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Pricing under uncertainty: Forward and option pricing in sports markets

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1. Introduction

Sports generate massive revenues. Despite COVID-19, total 2022 National Football League (NFL) revenue in the United States was $18 billion (Moore, 2022), and 2021 Premier League revenue in Europe was €6.1 billion.[1] The global sports market is expected to grow from US$355 billion in 2021 to $501 billion in 2022, and to an eye-watering $708 billion in 2026.[2]

Most sports markets feature one or more elimination tournaments. Currently, tournament game tickets are sold in advance, before the teams playing in the final games are known (we refer to this strategy as "advance" pricing). As it can be very competitive to purchase tickets to the final games, fans often purchase tickets before they know if their preferred team is going to play. Fans who purchase tickets in advance may face the prospect of attending a game they are not interested in—or reselling tickets in the gray and noisy secondary market.

Consider the NFL. Of the 32 NFL teams across the American Football Conference (AFC) and National Football Conference (NFC), only five teams made it to the final Superbowl game more than once in the past decade. Therefore, even for an ardent fan of a strong team, the likelihood their team will feature in a specific year's Superbowl is low. There is similar uncertainty in events such as the FIFA Soccer World Cup, the ICC Cricket World Cup, the NCAA College Basketball "March Madness" and so on. Yet, tickets for the final games in these tournaments may be sold a year in advance. Fans are highly uncertain about which teams will play that far out. Thus, scalpers and third parties corner these tickets and then sell them at a premium closer to the event.

Against this backdrop, we analyze two alternative pricing mechanisms for high-uncertainty environments—consumer forwards and consumer options. Contractually, a forward confers on the purchaser the right and the obligation to exercise the forward and complete a transaction should a certain "state of nature" occur. Here, the "state of nature" is the fan's chosen team making it to the final game. If a fan buys a team-specific "forward ticket" on a specific team, that forward confers a right and an obligation to purchase a final game ticket—contingent on that team featuring in that game. This ticket is initially purchased at a reserve price p_F. If her team makes it through, she must pay an additional exercise price p_e to obtain the ticket. If her team does not make it, the forward expires. We believe our work is the first to study the concept of forward pricing in consumer markets. We present a consumer decision tree for a forward ticket purchase in the context of sport tournaments (see Fig. 1).

In contrast, an option confers on the purchaser the right but not the obligation to exercise the option and complete a transaction after a state of the future is clarified. Here, if a fan buys an "option ticket" for a game, after finding out the identities of the playing teams the fan can (but is not obligated to) exercise the option and buy a final game ticket. While Sainam, Balasubramanian, and Bayus (2010) study option ticket pricing, we go beyond their work and compare how forward pricing performs relative to option pricing and conventional advance pricing. The primary difference between an option and a forward is that the fan can choose to exercise the option, or not, irrespective of the playing teams. We demonstrate that this seemingly trivial difference has significant implications for how the mechanisms work, capacity management, customer segmentation, and profits.

Our research is motivated from the following angles. First, sports tournament generate significant revenues from stadium seating. At an average price of $2,500 for the 2022 Superbowl, the 70,000-seat SoFi stadium generated about $66.5 million in ticket sales.[3] Consumers (also referred to as fans henceforth) avoid purchasing advance tickets in the

[1] https://www.statista.com/topics/8468/global-sports-market/#dossierKeyfigures
[2] https://www.globenewswire.com/news-release/2022/03/10/2400658/28124/en/350-Billion-Worldwide-Sports-Industry-to-2031-Identify-Growth-Segments-for-Investment.html
[3] https://www.zippia.com/answers/how-much-money-does-the-super-bowl-make/

face of uncertainty; instead, they often purchase from ticket brokers such as StubHub, SeatGeek, and Ticketmaster ("third-party" henceforth) after uncertainty related to the playing teams is resolved. These prices significantly exceed the tickets' face value (Tuchman, 2015). For example, tickets for the 2020 Super Bowl averaged $7,000 on StubHub.com. When the University of North Carolina and Duke met at the 2022 NCAA Men's Basketball Final Four, the average ticket price was over $6,000. Such exorbitant prices anger loyal fans. The fact that scalpers and third-party sites resell tickets at much higher prices indicates that the sports organizations are leaving money on the table. The pricing mechanisms we propose help sports organizations maintain control over ticket prices, profits, and sales processes.[4]

Second, legal concerns arise when tickets are scalped close to, or on, game day. Many U.S. state laws restrict resale (Happel and Jennings, 2002). In Arizona, ticket resale cannot happen within 200 feet of the sport arena entrance. In Florida it is a second-class misdemeanor to offer a resale ticket for more than $1 over the original price. Additionally, fraud is rampant. Parties may sell tickets they do not own (Courty, 2019), sell fabricated or illegally purchased tickets, or renege on ticket commitments hours before the game, leaving fans with little recourse other than refunds (ESPN, 2019). In April 2020 StubHub became the subject of two class action lawsuits for not offering refunds for events canceled due to COVID-19 (Randhawa, 2020). The pricing mechanisms we propose help protect consumers by reducing fraud, while supporting businesses through increasing profits.

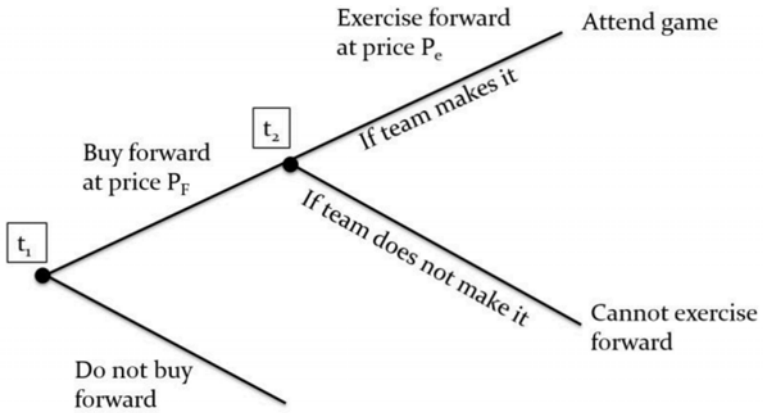
Third, there is substantial research on forwards and options in economics and finance. As a simple test, a search for "currency forwards" (only one specific type of forward) on Google Scholar yielded over 66,000 papers. The literature on options is similarly vast. However, though consumers face significant uncertainty in many markets, the literature on consumer forwards and options is almost non-existent. Our work fills this lacuna.

Fourth, to design an optimal fan experience, the stadium must contain a mix of different fan types. For example, selling many forward tickets will attract numerous noisy team-based fans who display their unflinching enthusiasm for every basket, goal, or touchdown their team makes. Stadiums have been redesigned to amplify the roar of 100,000 plus fans cheering at the edge of their seats, waving their team colors (Arkenberg et al., 2019). This can increase the attractiveness of the game to the online and broadcast audience and to advertisers.

Fifth, the idea of consumer forwards has been broached in the industry. For example, Sainam, Balasubramanian, and Bayus (2015) empirically examine the purchase and resale of ticket forwards in a third-party marketplace—a different angle from the research questions studied in this paper. The forward ticket concept also been implemented in the College Football National Championship Game as "RSVPs" (Arnold, 2019): "RSVPs are team and game-specific reservations that allow college football fans guaranteed access to purchase tickets at face-value, provided their team is playing. If a team does not advance to the game that it is based on, an RSVP will expire with no value, and is unable to be used towards a purchase" (CFP-RSVP, 2022).

To summarize, we are left at a confluence of a clear and enduring problem related to consumer market-related uncertainty, a substantial opportunity to model and apply uncertainty reduction concepts used extensively in the economics and finance arenas to those markets, and some fledgling attempts by sellers to apply such thinking in those markets. This presents a timely opportunity for our research on consumer forwards and options. We note that our analysis is focused on tournament games, where teams are knocked out of the competition based on whether or not they win a specific matchup or how they perform in a series of matchups. It does not apply to "regular season" games where the playing parties are known well in advance.

In Section 2, we survey the literature on pricing under uncertainty. In Section 3, we describe the consumer (fan) types. In Sections 3 and 4, we model forward and option pricing with and without capacity constraints. We also examine how the current practice of advance pricing performs relative to these mechanisms. In Section 5, we describe an exploratory empirical analysis that uses a representative US sample to establish the validity of forward pricing, and demarcate conditions under which the different pricing mechanisms are most profitable. We discuss managerial and research implications in Section 6. Here, we also anchor the paper to practice by presenting the insights from a discussion of our research with the Vice-President for Ticket Sales and Services for a leading NBA basketball team.



Notes: t_1 = outcome is unknown, t_2 = outcome is revealed, and P_F and P_e are set by the firm at t_1.

Fig. 1. A decision tree for consumer forwards Notes: t_1 = outcome is unknown, t_2 = outcome is revealed, and P_F and P_e are set by the firm at t_1.

[4] https://www.cnbc.com/2020/01/27/how-much-it-costs-to-go-to-super-bowl-2020.html; https://www.koobit.com/articles/valorant-champions-istanbul-begins-with-tickets-still-available-234; https://www.cnbc.com/2021/09/08/nfl-2021-season-whats-happening-with-the-leagues-business.html; https://onlocationexp.com/nfl/super-bowl-ticket-packages; https://www.si.com/college/2022/03/28/final-four-ticket-prices-skyrocket-unc-beats-saint-peters.

