Bargaining for Exclusive Rights in Two-Sided Markets: The Case of the NFL and Broadcast Channels

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Abstract

The National Football League (NFL) represents its 32 member teams when bargaining with broadcasters over NFL broadcasting rights. Current broadcasting contracts restrict access to NFL Sunday games based upon a viewer's location. I develop an *endogenous disagreement payoffs* extension to the standard bargaining model to describe the interaction between the NFL and broadcasters when allocating broadcasting rights. The disagreement payoff is found by calculating profits under the counterfactual when the broadcaster does not win. This is done by estimating viewer and advertiser benefits in a full two-sided equilibrium model of advertiser-consumer interaction mediated by channel ad choices and then changing broadcast programs. I estimate advertiser willingness-to-pay to reach a viewer at \$0.04. I conduct simulations for when NFL bargaining is decentralized to the division level. The estimates suggest that while the price of contracts increases, broadcaster profits increase due to the flexibility in bundling games.

JEL Classification: C78, L82, L83, M37

Keywords: two-sided markets, bargaining, advertising, media economics, broadcast television

1 Introduction

Collective bargaining and its effects on welfare have been a persistent and central concern for economists and policymakers. Inquiries on this topic focus mostly on the effects of unions and collective bargaining on the labor market (Davidson, 1988, Horn and Wolinsky, 1988, Jun, 1989) and the performance of firms (Bechter et al., 2021, Brandl and Braakmann, 2021). In the former, unions represent and advocate for the rights and interests of its members and via collective bargaining quasi-rents are distributed (Roberts and Acemoglu, 2023). However, most of these analyses consider bilateral relationships with exogenously given surplus, which is shared according to the Nash bargaining solution (Nash, 1950).[1] Although a convenient modeling assumption, this assumption does not apply to a more prevalent setting where relationships are multilateral, and parties strategically affect the surpluses and disagreement payoffs.

For instance, consider the National Football League (NFL), which collectively bargains with television channels for broadcasting contracts worth billions of dollars (see Table 1). The NFL and television channels manage the interests of the 32 NFL teams, consumers, and advertisers. Within these ad-financed two-sided markets for broadcasting contracts, the total surplus generated hinges on the NFL's design of tournaments, their bundling of games for channels, the interdependence between advertisers and television viewers, and the ad prices chosen by the channels.

What is the source of the bargaining power for the channels, and how does it affect television advertisements? What are the effects of reconfiguring programs and their broadcast timing on consumer welfare and the total surplus? What are the revenue and welfare implications of replacing collective bargaining with decentralized pairwise bargaining between a football division and a channel? In this paper, I answer these questions using data on

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[1]An notable exception being Cahuc et al. (2006) which accounts for competition between employers for employees. The authors find that without accounting for inter-firm competition the bargaining parameter is overestimated.

broadcasting contracts between NFL and television channels, demand for television adver-
tisements, and viewership.

To answer these questions, I develop a tractable empirical framework to study multilateral
bargaining with endogenous disagreement payoffs. The disagreement payoffs are endogenous
because they depend on how each channel behaves strategically as a platform in the ad-
financed two-sided market between viewers and advertisers. In particular, I build on the
existing framework of Nash-in-Nash bargaining (Collard-Wexler et al., 2019) and extend
it to allow endogenous disagreement payoffs by combining it with a two-sided ad-financed
market where on the demand side are consumers who make discrete choices across different
channels, and on the supply side are the advertisers who purchase ad slots.[2] My model
captures the competition between bargaining pairs that arise when securing broadcast rights
by allowing disagreement payoffs to be determined in equilibrium.

This generalization introduces new modeling and estimation challenges. For one, I must
determine the counterfactual profits when a channel fails to secure broadcasting rights. This
exercise requires estimating viewers' and advertisers' decisions in a two-sided market and us-
ing the estimates to determine the best alterations to broadcast programs to maximize the
channel's profit. Treating a channel as a two-sided market enables evaluating the trade-off
channels face between the level of advertisements (which consumers generally dislike) and
the presence of consumers (whom advertisers value). Quantifying these benefits is also fun-
damental to understanding the efficiency of the NFL and the welfare effects of reconfiguring
channels under decentralized bargaining.

I leverage a comprehensive data set encompassing consumer television and advertisement
viewership to conduct my analysis. This data set encompasses 2,000 distinct but representa-
tive households from 2019 to 2023, with a detailed record of viewership and advertisements
at both the broadcast and advertisement slot levels, offering a granular view of individual

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[2]Several important papers have used the Nash-in-Nash framework with passive beliefs, for example, to
study multichannel television (Crawford and Yurukoglu, 2012), medical equipment (Grennan, 2013), and
health insurance (Ho and Lee, 2017) or with exogenous outside options as in Leong et al. (2020). Passive
beliefs assume no contract renegotiation of other matched bargaining pairs in the case of disagreement.

programming and advertisement preferences. I also use data on advertisement spending provided by Nielsen Ad Intel that tracks television advertisement expenditure at the national and local market levels. Finally, I supplement these data with manually collected contract data on broadcasting rights for NFL games, including the specific games aired in each (geographic) market.

Using a two-level nested logit model where the upper nest is between broadcast programming and not, and the lower nest is between different types (e.g., comedy, news, sports) of broadcast programs, I find a high correlation between broadcast programming options, with viewers less likely to switch from broadcast to non-broadcast programming. On the demand side of advertising, the instrumental variables estimates suggest that viewers dislike advertising with an elasticity of -7.708. On the supply side, I estimate the advertisers' willingness to pay distribution and find that an advertiser is willing to pay \$0.04 to reach one "eyeball"- a result that is in line with Shapiro et al. (2021). I also find that NFL games hold significant value for advertisers given their viewership levels. On average, a broadcaster of an NFL game asks an additional payment of \$11,374 from an advertiser to air an advertisement instead of a tune-in when a related program airs the following day. The asking price increases to \$20,705 when the related program airs on the same day.

Using these model-based estimates, I consider the effects of removing collective bargaining by allowing each division to negotiate with the channels. The current collective negotiations between the league and broadcast channels have resulted in significant programming package consolidation. In particular, I estimate the effect of bargaining decentralization on content accessibility to consumers and their welfare as well as channel pricing dynamics. These effects become particularly salient as broadcast channels acquire newfound flexibility in optimizing their contract bundles. In contrast to the existing arrangements, where divisions within a conference are bundled together, the counterfactual scenario empowers channels to strategically craft contract combinations aligned with their specific objectives and strategies.

I estimate that decentralization *increases* the total value of all division contracts. My

model suggests that this increase in surplus is due to the heightened flexibility that the channels enjoy when configuring their programming packages. Furthermore, divisions leverage this newfound flexibility to improve their outside options. However, in equilibrium, this augmentation is offset to some extent by channels bolstering their outside options. Preliminary estimates suggest that only two divisions, namely the National Football Conference South and the American Football Conference South, experience a negative impact from decentralization, resulting in a loss of $10 million in broadcasting revenue per team. Given that each team currently generates approximately $255 million in annual revenue (Hendricks and Vockrodt, 2019), this decrease constitutes a 4% reduction in earnings. The lowest earning divisions are those the threaten the viability of a league. The modest reductions suggest that bargaining decentralization is unlikely to impact the league overall.

This paper makes three main contributions. First, I contribute to the rich and burgeoning literature that estimates a model of strategic interactions and bargaining (Lee et al., 2021) and two-sided ad-financed markets. My framework extends the prevalent Nash-in-Nash bargaining framework to allow for endogenous disagreement payoffs, combines it with a two-sided ad-financed market, and determines conditions under which the parameters can be uniquely recovered. I thus complement the research agenda of Ho and Lee (2019) to endogenize disagreement payoffs.[3]

Notably, all these models encompass a series of unrelated bilateral bargaining problems, needing a unified Nash equilibrium across bargaining pairs. In contrast, my model allows for multiple Nash bargaining pairs intricately connected to other pairs' outcomes within the equilibrium framework. By capturing this interdependence, I hope to provide a better understanding of multi-faceted multilateral bilateral bargainings.

Second, this paper also contributes to the literature on empirical analysis of two-sided, ad-financed models (Jullien et al., 2021). In an important paper, Rysman (2004) investigates network effects and competition in the Yellow Page directory market, finding that users value

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[3]Also, see Vartiainen (2007) for a theoretical treatment of Nash bargaining with endogenous disagreement payoffs.

Yellow Page advertisements. A similar finding has been found in the print magazine industry (e.g., Kaiser and Wright, 2006; Song, 2021). Wilbur (2008), and more recently Ivaldi and Zhang (2022), use a two-sided model to analyze the television industry and find that television viewers dislike advertisements. I complement this literature by incorporating upstream product decisions where, in equilibrium, the program offered by the channels depends on bargaining with the content provider, i.e., the NFL.

Third, this paper contributes to understanding broadcasting rights and the bargaining between NFL and television channels. This market holds particular interest given the substantial amount of time Americans devote to television, averaging three and a half hours per day.[4] Television channels generate approximately $17.12 billion in annual revenue through the sale of advertising slots, with NFL events consistently ranking among the most-watched broadcasts in the United States.[5] Consequently, if efficiency can be improved, it should be adopted to increase the welfare of the viewers. One such avenue that I explore is breaking up the NFL's bargaining cartel and estimating its effect on the efficiency of sports leagues. Thus, I contribute to an important literature in sports economics that explores the questions about the profitability of sports leagues and the design of tournaments, see Neale (1964) and Fort and Quirk (1995). On the one hand, the central economic entity is not individual teams but the league itself given factors such as match competitiveness, league organization, and climactic season events significantly influence league profitability. Conversely, the efficiency of a league hinges on elements like player drafts, salary caps, and free agency. Therefore, cross-subsidization under collective bargaining, where teams evenly share revenue from broadcasting contracts, merits scrutiny for its potential inefficiency.[6] My model allows me to empirically test the benefits of cross-subsidization in a league framework and comment on its necessity for the survival of the NFL.

The rest of the paper is organized as follows: Section 2 provides a discussion of the NFL

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[4]See https://www.statista.com/statistics/186833/average-television-use-per-person-in-the-us-since-2002/
[5]See https://my.ibisworld.com/us/en/industry/51512
[6]A summary of earlier literature can be found in Table 2 of Szymanski (2003)

structure and the market for television broadcasting rights as well as the current related antitrust lawsuit. Section 3 presents the two-sided advertiser and discrete-choice viewer demand model. Section 4 introduces the data used in the econometric analysis. Section 5 reports the estimation results of the model. Section 6 presents the counterfactual analysis. Finally, section 7 concludes.

