Economics of Sport (ECNM 10068)

Lecture 2: Demand, in theory

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Demand, in theory

Issues covered:

- What determines the demand for spectator sport?

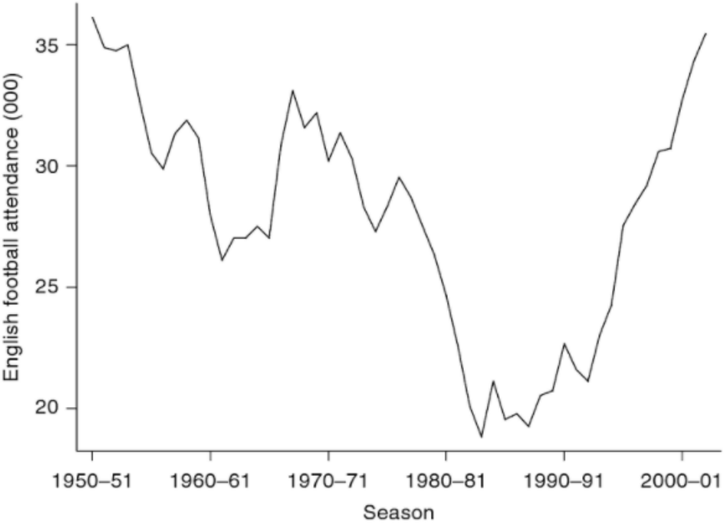
- Does standard economic theory suggest ticket prices are too low?

- The level of competition matters for demand: how do we measure it?

Main reading:

Chapter 3.1, Dobson-Goddard “The Economics of Football” 2nd ed. Cambridge 2011; Chapter 8 (Simmons), Andreff, W., & Szymanski, S. (2006). Handbook on the Economics of Sport. Cheltenham: Edward Elgar.

Ticket sales - Average Game Attendance English First Division (Premier League)



Source: Page 78, Simmons (2006)

Standard economic theory suggests demand should depend on the following:

- Price of the event (plus any travel costs)
- Real incomes of spectators
- Prices of substitute goods
- Market size (traditionally the local population size)
- Importance of the contest
- Competitive balance

Non-standard features of sport which might affect demand:

- Consumer habits/persistence (die-hard fans)
- Fickleness - unrealistic expectations
- Sale of complementary products - sources of revenue beyond the gate receipts

Price elasticity at the gate

- Because of fan loyalty (UK football) and geography (US football / NBA), we should think of sports teams as being approximately monopolists.
- Assuming costs are fixed (marginal costs are zero), a profit maximising firm/team would choose a ticket price, p_T, where the price elasticity of demand is equal to -1:

$$\eta(p_T) = \frac{\partial T(p_T)}{\partial p_T} \frac{p_T}{T(p_T)} = -1 \tag{1}$$

- But empirical studies across several sports have found $|\eta| < 1$
- Why then are firms not maximising revenues/profits?
  Is something missing from the revenue function?

The revenue function for a sports team or event

- Suppose a team hosting a football match chooses a ticket price p_T to maximise revenue (or profits, assuming only fixed costs):

$$\max_{p_T > 0} \; [p_T + X(p_T)]\, T(p_T) + B(T(p_T)) \, , \tag{2}$$

- $T(p_T)$ is the ticket demand function, with $T'(p_T) \leq 0$.
- $X(p_T) \geq 0$ is the revenue per attendee from other sources, such as fringe sales (programmes, drinks, merchandise), with $X'(p_T) \leq 0$.
- $B(T(p_T))$ is possible broadcast revenues, with $B'(T) \leq 0$.

The revenue maximising ticket price:

- The FOC for (2) implies:

$$T(p_T)\left[1+\frac{\partial X(p_T)}{\partial p_T}\right]+\frac{\partial T(p_T)}{\partial p_T}\left[p_T+X(P_T)+\frac{\partial B(T(p_T))}{\partial T(p_T)}\right]=0\,.$$

  Rearranging gives

$$-\eta(p_T)=1+\frac{1}{T(p_T)}\left[\frac{\partial X(p_T)}{\partial p_T}+\frac{\partial T(p_T)}{\partial p_T}\left[X(P_T)+\frac{\partial B(T(p_T))}{\partial T(p_T)}\right]\right]\,.$$

The revenue maximising ticket price (continued):

- $|\eta| < 1$ if ...
  - ... attendees make fewer fringe purchases when prices are high: $X'(p_T) < 0$;
  - ... fringe purchases are increasing in the number of attendees: $\frac{\partial T(p_T)}{\partial p_T} X(P_T) < 0$.
- But if $B'(T) < 0$, and fans prefer to stay at home and follow the game live, or watch highlights on TV/radio/internet when prices are high, then this would tend to increase $|\eta|$.
- Are there factors missing from the suggested revenue function?
- An example: Football - Deloitte Football Money League.
- What role does the mood or atmosphere among fans play in sport? e.g. Why have West Ham FC kept ticket prices low since moving to Olympic Stadium? News article
- Is it obvious that $B'(T) < 0$?