2. Related literature on pricing under uncertainty

The literature on pricing is vast and a comprehensive review is beyond the scope of this paper. Our contributions can be positioned more tightly with respect to existing research on price discrimination, advance pricing, and option and forward pricing.

To begin, almost every multi-price mechanism increases profits on account of superior price discrimination. Ticket prices have long varied by event and by seat location with prices based on researched estimates of consumer heterogeneity in willingness-to-pay for specific seat-event combinations (Rosen & Rosenfield, 1997). Our work differs from the literature on price discrimination in a few ways. First, the newly proposed forward pricing contract enables selling the same asset – the seat – to multiple fans from different teams, as only one fan can ultimately redeem the forward. This also makes it very different from the options contract studied by Sainam et al. (2010), where an option for a seat can only be sold once. The ability of forward pricing to facilitate overselling and its automatic linkage of future payments to uncertainty resolution also differentiate it from traditional two-part pricing that typically breaks payments into fixed and variable fees (Schmalensee, 1981). Second, a forward ticket contract is linked to a specific team, unlike a regular advance ticket or an option ticket, each of which are linked to a seat at the game. Thus, forward pricing can facilitate price discrimination across fans of different teams for this "expiring" asset. The ability to pay a smaller amount up front to reserve a team-specific forward has great value for fans with strong team preferences.

Next, under advance pricing, purchase occurs well before consumption. Fig. 2 describes the timing of prices paid under the different pricing mechanisms. When consumers are uncertain about future valuations, the firm can increase profits under advance pricing by charging a lower price based on the distribution of the expected value across consumers, attracting the entire market (Xie and Shugan, 2001,2009). Forward pricing differs from advance pricing in two ways. First, the forward price components are distributed across two stages: with uncertainty (at the start of the season) and without uncertainty (once the winners are revealed), creating a flexible platform to leverage shifts in uncertainty. Next, the asset can be resold multiple times but with only one consumer ultimately using it—this is particularly useful under capacity constraints. We will discuss this in detail later. Xie and Gerstner (2007) show that a capacity constrained organization can profit from offering refunds for service cancelations. The timing and structure of the contract differs in our case; in Xie and Gerstner's model the refund is decided upon receiving the cancelation notification from the consumer. This adds an additional layer of complexity in operationalizing the refunds in the sports context (i.e., what if the cancelation notice is not received?). In contrast, with both option and forward pricing the sports organization sets the prices upfront. The forward can be executed automatically (through a saved credit card) once the results of the match are known, enabling the recapture of some of the resale market revenues.

Finally, extensive research exists on forward and option pricing in the economics and finance literatures. Forward contracts have been applied across sectors. For example, the pre-sale of real estate through forwards helps provide builder funding and mitigate default risks (Chang & Ward, 1993). Uncertainties related to urban infrastructure investment and other project costs can be better managed using forward pricing contracts (Kasen & Oblas, 1996). In fact, forward contracts can even be used to manage future cloud computing capacities (Rogers & Cliff, 2012). Despite this proliferation of research, we believe this paper offers the first theoretical model and application of the forward pricing mechanism to the consumer market context.

Options offer a qualitatively different approach than forwards to managing uncertainty. Not surprisingly, there is a distinct and voluminous literature in economics and finance on both forwards and options (Alexander, 2008; Buckley & Eslami, 2008). Black and Scholes (1973) seminal work demonstrates pricing of options on financial securities. Shilling, Sirmans, and Benjamin (1987) show how a range of real estate decisions (including the choice to refinance) can be modeled using option pricing approaches. As we demonstrate below, forwards and options contracts work differently in the consumer context.[5]

Existing research on consumer forward and option pricing in the sports markets literature is limited to two papers. In the forward context, Sainam et al. (2015) present an empirical analysis of a market for tradeable forward-like tickets to NCAA Final Four basketball games with the goal of identifying optimal trading strategies for fans. In contrast, the current paper offers the first formal theory of consumer forwards, compares it to other pricing mechanisms, and examines the profitability of the mechanism under capacity constraints. Next, Sainam et al. (2010) explore the concept of consumer options in a sports context. In the ticket context, buying an option confers a fan the right but *not* the obligation to exercise it and purchase a final game ticket. This paper examines the idea of buying a forward, which confers a fan the right *and* an obligation to exercise it and purchase a final game ticket. These contractual differences have significant implications for how forward and option tickets would be differentially structured and their different approaches related to dealing with market uncertainty, managing capacity constraints, and driving profitability. Further, we provide face validity for the forward pricing concept using data collected from a nationally representative sample of fans.

3. The market: Definition of fan types

We first define the fan types in the market. Consistent with Sainam et al. (2010), a team-based fan is one who has zero utility if her favorite team is not playing in the final game. A game-based fan is one who has positive utility for *any* match up (she simply wants to attend this final game). The forward ticket is team-specific, whereas the option ticket is sold on a seat. Consequently, a fan who purchases an option can still exercise her option and decide to attend the final game even if her preferred team does not make it to that game.

Consider a situation where four teams are playing against each other ((A, B) and (C, D)) with one winning team per pair making it to the final game. Thus, the final game could feature one of the four possibilities (A, C), (A, D), (B, C) or (B, D). Under forward tickets, game-based fans who want to attend the final game irrespective of which teams play could purchase either the forwards of *both* A and B or those of *both* C and D to guarantee a seat at the final game. In contrast, under options, they could reserve their seat by buying a single option on a seat because the option is not linked to the performance of any team. The fan could always choose to exercise the option and attend the game. Thus, a nightmare scenario with overselling options involves numerous game-based fans unexpectedly exercising their options in a limited capacity setting. On the other hand, each forward is associated with only one team. If the team associated with the forward *does not* makes it, the fan *cannot* attend the game. This means that for elimination style tournaments, multiple forwards on each seat can be sold to fans of competing teams on one side of the bracket, because only one team will ultimately make it to the game. The fans of every other team lose their claim to that seat the moment their team is eliminated. Thus, forwards are particularly effective at profit management in constrained capacity settings.

This paper additionally differs from Sainam et al. (2010) in proceeding from the semi-final stage with two team pairs, (A, B) and (C, D) competing in the semi-finals. The prior work considers only the final

[5] There are a few examples of option pricing in consumer markets. For example, some hotels, including the MGM group of hotels in Las Vegas provide guests the ability to make a partial payment to 'reserve' the right to the room and then refund a portion of the reservation price depending on how close to the date of stay the cancellation is processed. Singapore Airlines has designed a call option feature called "secure my fare" for airline ticket purchases that holds the ticket price steady for up to 72 h, for a fee (Wong, 2017).

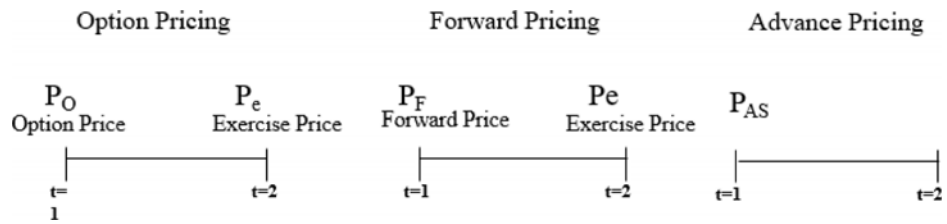


Fig. 2. Timing of price(s) paid by the fan under different pricing regimes.

game with the two teams, A and B, already having gone through previous rounds of uncertainty. Thus, the analysis in this paper is more general and provides a better perspective of how the proposed pricing mechanisms work at earlier tournament stages.

Further, unlike in Sainam et al. (2010), we model teams A and C as the preferred teams – something that is more representative of sports market settings. For instance, in the National Collegiate Athletic Association (NCAA) men's basketball tournament, an (A, C) matchup could mimic a preferred UNC (team A) versus Duke (team C) matchup—considered one of the most storied rivalries in the NCAA. This matchup, nicknamed the *Tobacco Road Rivalry*, has the highest TV ratings of any sporting events in the region (Smith, 2021). Players of both teams tend to compete at the highest level against each other. In fact, of the 108 meetings between the two teams through 2021, each team has won 54 times. Other matchups could be non-preferred by the market (e.g., St. Thomas Tommies versus Duke i.e., (B, C), St. Thomas Tommies versus North Dakota State Bisons (B, D) and UNC versus North Dakota State Bisons (A, D)).

The proposed alternatives—forward and option tickets—offer some clear advantages over advance tickets. On the demand side, these new mechanisms permit fans to (a) purchase directly from the sports organization and not engage with the risky gray market and (b) participate securely even though their team's outcome is uncertain, by paying just the forward price in advance. From the supply side perspective, they offer sports organizations a pathway to circumvent third party resellers, thereby increasing their profits and enhancing fan satisfaction. As we will demonstrate below, forward pricing also offers a powerful way to profit from capacity-constrained situations such as sports stadiums with limited seating.

4. Theory: Analytical models of forward pricing

We model forward pricing in a market with team- and game-based fans. Consistent with Sainam et al. (2010), team-based fans want to attend a game only if their favorite team plays; game-based fans favor some matchups but potentially want to attend the game regardless of who plays. Assuming the tournament is at the semi-final stage, a team-based fan will purchase a forward only on her favorite team. In contrast, game-based fans must purchase forwards on both teams on one side of the bracket if they want to ensure they attend the final game.

