reviewed literature (e.g., DeSchriver et al., 2016; Tyler et al., 2017) in an attempt to capture all salient predictor variables for both attendance and viewership. Specifically, the demand models were created to capture between club factors and individual game factors.

Demand models were created to estimate the impact of each of the included factors on overall NHL attendance, attendance for NHL teams located in the USA, and attendance for NHL teams located in Canada. The models treated the dependent variable (attendance) as a right-censored variable using the Tobit routine in Stata 16.1 while specifying an upper limit capacity constraint. Attendance must be treated as a censored variable in this context as contests within the NHL often reach (and sometimes exceed) the arena's capacity, which may affect true attendance demand (Morse et al., 2008; Rascher et al., 2007). Within the current study, 815 of the 2,454 games (33.2%) were right-censored. Similar models were created to estimate viewership in the USA and Canada separately. Since there is no capacity constraint on viewership, however, OLS regression was used.

Assumptions of regression were assessed via descriptive statistics, residual plots, and statistical tests for normality and equality of variances. The only violations found were due to the high level of correlation between the home and away moneylines. Theoretically, these highly correlated variables are justified to remain in the model. We also chose to collapse population and income into a single interaction term, total income area, calculated as the product between the two (e.g., Aiken and West, 1991). This eliminated collinearity concerns between income and area. We also chose to use the robust (or sandwich) estimator for standard errors in all models in an effort to mitigate any potential concerns with heteroskedasticity or normality of residuals (Huber, 1967; White, 1980).

8 Attendance results

Each demand model included four hierarchical censored (Tobit) regressions. All model statistics, including between club and individual game factors, will be provided for the overall NHL attendance model for clarity purposes (see Table 3). Subsequent results sections and tables will only include Models 3 and 4 for each demand estimation in an effort to present more succinct results as they included the primary independent variables of interest. Complete model statistics will be provided by the authors upon request

To test the sensitivity of our results to model misspecification or potential violation of assumptions, we conducted a sensitivity analysis using the lasso routine as implemented in Stata 16.1 (Hastie et al., 2015; Tibshirani, 1996). We use the lasso here to attempt to obtain the most precise estimates for fighting minutes, our primary variable of interest, and compare these estimates to the results we obtained from the more traditional regression approaches. We used three variants of the lasso approach to test for robustness (Belloni et al., 2014). The Appendix contains the lasso results for our three attendance models. We find that the lasso estimates for fighting minutes were positive and in the range of .001–.002 for eight of the nine lasso models. However, the fighting coefficient was only statistically significant in the three models specified for US and Canadian games combined.

Table 3 Overall NHL attendance 2014–2015 and 2015–2016 results

Variables	*Model 1: home team*			*Model 2: individual game*			*Model 3: penalty minutes*			*Model 4: fighting minutes*		
	Estimate	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*
Primary tenant	0.397**	(0.161)	2.468	0.692***	(0.149)	4.645	0.686***	(0.150)	4.588	0.678***	(0.149)	4.560
Arena capacity	0.025	(0.071)	0.355	–0.053	(0.069)	–0.776	–0.054	(0.069)	–0.781	–0.047	(0.068)	–0.689
Team history	0.073***	(0.004)	16.596	0.074***	(0.004)	18.718	0.073***	(0.004)	18.199	0.074***	(0.004)	18.476
Total income area	–1.68e-4***	(2.50e-5)	–6.737	–1.66e-4***	(2.40e-5)	–6.944	–1.68e-4***	(2.40e-5)	–7.011	–1.67e-4***	(2.38e-5)	–7.034
Home moneyline				–0.004***	(0.001)	–2.666	–0.004***	(0.001)	–2.670	–0.003**	(0.001)	–2.517
Away moneyline				0.001	(0.001)	0.763	0.001	(0.001)	0.771	0.001	(0.001)	0.982
Rivalry game				0.863***	(0.189)	4.558	0.861***	(0.190)	4.535	0.866***	(0.189)	4.572
Same division				0.034	(0.161)	0.209	0.042	(0.162)	0.260	0.010	(0.161)	0.065
Top 100 players				0.594***	(0.057)	10.505	0.598***	(0.056)	10.605	0.594***	(0.056)	10.606
Weekend				0.855***	(0.133)	6.411	0.856***	(0.134)	6.412	0.871***	(0.133)	6.542
Holiday				0.813*	(0.417)	1.952	0.823**	(0.418)	1.966	0.848**	(0.417)	2.035
Distance				3.70e-5	(9.24e-5)	0.400	4.82e-5	(9.32e-5)	0.518	4.43e-5	(9.29e-5)	0.476
Televised				1.290***	(0.234)	5.504	1.281***	(0.235)	5.459	1.257***	(0.235)	5.348
Penalty minutes							3.32e-4	(2.50e-4)	1.325	3.28e-4	(2.55e-4)	1.288
Fighting minutes										1.66e-3***	(4.02e-4)	4.133
Intercept	15.578***	(1.267)	12.299	13.782***	(1.214)	11.356	13.801***	(1.218)	11.333	13.221***	(1.200)	11.022
N	2,455			2,453			2,453			2,453		
Pseudo-R^2	0.0713			0.115			0.115			0.117		
LLV	–3,798			–3,618			–3,617			–3,609		