Another economic puzzle - Season Tickets

- Consumers of sport who buy multi-game tickets, well in advance of the games, should have a lower price elasticity of demand than fans who buy tickets at the gate.
- Why then are tickets at the gate more expensive?
  Why do season tickets come with perks? (e.g. preferential treatment for cup and away games)
- **Possible reasons:** "Mood / atmosphere" matters;
  Scheduling - not knowing if some games will be scheduled at inconvenient times; Broadcasting - similar to scheduling;
  Uncertainty of relegation/promotion and quality;
  Cheaper for the sports team to sell tickets "wholesale";
  Precarious club finances - football clubs overspend, and often leverage/borrow against future "certain" season ticket revenue.

Demand and Competitive Balance

- It is clear (empirically) that unpredictability and competitive balance (inequality) are also important for sports demand.
- This can be measured in many ways:
- Ex ante: we can free ride on the “professionals” - betting odds.
- Ex post: we can look back over a sample of games in a season to measure how competitive the league was.

Ex Ante - Bookmaker odds and potential returns

- Perhaps more familiar with decimal odds:
  stake x at price p and winnings/returns are then xp.
- Let's define odds in traditional English ("Fractional") style: a/b.
- If you stake/bet/pay b and if you win your bet, then you receive $a+b$.
- More generally, if you stake x at odds of a/b your potential returns would be $x(1+a/b) = x\frac{a+b}{b}$.

Competitive balance in the eyes of the bookmaker

- Assuming odds reflect the bookmakers' expectations about the probability of an event resulting in a win, Π_w, it must be that their expected returns from laying and taking the bet x at odds a/b are

$$-\Pi_w \left(x\frac{a}{b} \right) + (1 - \Pi_w)x = xc \ , \tag{3}$$

- where $0 < c \leq 1$ is the bookmaker's "commission" rate.

- This implies:

$$\Pi_w = \frac{b(1-c)}{a+b}. \tag{4}$$

- A measure of competitive balance is given by $\Pi_w(1-\Pi_w)$.
- But what does c equal? For most real-life bookmakers, assuming there is an even win/lose contest, $\Pi_w = 0.5$, then offered fractional odds are $10/11$, or $19/20$, in which case c is in the range of 2.5-4.5%.
- But in reality, c is endogenous.
- Unobserved commission rates increase with the unevenness of the contest, reflecting bookmaker risk aversion, and/or exploiting over-optimism of punters towards favourites.
- This is likely to make ex ante measurement of competitive balance imprecise in practice.

Ex Post - How competitive was that league/season I just saw?

- We don't really know how the measure of competetive balance/inequality in a sports league motivates the supporters.
- Unsurprisingly then, there is not one definitive way to measure it.
- For professional leagues, this measurement is more straightforward when draws are not possible, like in North American sports.
- There is a large literature on measuring ex post competitive inequality, and correlating that to outcomes such as spectator demand, addressing specific issues such as home-field advantage.
- These are just some of the more popular approaches to measurement:

Sample variance of win ratios

- Often used to describe the level of competition in North American sports.
- Let there be n teams, each of which has an observed win ratio of w_i for the season in some league.
- The sample variance for the league is then given by

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} (w_i - 0.5)^2}{n}}\,, \tag{5}$$

where 0.5 is the mean win ratio.

- Comp. balance is decreasing in σ, but what is the ideal level?

- Can we compare it across leagues with different numbers of matches or teams?

- What is the ideal sample variance?

- Consider an m game season where each team has $p^e = 0.5$ expected chance of winning each game. Assume that a team's wins come from a binomial distribution. Then the expected number of wins for each team is $E(W_i) = 0.5m$. The variance is then $V(W_i) = 0.25m$. The expected win ratio is $E(w_i) = 0.5$, and the variance is $V(w_i) = V(W_i)/m^2$. So the ideal sample variance would be $\sqrt{V(w_i)} = 0.5/\sqrt{m}$.

- Using this, we can define a relative measure of competition, comparable across leagues with different numbers of matches, as

$$\begin{aligned}\tilde{\sigma} =& \sqrt{\frac{m\sum_{i=1}^{n}\left(w_i - 0.5\right)^2}{0.25n}} \\ =& \sigma / \left(0.5/\sqrt{m}\right)\end{aligned}$$

- For perfect competition, $\tilde{\sigma}$ should not be significantly different from 1.

- But this measure is also imperfect. For example, it doesn't allow for home-field advantage, such that in a perfectly competitive league $p \neq 0.5$ for each game.

- Not addressing this will lead to a downwards bias in estimates of $\tilde{\sigma}$, overstating the degree of competitive balance.