4.1. Model set up

Each of the four teams (A, B, C and D) has N_T team-based fans. The market also includes N_G game-based fans. Under advance pricing, which is consistent with current practice, the sports organization sells tickets in advance, before uncertainty about the playing teams is resolved. Likewise, we assume that forward and option tickets are sold before uncertainty is resolved, though exercise of the tickets occurs after uncertainty is resolved.

Teams A and C are the popular teams and have an equal (a priori) probability γ of winning their games ($\gamma > 0.5$). We consider cases where both fan types (game- and team-based fans) attend the final game.[6] The team-based fans are willing to pay U_T for a game involving the preferred team, and 0 otherwise. We assume that if Teams A and C play in the finals, then game-based fans prefer that game, and have a higher utility from watching that game. The game-based fan's utility for the preferred game (between teams A and C) is U_G^+ and for the non-preferred game is U_G^-. The data from Sainam et al. (2010) indicates that the utility ordering in their fan sample corresponds to $U_G^+ > U_T > U_G^-$. We verify this utility ordering later in the empirical analysis (please see Section 5). As an aside, this first finding confirms the consistency of the utility ordering across two distinctive samples across years. Therefore, we assume that U_G^- is the lowest of the three utilities, on average. However, unlike in Sainam et al. (2010) we present a more general framework by considering both resulting possible utility orderings in the subsequent analyses: a) $U_T > U_G^+ > U_G^-$ and b) $U_G^+ > U_T > U_G^-$.

Under forward pricing, the team-based fan pays p_{Fi} to buy one forward ticket associated with her team i and *is automatically charged* the exercise price p_{ei} *if* that team advances to the final. Each game-based fan will buy two forward tickets (either of teams A and B, or of teams C and D) at a total price of $2p_{Fi}$, and then pay the exercise price of p_{ei} when any one of those teams makes it to the final game, *provided* her utility for the final game is higher than the combined price (to maintain incentive compatibility). Under option pricing, either fan pays an option price p_O upfront and then an exercise price p_e after the teams playing in the final are revealed, but only if she wants to attend the game. Under advance pricing, tickets are priced at p_{AS} well in advance of the game.

We consider multiple parametric regions or "zones" within which we evaluate the pricing mechanisms. This increases the generality of our findings by not overly constraining the assumed utility structure and instead designing the analysis to include a wide parameter space.

4.2. No capacity constraint case

We first model forward, option and advance pricing when there is no limit on the number of fans who can attend the game (i.e., when capacity is not a binding constraint).

4.2.1. Forward pricing

Given that teams A and C are the preferred teams, let the forward price of teams A and C be p_{F1} and let p_{e1} the exercise price. The individual rationality (IR) constraint for the team-based fans of teams A and C is : $p_{F1} + \gamma p_{e1} \leq \gamma U_T$. Game-based fans prefer the final game to be between Teams A and C. Consider a fan who buys a forward on Team A. Team A will be in the final with a probability of γ. Further, the winner of

[6] We also considered partial market coverage (i.e., only one fan segment participates) and identify when forward and option pricing are profitable than advance selling. We do not present those details here because both fan types participating is more representative of reality—we verify this in our Empirical Section. Additional details are available from the authors.

the other semi-final game will be either Team C (with a probability of γ, leading to a utility of U_G^+ from that game), or Team D (with a probability of $1-\gamma$, leading to a utility of U_G^- from that game). The utility for game-based fans buying a forward on Team C is symmetrical. Hence, if game-based fans buy a forward ticket on either of these teams, the IR constraint is $p_{F1} + \gamma p_{e1} \leq \gamma^2 U_G^+ + \gamma(1-\gamma)U_G^-$. Similarly, if p_{F2} and p_{e2} are the forward and exercise price of fans of teams B and D respectively, the IR constraint of team-based fans is: $p_{F2} + (1-\gamma)p_{e2} \leq (1-\gamma)U_T$, while for game-based fans, the IR-constraint is $p_{F2} + (1-\gamma)p_{e2} \leq (1-\gamma)U_G^-$.

The sports organization earns $p_{F1} + \gamma p_{e1}$, from both team-based and game-based fans of teams A and C. Similarly, the organization earns $p_{F2} + (1-\gamma)p_{e2}$ from both team-based and game-based fans of Teams B and D. The pricing problem from using the forward pricing mechanism can be formally stated as follows:

$$\text{Max}(2N_T + N_G)[p_{F1} + \gamma p_{e1} + p_{F2} + (1-\gamma)p_{e2}]$$

$$\text{s.t.} p_{F1} + \gamma p_{e1} \leq \gamma U_T$$

$$p_{F1} + \gamma p_{e1} \leq \gamma^2 U_G^+ + \gamma(1-\gamma)U_G^-$$

$$p_{F2} + (1-\gamma)p_{e2} \leq (1-\gamma)U_T$$

$$p_{F2} + (1-\gamma)p_{e2} \leq (1-\gamma)U_G^-$$

$$p_{F1}, p_{e1}, p_{F2}, p_{e2} \geq 0$$

Table 1 summarizes the pricing and profits when using forward pricing across all regions.

All proofs are in the Appendix.

4.2.2. Option pricing

Let p_O be the option price and p_e the exercise price. The IR constraints for the team-based fans are identical to those under forward pricing. For fans of Teams A and C, the IR constraint is $p_O \leq \gamma(U_T - p_e)$, while for fans of Teams B and D, the IR constraint is $p_O \leq (1-\gamma)(U_T - p_e)$. Under full coverage, hence, $p_O \leq (1-\gamma)(U_T - p_e)$, ensuring that all team-based fans purchase options. Game-based fans need to buy just one option, and their IR constraint is: $p_O + p_e \leq \gamma^2 U_G^+ + (1-\gamma^2)U_G^-$. For ease of notation, let $\gamma^2 U_G^+ + (1-\gamma^2)U_G^- = E_1$. Team-based fans of Teams A and C will purchase the option and attend the game with a probability of γ, while fans of Teams B and D will purchase the option and attend the game with a probability of $(1-\gamma)$. Game-based fans will provide a revenue of: $p_O + p_e$ to the organization. Hence, the profits of the organization from options pricing are given by: $\Pi_O = 2N_T[p_O + \gamma p_e + p_O + (1-\gamma)p_e] + N_G[p_O + p_e]$. Hence, the pricing problem from using the options pricing mechanism is:

$$\text{Max}(4N_T + N_G)p_O + (2N_T + N_G)p_e$$

$$\text{s.t.} p_O \leq (1-\gamma)(U_T - p_e)$$

$$p_O + p_e \leq \gamma^2 U_G^+ + (1-\gamma^2)U_G^- = E_1$$

$$p_O, p_e \geq 0$$

Table 2 summarizes the pricing and profits when using option pricing across all regions.

4.2.3. Advance selling

If p_{AS} is the advance selling price, the IR constraints for team-based fans are: $p_{AS} \leq \gamma U_T$ for fans of Teams A and C and $p_{AS} \leq (1-\gamma)U_T$ for fans of Teams B and D. As before, the latter is binding. Hence, $p_{AS} \leq (1-\gamma)U_T$. The IR constraint for game-based fans is: $p_{AS} \leq E_1$. The pricing problem from using the advance pricing mechanism is:

$$\text{Max}(4N_T + N_G)p_{AS}$$

$$\text{s.t.} p_{AS} \leq (1-\gamma)U_T$$

$$p_{AS} \leq \gamma^2 U_G^+ + (1-\gamma^2)U_G^- = E_1$$

$$p_{AS} \geq 0$$

Table 3 summarizes the pricing and profits when using advance selling across all regions.

4.2.4. Comparison of profits across pricing mechanisms

The profits from each pricing mechanism in each zone are demarcated below (see Table 4).

We consider the following utility orderings across zones: **Zone 1** where the expected utility of the game-based fan is lower than that of the non-preferred team-based fan, **Zones 2, 3 and 4** where the expected utility of the game-based fan is higher than that of the non-preferred team-based fan. Here we focus on three sub-cases: **Zone 2** where $(1-\gamma)U_T < E_1 < (1-\gamma)U_T + \gamma U_G^-$; **Zone 3** where $(1-\gamma)U_T + \gamma U_G^- < E_1 < U_T$; and **Zone 4** where $E_1 > U_T$. [7]

Proposition 1 identifies the best pricing mechanism based on fans' relative utility levels.

Proposition 1. *The optimal pricing mechanisms based on fans' relative utility levels are:*

(i) *When team-based fans of non-preferred teams have significantly higher utilities than game-based fans* (i.e., $(1-\gamma)U_T > E_1$), *the organization should use advance selling or option pricing.*

(ii) *When team-based fans of non-preferred teams have closer utilities to game-based fans* (i.e., $(1-\gamma)U_T < E_1 < (1-\gamma)U_T + \gamma U_G^-$), *the organization should use option pricing.*

(iii) *When game-based fans have moderately higher utilities than team-based fans of non-preferred teams* (i.e., $(1-\gamma)U_T + \gamma U_G^- < E_1 < U_T$), *the organization should use either option pricing or forward pricing.*

(iv) *When game-based fans have significantly higher utilities than team-based fans of non-preferred teams* ($E_1 > U_T$) *and sufficient game-based fans in the market* (*i.e.*, $(6\gamma - 4)N_T + (2\gamma - 1)N_G > 0$), *the organization should use forward pricing and option pricing, otherwise.*

Proposition 1 offers some interesting insights. In Zone 1, where $E_1 \leq (1-\gamma)U_T$, advance and option pricing deliver the same profits, so either can be used. Advance pricing may be preferred here because it is easier to administer. Forward pricing is not optimal in this zone because it requires game-based fans to buy two forwards. In this zone, game-based fans have low utilities, so buying two forwards results in a low forward price in order to satisfy their IR constraint.