2 Industry Description

2.1 Television Broadcasting

According to IBIS World's report in July 2022, the television broadcasting industry in the United States generated a profit of $7.9 billion from a total revenue of $72.8 billion.[7] A significant portion, over 40%, of this revenue is derived from national and regional advertising, while nearly 15% comes from local advertising. National and regional advertising encompasses advertising slots sold across multiple network affiliates, which are local channels in specific regions, such as local news stations. Local advertising, on the other hand, refers to ad slots sold to a particular network affiliate, and these advertisements are bought and sold directly by the local network affiliate.

Broadcast channels, which can be accessed freely by consumers through a simple antenna, have remained resilient despite the recent trend of consumer cord-cutting. Unlike cable packages, the reach of broadcasters is not dependent on such subscription-based services, allowing them to continue reaching audiences effectively.

Television broadcasters play a unique role in the television supply chain. They engage in various activities, including the creation of original programming such as scripted shows, news programs, reality TV, and sports broadcasts. These programs may be produced in-house or developed through partnerships with independent production companies. Additionally, broadcasters acquire programming from third-party studios and syndicators. The

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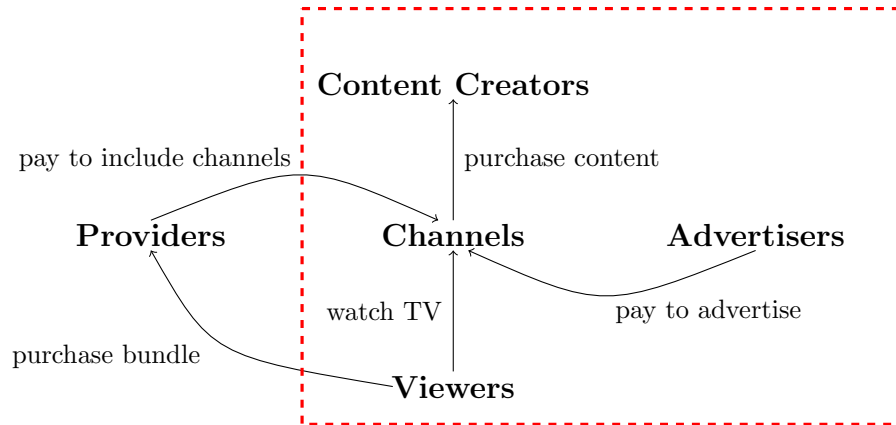[7]See https://my.ibisworld.com/us/en/industry/51512

Figure 1: Television Broadcasting Market Structure

content acquired by broadcasters is then purchased by cable/satellite providers, who bundle and offer it to consumers as part of television packages. When a content creator, such as a TV producer, pitches a program to a channel, the channel negotiates and purchases the rights to the content, earning income from two primary sources: (1) advertisers seeking ad slots during that specific program and (2) television providers. Advertising contributes to approximately 55% of broadcasters' revenue, while selling rights to television providers accounts for just under 19% as of 2022, as reported by IBIS World.

This structure of the television market can be seen in Figure 1, where the section contained within the red dashed box is my area of focus. This narrowing is possible because this paper focuses on broadcast channels that are accessible without requiring the purchase of a television package from a provider and are included in all cable packages. According to the Federal Communications Commission (FCC), cable companies are obliged to offer a basic tier of programming to all subscribers, which must include local broadcast television stations and public access channels, as mandated by agreements with local governments.[8]

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[8] Per the F.C.C. "Cable companies are generally required to offer a "basic tier" of programming to all subscribers before they purchase additional programming. This basic tier includes, at a minimum, the local broadcast television stations and public access channels that the operator may be required to offer through an agreement with the local government." (Source: https://www.fcc.gov/consumers/guides/choosing-cable-channels)

2.2 NFL Structure

The NFL is the premier professional American football league in the United States. It consists of 32 teams, each representing a different city or region. The league is organized into two conferences: the National Football Conference (NFC) and the American Football Conference (AFC), with each conference further divided into four divisions: North, South, East and West. The divisional alignment is based on geographical considerations, with teams grouped together to foster regional rivalries and minimize travel distances.

The NFL regular season spans 18 weeks, during which each team plays 17 games.[9] The schedule is designed to ensure that teams face a mix of divisional opponents, conference rivals, and teams from the opposing conference. The league uses a formula to determine the schedule, taking into account factors like competitive balance and broadcasting considerations. At the end of the regular season, the top teams from each division, as well as a set number of wild card teams with the best records, advance to the playoffs. The playoffs consist of a single-elimination tournament, culminating in the AFC and NFC Championship Games. The winners of these conference championships then face off in the Super Bowl, which determines the NFL champion for that season. The prevelance of the NFL in American sports can be seen in Figure 2. NFL games dominate the top 10 most watched sporting events in the United States.

The NFL operates as a single entity, with all teams jointly owned by the team owners.[10] This structure allows for centralized decision-making and coordination among teams. The league is governed by a Commissioner, who oversees the day-to-day operations and enforces league rules and policies.

One of the key aspects of the NFL's setup is its revenue-sharing system. The league generates substantial revenue from various sources, including television broadcasting rights,

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[9]Prior to the 2021 season, the regular season was 17 weeks, and each team has what is referred to as a bye-week in which they do not play. This results in each team playing 16 games in the regular season.

[10]The team owners make strategic decisions for their respective franchises and represent the interests of their teams within the league. Ownership changes, such as the sale of a team or the addition of new owners, require approval from the league and other team owners.
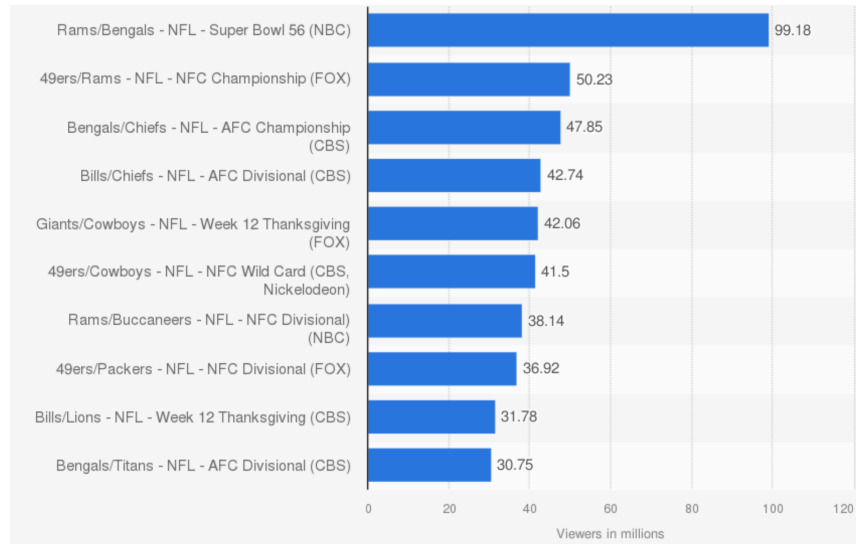
Figure 2: Number of TV viewers of most watched sporting events in the U.S. in 2022
Source: https://www.statista.com/statistics/619023/number-tv-viewers-sporting-events-usa/

ticket sales, merchandising, and sponsorships. The revenue is shared among the teams to promote parity and ensure competitive balance. This revenue-sharing model helps smaller-market teams compete with larger-market teams, contributing to the overall competitiveness of the league.[11] Television broadcasting plays a crucial role in the NFL's financial success. The league negotiates television broadcasting contracts with networks to secure the rights to broadcast NFL games. These contracts are typically for a specific number of years and involve substantial financial agreements. The NFL's broadcasting arrangements include national broadcast partners, who have the rights to televise games nationwide, as well as regional broadcast affiliates that cover specific local markets. The broadcasting structure of NFL games is expanded up in Section 2.2.1.

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[11]Further means of ensuring competitive balance can be seen in the NFL Draft and in the salary cap system. The NFL has a system in place for player recruitment called the NFL Draft. This annual event allows teams to select college football players who are eligible to enter the professional league. The draft order is determined based on the previous season's performance, with the lowest-ranked teams having the earliest picks. This system aims to promote parity and give struggling teams a chance to improve through the acquisition of talented players. The NFL operates under a salary cap system, which sets a maximum limit on the amount of money teams can spend on player salaries. The salary cap helps maintain competitive balance by preventing wealthier teams from simply outspending others to assemble dominant rosters. The cap is adjusted each year based on league revenues and is enforced to ensure teams operate within the set limits.

Broadcaster	Package	Annual Value	Contract Length
Current:			
ESPN	Monday Night	2.7 billion	2022-2033
Fox	NFC Sunday	2.2 billion	2023-2033
CBS	AFC Sunday	2.1 billion	2023-2033
NBC	Sunday Night	2 billion	2023-2033
Previous:			
ESPN	Monday Night	1.9 billion	2014-2021
Fox	NFC Sunday	1.1 billion	2014-2022
CBS	AFC Sunday	1 billion	2014-2022
NBC	Sunday Night	950 million	2014-2022

Table 1: NFL Broadcasting Contracts
Source: https://www.statista.com/statistics/615688/ nfl-national-television-broadcast-deals-average-annual-value/

2.2.1 NFL Broadcasting

The most popular sport in the United States is American football, generating approximately $15 billion in revenue in 2019 (Gough, 2020). A significant portion of this revenue comes from selling television broadcasting rights. For instance, major networks such as CBS, Fox, and NBC pay substantial amounts to the NFL for the broadcasting rights to NFL Sunday games. According to Young (2019), CBS pays around $1 billion, Fox pays $1.1 billion, and NBC pays $950 million annually for these rights. The current broadcasting contracts are outlined in Table 1.[12] The NFL has a unique approach to distributing broadcasting revenues. Rather than favoring certain teams or markets, the league ensures that each team receives an approximately equal share of the broadcasting earnings. In 2019, this amounted to around $255 million per team (Hendricks and Vockrodt, 2019).

It is important to note that the broadcast of NFL games is regionally dependent, meaning that different regions in the United States have access to different games. This can be understood by examining the scheduling and broadcasting rights allocation. Figure 3 provides an example for Week 1 of the 2019 season. While Thursday, Monday, and Sunday night games are broadcasted nationwide, Sunday afternoon games are subject to regional broadcasting

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[12]Note that Thursday Night Football, which is broadcasted by multiple networks, including the NFL Network, is excluded from the table.