Herfindahl Index (HI)

- Borrowed from Industrial Organization literature, where it is used to measure the degree of competition in an industry:

$$HI = \sum_{i=1}^{n} w_i^2 \; . \tag{6}$$

- Competitive balance is decreasing in HI.
- Hard to compare across time/leagues as the value depends on n.
- In particular, it's potential value is bounded below by $1/n$, so possible adjusted or normalised (between zero and one) measures are given by:

$$adjusted\ HI = HI - 1/n \; ; \tag{7}$$

$$normalised\ HI = \frac{HI - 1/n}{1 - 1/n} \; . \tag{8}$$

Concentration ratio

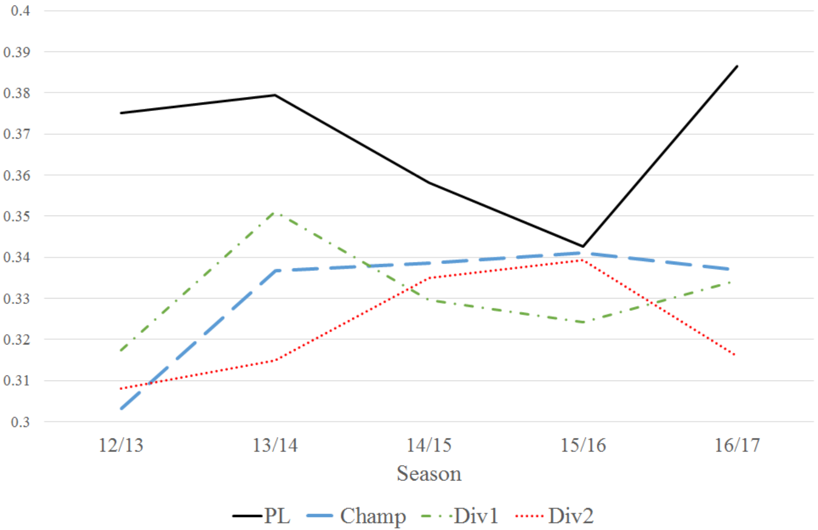
- How much of the winning is concentrated among the top teams? Many sensible ways to measure this, depending on sports league.

- An example: English lower league fans often argue with fans of the Premier League that the football they watch is more competitive, and this is why they prefer it, despite lower quality.

- Let's construct a simple "concentration" ratio to compare how competitive English football leagues were in the past 5 seasons, based on final standings.

$$C = \frac{\text{Total points won by top 25\% of teams}}{\text{Total points won by all teams}} \,. \tag{9}$$

Share of points won by top 25% of teams - English Football Leagues)



Source: own calculations

Lorenz curve - Gini coefficient

- Often used to compare income inequaltiy between countries, the Gini coefficient for team win ratios in a league is given by

$$G = \frac{2\sum_{i=1}^{n} i w_i}{n\sum_{i=1}^{n} w_i} - \frac{n+1}{n} \,, \tag{10}$$

  where before calculating G it must be that $w_i \leq w_{i+1}$; i.e. the team win ratios are listed over i in non-decreasing order.

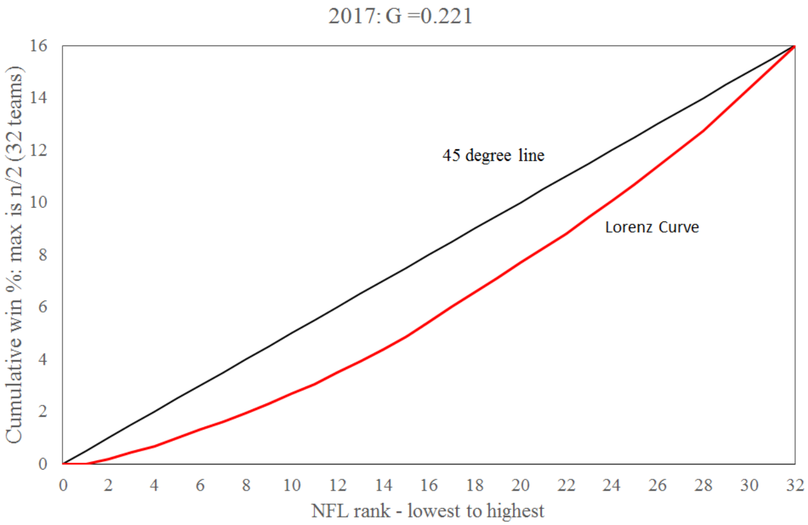
- This measure, increasing in the amount of competitive inequality, can be represented graphically using a Lorenz curve.

- An example... [n.b. you should learn how to construct a Lorenz curve and calculate Gini coefficients.]

Is the NFL more or less competitive in 2017 than in 1977?