In Zone 2, where $(1-\gamma)U_T < E_1 < (1-\gamma)U_T + \gamma U_G^-$, option pricing yields higher profits than advance and forward pricing. Here, the exercise price helps extract additional surplus compared to advance pricing. Again, since forward pricing requires game-based fans to buy two forwards, the forward price must be lowered to satisfy the IR constraints—this reduces profits.

In Zone 3, where $(1-\gamma)U_T + \gamma U_G^- < E_1 < U_T$, option pricing again yields higher profits than advance pricing for similar reasons. However, since the utility of game-based fans is higher here, forward pricing can yield higher profits than option pricing in some cases. The intuition is

Table 1
Optimal prices and profits under forward pricing.

Zone	$\gamma U_G^+ + (1-\gamma)U_G^- < U_T$	$\gamma U_G^+ + (1-\gamma)U_G^- \geq U_T$
p_{F1}, p_{e1}	$p_{F1} + \gamma p_{e1} = \gamma^2 U_G^+ + \gamma(1-\gamma)U_G^-$	$p_{F1} + \gamma p_{e1} = \gamma U_T$
p_{F2}, p_{e2}	$p_{F2} + (1-\gamma)p_{e2} = (1-\gamma)U_G^-$	$p_{F2} + (1-\gamma)p_{e2} = (1-\gamma)U_G^-$
Π_F	$(2N_T + N_G)E_1$ (where $E_1 = \gamma^2 U_G^+ + (1-\gamma^2)U_G^-$)	$(2N_T + N_G)[\gamma U_T + (1-\gamma)U_G^-]$

[7] As a point of comparison, Sainam et al. (2010) consider just one case (expected utility of the game-based fan is higher than that of the team-based fan) and two subcases within that ($U_T > U_G^+$ and $U_T < U_G^+$).

Table 2
Optimal prices and profits under option pricing.

Zone	$E_1 < (1-\gamma)U_T$	$(1-\gamma)U_T < E_1 < (1-\gamma)U_T + \gamma U_G^-$	$E_1 > (1-\gamma)U_T + \gamma U_G^-$
p_O	$p_O = E_1$	$p_O = \frac{(1-\gamma)(U_T - E_1)}{\gamma}$	$p_O = (1-\gamma)(U_T - U_G^-)$
p_e	$p_e = 0$	$p_e = \frac{E_1 - (1-\gamma)U_T}{\gamma}$	$p_e = U_G^-$
Π_O	$(4N_T + N_G)E_1$	$\frac{2(1-\gamma)N_T U_T + [(4\gamma-2)N_T + \gamma N_G]E_1}{\gamma}$	$(4N_T + N_G)(1-\gamma)U_T + [(4\gamma-2)N_T + \gamma N_G]U_G^-$

Table 3
Optimal prices and profits under advance pricing.

Zone	$E_1 < (1-\gamma)U_T$	$E_1 > (1-\gamma)U_T$
p_{AS}	E_1	$(1-\gamma)U_T$
Π_{AS}	$(4N_T + N_G)E_1$	$(4N_T + N_G)(1-\gamma)U_T$

Table 4
Comparison of profits from different pricing mechanisms.

	Zone 1: Expected utility of the game-based fan is lower than that of the non-preferred team-based fan	Zone 2: Expected utility of the game-based fan is higher than that of the non-preferred team-based fan		
	$E_1 < (1-\gamma)U_T$	Subzone 2a: $(1-\gamma)U_T < E_1 < (1-\gamma)U_T + \gamma U_G^-$	Subzone 2b: $(1-\gamma)U_T + \gamma U_G^- < E_1 < U_T$	Subzone 2c: $E_1 > U_T$
Forward pricing	$(2N_T + N_G)E_1$			$= (2N_T + N_G)E_1$ (if $\frac{E_1}{\gamma} < U_T$) $= (2N_T + N_G)[\gamma U_T +$ $(1-\gamma)U_G^-]$(if $\frac{E_1}{\gamma} \geq U_T$)
Option pricing	$(4N_T + N_G)E_1$	$\frac{2(1-\gamma)N_T U_T + [(4\gamma-2)N_T + \gamma N_G]E_1}{\gamma}$	$(4N_T + N_G)(1-\gamma)U_T + [(4\gamma-2)N_T + \gamma N_G]U_G^-$	
Advance pricing	$(4N_T + N_G)E_1$	$(4N_T + N_G)(1-\gamma)U_T$		

better understood in Zone 4 where the game-based fan's utility is highest.

In Zone 4, where $E_1 > U_T$, the expected utility of the game-based fan is higher than that of the preferred team-based fan as well. Here, forward pricing yields higher profits than option pricing if $(6\gamma - 4)N_T + (2\gamma - 1)N_G > 0$. [8] The advantage of forward pricing is that when game-based fans have high utilities, making them purchase two forwards increases profits. If the probability of the preferred team winning is high, since forward pricing extracts the full utility of preferred team fans (both game-based and team-based), forward pricing does better. If the condition is not met, option pricing yields higher profits.

Overall, the superiority of the pricing mechanisms varies depending on the ordering of utilities and the magnitude of γ. A natural question that arises relates to which such parametric configuration best corresponds to real-life contexts. Interestingly, the data from Sainam et al. (2010) and our current empirical work indicate that the utility ordering in their studied fan sample corresponds to Zone 4 (i.e., $U_G^+ > U_T > U_G^-$). From our analytical model, forward pricing yields higher profits than other mechanisms in Zone 4 if $\gamma > 0.6$. This highlights the practical relevance of forward pricing, especially in the presence of preferred teams with a significantly higher likelihood of making it to the final game.

[8] The standalone sufficient conditions for this inequality to be true are $\gamma > 0.66$, and the number of game-based fans (N_G) to be significantly higher than the number of team-based fans (N_T).

4.3. Pricing under capacity constraints

The scenario with capacity constraints is of central interest to sports organization under forward pricing. For most high-profile sports events, ticket prices on informal markets soar closer to the date of the game. This is a credible signal of demand outstripping available seating capacity at reasonable price levels. Under forward pricing, a sports organization can sell the same seat to fans of multiple teams on one side of the bracket. As explained earlier, this unique ability can potentially boost market participation by fans and reduce the risk faced by them, curtail the role of third-party resellers and scalpers, and enhance the profitability of the sports organization.

We now assume that the game has a capacity constraint denoted by $\overline{C}$, where $\overline{C}$ is the upper limit on the number of attendees in the game. We analyze the pricing problem with the limited capacity for the different pricing strategies in Zone 4 $[U_T < E_1 < \left(1 + \frac{2N_G}{N_T}\right)U_T]$ only. This zone represents the utility ordering in our fan sample (more details in the Empirical Section).

4.3.1. Forward pricing

In Zone 4, the organization will sell an equal number of forwards of Teams A and C (the preferred teams), and of Teams B and D (non-preferred teams). For forward tickets, the capacity limit is based on the number of tickets that will be potentially exercised, i.e., the organization can sell more tickets than the capacity of the game, as long as the number of tickets that are exercised will be less than the seating capacity.

Table 5 summarizes the prices and the profits in the pricing problem under forward pricing.

4.3.2. Option pricing

If the organization uses option pricing, it can only sell a number of options that is equal to the seating capacity of the game. Unlike the forward pricing scheme, the option mechanism is not able to target the sold tickets to specific team-based or game-based fans. While the organization can control the number of fans by pricing them such that only

Table 5
Optimal prices and profits for forwards with capacity constraints.

Capacity Zone	Prices	Profits
Low : $\overline{C} < N_G$	$p_{F1} + \gamma p_{e1} = \gamma^2 U_G^+ + \gamma(1-\gamma)U_G^- p_{F2} + (1-\gamma)p_{e2} = (1-\gamma)U_T$ if $N_T > \frac{\overline{C}}{2}$ $p_{F2} + (1-\gamma)p_{e2} = (1-\gamma)U_G^-$ if $N_T < \frac{\overline{C}}{2}$	$\overline{C}[\gamma^2 U_G^+ + \gamma(1-\gamma)U_G^- + (1-\gamma)U_T]$ if $N_T \geq \frac{\overline{C}}{2}$. $\overline{C}E_1$ if $N_T < \frac{\overline{C}}{2}$.
Medium:$N_G < \overline{C} < N_G + 4N_T$	$p_{F1} + \gamma p_{e1} = \gamma U_T p_{F2} + (1-\gamma)p_{e2} = (1-\gamma)U_G^-$	$\overline{C}[\gamma U_T + (1-\gamma)U_G^-]$ if $\overline{C} < N_G + 2N_T$ $(2N_T + N_G)[\gamma U_T + (1-\gamma)U_G^-]$if $\overline{C} > N_G + 2N_T$
High:$\overline{C} > N_G + 4N_T$	$p_{F1} + \gamma p_{e1} = \gamma U_T p_{F2} + (1-\gamma)p_{e2} = (1-\gamma)U_G^-$	$(2N_T + N_G)[\gamma U_T + (1-\gamma)U_G^-]$

the fans with the highest utility (game-based fans in Zone 4) are targeted, or market to a larger set of fans including team-based fans by pricing lower they cannot predict the number of fans who will attend as the options are not team-specific. Hence, the organization has to limit the number of tickets sold to the capacity of the game. Table 6 summarizes the prices and the profits in the capacity constrained case when the organization uses the options pricing mechanism.