Thursday		
Packers vs. Bears	8:20 pm	

Sunday					
Rams vs. Panthers	1:00 pm	Colts vs. Chargers	4:05 pm	49ers vs. Buccaneers	4:25 pm
Redskins vs. Eagles		Bengals vs. Seahawks		Giants vs. Cowboys	
Bills vs. Jets				Lions vs. Cardinals	
Falcons vs. Vikings					
Ravens vs. Dolphins					
Chiefs vs. Jaguars					
Titans vs. Browns				Steelers vs. Patriots	8:20 pm

Monday			
Texans vs. Saints	7:10 pm	Broncos vs. Raiders	10:20 pm

Figure 3: NFL Schedule 2019 Week 1
Source: https://www.sportingnews.com/ca/nfl/news/nfl-2019-week-1-schedule-results-scores-tv-stream-canada/r6u6j3mpp9ko1w12fk72aqruz

restriction. On a typical Sunday afternoon, multiple games are played simultaneously. For example, in Week 1, there were seven games scheduled for 1:00 pm EST. The teams are divided into two conferences: the American Football Conference (AFC) denoted by red, and the National Football Conference (NFC) denoted by blue. The broadcasting rights for dual AFC games belong to CBS, while dual NFC games are broadcasted by Fox. In the case of AFC teams playing against NFC teams, the broadcasting rights are usually determined by the away team (e.g., Houston Texans vs. New Orleans Saints).

As a result of these regional broadcasting restrictions, viewers in a specific region may have access to some games while missing others.[13] To address this issue and provide fans with access to all NFL games, regardless of their location, the NFL introduced *NFL Sunday Ticket* in partnership with DirecTV in 1994. *NFL Sunday Ticket* is an exclusive package available to DirecTV subscribers, allowing them to watch out-of-market NFL games that are not typically available in their local regions.[14] Out-of-market games refer to those where one

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[13]For example in Figure 3, if in a given region Rams v. Panthers game is shown then the Falcons v. Vikings game will not be available given that Fox holds exclusive rights to broadcast both of these NFC games.

[14]Recently, *NFL Sunday Ticket* has been offered to those subscribed to streaming services. Beginning in 2023, for customers in the United States out-of-market games will be offered through YouTube TV as an

of the teams is not the primary team for a given region or does not belong to the region's division. On any given Sunday during the American football season, approximately 12 games are played, and the selection and distribution of these games across regions are determined by the NFL. When viewers tune-in to programming on *NFL Sunday Ticket* CBS and Fox local affiliates experience a considerable loss in revenue given that broadcast viewership decreases and therefore decreases revenue from local commercials. Given that local affiliates play a role in supporting the networks' programming expenses, CBS and Fox have incorporated provisions in their broadcasting contracts stipulating that subscribers of NFL Sunday Ticket must be charged a premium price.[15]

2.3 Antitrust Lawsuit

Exclusive-dealing contracts, such as the case of *NFL Sunday Ticket* offered by DirecTV, do not face an outright ban under antitrust law and are subject to the "rule of reason." This legal doctrine places the burden on consumers to demonstrate that harm is caused by the conduct of the firms involved, namely the NFL and DirecTV.[16] The central question is whether, in the absence of this exclusive agreement, consumers would have access to more games at lower costs, with the argument being that the high prices are a result of the relative market power held by the NFL and DirecTV.[17]

In December 2015, multi-district litigation was formed by consolidating over twenty lawsuits, primarily initiated by sports bar owners, against the NFL and DirecTV (Curley, 2019). These legal actions claimed that the exclusive dealing arrangement violated the Sherman Act due to alleged collusive behavior among the NFL's thirty-two teams and DirecTV's market monopoly. Initially dismissed, the litigation was reopened following a letter submitted by a

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ad-on package.

[15]https://profootballtalk.nbcsports.com/2022/06/25/cbs-fox-contracts-with-nfl-will-prevent-significant-reduction-in-price-of-sunday-ticket/

[16]Typically, antitrust conduct is considered "per se" illegal, meaning it is assumed to violate the law unless the firms can prove otherwise. However, in this case, the conduct is presumed legal unless consumers can provide sufficient evidence to the contrary.

[17]For the 2020 season, the cost of *NFL Sunday Ticket* was $293.94 on top of the required DirecTV package.

group of economists (Curley, 2019). The economists' letter argues that the NFL essentially represents a horizontal merger of teams rather than a joint venture with the product being NFL broadcasts (v DirecTV, 2018).[18]

3   Model

I develop a model with four agents: the NFL, broadcasters/channels, advertisers, and consumers. The model's objective is to construct a bargaining equilibrium that can be used for the counterfactual exercise of breaking up the NFL and having divisions directly bargain with channels.

The game has three stages. In stage 1, broadcasters and the NFL bargain over the cost of broadcast rights T. In stage 2, broadcasters set the optimal advertising price p, and advertisers decide whether to purchase an ad slot given p. In stage 3, consumers make a choice of whether to view the content/program on a given channel/broadcaster. To solve the model, I use backward induction.

3.1   Consumer Viewership Demand

Consumers select what to watch, if anything. I model the demand for broadcast channel programming using a two-level nested logit structure (e.g. Verboven, 1996; Björnerstedt and Verboven, 2016; Ciliberto et al., 2019). The assumed nesting structure is illustrated in Figure 4, where the upper nest is watching broadcast programming (inside goods) or not (outside option), and the lower nest is between what type of broadcast programming to watch. The rationale behind this partitioning framework is that consumers interested in watching sport programming are more likely to switch to other sport programming than something else. Furthermore, broadcast channel programming is dominant across television programming. Therefore, switching to the outside good of not watching broadcast channel programming is

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[18]The unified bargaining of the NFL is permitted by the Sport Broadcasting Act of 1961 enacted by Congress.
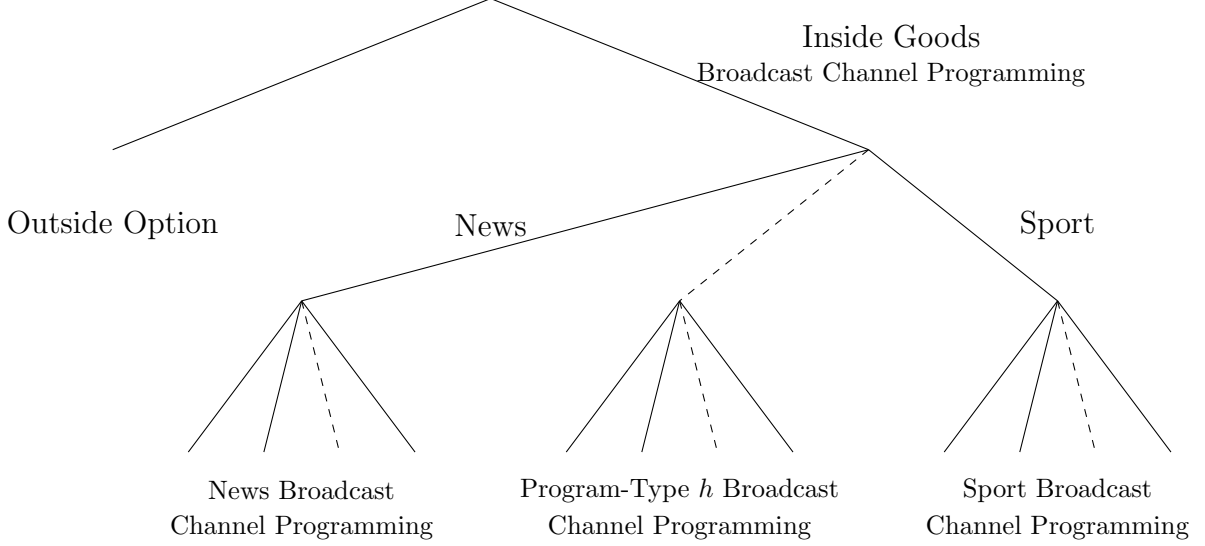
Figure 4: Structure of the Two-level Nested Logit Model

less likely than switching across broadcast offerings. The utility for consumer i of watching a channel c at time t in market n is given by

$$u_{ictn} = \mathbf{X}_{ctn}\boldsymbol{\beta} + \beta^A s^A_{ctn} M^A_n + \xi_{ctn} + v_{ictn}. \tag{1}$$

$\mathbf{X}_{ctn}$ are program-specific characteristics, e.g. genre, the time of day aired, and whether the program is shown on a weekend or not. Consumers view advertisements as a nuisance. s^A_{ctn} is the share of total potential advertisers who choose to air an ad during the program while M^A_n is the number of possible advertisers in market n. Therefore, $s^A_{ctn} M^A_n$ is the total number of ads shown, and β^A can be interpreted as a nuisance parameter. ξ_{ctn} is an unobservable program attribute. v_{ictn} is an unobservable program-specific taste component. The mean utility of the outside option of not watching a broadcast channel c is normalized to one. The distinction between broadcast and cable channels is made as broadcast channels are offered in all bundles and thus their presence in a consumer's choice set is not dependent on price. On the other hand, cable channels are specific to which cable package a consumer purchases and thus are a function of the package's price.

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Grigolon and Verboven (2014) demonstrates that the more tractable nested logit model can achieve comparable performance to more computationally intensive random coefficient models. This underscores the notion that the nested logit model, despite its relative simplicity, can achieve similar levels of performance to more complex alternatives when applied to scenarios where market segmentation plays a substantial role in shaping consumer behavior. The two-level nested logit structure is embedded in v_{ictn}. v_{ictn} is defined as

$$v_{ictn} = \epsilon_{igtn} + (1 - \sigma_2)\epsilon_{ihgtn} + +(1 - \sigma_1)\epsilon_{ictn}. \tag{2}$$

ϵ_{igtn}, ϵ_{ihgtn}, and ϵ_{ictn} are the random utility components and are assumed to follow an extreme value distribution, e.g. Gumbel distribution. By assuming an extreme value distribution for the random utility components, the nested logit model allows for capturing heterogeneity and unobserved factors that influence individuals' choices. The upper nest is denoted by the subscript $g \in \{0, 1\}$, with $g = 1$ for inside goods and $g = 0$ for outside goods. And the lower-nest is denoted by subscript $h \in \{1, .., H\}$ for program-type h programming. For consistency of random-utility maximization it must be the case that $0 \leq \sigma_2 \leq \sigma_1 < 1$. σ_1 and σ_2 represent the correlations between choices within the varying layers of the nests. Therefore choices within a given nest are allowed to have utilities that are more correlated compared to the standard logit model. The nested structure relaxes the independence of irrelevant alternatives assumption found in the traditional logit model, therefore allowing for more flexible substitution patterns.[19] When $\sigma_2 = \sigma_1 = 0$, the nested logit collapses to the traditional logit model.