Notes: Robust standard errors in parentheses. Outcome is number of attendees, scaled by 1,000. 1,249 observations were right-censored
*** $p < 0.001$, **$p < 0.05$, *$p < 0.01$.

8.1 Overall attendance estimates

For the overall NHL attendance estimates, in model 3, all variables maintained their sign and significance from models 1 and 2; however, the penalties in minutes variable was not a significant predictor of attendance. Model 4 included all of the variables included in the first three models, as well as the fighting minutes variable. Again, all variables from the first three models held their significance level and sign while fighting minutes was a significant positive predictor of overall NHL attendance. Model 4, which included all variables, was found to have the highest pseudo-R^2 of the four models tested (and the lowest log-likelihood, an additional indicator of model explanatory power).

8.2 US attendance estimates

The next set of models aimed to estimate attendance determinants for US-based NHL franchises. Model 3 indicated that all of the between-club and individual game variables held their significance and sign found in models 1 and 2. The penalties in minutes variable was a positive and significant predictor in model 3. Results from model 4 matched those of models 1, 2, and 3, and fighting minutes was found to be a significant predictor of attendance. Similar to the results in estimating overall NHL attendance, US-based team attendance was best estimated by Model 4 as this had the highest pseudo-R^2 of .139.

8.3 Canadian attendance estimates

The final set of attendance models aimed to estimate attendance determinants for Canadian-based NHL franchises. Model 3 indicated that all of the between-club and individual game variables from models 1 and 2 held their significance and sign. The Penalties in Minutes variable was not a significant positive predictor in model 3. Model 4 included all of the variables in models 1, 2, and 3 and included the fighting minutes variable. All of the results from model 4 matched those of model 3, and fighting minutes was found to be a significant predictor of attendance. Model 4 was found to be the best-fitting model of the set with a pseudo-R^2 = .39 (see Table 4).

9 Viewership results

Considering there are many constraints that limit or prevent patronage at sporting events (Kim and Trail, 2010), simply looking at attendance as a holistic demand measure for a given sports league would be ill-advised. As noted by Simmons et al. (2017), several internal and external constraints may prevent an individual from attending a game. However, many of the constraints to attendance such as lack of friends/spouse to attend the game with, lack of interest in the game from others, prior commitments, financial cost, venue location, parking accessibility, inability to get tickets or good seats, and diminished game appeal due to weather are not constraints from watching a game on television (Kim and Trail, 2010; Pritchard et al., 2009).