4.3.3. Advance selling

If the organization uses advance selling, as in the options pricing case, it can only sell a number of tickets that is equal to the seating capacity of the game. Table 7 summarizes the prices and the profits in the capacity constrained case when the organization uses advance selling.

Proposition 2 summarizes the profits of the different pricing mechanisms when there is a capacity constraint on the number of seats for the game.

Proposition 2. *The optimal pricing mechanisms under capacity constraint when the expected utility of a game-based fan is higher than the utility of a team-based fan (i.e., $E_1 > U_T$) are as follows:*

(i) *If the capacity is low ($\overline{C} < N_G$), to moderate compared to the number of fans ($N_G < \overline{C} < N_G + 2N_T$), the organization should use forward pricing.*

(ii) *If the capacity is close to the number of fans ($N_G + 2N_T < \overline{C} < N_G + 4N_T$), the organization should use forward or option pricing. Forward pricing is preferable to option pricing in a larger domain compared to the case where there are no capacity constraints.*

(iii) *If the capacity is higher than the number of fans ($\overline{C} > N_G + 4N_T$), the firm should use either forward pricing or option pricing as recommended in Proposition 1.*

If the capacity is higher than the total number of fans (Proposition 2, case (iii)), then the capacity constraint is not tight, and the organization prices tickets for the final game using either forward or option pricing (depending on the size of the fan segments as described in Proposition 1, case iv). When the capacity of the game is low to moderate, the firm should use forward pricing. The primary advantage of forward pricing in a capacity constrained case is that the forward pricing method is team-based, enabling the firm to control the number of attendees of the final game based on the number of tickets. Since the fans can attend the final game only if the team for which they bought the forward is in the final game, the organization can sell more forwards than the capacity of the game, as game-based fans and only team-based fans of the teams that make it to the final can attend the game. In contrast, if the organization uses the options mechanism, it can sell a limited number of options (equal to the capacity of the game), as it cannot predict the teams that will be in the final game at the time of selling tickets nor control the number of option holders who choose to exercise the options. If the capacity is low, then the organization can price the tickets higher for the non-preferred games using the forward mechanism (at U_T to the team-based fans of the non-preferred teams). However, it cannot increase the exercise price of the non-preferred game when it uses the option mechanism.

As we have argued earlier, capacity constraints are routinely encountered in this context. Importantly, our findings highlight that option pricing and forward pricing—and the latter, in particular—dominate advance pricing from a profitability standpoint in all scenarios in the presence of capacity constraints. As seen above, they also yield other benefits related to broader fan participation and restraints on third-party resellers and scalpers. This underscores their usefulness and usability in these and similar market contexts.

Table 6
Optimal prices and profits for options pricing with capacity constraints.

Capacity Zone	Prices	Profits
Low:$\overline{C} < N_G$	$p_O = E_1 - U_G^-$, $p_e = U_G^-$	$\overline{C}E_1$
Low to Medium:$N_G < \overline{C} < N_G + 2N_T$	$p_O = \gamma(U_T - U_G^-)$, $p_e = U_G^-$	$\overline{C}[\gamma(U_T - U_G^-) + \frac{N_G + 2N_T\gamma}{N_G + 2N_T}U_G^-]$
Medium : $N_G + 2N_T < \overline{C} < N_G + 4N_T$	$p_O = (1-\gamma)(U_T - U_G^-)$, $p_e = U_G^-$	$\overline{C}[(1-\gamma)(U_T - U_G^-) + \frac{N_G + 2N_T}{N_G + 4N_T}U_G^-]$
High:$\overline{C} > N_G + 4N_T$	$p_O = (1-\gamma)(U_T - U_G^-)$, $p_e = U_G^-$	$(4N_T + N_G)(1-\gamma)U_T + [(4\gamma - 2)N_T + \gamma N_G]U_G^-$

Table 7
Optimal prices and profits for advance selling with capacity constraint.

Capacity Zone	Prices	Profits
Low:$\overline{C} < N_G$	$p_{AS} = E_1$	$\overline{C}E_1$
Low to Medium:$N_G < \overline{C} < N_G + 2N_T$	$p_{AS} = \gamma U_T$	$\overline{C}[\gamma U_T]$
Medium:$N_G + 2N_T < \overline{C} < N_G + 4N_T$	$p_{AS} = (1-\gamma)U_T$	$\overline{C}[(1-\gamma)U_T]$
High:$\overline{C} > N_G + 4N_T$	$p_{AS} = (1-\gamma)U_T$	$(4N_T + N_G)(1-\gamma)U_T$

5. Empirical validation

Our primary focus is to provide the first formal model of forward pricing in the marketing literature, and to compare such pricing with other mechanisms. Correspondingly, the modest goals of the empirical analysis of ticket forwards are to serve as a touchstone for the assumptions in the theoretical model, examine fan comfort with the forward pricing concept, and provide some preliminary, exploratory insights into the performance of the different pricing mechanisms.

5.1. Data collection

Data was collected on the Qualtrics platform, using a representative US sample. Participants (fans) completed an online survey, which took

approximately 10 min and provided $2 compensation for their time. Participants indicated their favorite NCAA men's basketball team, which then populated all subsequent questions with their corresponding favorite team name.

In addition, to create a realistic, incentive-compatible environment that encouraged subjects to reveal their true willingness-to-pay (WTP), participants chose to enter a drawing to purchase a real ticket to the NCAA men's basketball Final Four game, held in New Orleans in 2022. To make the study incentive compatible, the winning participant agreed to pay the average of the WTP prices from their survey responses to obtain the ticket.

We eliminated fans from the sample who met one or more of the following three criteria: (a) those that did not pass the inbuilt attention checks; (b) those that did not agree to purchase the ticket (thereby violating the incentive compatibility constraint); or (c) those that exhibited logically inconsistent ticket valuation responses (such as being willing to pay less when their preferred team had a higher probability of making it to the final game than when that probability was lower). We had 595 participants in our final sample.

In a within-subjects design, the survey led participants through questions about their WTP for a ticket to see their favorite team play in the NCAA Men's Basketball Tournament ("March Madness") final game. Three different pricing conditions were explored in random order: (1) advance selling (2) forward pricing and (3) option pricing (see Table 8 for a description of each). Participants also provided demographic information.

For the advance selling, option pricing, and forward pricing conditions, three different probabilities for fans' preferred team making it to the final game were presented sequentially (i.e., $\gamma = 25\%$, 50% or 75%). Fans indicated their WTP in each case. Pretests indicated that the use of three pricing conditions was not mentally overtaxing and participants felt confident in their ability to evaluate their WTP under each pricing condition. We randomly counterbalanced questions by ticket type to reduce order effects. We found no significant order effects.

Given that forward and option pricing are two new pricing mechanisms, we described them in detail and had the participants complete a short 'check your understanding' section before they could continue. Participants had two attempts to complete this test, with 100% of participants passing the understanding check. This assures us that the fans understood the alternative ticket mechanisms. Indeed, the majority of the participants (94%) reported that they found the forward and options pricing concepts easy to understand. This positively answers one of the straightforward but important questions we set out to verify: whether the newer pricing mechanisms (forward and option pricing) were easily understood and accepted by fans.

Table 8
Description of ticket types presented in the experiment.

Ticket type	Advance ticket	Forward ticket	Option ticket
Description	A ticket purchased *before* the teams in a game are identified	A reserve price paid for a ticket before the teams in a game are identified, allowing the fan to purchase the ticket for an additional price if their preferred team qualifies for the game (fan has the right *and the obligation* to exercise the forward)	A reserve price paid for a ticket before the teams in a game are identified, allowing the fan to purchase the ticket for an additional price if their preferred team qualifies for the game (fan has the right *but not the obligation* to exercise the forward)
Teams playing	Unknown at time of purchase	Unknown at time of ticket reserve payment	Unknown at time of ticket reserve payment
Exercise price to claim ticket	n/a	Yes	Yes, if fan chooses to exercise; otherwise they could simply let the ticket expire
Fan reasoning	"I will buy a Final Four ticket three months in advance; I hope my team makes it that far."	"I'm not sure if my team is going to play in the Final Four, but I will pay a reserve price to have the opportunity to buy a ticket later if my team makes it."	"I'm not sure if I will exercise the ticket; depends on how well they play during the season. I may just lower my losses and lose the reserve price; however, if they play well, I will buy a ticket because I know that that will be a game worth watching."