Following the notation of Björnerstedt and Verboven (2016) and Ciliberto et al. (2019), let the set of programming option in subgroup h of group g be denoted C_{hgtn} for market

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[19]The independence of irrelevant alternatives (IIA) assumption states that the probability ratio between two alternatives is not affected by the presence or absence of other alternatives. In the context of logit models, this assumption means that the probability of choosing one alternative over another is solely determined by the attributes and characteristics of those two alternatives. The inclusion or exclusion of additional alternatives should not impact the relative choice probabilities. In more flexible choice models, such as nested logit models, relaxations of the IIA assumption are introduced to account for potential correlation or dependence among alternatives.

n at time t. The resulting share of consumers watching channel c at time t in market n is therefore

$$s_{ctn}^C = \frac{\exp(\delta_{ctn}/(1-\sigma_1)\exp(I_{hgtn}/(1-\sigma_1)\exp(I_{gtn})}{\exp(I_{hgtn}/(1-\sigma_1)\exp(I_{gtn}/(1-\sigma_2)\exp(I_{tn})} \tag{3}$$

where $c \in C_{hgtn}$ and I_{hgtn}, I_{gtn}, and I_{tn} are the "inclusive values" defined in Björnerstedt and Verboven (2016) and Ciliberto et al. (2019):

$$I_{hgtn} = (1-\sigma_1)\ln\sum_{k \in C_{hgtn}}\exp(\delta_{ktn}/(1-\sigma_1)) \tag{4}$$

$$I_{gtn} = (1-\sigma_2)\ln\sum_{h \in \{1,2\}}\exp(I_{hgtn}/(1-\sigma_2)) \tag{5}$$

$$I_{tn} = \ln(1+\exp(I_{gtn})). \tag{6}$$

δ_{ctn} denotes the mean utility common across programming in market n at time t and is defined as

$$\delta_{ctn} = \mathbf{X}_{ctn}\boldsymbol{\beta} + \beta^A(s_{ctn}^A M_n^A) + \xi_{ctn}. \tag{7}$$

3.2 Advertisement Price and Decision

Following e.g. Armstrong (2006) and Anderson and Coate (2005), advertisers decide whether to place an ad on a program given the ad price. Advertiser decisions are assumed to be independent across broadcasts.[20] In turn, each broadcast acts as a monopoly towards advertisers. An advertiser j places an ad if they receive positive profits from placing the ad. An advertiser is defined by their type α^j, which reflects that different advertisers have different willingness to pay for a program's consumer base.[21] Therefore the profits for advertiser j if j purchases

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[20]This assumption is justified given that an individual can at most watch one program at a time. Therefore each program has a unique set of individuals that advertisers decide whether to advertise to.

[21]Implicit in this structure is that advertisers multi-home. They are able to place ads on multiple channels at any given time.

an ad slot on channel c at time t in market n is given by

$$\pi_{ctn}^j = \alpha^j \psi_{ctn} s_{ctn}^C M_n^C - p_{ctn} \tag{8}$$

where s_{ctn}^C and M_n^C are the share of consumers viewing the program and the mass of consumers respectively. ψ_{ctn} is the advertiser-relevant program quality and reflects the attractiveness of the market/program. It can be thought of as the average over the consumer basket per-viewer profit from the ad. Together with the advertiser type, $\alpha^j \psi_{ctn}$ is the individual advertiser-specific profitability of placing an ad. Advertisers pay price p_{ctn} to place an ad on channel c at time t in market n.

If α^j is distributed according to c.d.f. $F(\alpha|\theta)$, then the equation for the share of ads shown on a given program is:[22]

$$s_{ctn}^A = 1 - F\left(\frac{p_{ctn}}{\psi_{ctn} s_{ctn}^C M_n^C}\bigg|\theta\right). \tag{9}$$

In other words, the share of ads is the fraction of advertisers whose effective per-viewer ad price is positive.

The price of an ad, p_{ctn}, is determined by the optimization problem of the channel c. The channel is unable to price discriminate and therefore sets a single ad price at a given time t in market n. Profits to channel c are

$$\pi_{ctn} = (p_{ctn} - mc_{ctn}) s_{ctn}^A M_n^A \tag{10}$$

where mc_{ctn} is the marginal cost to the channel of placing an ad on their program, s_{ctn}^A is the share of advertisers who advertise, and M_n^A is the set of potential advertisers. In this structure, channels do not directly earn profits from consumers, only indirectly. As it is written, this appears to be a traditional one-sided market. It is, in fact, two-sided given that

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[22]As noted in Song (2021) θ is a nonlinear parameter in the GMM estimation.

the share of advertisers, s_{ctn}^A, is a function of the share of consumers, s_{ctn}^C, and that the share of consumers is a function of the share of advertisers. The optimum price is found by taking the derivative of (10) with respect to price:

$$\frac{\partial \pi_{ctn}}{\partial p_{ctn}} = s_{ctn}^A + (p_{ctn} - mc_{ctn})\frac{\partial s_{ctn}^A}{\partial p_{ctn}} \tag{11}$$

where

$$\frac{\partial s_{ctn}^A}{\partial p_{ctn}} = \frac{-1}{\psi_{ctn}s_{ctn}^C M_n^C}f\left(\frac{p_{ctn}}{\psi_{ctn}s_{ctn}^C M_n^C}|\theta\right) \tag{12}$$

and $f(\cdot)$ is the p.d.f. of $F(\alpha|\theta)$.

3.3 Bargaining over Broadcast Rights

The NFL engages in bargaining negotiations with channels to allocate rights for the broadcasting of NFL games. Exclusive rights are granted to channels for bundles of games, including Monday, Thursday, and Sunday Night Football (all three of which are national games), as well as Sunday AFC and Sunday NFC games. The latter two bundles are specific to regional markets and represent only a subset of all potential games that could be broadcast as discussed in Section 2.2.1.

I analyze the bargaining dynamics between the channels and the NFL using a Nash-in-Nash framework. The equilibrium concept for this framework is further elaborated in Section 3.4. The bargaining problem can be formulated as follows:

$$T_c^\tau \equiv \operatorname{argmax}_T\left\{\left(\sum_{(t,n)\in\tau}\pi_{ctn} - T - \sum_{(t,n)\in\tau}\pi_{ctn}^0\right)^{\lambda_c}\left(T - \pi_{NFL}^0\right)^{1-\lambda_c}\right\} \tag{13}$$

where T_c^τ is the lump-sum transfer from channel c to the NFL in exchange for broadcasting rights and τ is a set of (t,n) pairs which denote the bundle of games that occur at time t in market n that the channel will be granted rights to broadcast. In other words, τ is
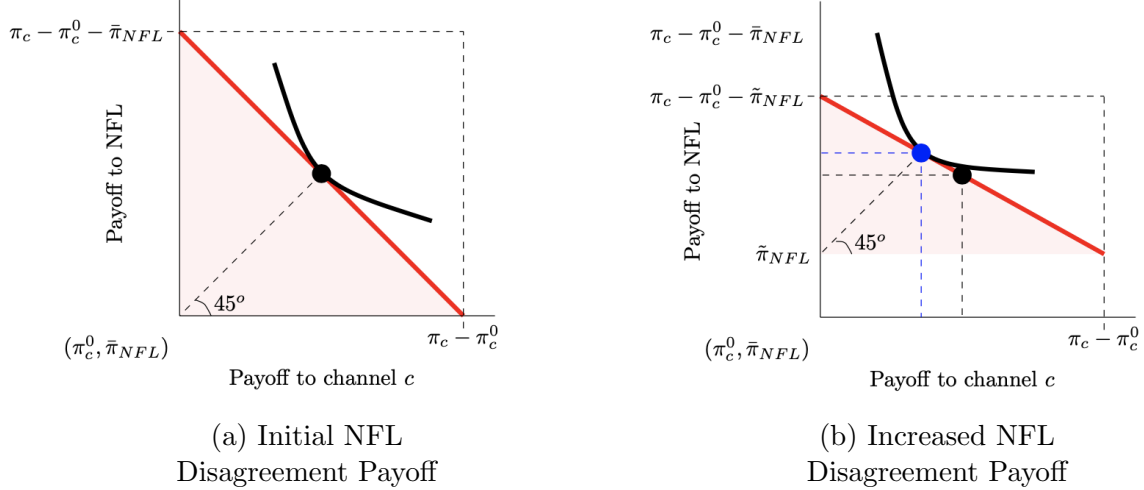
Figure 5: Impact of Disagreement Payoffs on Outcomes

the set of the games included in the bundle.[23] The disagreement payoff is denoted by π_{ctn}^0 which is the profits channel c would earn if it did not secure the contract with the NFL. The determination of π_{NFL}^0 as the disagreement payoff for the NFL is pivotal to the equilibrium concept and is defined in Section 3.4. The bargaining parameter λ_c is specific to channel c and influences the channel's relative bargaining power.

The lump-sum transfer is determined by the first-order condition, yielding the following expression:

$$T_c^\tau = \lambda_c \pi_{NFL}^0 + (1 - \lambda_c) \sum_{(t,n)\in\tau} (\pi_{ctn} - \pi_{ctn}^0). \tag{14}$$

Equation (14) shows that, as the reservation price of channel c, represented by $\sum_{(t,n)\in\tau}(\pi_{ctn} - \pi_{ctn}^0)$, increases, the lump-sum transfer also increases.[24] The same principle applies to the NFL's disagreement point, meaning that the NFL benefits more when it has a stronger alternative option. Conversely, if channel c's outside option, π_{ctn}^0, increases, the lump-sum transfer decreases. The effect of changing the NFL's disagreement point can be seen in Figure 5.[25] The vertical axis represents the NFL's payoff, while the horizontal axis represents the

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[23]Bundle τ is an institutional detail exogenously given.

[24]$\sum_{(t,n)\in\tau}(\pi_{ctn} - \pi_{ctn}^0)$ can be understood as the reservation price of channel c since it represents the maximum amount the channel is willing to pay to acquire the NFL broadcasting rights. For the acquisition of rights to be worthwhile, it must hold true that $\sum_{(t,n)\in\tau} \pi_{ctn} - T_c^\tau > \sum_{(t,n)\in\tau} \pi_{ctn}^0$.