Table 4 NHL US and Canadian attendance 2014–2015 and 2015–2016 results

Variables	*US attendance*						*Canadian attendance*					
	Model 3: penalty minutes			*Model 4: fighting minutes*			*Model 3: penalty minutes*			*Model 4: fighting minutes*		
	Estimate	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*
Primary tenant	0.782***	(0.193)	4.063	0.776***	(0.192)	4.050	0.163	(0.299)	0.547	0.146	(0.309)	0.472
Arena capacity	–0.121	(0.098)	–1.231	–0.112	(0.098)	–1.153	0.698***	(0.062)	11.270	0.698***	(0.062)	11.250
Team history	0.092***	(0.005)	16.928	0.093***	(0.005)	16.991	0.029***	(0.008)	3.521	0.029***	(0.008)	3.470
Total income area	–1.62e-4***	(3.08e-5)	–5.237	–1.60e-4***	(3.08e-5)	–5.211	–5.84e-4***	(3.13e-4)	–1.862	–5.78e-4***	(3.20e-4)	–1.803
Home moneyline	–0.006**	(0.002)	–2.953	–0.005**	(0.002)	–2.804	–9.53e-5	(5.67e-4)	–0.168	–1.40e-4	(5.66e-4)	–0.247
Away moneyline	0.001	(0.002)	0.607	0.001	(0.002)	0.733	–3.29e-4	(5.62e-4)	–0.585	–2.47e-4	(5.60e-4)	–0.443
Rivalry game	0.973***	(0.252)	3.854	0.977***	(0.252)	3.883	0.168	(0.097)	1.730	0.156	(0.096)	1.619
Same division	–0.182	(0.211)	–0.863	–0.200	(0.211)	–0.948	0.049	(0.085)	0.574	0.039	(0.084)	0.470
Top 100 players	0.699***	(0.072)	9.687	0.699***	(0.072)	9.732	–0.127***	(0.034)	–3.723	–0.135***	(0.034)	–4.011
Weekend	1.201***	(0.174)	6.904	1.199***	(0.173)	6.927	0.175**	(0.066)	2.672	0.195**	(0.064)	3.019
Holiday	1.102**	(0.497)	2.219	1.121**	(0.496)	2.262	0.077	(0.217)	0.356	0.069	(0.223)	0.309
Distance	–3.03e-4**	(1.24e-4)	–2.446	–3.02e-4**	(1.23e-4)	–2.449	3.14e-5	(4.60e-5)	0.681	2.70e-5	(4.65e-5)	0.578
Televised	1.175***	(0.280)	4.192	1.150***	(0.280)	4.103	0.510	(0.451)	1.132	0.589	(0.408)	1.446
Penalty minutes	7.13e-4**	(3.16e-4)	2.258	7.20e-4**	(3.19e-4)	2.259	4.83e-5	(2.27e-4)	0.212	4.27e-5	(2.32e-4)	0.184
Fighting minutes				0.001**	(5.02e-4)	2.238				6.66e-4**	(2.17e-4)	3.071
Intercept	14.198***	(1.816)	7.819	13.735***	(1.809)	7.591	5.410***	(0.774)	6.995	5.262***	(0.766)	6.866
N	1,878			1,878			574			574		
Pseudo-R^2	0.138			0.139			0.384			0.390		
LLV	–2,706			–2,704			–505.3			–500.1		

Notes: Robust standard errors in parentheses. Outcome is number of attendees, scaled by 1,000. 1,006 observations were right-censored.
***$p < 0.001$, **$p < 0.05$, *$p < 0.01$.

Table 5 NHL US national television viewership 2014–2015 and 2015–2016 regression results

Variables	*US viewership*						*Canadian viewership*					
	Model 3: penalty minutes			*Model 4: fighting minutes*			*Model 3: penalty minutes*			*Model 4: fighting minutes*		
	Estimate	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*
Primary tenant	–85.311	(63.239)	–1.349	–85.230	(64.378)	–1.324	2.066	(34.521)	0.060	0.037	(34.521)	0.001
Arena capacity	9.059	(22.304)	0.406	9.092	(21.457)	0.424	3.706	(13.902)	0.267	3.211	(13.942)	0.230
Team history	2.178	(1.309)	1.664	2.180	(1.387)	1.572	4.494***	(0.875)	5.135	4.370***	(0.876)	4.989
Total income area	–0.015	(0.009)	–1.707	–0.015	(0.009)	–1.712	–1.47e-10**	(5.48e-11)	–2.680	–1.47e-10**	(5.48e-11)	–2.695
Home moneyline	–0.679	(0.419)	–1.623	–0.679	(0.420)	–1.616	0.366	(0.328)	1.117	0.360	(0.329)	1.094
Away moneyline	–0.709	(0.396)	–1.792	–0.709	(0.401)	–1.766	0.323	(0.310)	1.042	0.317	(0.311)	1.019
Rivalry game	79.761	(59.013)	1.352	79.796	(60.519)	1.319	108.166*	(42.010)	2.575	109.536**	(42.062)	2.604
Same division	–120.215*	(51.343)	–2.341	–120.215*	(51.466)	–2.336	27.567	(38.761)	0.711	31.021	(38.751)	0.801
Top 100 players	13.148	(24.827)	0.530	13.131	(24.872)	0.528	–30.606*	(13.011)	–2.352	–30.319*	(13.046)	–2.324
Weekend	346.057***	(77.442)	4.469	346.045***	(77.213)	4.482	126.249***	(32.130)	3.929	128.570***	(32.036)	4.013
Holiday	767.413	(474.637)	1.617	767.419	(475.734)	1.613	–6.389	(106.773)	–0.060	–7.593	(106.362)	–0.071
Distance	–0.108**	(0.038)	–2.880	–0.108**	(0.038)	–2.874	–0.031	(0.022)	–1.403	–0.029	(0.022)	–1.319
Penalty minutes	0.064	(0.134)	0.473	0.063	(0.137)	0.464	–0.042	(0.058)	–0.721	–0.037	(0.058)	–0.630
Fighting minutes				0.003	(0.330)	0.008				–0.184	(0.098)	–1.868
Intercept	213.471	(400.751)	0.533	212.410	(396.634)	0.536	231.822	(255.358)	0.908	290.453	(256.501)	1.132
N	208			208			486			486		
Adj. R^2	0.354			0.351			0.187			0.191		