5.2. Consumer segmentation measure: Team-based versus game-based fans

In this section we examine preferences for pricing mechanisms depending on whether they are team- or game-based fans. Following Sainam et al. (2010), fans who noted they would *not* attend the game when their favorite team was not playing in it were classified as *team-based*, and fans who indicated they would still be interested in attending the game were classified as *game-based*. In our sample we had 93 team-based fans (16%) and 502 game-based fans (84%), taken from a nationally representative online sample. This is in contrast to Sainam et al. (2010), which used an undergraduate sample from two college towns; which resulted in a higher proportion of team-based fans.

We provide summary statistics of the sample in Fig. 3. We also provide a count of our sample's reported top college basketball teams (Fig. 4). About 57% of our sample were fans of preferred (top 15) teams and the remaining 43% were fans of non-preferred teams. This distribution validates our assumption of preferred and non-preferred teams in our model.

Fig. 5 reveals the frequency distribution for fans' WTP given a final game with their favorite team (Yes = preferred game), or without their favorite team (No = non-preferred game). As noted earlier, we had 93 team-based fans who were unwilling to pay *any* money to watch their non-preferred game. Further among the game-based fans we see a higher willingness to pay for a preferred game (captured by U_G^+ in our model) than for a non-preferred game (U_G^- in our model). The presence of these distinct segments in a nationally representative sample validates the demand-side market segment structure hypothesized in the analytical model.

Next, we verified that the utility ordering in the fan sample was the same as that assumed in the analytical model. We find that, indeed, the (average) utility of the game-based fan for the preferred team is highest, followed by that of the team-based fan for the preferred team, and then by that of the game-based fan for the non-preferred team (i.e., $U_G^+(\$213) \rangle U_T^+(\$163) \rangle U_G^-(\$100)$). While we employ a nationally representative sample in this study, this utility ordering is consistent with that in the college student sample used by Sainam et al. (2010). This provides a strong justification for the specification of the parametric space in the analytical model.

Next, we discuss the methodologies used to calculate the respondent's WTP for the three ticket pricing types and to compute profits in each case. Finally, we examine how WTP varies as a function of (1) being game-based vs. team-based, (2) the pricing condition, and (3) the probability of the preferred team making it to the final game.

5.3. Calculating firm profits across pricing conditions

5.3.1. Advance selling

Advance selling WTP is stated by the fan for each level of probability

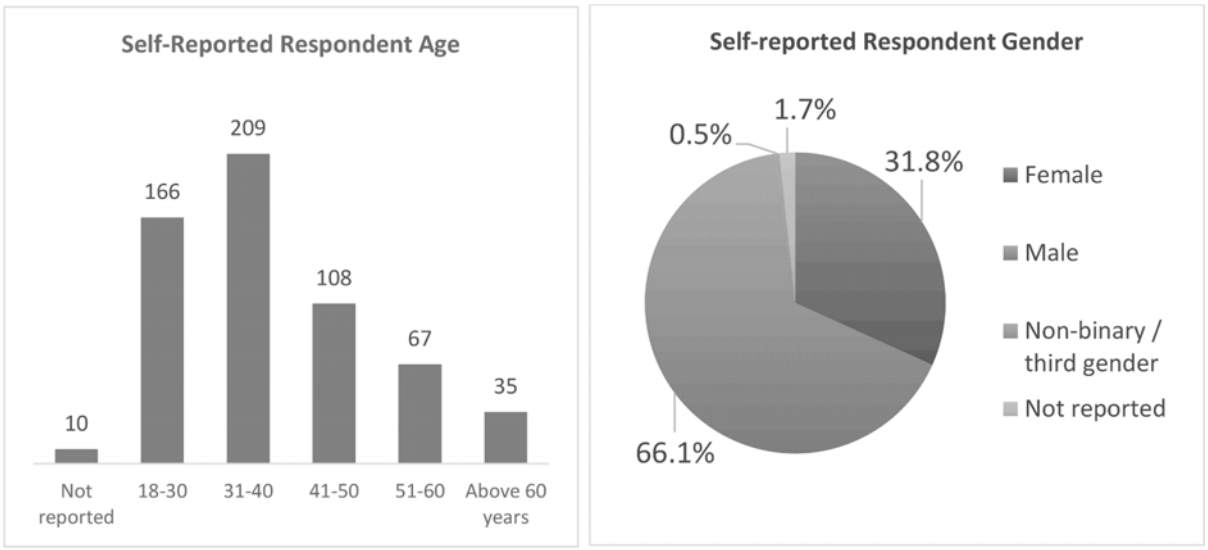


Fig. 3. Summary statistics for the respondent sample (age and gender distributions).

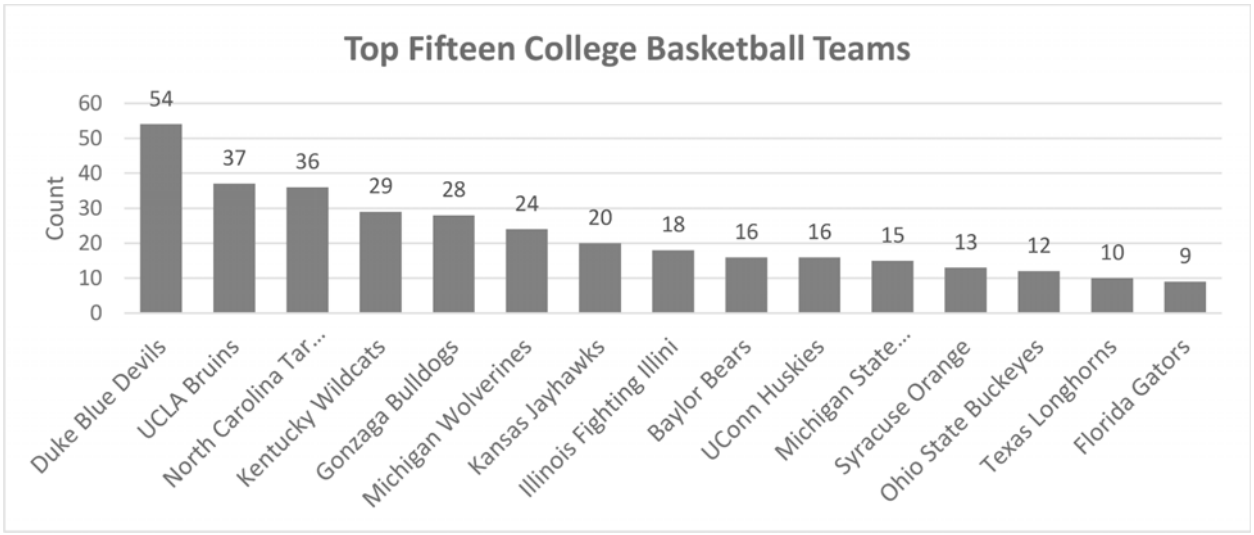


Fig. 4. Top 15 college basketball teams as reported by the respondent sample.

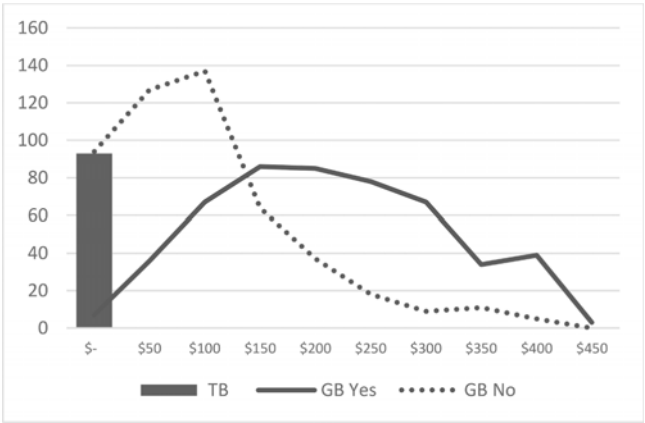


Fig. 5. Fan types and WTP.

(25%, 50% or 75%) that their preferred team may make it to the final game. At each level of probability, the fan is asked how much she is willing to pay, with ticket prices ranging from $0–500, at $50 intervals.[9]

For the forward and option cases, WTP is calculated by asking fans what exercise price they would be willing to pay given a particular probability of their team making it to the championship game (25%, 50% or 75%), and at a particular reserve price ($80).[10] The exercise price is given as a choice between $0 and $500 in $50 intervals. The difference between the forward and option tickets were explained as follows: "With a forward ticket, if your preferred team does not make it to the final game, you lose the reserve price and your claim to the ticket, whereas with an option ticket even if your preferred team does not make it to the final game, you can still choose to exercise the option by paying the additional exercise price and buying the ticket." This set up the option ticket as being more flexible than a forward ticket (just as it is

[9] Across all pricing conditions, fans had the choice to not purchase any ticket by clicking on $0.

[10] We also pre-tested other reserve prices in the study and settled on $80 as this was profit-maximizing and considered most reasonable by fans.

defined and differentiated in the finance literature); therefore, we expect WTP for the option ticket to be higher than that for the forward ticket, which we verify empirically.

5.3.2. Forward pricing

We checked for fans' WTP for a given reserve price of $80. If a fan indicated she was willing to pay $150 as the exercise price at 25% probability (over and above the reserve price), we assumed she was willing to pay anything less than $150 as well. This enabled us to compute the demand at any given price and probability level. Once we had the demand, we multiplied it by the respective price, to obtain the profits at each price point and probability. We determine the optimal exercise price by choosing the price associated with the highest profits at each probability; the optimal price was then used for the calculation of total profits.