[25]Figure 5 only represents the bargaining occurring between channel c and the NFL in a vacuum.

payoff for channel c. Channel c's maximum payoff corresponds to its profit from obtaining the contract, denoted as π_c, minus its outside option, represented as π_c^0. Similarly, the NFL's maximum payoff is derived from the reservation price of channel c minus its outside option, denoted as $\bar{\pi}_{NFL}$. The minimum payment that channel c can obtain is π_c^0 and the minimum payment the NFL can receive is $\bar{\pi}_{NFL}$. The origin of the graph has been scaled to reflect this. The red line delineates the Pareto frontier of the bargaining problem, with the shaded red area indicating the region of feasible and individually rational payoffs. The bold black lines signify the level curves, and the point of tangency between the level curves and the Pareto frontier represents the equilibrium outcome. In Figure 5, the optimality aligns with the 45-degree line, assuming a bargaining parameter λ_c of 0.5.[26] If the NFL's disagreement payoff were higher, $\tilde{\pi}_{NFL}$ where $\tilde{\pi}_{NFL} > \bar{\pi}_{NFL}$, the outcome would resemble Figure 5(b), indicated by the blue point. As observed on the y-axis reflecting NFL payoffs, the NFL achieves higher payoffs when its outside option is greater. Conversely, channel c attains lower payoffs when the NFL's disagreement payoff is increased. This relationship is evident when comparing the outcomes between the blue and black points on each axis.

3.4   Equilibrium Concept

In order to incorporate the impact of unmatched bargaining pairs on the equilibrium lump-sum transfer, I propose a competitive bargaining extension *Nash-in-Nash with Endogenous Outside Option* (NNEOO). NNEOO relaxes the assumption of passive beliefs and introduces a ranking of channels based on their reservation prices, which reflect their profits from acquiring the contract net their outside options. Specifically, when the NFL engages in bargaining with the channel possessing the highest reservation price, the second highest reservation price is considered as the NFL's disagreement point within the NNEOO framework.

This model complements Milgrom and Weber (1982) by accounting for competitive bidding. In an English open outcry auction the auctioneer continues raising the bid price until

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[26]In Figure 5(b), the 45-degree line is from where channel c and the NFL each make zero payoffs.
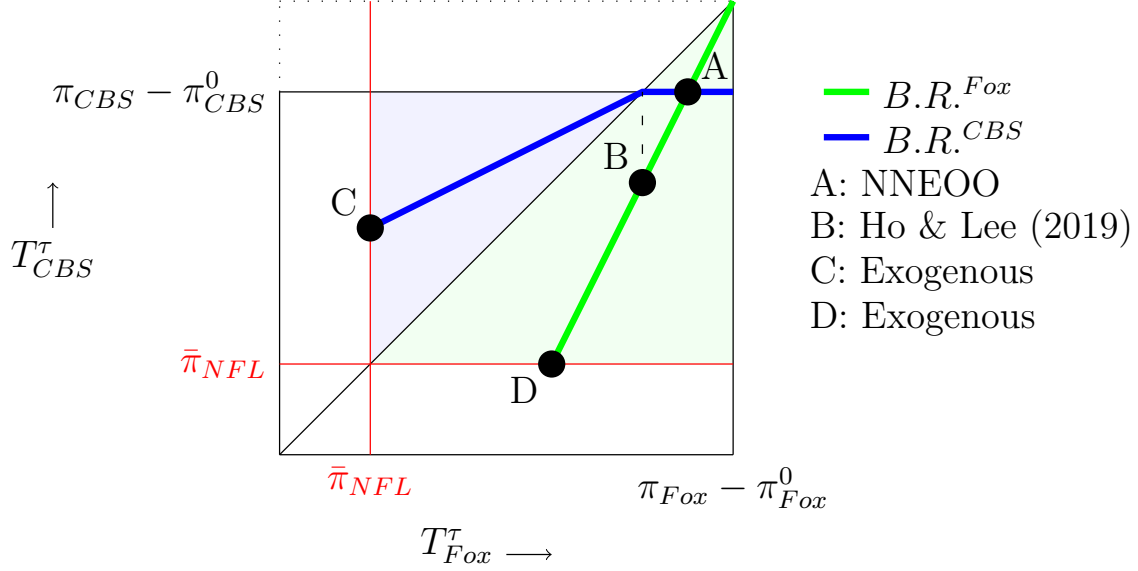
Figure 6: Graphical Representation of NNEOO

only one bidder remains. The last and highest bidder wins the item and the winning bidder pays the amount they bid as the final price, effectively paying the second-highest bidder's last bid (reservation price). Departing from the auction literature, I then introduce a second stage where the auctioneer and the last and highest bidder bargain over remaining surplus.

The bargaining problem is complex in that there are multiple simultaneous two-player bargaining problems with interdependent Pareto frontiers. The two-players are the NFL and the channels, which are bargaining over the exclusive broadcasting rights to a bundle of games τ. Let $\mathcal{C}$ be the set of channels; this set is assumed to be exogenous. The NFL aims to maximize its utility, which is the lump-sum transfer T_c^τ, and channel $c \in \mathcal{C}$ maximizes its utility $\sum_{(t,n)\in\tau} \pi_{ctn} - T_c^\tau$, where π_{ctn} is the profit from the NFL game broadcast at time t in market n. In the case of disagreement the NFL receives $\max\{\max_{h\neq c} T_h^\tau, \bar{\pi}_{NFL}\}$. In the event of disagreement channel c obtains π_c^0.

Figure 6 is a graphical representation of NNEOO with two channels. In the figure, Fox has the highest reservation price, $\pi_{Fox} - \pi_{Fox}^0$, while CBS has the second highest.[27] The vertical and horizontal axes are the lump sum transfers from CBS and Fox, respectively, to NFL for

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[27] For ease and clarity π_{Fox} and π_{CBS} represent $\sum_{(t,n)\in\tau} \pi_{ctn}$ and π_{Fox}^0 and π_{CBS}^0 represent $\sum_{(t,n)\in\tau} \pi_{ctn}^0$ where $c = \{Fox, CBS\}$.

game bundle τ. The blue shaded region is when CBS wins the contract, i.e. $T^\tau_{CBS} > T^\tau_{Fox}$, and greater than the NFL's exogenous outside option of $\bar{\pi}_{NFL}$ were the NFL not to contract with either channel. Similarly, the green region is when Fox wins the contract. The best response functions of CBS and Fox are noted by the blue and green lines respectively.[28] Point A reflects the NNEOO outcome where CBS offers its reservation price and Fox and the NFL bargain over the remaining surplus. Point B is the corresponding outcome to Ho and Lee (2019)'s solution concept.[29] Ho and Lee (2019) model the negotiations between insurers and hospitals. In their setup contracts are not exclusive. The exclusivity combined with the two-sided market structure employed in my application allow me to disentangle the bargaining game from the downstream profits. Therefore, I can place the second-highest competitor's reservation price directly into the bargaining game between the highest-value channel and the NFL.

Formally this can be defined in the following way: Let channel c contract with the NFL in equilibrium. I define the NNEOO lump-sum transfer for channel c over the bundle τ to be

$$T^\tau_c \equiv \mathrm{argmax}_T \left\{ \left(\sum_{(t,n)\in\tau} \pi_{ctn} - T - \sum_{(t,n)\in\tau} \pi^0_{ctn} \right)^{\lambda_c} \left(T - \max\left\{ \max_{h\neq c}\{ \sum_{(t,n)\in\tau} (\pi_{htn} - \pi^0_{htn})\}, \bar{\pi}_{NFL} \right\} \right)^{1-\lambda_c} \right\}$$

(15)

where notation follows that of (13) and the disagreement point for the NFL is the highest reservation price of the remaining channels. The NFL's exogenous outside option of $\bar{\pi}_{NFL}$ is

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[28]The best response functions come from placing T^τ_{Fox} and T^τ_{CBS} in the opposing broadcasters bargaining problem. For example, placing T^τ_{CBS} in place of π^0_{NFL} in equation (13). Note the horizontal portion of the best response function of CBS. This is a corner solution. CBS is unwilling to offer more than its reservation price. Therefore, even though Fox offers more CBS continues to offer its reservation price.

[29]Using Ho and Lee (2019)'s solution concept *Nash-in-Nash with Threat of Replacement* results in Fox offering the reservation price of CBS given that this paper focuses on exclusive contracts. The NFL uses the reservation price of CBS to better its position when bargaining with Fox in NNEOO, while in Ho and Lee (2019) Fox offers the NFL a take-it or leave-it offer at CBS's reservation price. Points C and D are the outcomes when the outside option of the NFL is exogenous.

used as the NFL's minimum payoff to engage in negotiations.[30,31] To guarantee that NNEOO prices exist and are unique I establish the following lemma.[32]

Proposition 3.1. For any negotiated lump-sum transfer prices over bundle τ, there exists a unique NNEOO transfers $T^{\tau*}$, given unique equilibrium market shares.

Proof. The lump-sum NNEOO payments are defined as:

$$T_c^{\tau*} = (1 - \lambda_c) \sum_{(t,n) \in \tau} (\pi_{ctn} - \pi_{ctn}^0) + \lambda_c \max\Big\{ \max_{h \neq c}\{ \sum_{(t,n) \in \tau} (\pi_{htn} - \pi_{htn}^0)\}, \bar{\pi}_{NFL} \Big\}.$$

The lump-sum NNEOO payments are a function of profit terms which are assumed to be independent of the lump-sum payments and are unique, then given that $T_c^{\tau*}$ is defined above as a closed form solution of the profit terms, the payments exist and are unique. ■

The existence of Proposition 3.1 holds without having unique market shares given the closed-form solution; it is the uniqueness that is dependent on unique market shares. In the case of two-sided markets multiplicity of market shares is a concern. For example, as shown in Song (2021) if both sides of the market, i.e. viewers and advertisers, face a traditional Logit demand then the uniqueness of the market shares exists if $\{(\beta^A, \alpha) \mid -2 \leq \beta^A \leq 2 \text{ and } -2 \leq \alpha \leq 2\}$, where β^A is how much consumer's value advertisers and α is how much advertiser's value consumers.[33]

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[30]To compare (15) to other solution concepts in the literature: replace π_{NFL}^0 in (13) with $\bar{\pi}_{NFL}$ for the solution under passive beliefs. This is because under my framework of exclusive contracts when there is no renegotiation then the NFL is left "unmatched" in the case of disagreement. This is reflected in points C and D in Figure 6. Ho and Lee (2019) have the outcome, in my setting, as the maximum of the $\max_{h \neq c}\{\sum_{(t,n) \in \tau} (\pi_{htn} - \pi_{htn}^0)\}$ and the solution of (13) when $\bar{\pi}_{NFL}$ is the NFL's disagreement point.

[31]When $\max\Big\{ \max_{h \neq c}\{\sum_{(t,n) \in \tau} (\pi_{htn} - \pi_{htn}^0)\}, \bar{\pi}_{NFL} \Big\} = \bar{\pi}_{NFL}$, NNEOO reduces to the solution concept of Ho and Lee (2019).