Notes: Robust standard errors in parentheses. Outcome is number of television viewers, scaled by 1,000.
***$p < 0.001$, **$p < .01$, *$p < 0.05$.

Similar to the models described above estimating attendance, the viewership estimates took the form of four hierarchical models; however, only results from Models 3 and 4 will be reported and discussed. The only notable difference in this analysis compared to the attendance models was the removal of the TV explanatory variable as all games included in this dataset were nationally televised, and a censored regression was no longer needed as viewership does not have a cap the way attendance does. OLS regression was therefore used, with robust standard errors implemented via the sandwich estimator.

A similar sensitivity analysis for the viewership models was conducted using an inferential lasso approach. Here, we found three positive and three negative coefficient estimates for fighting minutes. None of the six models tested found a statistically significant relationship between fighting minutes and television viewership. See Appendix for complete statistics.

9.1 US viewership estimates

Model 3 included all of the variables from models 1 and 2 with the addition of the (residual) penalties in minutes variable. Results indicated that all of the between-club and individual game variables held their significance and sign in model 2. The penalties in minutes variable was not found to be a significant predictor in model 3. Model 4 included all of the variables in models 1, 2 and 3 and included the fighting minutes variable, which was not found to be a significant predictor of TV viewership. In terms of model fit, Model 3, which included between-club and individual game predictors only, was found to have the highest adjusted $R^2 = .354$ (see Table 5).

9.2 Canadian viewership estimates

The final set of models aimed to estimate consumption determinants for Canadian national TV viewership. Model 3 included all of the variables in models 1 and 2 with the addition of the penalties in minutes variable. Again, all of the between-club and individual variables held their level of significance and sign from models 1 and 2. Findings indicated that penalties in minutes was not a significant predictor of viewership. Findings from model 4 indicated that all of the previously introduced variables maintained their level of significance and sign as found in model 3. Fighting minutes was not found to be a significant negative predictor of attendance. Model adjusted R^2 values indicated that model 4, which included all variables, was the best model to explain national Canadian TV viewership, with an adjusted $R^2 = .191$.

10 Discussion

The NHL is uniquely positioned in that it must appeal to an audience situated in two countries (USA and Canada) with differing sentiments regarding the game of hockey. Recall that the purpose of the first component of the study was to understand the factors that influence attendance in the NHL, with a particular emphasis placed on fighting. To analyse these results, each model was assessed to determine the relative influence of each

predictor. In general, discussions will focus on the primary predictors of interest and models with the greatest explanatory power.

As it relates to this purpose, the results of the various models indicated that fighting is a positive predictor of attendance. In each of the models (overall, USA, and Canada), fighting was a significant positive predictor of attendance, albeit only exhibiting minimal influence. In the Overall attendance model, where fighting minutes had the greatest impact, one would only expect to see an increase of roughly 2 (1.66) fans for each additional fighting minute. These findings run counter to previous studies on the topic (e.g., Jones et al., 1996; Paul, 2003) and align with more recent studies (e.g., Rockerbie, 2016). As such, we conclude that instances of fighting should no longer be considered as a primary driver of attendance, regardless of geographic location. It should be noted that the sentiments from Jones et al. (1996) suggesting that US fans preferred violence more so than their Canadian counterparts is supported by our results. However, the difference between the two nations is minimal, suggesting that the creation of a marketing strategy around the promotion of violence would not significantly increase attendance.