In the forward case the fan loses the right to the ticket if her preferred team does not make it to the final game. Therefore, across fan type, we assume the sports organization receives the [reserve price + (probability team will make it * exercise price)], from each fan, provided the fan's WTP was greater than the exercise price. If not, the firm receives just the reserve price from the fan. Further, this provides the opportunity for the sports organization to sell multiple forwards across teams for one seat; given only the fans of the two winning teams will finally attend the game. We captured this idea by providing fans the opportunity to purchase multiple forwards across teams to increase their chances of attending the final game. As conjectured, numerous game-based fans (42%) thought this was a good idea and wanted to 'cover their bases' by purchasing multiple forwards by paying the additional reserve price. We added the additional profits to the above profit calculation to compute the total profits from forward pricing.

5.3.3. Option pricing

Similar to the forward case, we checked for fans' WTP. Unlike in the forward case, this ticket does not expire even if the preferred team does not make it. Therefore, if a game-based fan bought an option ticket we assume the sports organization will receive the [reserve price + exercise price], provided the game-based fan's WTP was greater than the exercise price. If a team-based fan bought the ticket, we assume the sports organization receives the [reserve price + (probability team will make it * exercise price)], provided the team-based fan's WTP was greater than the exercise price. If neither fan type was willing to pay the exercise price, the firm receives just the reserve price from the fan.

We then compute the demand and then multiplied it by the respective price, to obtain the profits at each price point and probability. We determine the optimal exercise price by choosing the price associated with the highest profits at each probability.

5.4. Overall results

Looking across all fans (see Fig. 6) and across ticket types, option pricing has the highest maximum profit across all levels of uncertainty. We conjectured that because option pricing was more flexible than forward pricing, it would also be more profitable than forward pricing. While this conjecture is true, we found that options can be more profitable than advance selling as well. Surprisingly, at lower probabilities of the favorite team making it (i.e., at 25% chance of the team making it to the final game) profits from forward pricing can be higher than those from advance selling. Conceptually this fits with the theory on consumer forwards because forwards are used as an uncertainty reduction mechanism. Therefore, when the uncertainty levels are high (25% probability of the team making it), offering fan forward tickets can increase sports organization's profitability. Further, the profits from option pricing increases considerably over that from both forward and advance selling at the 50% and 75% probabilities. This indicates that fans are also willing to pay more for the flexibility of an option ticket, which protects them from the uncertainty of the tournament, compared to advance selling.

Next, we wanted to check whether there is a preference of ticket type by fan type. We find that compared to advance selling, game-based fans prefer option pricing at all probability levels and forward pricing at lower probability levels (25% and 50%). Because game-based fans have a higher valuation for their preferred game, they are willing to pay more for alternate ticketing mechanisms that provide them with the additional flexibility, especially at lower probability levels (see Fig. 7). For team-based fans there is more value from forwards compared to advance

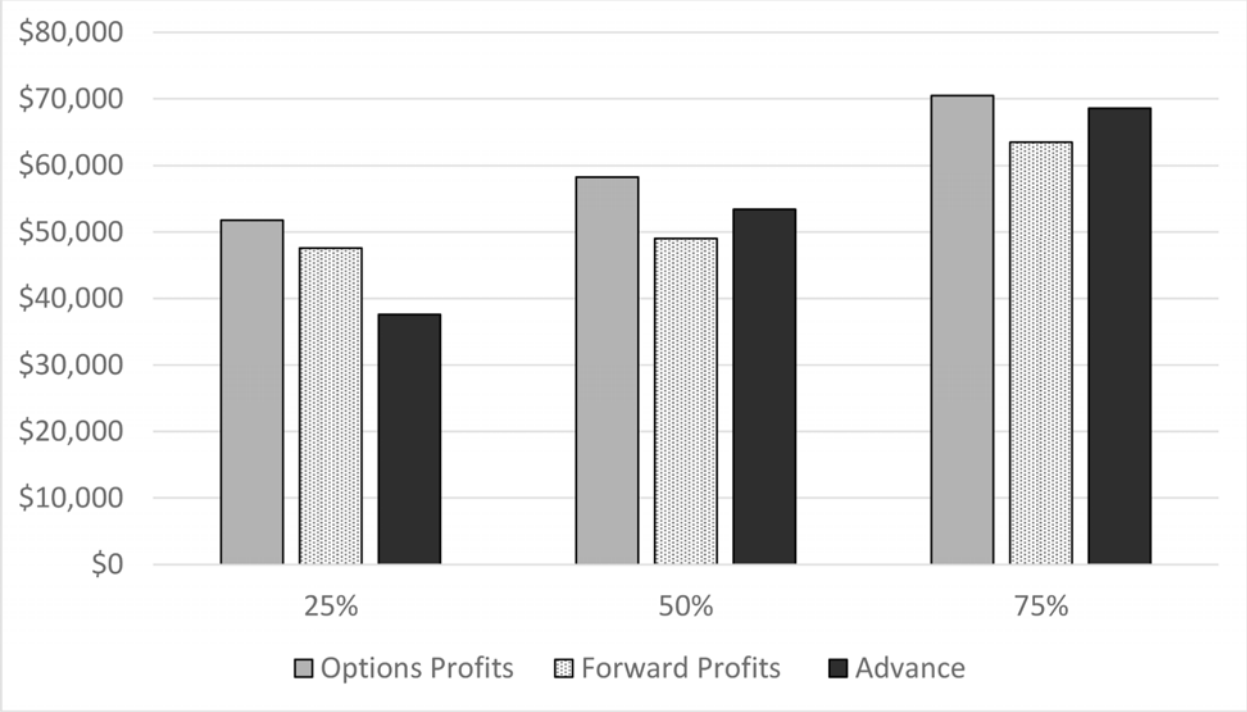


Fig. 6. Maximum profits across probabilities and ticket types at reserve price of $80.

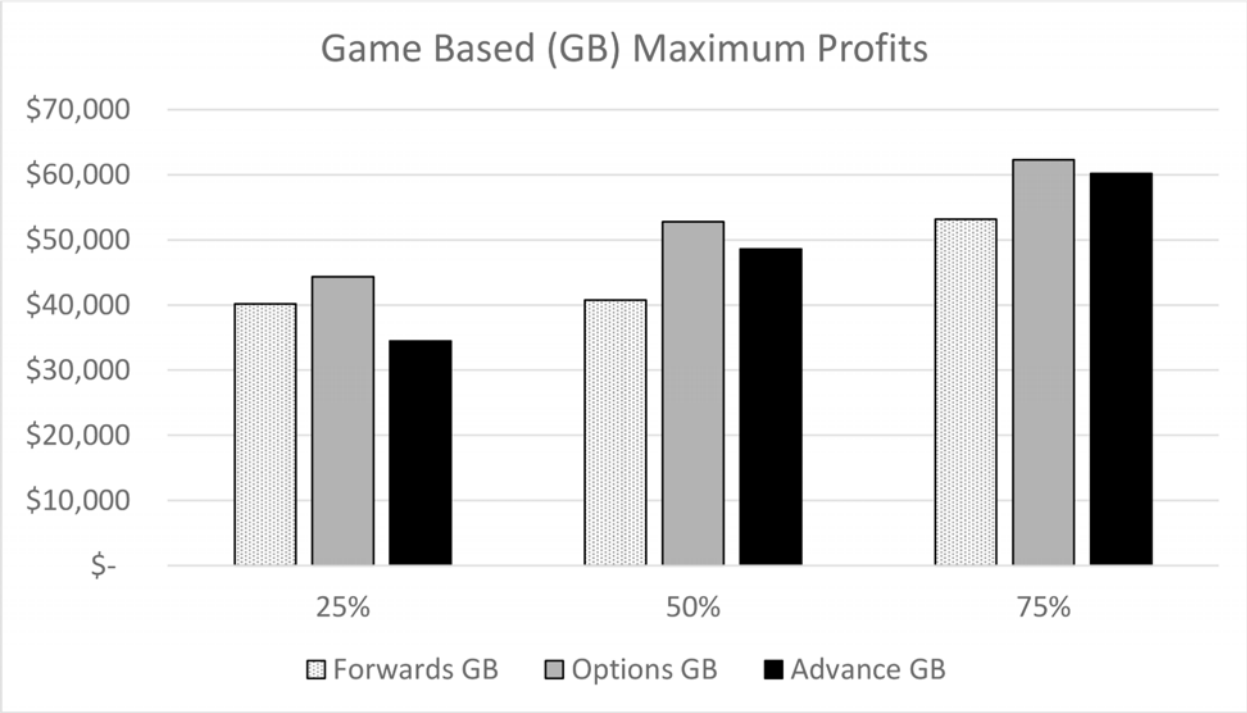


Fig. 7. Maximum profits across ticket types for game-based fans.

selling because forward pricing offers them the higher level of protection that they need against a non-preferred outcome (in which case their utility plummets to zero). Therefore, for team-based fans, forward tickets show higher levels of profitability compared to advance selling across all probabilities of the team making it to the final game (25%, 50% and 75%)—see Fig. 8. The profitability of forward pricing by fan type illustrates the power of forward pricing in providing protection for those fans who value different outcomes (heterogenous valuations). Our empirical analysis finds both fan types generally prefer these newer alternatives (forwards, options) to the current practice of advance selling.