[32]NNEOO prices are assumed to lie on a compact interval of the real line.

[33]The uniqueness follows from Gale and Nikaido (1965) which states that a function mapping from a convex set $X \subset \mathbb{R}^m$ to $\mathbb{R}^m$ is one-to-one if its Jacobian is negative quasidefinite for all $x \in X$. The intuition is that for smaller the preferences for interacting with the other side the more likely the market shares are unique.

3.4.1 Microfoundation for Nash-in-Nash with Endogenous Outside Options

The bargaining stage in my model is simultaneous, but the following sequential game between the NFL and two channels v and w—that results in the same outcome—can also be constructed.

- In period 0, the NFL announces its intention to bargain openly with channel v and w over a given bundle τ.

- In period 1 the outcome of bargaining is determined according to equation (14), where $\pi^0_{NFL} = \bar{\pi}_{NFL}$ in both bargaining pairs.

- In period $t > 1$, assuming an agreement has not been reached, representatives of the NFL and channels v and w respectively meet. The outcome of bargaining in period t is found by comparing T^τ_v and T^τ_w from period $t-1$. If $T^\tau_v > T^\tau_w$, without loss of generality, then in the bargaining with v, the outside option of the NFL, π^0_{NFL} is updated to T^τ_w.

- This iterative bargaining continues until one of the channels has dropped out of the race. In period T when only one channel remains, assuming that $\sum_{(t,n)\in\tau}(\pi_{vtn} - \pi^0_{vtn})\} > \sum_{(t,n)\in\tau}(\pi_{wtn} - \pi^0_{wtn})\}$, without loss of generality, then the solution is that the NFL's outside option is updated to $\sum_{(t,n)\in\tau}(\pi_{wtn} - \pi^0_{wtn})\}$, given that in period $T-1$ channel w has offered up all its remaining surplus to the NFL. In turn, the NFL then uses this updated outside option to bargain with the channel v. The resulting prices is given by solving for the optimal lump-sum transfer according to equation (15).

Examination of the lump-sum transfer conditions in equation (14) implies there is a linear relation between the transfers. This induces an iterative procedure akin to a step-function, characterized by successive transitions between best-response strategies. This cycle persists until the channel with the second-highest reservation price stabilizes, reaching its reservation threshold. Subsequently, the channel with the highest reservation price responds optimally
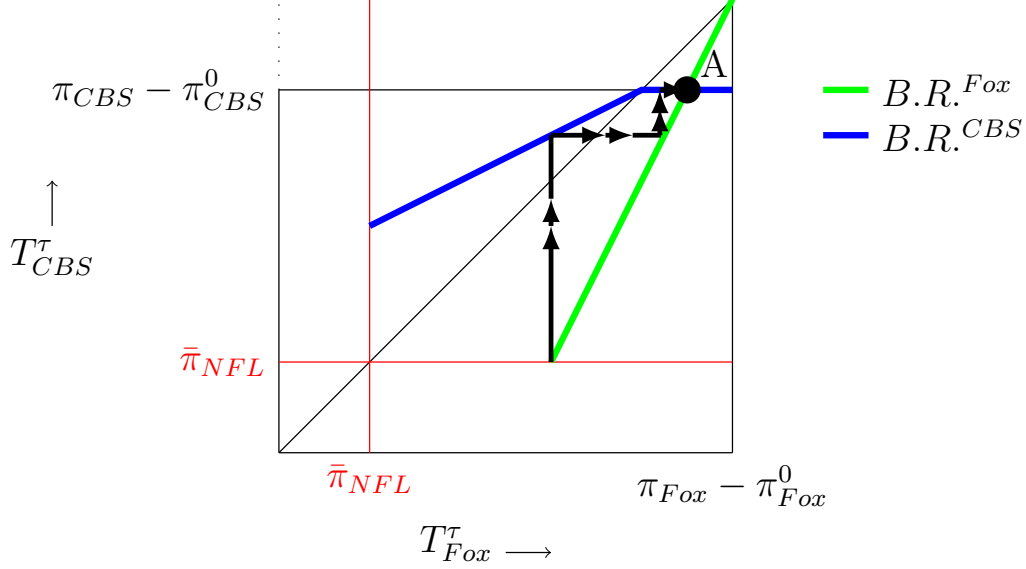
Figure 7: NNEOO as an Iterative Process

to this condition. This dynamic is visually depicted in Figure 7 by the prominent, thick black arrowhead line.

3.5 Estimation Strategy

Given that I assume a two-level nested logit consumer demand I can use Berry (1994)'s solution to back out demand parameters using the shares of consumers viewing a channel. I divide the share of consumers viewing a channel by that of the outside option and I normalize the mean utility of the outside option of not watching a broadcast channel to one to get the following moment condition

$$\ln(s_{ctn}^C) - \ln(s_{0tn}^C) = \mathbf{X}_{ctn}\boldsymbol{\beta} + \beta^A(s_{ctn}^A M_n^A) + \sigma_1\ln(\bar{s}_{ctn|hg}^C) + \sigma_2\ln(\bar{s}_{h|g}^C) + \xi_{ctn} \qquad (16)$$

where s_{0tn}^C is the share of consumers not watching a broadcast channel at time t in market n. $\bar{s}_{ctn|hg}^C$ is the market share of channel c as a fraction of the total subgroup-h's share giving the probability of product c conditional on its subgroup being selected. $\bar{s}_{h|g}^C$ is the probability that product c's subgroup is selected conditional on its group being selected.

Using Song (2021), if advertiser type is drawn from a log normal distribution then (9) becomes

$$s_{ctn}^A = 1 - \Phi\left(\frac{1}{\sigma_A}\ln\left(\frac{p_{ctn}}{\psi_{ctn}s_{ctn}^C M_n^C}\right)\right). \tag{17}$$

where σ_A is the standard deviation of the distribution, and $\Phi(\cdot)$ is the c.d.f. of the standard normal distribution.[34] ψ_{ctn} is assumed to have a linear functional form

$$\psi_{ctn}(\theta) = \mathbf{Y}_{ctn}\boldsymbol{\gamma} + e_{ctn}^A \tag{18}$$

where $\mathbf{Y}_{ctn}$ are observable advertiser relevant broadcast attributes outside of the number of viewers on channel c, e.g. average consumer age and income. $\hat{\psi}_{ctn}$ is found by rearranging (17):

$$\hat{\psi}_{ctn} = \frac{p_{ctn}}{s_{ctn}^C M_n^C}\frac{1}{\exp(\sigma_A(\Phi^{-1}(1 - s_{ctn}^A)))}. \tag{19}$$

Combing (19) with (18) gives

$$e_{ctn}^A = \hat{\psi}_{ctn} - \mathbf{Y}_{ctn}\boldsymbol{\gamma} \tag{20}$$

as the advertiser moment condition.

To estimate the broadcaster moment condition a channel's marginal cost is treated as the opportunity cost of placing an ad. In lieu of placing an ad, the channel could instead advertise an upcoming program. I assume marginal cost is a linear function of observable cost shifters, $\mathbf{Z}_{ctn}$,

$$mc_{ctn} = \mathbf{Z}_{ctn}\boldsymbol{\omega} + e_{ctn}^C. \tag{21}$$

$\mathbf{Z}_{ctn}$ includes whether in the adjacent day there is an upcoming new program airing.[35] Using

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[34]This formulation assumes the mean of the log-normal distribution is zero. As noted in Song (2021), given that I assume the utility of not advertising is zero, the distribution's mean is therefore also zero. Furthermore, the constant present in (18) cannot be disentangled from the mean of the distribution, and therefore both parameters cannot jointly be identified.

[35]The idea behind this cost shifter is that the opportunity cost of having an advertiser place an ad is higher given that the channel desires to promote a new program more than a rerun.

the first order condition of the channel, (11), marginal cost is estimated by

$$\hat{mc}_{ctn} = p_{ctn} + \frac{s_{ctn}^A}{\frac{\partial s_{ctn}^A}{\partial p_{ctn}}} \tag{22}$$

where $\frac{\partial s_{ctn}^A}{\partial p_{ctn}}$ is as defined in (12) and $f(\cdot)$ is the p.d.f of the log normal distribution with standard deviation σ. The resulting broadcaster moment condition is

$$e_{ctn}^C = \hat{mc}_{ctn} - \mathbf{Z}_{ctn}\boldsymbol{\omega}. \tag{23}$$

To estimate the bargaining problem between the NFL and a given channel c I first need to conduct a counterfactual to see what the profits for channel c would have been had the NFL not contracted with c, i.e. $\sum_{tn \in \tau} \pi_{ctn}^0$, and what channel h's profits would have been had they contracted with the NFL, $\sum_{tn \in \tau} \pi_{htn}$. This is done by first estimating the consumer, advertiser, and channel parameters $\{\boldsymbol{\beta}, \beta^A, \boldsymbol{\gamma}, \sigma, \boldsymbol{\omega}\}$ from (16), (20), and (23). I then solve for the optimal counterfactual ad prices, $\{\widetilde{p}_{jtn}\}_j$, once program offerings are changed; the tilde represents counterfactual outcomes. The new program offerings are based on not only estimating which programming type would yield the highest profits for the channel, but also I am able to extract additional information regarding what a channel views as the next-best programming option by leveraging the NFL's double-header programming guidelines. The NFL states that "Fox and CBS will each have eight doubleheaders. In those weeks, one network will show games in both Sunday afternoon time slots, while the other will air only one game in either of the two time slots."[36,37] Given that each network will therefore effectively have an open time slot periodically throughout the season I can use this information to determine a channel's perceived second-best programming option aiding in the computation

[36]See https://operations.nfl.com/gameday/nfl-schedule/creating-the-nfl-schedule/

[37]Further information regarding how double-header rools along with general league broadcasting guidelines impact broadcasters can be found at https://fox11online.com/sports/packers-and-nfl/an-explanation-of-the-guidelines-for-nfl-tv-coverage . Fox11 is a local Fox affiliate stationed in Green Bay, Wisconsin and is the home station of the Green Bay Packers. The article discusses how local programming can be impacted by league broadcasting rules.

of the broadcasters outside option. The set of prices $\{\widetilde{p}_{jtn}\}_j$ are then used to calculate the share of advertisers who choose to advertise in the counterfactual, $\{\widetilde{s}^A_{jtn}\}_j$, to calculate counterfactual profits. To back out the Nash bargaining parameter λ_c, I use

$$0 = T^\tau_c - (1 - \lambda_c) \sum_{tn \in \tau} (\pi_{ctn} - \pi^0_{ctn}) - \lambda_c \max_{h \neq c} \left\{ \sum_{tn \in \tau} (\pi_{htn} - \pi^0_{htn}) \right\}.$$

4 Data

This paper utilizes two primary data sources to support its analysis. The first is a proprietary data set comprising individual-level consumer television viewership data, covering a span of five years from 2019 to 2023. This data set includes a representative sample of 2,000 households in the United States, with each entry containing unique identifiers for both the household and the individuals within it. The data captures detailed information such as the start time of viewing, channel, channel type (e.g., broadcast cable, premium cable), and program title. Additionally, program characteristics data is available, including genre, type, and whether the broadcast is a rerun. Individual-level demographics, including age, gender, education level, and income bracket, are also provided. The data set further includes information on the advertisements seen by individuals during the broadcast, such as advertisement title, length, type (e.g., local, national), and its position in the advertisement lineup.