The results from the viewership portion of this study provide a great deal of insight into the largely understudied area of NHL viewership. Similar to estimating attendance, the overarching purpose was to better understand the significant predictors of viewership in the US and Canadian national TV markets, with particular consideration given to physicality and fighting. As it relates to this purpose, fighting was not a significant predictor of viewership in either the US or Canadian markets. A future avenue for research consideration is to analyse the impact that physicality has on local and regional broadcast viewership. This study only considered nationally broadcast games, wherein the networks and League are primarily trying to maximise ratings. Thus, their selection of games is primarily based on whether the two teams will appeal to a large audience. An examination of local/regional viewership may yield different results.

These results from this study demonstrate that the promotion of fighting in the NHL is no longer a viable driver of consumption. While the findings from Novak (1993) and Zillmann et al. (1989) that violence creates compelling drama cannot be refuted, our results show that these actions do not positively influence consumption in the NHL. As such, the NHL's focus on the promotion of other non-violent aspects of its game are supported by these results. Although a significant predictor, fighting does not influence consumption for the broader audience in the way that it did in the past (e.g., Jones, 1984). While there remains a place to promote the physicality of the game, the fervour for fighting appears to have dwindled. As a sport that continues to struggle for notoriety among the other professional sporting leagues, especially in the US, the NHL must ensure that it appropriately markets its product in order to attract the greatest number of consumers possible.

11 Conclusions

Fighting has been engrained within the culture of hockey since the NHL's inception. The tolerance for violence in the sport is largely what distinguishes it from other sports leagues in North America. While fighting has effectively been used as a mechanism to increase consumption in the past, the results of the current study suggest that doing so is no longer a viable strategy. In each of the models presented, fighting had a modest impact on attendance and no significant influence on viewership. The impact of fighting on

attendance demonstrates the need for the NHL to focus their attention on other mechanisms to increase in-arena consumption. The outcomes associated with the viewership models provide marketers with a foundation upon which to further develop their media strategies. Given that the NHL has a unique and diverse fanbase with significant influence in both the USA and Canada, these results are particularly salient to the future of the sport.

References

Adgate, B. (2019) *Hockey's Big Pay Day is Coming*, 15 January [online] https://www.forbes.com/sites/bradadgate/2019/01/15/hockeys-big-pay-day-is-coming/#ff70a854e445 (accessed 14 April 2020).

Aiken, L.S. and West, S.G. (1991) *Multiple Regression: Testing and Interpreting Interactions*, Sage, Thousand Oaks, California.

Belloni, A., Chernozhukov, V. and Hansen, C. (2014) 'High-dimensional methods and inference on structural and treatment effects', *The Journal of Economic Perspectives: A Journal of the American Economic Association*, Vol. 28, No. 2, pp.29–50 [online] https://doi.org/10.1257/jep.28.2.29.

Berri, D.J. and Schmidt, M.B. (2006) 'On the road with the National Basketball Association's superstar externality', *Journal of Sports Economics*, Vol. 7, No. 4, pp.347–358.

Berri, D.J., Schmidt, M.B. and Brook, S.L. (2004) 'Stars at the gate: the impact of star power on NBA gate revenues', *Journal of Sports Economics*, Vol. 5, No. 1, pp.33–50.

Birnie, J. (2019) *NHL Data Report, 2019*, 3 May [online] https://media.sportbusiness.com/2019/05/free-nhl-data-report-2019/ (accessed 7 April 2020).

Bryant, J. and Zillmann, D. (1983) 'Sports violence and media', in Goldstein, J.H. (Ed.): *Sports Violence*, pp.195–208, Springer-Verlag, New York, New York.

Bryant, J., Comisky, P. and Zillmann, D. (1981) 'The appeal of rough-and-tumble play in televised professional football', *Communication Quarterly*, Vol. 29, No. 4, pp.256–262.

Burnside, S., LeBrun, P., McDonald, J. and Custance, C. (2017) *This Week's Big Question: What Role Does Fighting Have in the Game?*, 7 February [online] https://www.espn.com/nhl/story/_/id/18638712/nhl-big-question-players-see-role-fighting-game (accessed 17 April 2020).

Coates, D. and Humphreys, B.R. (2011) *Game Attendance and Competitive Balance in the National Hockey League*, Working Paper No. 2011-08 [online] https://econpapers.repec.org/paper/spewpaper/1114.htm (accessed 1 April 2020).