A key finding from the empirical study is that forward pricing resonates most strongly with team-based fans who are faced with high levels of uncertainty during earlier tournament stages. We can expect that forward profits will be highest when the forward is sold earlier in the season when uncertainty is the highest, with the forward on each seat potentially being "oversold" to one fan from each team on one side of the

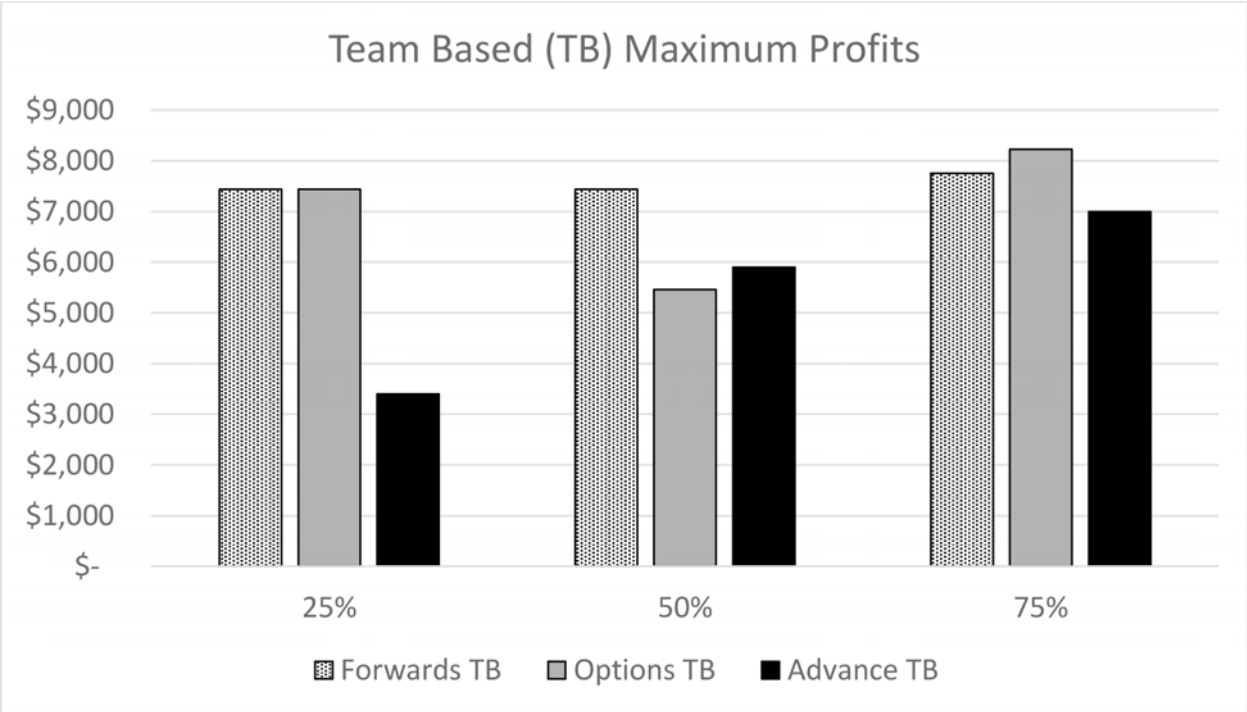


Fig. 8. Maximum profits across ticket types for team-based fans.

tournament bracket.

6. Conclusion: Managerial and research implications

Forward pricing is well-suited to elimination-style tournaments where there is a) uncertainty regarding the team that will ultimately make it at each stage and b) different consumer preferences for the playing teams—represented as team- and game-based fans. Forward pricing is particularly applicable to bracket-based elimination tournaments ranging from the NCAA College Basketball March Madness and the FIFA World Cup. More generally, forward pricing can be applied to any tournament that involves the elimination of teams at some stage, including mixed-style tournaments that feature round robin patterns of play where each team plays every other team at the early stages to decide which team enters the elimination rounds.

6.1. Managerial implications

We establish the practical viability and profitability of consumer forwards in Section 5 of the paper. Consumer forwards are a theoretically novel concept and there is no available secondary data to analyze. Therefore, using an experimental study conducted with a national US sample (n = 595), we first demonstrated that the forward concept resonates with consumers. The respondents liked the concept, believed that it delivered value, and found it easy to understand.

Further, our experiment also demonstrated that the forward and option pricing generated higher profits than advance selling, capturing consumers' willingness to spend more for flexibility to counterbalance the uncertainty of tournament matchups. Forward pricing resonates most strongly with team-based fans who are faced with high levels of uncertainty during earlier tournament stages. Consistent with our theoretical conceptualization of forwards as uncertainty reduction mechanisms, the incremental profitability of forwards over advance selling is highest when the probability of the favorite team making it to the final game is low.

It is important to recognize that our estimate of the relative profitability of forward pricing is highly conservative because we apply forward pricing only to the final game. In reality, forward pricing can be applied at each successive stage of the tournament. Consider the round of 32 teams playing in the NCAA College Basketball March Madness tournament, with 16 teams on each side of the bracket. Forwards can be sold at this stage on each of the 32 teams, for the next "Sweet 16" round of the tournament, for the following "Elite 8" round, the subsequent "Final Four" round, and then for the Final Game. At each stage only the fans who hold the forward for the teams that make it through to that stage will be obliged to purchase the ticket for that stage—all other forwards expire. Thus, the forward related to each seat in the arena for a specific stage of the tournament can be sold to fans of multiple teams on one or the other side of the bracket that could potentially feature in the game at that stage. Alternatively, a game-based fan with a very high willingness to pay to attend the final game may purchase forwards on all 32 teams on one side of the bracket to secure their seat at the championship game. In either case, profits will greatly increase.

To anchor our research to practice, we requested the Vice-President for Ticket Sales and Services for a major NBA team to read and discuss the paper with us, yielding multiple insights. First, the executive noted that arena tickets remained a primary revenue source even in this broadcast and streaming age. Therefore, ideas to better leverage the limited seating capacity were welcome. In addition, arena events had significant local economic impacts, from ticket sales to the approval of additional major revenue projects by the local government. In contrast, under advance pricing, the profits substantially accrued to geographically dispersed scalpers. The executive was enthused by the idea of taking back control from scalpers. Second, the executive believed that the ideas in the paper were simple and implementable, and appreciated the self-executing nature of ticket forwards (that is, by automatically charging credit cards of fans holding forwards on the qualifying teams).

A practical question that arises relates to knowing what forward, option and exercise prices to charge. Managers can experiment with these mechanisms, offering a subset of seats for sale under the mechanism at different tournament stages. In fact, managers can even test a range of forward and exercise prices for those seats by varying them across different rows and seating areas and then deciding what pieces to charge. Alternatively, using incentive-compatible empirical research approaches such as those we implement in the paper, managers can gauge willingness to pay at different stages of the tournament for hypothetical matchups.

In 2021 TV, mobile, and internet streaming rights generated significant revenue (McFarlane, 2021). In 2022, the NFL brought in $249 million in broadcasting deals (Statista, 2022). Such streaming revenues are dependent on many factors, including the atmosphere in the stadium (Arkenberg et al., 2019). Forward and option tickets allow sports organizations to control the mix of fans and their seat locations. They can specify seats for which only one team forward can be purchased per fan (targeting team-based fans) and seats for which multiple forwards can be purchased by a single fan (targeting game-based fans). This allows the sports organization to maximize the fan noise and activity in the stadium by controlling the spatial distribution of fan types.

Finally, forward pricing concept can be applied in other markets with outcome uncertainty. Consider the vacation travel market. The weather regularly injects unwelcome uncertainty into vacation plans. Vacationers could be offered travel forwards that were conditional on a weather quality index at their destination. These forwards would automatically expire a few days before travel if the projected conditions did not meet pre-specified index thresholds. Otherwise, the forwards would be executed and the travelers' accounts would be automatically charged. More generally, the concepts of consumer forwards and options can serve as platforms for marketing managers to think broadly about consumer risk-mitigation mechanisms.

6.2. Research implications

Much remains to be researched in the area of consumer forwards and options. First, consumer forwards could co-exist with other pricing mechanisms such as advance pricing and option pricing. Future research could examine firm profitability when multiple pricing mechanisms are employed in markets with significant outcome uncertainty and consumer heterogeneity. Further, combining such pricing mechanisms with probabilistic goods (Fay & Xie, 2008) could lead to fine-grained portfolios of offerings.

Second, as noted earlier, scholars could model and validate consumer forwards and options in other markets with uncertainty, such as travel and technology product markets. Third, field experiments applying forwards and options conducted in partnership with sports organizations would yield some interesting insights about how the concepts could be fine-tuned and positioned to appeal strongly to fans, and ultimately, to maximize profits. We believe this paper provides a strong starting point for future research and managerial initiatives related to consumer forwards and options.

CRediT authorship contribution statement

Preethika Sainam: Conceptualization, Writing – original draft, Writing – review & editing, Investigation, Validation, Formal analysis. **Sridhar Balasubramanian:** Conceptualization, Writing – original draft, Writing – review & editing. **Shantanu Bhattacharya:** Formal analysis, Writing – review & editing. **L. Lin Ong:** Investigation, Formal analysis, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial

interests or personal relationships that could have appeared to influence the work reported in this paper.

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