The second data source is Nielsen Ad Intel, which offers comprehensive data on advertisement spending across various media, including television. In addition to expenditure data, Ad Intel provides detailed information about the television advertisements, including the channel, ad length, and the precise date and time of airing within a five-minute window. Furthermore, Ad Intel offers impression data, which estimates the number of consumers reached for each TV program. To complement these data sets, the terms of broadcaster and NFL contracts are collected from reliable news sources, and information on the differences

	ABC	CBS	Fox	NBC
Adv. price ($000)	60	116	194	124
Adv. second	512	432	397	421
CPM ($)				
Monday	14	15	40	23
Tuesday	16	13	41	30
Wednesday	17	19	45	21
Thursday	14	22	51	31
Friday	13	15	31	16
Audience (000)				
Monday	4,709	3,986	2,610	5,086
Tuesday	3,280	5,049	2,285	5,217
Wednesday	3,403	3,574	3,330	4,743
Thursday	3,773	4,418	4,393	3,162
Friday	3,037	4,165	1,899	2,941

Table 2: Prime Time Major Network Descriptive Statistics

in regional airings of NFL Sunday games is compiled.

These data sources, together with the contract terms and regional airing disparities, form the foundation for the empirical analysis in this study, enabling a comprehensive examination of the dynamics and outcomes within the television broadcasting industry.

Table 2 provides an overview of the price of an advertisement on the major networks during prime time. Further provided are the average number of seconds of advertisements per thirty minute slot, the average audience sizes for Monday to Friday,and the cost-per-thousand viewers (CPM). Fox charges the highest price for a thirty second ad slot, and also has the lowest level of advertisements, while ABC both charges the least and has the highest ad level. Table 3 provides the summary statistics for all the variables in the data set.

5   Results

The estimation results for four different specifications of viewership demand are presented in Table 4. Columns (1) and (2) present two-level nested logit structure estimations with different fixed effects. The preferred specification, Column (1), includes month fixed effects in addition to time of day and weekday indicators. Columns (3) and (4) present the tradi-

	# obs.	mean	s.d.	min	max
Advertiser Variables					
Duration	34,285	388.8	203.4	5	960
Impression	34,285	2,464,179	2,561,971	88,669	49,300,000
Price	34,285	60,616.2	158,994.2	180	5,201,300
Ad Share	34,285	0.0016	0.0009	0.00002	0.0043
Marginal Cost	34,285	0.9705	0.1693	0	1
Consumer Variables					
Ad Level	3,721,707	20.733	7.514	0.6	82.5
NFL	3,721,707	0.01871	0.1355	0	1
Competitors Marginal Cost	3,721,707	2.368	0.956	0	3
Upper Nest Marginal Cost	3,721,707	0.8867	0.23296	0	1
Lower Nest Marginal Cost	3,721,707	0.8867	0.3039	0	1

Table 3: Variable Descriptive Statistics

tional logit specifications. The inclusion of day-part fixed effects accounts for variations in viewing habits based on different times of the day, such as early morning, mid-afternoon, and prime time. The inclusion of a weekend indicator captures differences in viewing behavior between weekends and weekdays. The coefficient on the level of advertising is negative and significant, indicating a traditional price effect. The ordering of the σ_1 and σ_2 parameters aligns with random-utility maximization. The estimate for the correlation coefficient of the upper nest, σ_1, signals high correlation between broadcast programming options. Viewers are less likely to switch from broadcast programming to other avenues (e.g., cable) compared to switching between different broadcast programming offerings. The estimation utilizes eight instrumental variables, including marginal costs for the broadcaster, mean marginal costs for the lower and upper nests, and marginal costs for competitors. These instrumental variables are calculated for both the day of programming and the following day. The presence of a new program in a related programming type on the day of or the following day is used as a proxy for the marginal cost the broadcaster faces when allocating advertisement slots. This assumes that broadcasters prioritize promoting new programming over reruns, as they value drawing additional viewers to future programming on the channel.

	Nested Logit		Basic Logit	
	(1)	(2)	(3)	(4)
Ad Level	-0.034***	-0.023***	-0.023***	-0.011***
	(0.001)	(0.001)	(0.001)	(0.001)
σ_1	0.879***	0.868***		
	(0.021)	(0.021)		
σ_2	0.558***	0.577***		
	(0.028)	(0.027)		
NFL	0.760***	0.814***	0.912***	0.975***
	(0.007)	(0.007)	(0.003)	(0.003)
Elasticities:				
Own	-7.7075	-4.778	-0.4648	-0.2223
	(3.763)	(2.280)	(0.173)	(0.083)
Cross: Within Program	1.8545	1.1482	0.0006	0.0003
	(2.526)	(1.482)	(0.013)	(0.006)
Cross: Across Program	0.4018	0.2948	0.0006	0.0003
	(0.634)	(0.464)	(0.013)	(0.006)
Cross: Outside Good	0.0211	0.0143	0.0006	0.0003
	(0.019)	(0.013)	(0.013)	(0.006)
IVs	Yes	Yes	Yes	Yes
Fixed Effects	Month,	Day-Part,	Month,	Day-Part,
	Day-Part,	Weekday	Day-Part,	Weekday,
	Weekday		Weekday	
R-squared:				
Within	0.3874	0.4141	0.3984	0.4008
Between	0.0011	0.0142	0.9215	0.8211
Overall	0.4383	0.4481	0.3759	0.3734

Note: This table presents the estimation results of four different specifications of the viewership demand model. There are 2,614,837 observations. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 4: Estimated Parameters of Programming Demand by Viewers

	(1)	(2)
$\alpha_i \sim LN(0, \sigma_A^2)$	0.04 ***	0.04 ***
	(0.00003)	(0.00003)
Sport Event	0.0123***	0.0123***
	(0.0032)	(0.0032)
NFL	0.0100***	0.0097***
	(0.0010)	(0.0010)
Prime–Time	0.0100***	0.0100***
	(0.0007)	(0.0007)
Overnight	-0.0016***	-0.0016***
	(0.0005)	(0.0005)
IVs	Yes	Yes
Fixed Effects	Month, Day-Part, Weekday Program-Type	Day-Part, Weekday Program-Type

Note: There are 24,067 observations. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 5: Estimated Parameters of Advertisers

	(1)
Marginal Cost	20,705.801***
	(7,957.8)
Lead Marginal Cost	11,374.545*
	(6,845.5)
IVs	Yes

Note: There are 24,067 observations.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 6: Estimated Parameters of Channel Pricing Optimization

The results of the advertiser demand estimation are presented in Table 5.[38] The estimated value of σ_A represents the average willingness to pay of advertisers to reach an individual consumer, which is estimated to be \$0.04. This finding aligns with the observed spending patterns for Super Bowl advertisement expenditures. Specifically, the average cost per viewer for a 30-second ad slot during the 2023 Super Bowl was \$0.06 dollars.[39] It is worth noting that there is a positive coefficient associated with advertising on sporting events - this variable includes a wide range of sporting events included in the analysis, ranging from traditional football, basketball, baseball, and soccer games to niche events such as dirt bike racing and monster truck rallies. Advertisers place an even higher premium on NFL games, as indicated by the statistically significant positive coefficient on the NFL indicator given that this coefficient is compounded by that of general sporting. Instrumental variables are the same as those used in the viewer demand estimation.

The findings of the channel pricing optimization, based on equation (23), are presented in Table 6. Column (1) presents the results and includes an additional fixed effect for the month compared to column (2). The estimation incorporates two marginal cost shifters. The first shift is determined by whether there is a new show in the related programming category on the same day as the programming in question. For instance, if a drama show like Grey's Anatomy is followed by a new episode of another drama show like The Good

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[38]Some coefficients have been suppressed for clarity. The estimation included fixed effects for 40 program types (e.g. adventure, award ceremonies, news, sports event) as well as time of day fixed effects.

[39]See https://www.statista.com/statistics/217134/total-advertisement-revenue-of-super-bowls/

Fox	(0.327, 0.673)
NBC	(0.264, 0.736)
CBS	(0.295, 0.705)
ABC	(0.236, 0.764)

Table 7: Estimated Bargaining Parameters

Doctor, this marginal cost shifter is activated. The second shift is based on whether there is a new show in the related programming category on the following day. The marginal cost shifter for a new related show today is positive and significant. A broadcaster, on average, needs to be compensated an additional $20,705 to air an ad slot instead of a tune-in when there is a related program the same-day and $11,374 for the following day. Instrumental variables used include the means across both all broadcast programming as well as within a broadcast program type for all channels for whether there was a new program day of or the following day of a related program and the sum of marginal cost shifters of other channels.

The results of bargaining between channels and the NFL is presented in Table 7. Each cell presents the bargaining parameter for the channel and then that of the NFL. Fox's relative bargaining power against the NFL is the highest of the broadcast channels, this is consistent with the findings of Table 2 given that advertisers are willing to pay a higher premium to reach Fox's audience regardless of programming.

6   Counterfactual Analysis

The collective bargaining negotiations between the NFL and broadcast channels have led to significant consolidation in the programming packages offered to broadcasters. Within the framework of my estimated NFL programming demand model, as detailed in Sections 3 and 5, I am able to examine the implications of bargaining decentralization. In this paper, I focus on decentralization at the divisional level as my counterfactual scenario. Within this

framework, bargaining decentralization has the potential to impact various aspects, including the content delivered to consumers and its consequent effects on consumer welfare, channel pricing structures, and the advertisement slot fees advertisers incur to access their target audience.