Comisky, P., Bryant, J. and Zillmann, D. (1977) 'Commentary as a substitute for action', *Journal of Communication*, Vol. 27, No. 3, pp.150–153.

DeSchriver, T.D., Rascher, D.A. and Shapiro, S.L. (2016) 'If we build it, will they come? Examining the effect of expansion teams and soccer-specific stadiums on Major League Soccer attendance', *Sport, Business and Management: An International Journal*, Vol. 6, No. 2, pp.205–207.

Federal Bureau of Investigation (2020) *Rate of Violent Crime Offenses by Population* [online] https://crime-data-explorer.fr.cloud.gov/pages/explorer/crime/crime-trend (accessed 17 April 2020).

Fitzpatrick, J. (2019) *History of Hockey Fights*, 1 June [online] https://www.liveabout.com/history-of-hockey-fights-2779322 (accessed 7 May 2021).

Harrell, W.A. (1981) 'Verbal aggressiveness in spectators at professional hockey games: the effects of tolerance of violence and amount of exposure to hockey', *Human Relations*, Vol. 34, No. 8, pp.643–655.

Hastie, T., Tibshirani, R. and Wainwright, M. (2015) *Statistical Learning with Sparsity: The Lasso and Generalizations*, CRC Press, Boca Raton, Florida.

Havard, C.T., Gray, D. P., Gould, J., Sharp, L.A. and Schaffer, J.J. (2013) 'Development and validation of the sport rivalry fan perception scale (SRFPS)', *Journal of Sport Behavior*, Vol. 36, No. 1, pp.45–65.

Huber, P.J. (1967) 'The behavior of maximum likelihood estimates under nonstandard conditions', *Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability*, Vol. 1, pp.221–233.

Humphreys, B.R. and Johnson, C. (2017) *The Effect of Superstar Players on Game Attendance: Evidence from the NBA*, Working Paper 17-16 [online] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3004137 (accessed 17 May 2022).

Jones, J.C.H. (1984) 'Winners, losers and hosers: demand and survival in the National Hockey League', *Atlantic Economic Journal*, Vol. 12, No. 3, pp.54–63.

Jones, J.C.H., Ferguson, D.G. and Stewart, K.G. (1993) 'Blood sports and cherry pie: some economics of violence in the National Hockey League', *American Journal of Economics and Sociology*, Vol. 52, No. 1, pp.63–78.

Jones, J.C.H., Stewart, K.G. and Sunderman, R. (1996) 'From the arena into the streets: Hockey violence, economic incentives and public policy', *The American Journal of Economics and Sociology*, Vol. 55, No. 2, pp.231–243.

Kim, Y.K. and Trail, G. (2010) 'Constraints and motivators: a new model to explain sport consumer behavior', *Journal of Sport Management*, Vol. 24, No. 2, pp.190–210.

Leitch, W. (2018) *Nobody's Going to Sports in Person Anymore. And No One Seems to Care*, 11 July [online] http://nymag.com/intelligencer/2018/07/nobodys-going-to-sports-in-person-and-no-one-seems-to-care.html (accessed 7 May 2020).

Moreau, G. (2021) *Police-Reported Crime Statistics in Canada, 2020*, Statistics Canada, Ottawa, Ontario, Canada.

Morse, A.L., Shapiro, S.L., McEvoy, C.D. and Rascher, D.A. (2008) 'The effects of roster turnover on demand in the National Basketball Association', *International Journal of Sport Finance*, Vol. 3, pp.8–18.

Novak, M. (1993) *The Joy of Sports*. Madison Books, Lanham, Maryland.

Paul, R.J. (2003) 'Variations in NHL attendance. The impact of violence, scoring and regional rivalries', *American Journal of Economics and Sociology*, Vol. 62, No. 2, pp.345–364.

Pritchard, M.P., Funk, D.C. and Alexandris, K. (2009) 'Barriers to repeat patronage: the impact of spectator constraints', *European Journal of Marketing*, Vol. 43, Nos. 1–2, pp.169–187.

Rascher, D.A., McEvoy, C.D., Nagel, M.S. and Brown, M.T. (2007) 'Variable ticket pricing in Major League Baseball', *Journal of Sport Management*, Vol. 21, No. 3, pp.407–437.