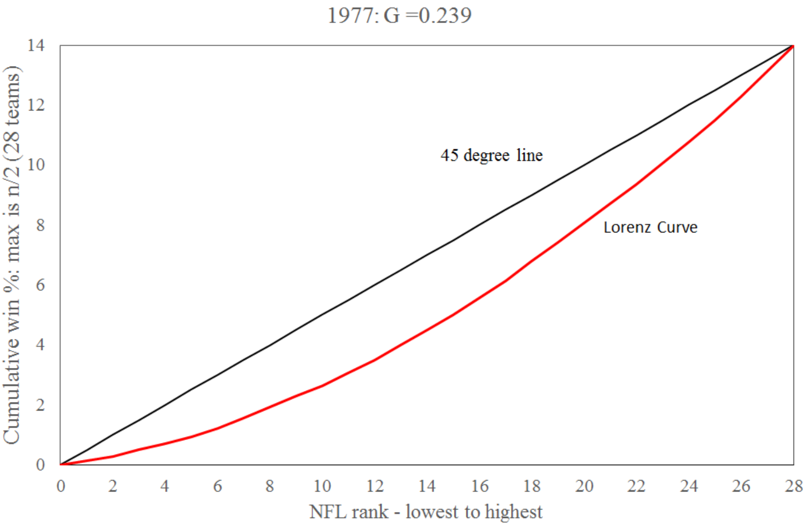
- Data: https://www.nfl.com/standings/league/2017/REG

Lorenz curve and Gini coefficient of NFL team win %: 2017



Source: own calculations

Lorenz curve and Gini coefficient of NFL team win %: 1977



Source: own calculations

A practice exam-type problem

The Jacksonville Jaguars (J) will play at the New England Patriots (NE) in the AFC championship game [Qualifier for the NFL Super Bowl - draw not possible].
Bookmaker A is offering fractional odds of $1/4$ for NE to win the game, and odds of $3/1$ for J to win.
Bookmaker B is offering fractional odds of $2/7$ for NE to win the game, and odds of $14/5$ for J to win.
The commission rates of the bookmakers, c_A and c_B, are defined as their expected profit from accepting a bet of \$1 on either team.

Continued:

(i) Briefly discuss why measuring competitive balance is important if, as economists, we want to understand the ticket prices paid for spectator sports.

(ii) Assume that the odds described above reflect the bookmakers' expectations over who will win the AFC game. Compute: Bookmaker A's belief about the probability NE will win, the Bookmaker's rate of commission c_A, and a derived measure of competitive balance.

(iii) Using your answer to (ii) and more generally, discuss why it could be unrealistic to assume the bookmaker aims for a constant commission rate on each bet they accept.

(iv) A punter has $1 to bet on the game, with Bookmaker A and B being the only available options. He/she is risk neutral and has no priors about the likely outcome of the game. Describe the possible betting strategies whereby the punter can make a risk free profit. *[Hint: let* α *be the amount bet on NE, and* $1 - \alpha$ *the amount bet on J. Describe the strategies in terms of* α*.]*

Outline answer:

(i) ...

(ii) Let Π_A be A's belief about the probability of NE winning. We can write A's expected profit from laying bets on NE and J as:

$$-\Pi_A(1/4) + (1 - \Pi_A) = c_A \ , \tag{11}$$

$$-(1 - \Pi_A)(3/1) + \Pi_A = c_A \ . \tag{12}$$

Solving these two equations gives $\{\Pi_A, c_A\} = \{\frac{16}{21}, \frac{1}{21}\}$. Implied competitive balance is given by $\Pi_A(1 - \Pi_A) = 80/441$.

Continued:

(iii) In reality the bookmaker will anticipate that NE are big favourites among punters, and they will take a large amount of money on them. And so they will set lower commission on those bets. This is why the ex ante probabilities we derived in (ii) do not reflect the (real) odds being offered by A on the game. To see this more clearly, assume that the commission rate for taking bets on J is now βc_A, with $\beta > 1$. Then we would find that $\Pi_A = \frac{4\beta+12}{5\beta+16}$. Which is decreasing as β becomes large. Although this is a contrived example, this is approximately why bookmakers make almost all their money when big favourites lose.

Continued:

(iv) The options are betting on NE at $2/7$ or J at $3/1$. So for what values of α is it the case that:

$$\alpha\frac{2}{7} - (1-\alpha) \geq 0 \tag{13}$$

and

$$(1-\alpha)3 - \alpha \geq 0 \ . \tag{14}$$

Answer: Requires $\alpha \leq \frac{3}{4}$ and $\alpha \geq \frac{7}{9}$. So there is no such value of α whereby the punter makes a profit. His best strategy is to not bet at all. Due to competition and public information, it is very rare to find a free lunch in sports betting markets. Given that these forces also drive the odds offered, is ex ante measurement of competitive balance using these odds then likely to be precise?