This multifaceted impact stems from the newfound ability of channels to enhance their outside option profits by leveraging the variety of contracts available to a channel. My model accommodates the possibility for broadcast channels to hold multiple division-level contracts, allowing them flexibility in selecting which bundle of contracts aligns with their strategic objectives. As previously discussed in Section 2, the current arrangement divides available Sunday contracts by conference, effectively bundling divisions within a conference together. In the counterfactual scenario, channels gain the autonomy to strategically choose the combination of contracts that best suits their preferences and objectives.[40] This flexibility impacts the equilibrium concept as the channel is now also able to update its outside option π_c^0 in equation (15).

Figure 8 illustrates the favored division choice for each market. Several critical factors, including fan distribution, fan volume, and regional demographics, significantly influence a channel's preference toward a particular division. Moreover, broadcasters consider factors such as the secondary division preference within a market. In cases where a channel does not possess broadcasting rights for the most sought-after game within a market, they will opt to air the subsequent preferred game if contractual arrangements allow for its broadcast. These factors, in turn, exert a profound impact on the advertising slot pricing strategies that channels can employ. For instance, while the NFC West (indicated in yellow) enjoys a substantial presence across multiple states, the lower population density of these states renders it less lucrative compared to the AFC East (indicated in purple). Consequently,

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[40]In the existing NFL contractual agreements, cross-conference game broadcasting rights are assigned to the channel holding the contract for the home team. To simulate cross-division game scenarios, I apply a comparable structural assumption, stipulating that the contract holder representing the home team's division possesses the authority to televise the game. I also eliminate double-header rules in the counterfactual for ease of computation.
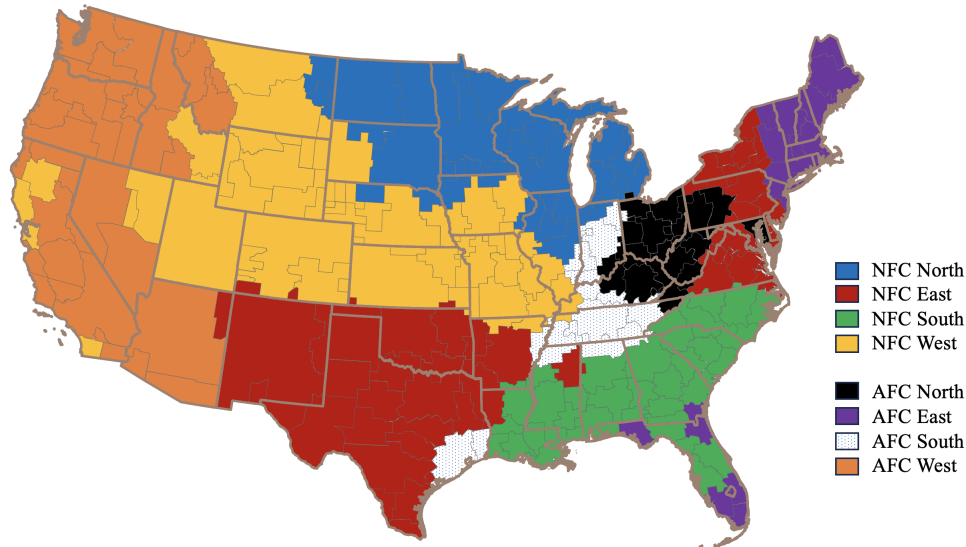
Figure 8: Market-level Division Preference

from a broadcasting rights perspective, the AFC East emerges as a more valuable acquisition than the NFC West.

Table 8 provides both who purchases which NFL Sunday contracts and at what price. Fox holds the most contracts, with three in its portfolio, while NBC holds the fewest, with just one contract.[41] This distribution aligns with expectations, given Fox's advantageous bargaining position, allowing them to secure favorable agreements that diminish the significance of a division's outside options. Notably, Fox has secured the NFC East contract, which enjoys the highest viewership and consequently holds the greatest value. The second and third most valuable contracts, namely the NFC North and AFC East, are held by CBS and ABC, respectively. Fox's strategic choice not to pursue these contracts can be rationalized by the considerable competition and escalating costs associated with retaining exclusive broadcasting rights. Instead, Fox focuses on contracts for divisions of intermediate popularity. These divisions exhibit substantial regional appeal without incurring the high

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[41]The reconfiguration of the NFL Sunday game contracts leads to an increased number of games available for viewers. This restructuring allows for the potential airing of up to four games concurrently, as opposed to the current limit of two. Additionally, under the counterfactual contract structure, broadcasters such as NBC may choose to air alternative programming based on market demand, despite having the option to broadcast a game within that market.

	Broadcaster	Annual Value
NFC North	CBS	$344 million
NFC East	Fox	$352 million
NFC South	Fox	$207 million
NFC West	CBS	$264 million
AFC North	NBC	$270 million
AFC East	ABC	$335 million
AFC South	ABC	$205 million
AFC West	Fox	$306 million

Note: From 2014-2022 Fox paid $1.1 billion for NFC Sunday and CBS paid $1 billion for AFC Sunday annually.

Table 8: Counterfactual Contract Allocation

national broadcasting fees characteristic of more prominent divisions during negotiations.

In the counterfactual contract allocation, as illustrated in Table 8, the total annual value of contracts surpasses that negotiated under a unified bargaining framework. Instead of the previously established $2.1 billion, a total of $2.28 billion is collectively expended by all broadcasting channels to secure these contracts.[42] This outcome can be rationalized by recognizing that, although the diversity of contract options amplifies channels' outside options, divisions themselves benefit from the flexibility provided to channels in how they bundle offerings. Channels are motivated by a twofold incentive when acquiring a bundle of games. Firstly, they gain the ability to broadcast these games, potentially expanding their viewership by broadening the range of content available to consumers. Consequently, they can offer more appealing content to their target markets. Secondly, channels seek contract rights to preempt competitors from acquiring the same content, thereby diverting consumers away from rival programming.

Figure 9 presents the estimates of per team revenue from the counterfactual contracts. The thick red line indicates per team revenue, $53.8 million, under the current revenue sharing framework. Only two divisions, NFC South and AFC South, lose revenue under decentralization. This loss is roughly $10 million dollars annually or a modest decrease

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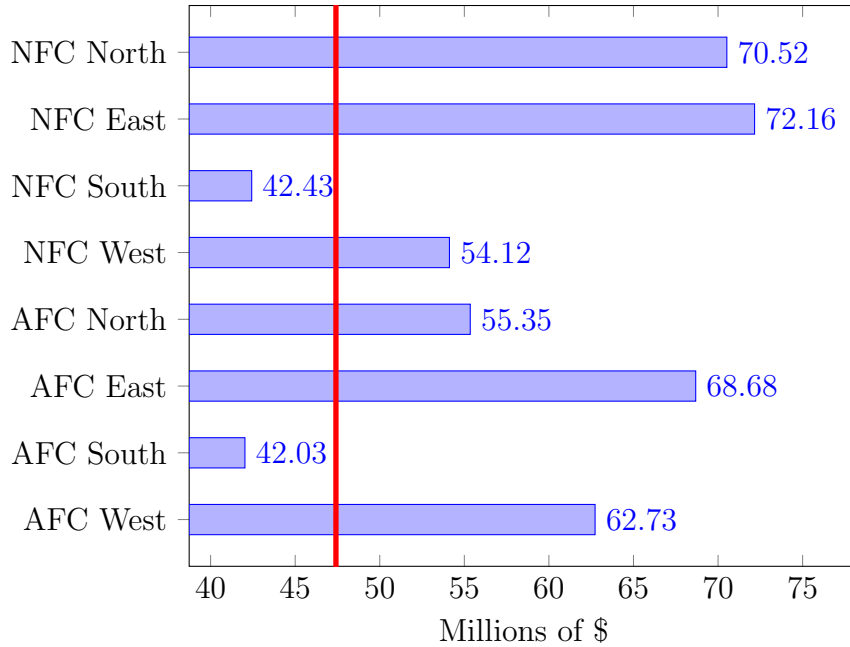[42]See Table 1 for current existing NFL contracts.

Figure 9: Counterfactual NFL Sunday Contracts per Team Revenue

in overall broadcasting revenue of 4% per team in the NFC South and AFC South. This decrease is relatively insignificant highlighting the potential ability of the league to survive without collective bargaining. I do not alter other safe-guards the NFL employs to ensure league viability, e.g. salary caps.

7   Conclusion

The average American spends a significant amount of time watching television, with television channels playing a crucial role in offering diverse programming and generating revenue through advertising. This paper delves into the economic implications of the television industry, with a specific focus on the NFL's role in negotiating broadcasting contracts on behalf of all teams.

The prevailing model used in empirical studies of bilateral bargaining, Nash-in-Nash bargaining, serves as the foundation for analyzing multiple interrelated bilateral bargaining pairs. Expanding upon the existing literature on endogenous outside options in bilateral

bargaining, this paper extends the framework to incorporate competitive interactions among broadcasters competing for NFL broadcasting rights. I propose the bargaining concept *Nash-in-Nash with Endgoenous Outside Options* whereby firms are able to exert greater influence when bargaining via updating their outside option using outcomes from other bargaining pairs for which it is a part of. The extension of the endogenous outside option calculates the channel's outside option by estimating profits in a counterfactual scenario where the broadcaster fails to secure rights to broadcast NFL games. A two-sided equilibrium model of advertiser-consumer interaction is utilized to estimate viewer and advertiser benefits, accounting for channel ad choices and program alterations.

I found that while viewers disliked television advertisements, advertiser's willingness-to-pay per viewer was $0.04. Empirical findings highlighted an overall increase in the total value of division contracts under bargaining decentralization. This rise can be attributed to the enhanced flexibility of channels in configuring programming packages. However, this increase was tempered by the channels' strengthening of their outside options. Notably, this paper found that only two divisions, the NFC South and the AFC South, experienced a negative impact from bargaining decentralization, resulting in a moderate loss of approximately $10 million in broadcasting revenue per team.

These findings collectively emphasize the intricate dynamics in two-sided markets, particularly within industries characterized by bargaining mechanisms for product allocation. This study opens up promising avenues for future research, warranting exploration along at least two distinct dimensions.

Firstly, my analysis confines advertiser types to be drawn from a log-normal distribution, wherein advertisers purchase at most a single ad slot per time period. Expanding this framework to encompass the purchase of multiple ad slots would enable the estimation of the value attributed to subsequent impressions. Theoretically, repeat impressions are often regarded as possessing diminished value, and empirical scrutiny of this assumption carries significant implications for the broader field of two-sided market analysis. This question is

particularly of importance where advertisers care about consumer demographics, e.g. does the value of repeat impressions depend on consumer characteristics. Another avenue of research is to incorporate budget constraints. I currently assume that an agreement is reached as long as profits are positive. Realistically firms make decisions with a budget in mind. This is particularly salient in the advertising industry.

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