Roberts, J.V. and Benjamin, C.J. (2000) 'Spectator violence in sports: a North American perspective', *European Journal on Criminal Policy and Research*, Vol. 8, No. 2, pp.163–181.

Rockerbie, D.W. (2012) 'The demand for violence in hockey', in Kahane, L.H. and Shmanske, S. (Eds.): *The Oxford Handbook of Sports Economics: The Economics of Sports*, Vol. 1, pp.159–176, DOI: 10.1093/oxfordhb/9780195387773.013.0009.

Rockerbie, D.W. (2016) 'Fighting as a profit maximizing strategy in the National Hockey League: more evidence', *Applied Economics*, Vol. 48, No. 4, pp.292–299.

Simmons, J., Popp, N., McEvoy, C. and Howell, S. (2017) 'Tomorrow's fans gone today: Assessing constraints to student attendance at college football games', *Journal of Applied Sport Management*, Vol. 9, No. 3, pp.13–23.

Singer, D. (2017) *We are Wrong about millennials; They are Sports Fans*, 18 September [online] https://www.sportsbusinessdaily.com/Journal/Issues/2017/09/18/Opinion/Singer.aspx (accessed 17 May 2020).

Stewart, K.G., Ferguson, D.G. and Jones, J.C.H. (1992) 'On violence in professional team sport as the endogenous result of profit maximization', *Atlantic Economic Journal*, Vol. 20, pp.55–64 [online] https://doi.org/10.1007/BF02300087.

Tibshirani, R. (1996) 'Regression shrinkage and selection via the lasso', *Journal of the Royal Statistical Society. Series B, Statistical Methodology*, Vol. 58, No. 1, pp.267–288 [online] https://doi.org/10.1111/j.2517-6161.1996.tb02080.x.

Tyler, B.D., Morehead, C.A., Cobbs, J. and DeSchriver, T.D. (2017) 'What is rivalry? Old and new approaches to specifying rivalry in demand estimations of spectator sports', *Sport Marketing Quarterly*, Vol. 26, No. 4, pp.204–222.

Vincent, J. and Crossman, J. (2015) ''Our game our gold': newspaper narratives about the Canadian men's ice hockey team at the 2010 Winter Olympic Games', *Journal of Sport Behavior*, Vol. 38, No. 1, pp.97–117.

White, H. (1980) 'A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity', *Econometrica: Journal of the Econometric Society*, Vol. 48, No. 4, pp.817–838.

Wyshynski, G. (2012) *Once Again, NHL Players Voice Overwhelming Opposition to Fighting Ban*, 20 February [online] https://sports.yahoo.com/blogs/nhl-puck-daddy/once-again-nhl-players-voice-overwhelming-opposition-fighting-175557533.html (accessed 17 April 2020).

Zillmann, D., Bryant, J. and Sapolsky, B.S. (1989) 'Enjoyment from sports spectatorship', in Goldstein, J.H. (Ed.): *Sports, Games, and Play: Social and Psychological Viewpoints*, pp.241–274, Lawrence Erlbaum Associates, Hillsdale, New Jersey.

Appendix

Sensitivity analysis for fighting minutes using inferential lasso model – attendance

Variable	*Lasso 1*		*Lasso 2*		*Lasso 3*	
	B	*p*	*B*	*p*	*B*	*p*
All attendance (N = 2,453)	0.002	0.000	0.002	0.005	0.002	0.002
Canadian attendance (N = 574)	5.50E-04	0.218	0.002	0.134	–1.04E-04	0.829
US attendance (N = 1,878)	0.001	0.204	0.001	0.228	0.001	0.158

Notes: All models included covariates at the home team and game-specific levels.
Lasso1 – partialling out with plugin estimator, Lasso2 – partialling out with cross validation, Lasso3 – double selection.

Sensitivity analysis for fighting minutes using inferential lasso model – viewership

Variable	*Lasso 1*		*Lasso 2*		*Lasso 3*	
	B	*p*	*B*	*p*	*B*	*p*
Canadian TV (N = 486))	0.086	0.741	–0.045	0.867	0.018	0.947
US TV (N = 208)	0.460	0.520	–0.089	0.919	–0.716	0.400

Notes: All models included covariates at the home team and game-specific levels.
Lasso1 – partialling out with plugin estimator, Lasso2 – partialling out with cross validation, Lasso3 – double selection.