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From Competitive Balance to Match Attractiveness in Rugby Union

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ABSTRACT

Professional sports leagues aim to provide attractive contests that maximise fan interest. Literature on the demand for professional sport suggests that fans derive utility from identifying with teams and from the quality of contests, which depends on uncertainty of outcome and demonstration of the skills required to excel at the game. Measures of the attractiveness of sports contests should incorporate these two dimensions of quality. This paper proposes measures of the attractiveness of rugby union matches corresponding to Newton's gravity equation. These measures proxy the extent of uncertainty of outcome by the points margin between the participating teams and demonstration of playing skills by the total number of points scored in a match, respectively. Using hypothetical match scores, the paper shows that the most accurate of the proposed measures uniquely identify degrees of "attractiveness". A comparison of major rugby leagues for the period 2006 to 2008 suggests that the Guinness Premiership provided the most attractive matches, followed by the Magners League and the Super 14.

Keywords: Economics of sport leagues, Rugby union, Competitive balance,
Uncertainty of outcomes, Match attractiveness

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1. INTRODUCTION

Played and supported in most countries, rugby union is one of the world's leading team sports.^{2 3} The total attendance at the 48 matches of the Rugby World Cup hosted by France in September and October 2007 was 2,246,377, while more than 4,000 million viewers followed the competition on television (International Rugby Board, 2008, pp. 14, 18-19). In the highly competitive milieu of professional sport, the rugby competitions of countries vie with each other and with competitions in other sports codes (notably football or soccer, rugby league, cricket and country-specific sports) for sponsorships, spectators and television viewers. All such competitions therefore aim to provide attractive rugby.

This paper proposes a set of indicators of the attractiveness of rugby union matches. Based on Newton's gravity equation, these indicators incorporate two important determinants of the appeal of rugby matches: the closeness of the outcome (proxied by the points margin between the winning and losing teams) and demonstration of playing skills (proxied by the total number of points scored). The indicators are simple to calculate and interpret – the only data required to compute their values are the results of matches – and their usefulness for comparative purposes is not affected by aspects of the structure of competitions (e.g. the number of participating teams and the number of matches played by each team). Hence, they should be useful for various purposes, including analyses of the attractiveness of matches in specific competitions over time, comparisons of the attractiveness of matches in different competitions, and studies of the effects of rule changes on the attractiveness of rugby matches.

The remainder of the paper consists of four sections. Section 2 links the conceptual groundings of the proposed indicators to key ideas in theoretical economic analysis of sports leagues. Section 3 outlines the proposed indicators. Section 4 contains an empirical application in which some of the indicators are used to compare the attractiveness of matches in several prominent rugby leagues during the period 2006 to 2008. Section 5 provides concluding comments.

2. TOWARDS INDICATORS OF THE ATTRACTIVENESS OF RUGBY MATCHES

An important objective for sports leagues is to maximise fan interest, which Borland and MacDonald (2003, p. 479) described as the essence of the demand for sports contests. According to Borland and MacDonald (2003, p. 479) the major sources of the utility that fans derive from their interest in sports contests are (i) identification with specific teams and (ii) the quality of the contest, which depends on uncertainty of outcome and demonstration of the physical and mental skills required to excel at the game. Adequate measures of the attractiveness of rugby games (and, for that matter, contests in other sports codes) therefore should incorporate these two dimensions of high-quality matches.

² Rugby union is an outdoor team sport played by two teams with 15 players each. The objective of the game is to score as many points as possible, as the team that scores the most points wins the match. Points are obtained by: (i) scoring a try, that is, grounding the ball in the opponents' in-goal area (five points), (ii) converting a try by means of a goal kick (two points), (iii) kicking a drop goal (three points) and (iv) kicking a penalty goal (three points).

³ Rugby union has established itself as a popular sport, particularly in Australia, Argentina, Canada, England, Fiji, France, Georgia, Ireland, Italy, Japan, New Zealand, Romania, Samoa, Scotland, South Africa, Tonga and Wales. Other countries with a long tradition of rugby, although as a minority sport, include the USA, Sri Lanka, India, Singapore, Malaysia, Paraguay, Uruguay, Chile, Netherlands, Belgium, Russia, Moldova, Portugal, Spain and numerous African countries (Wikipedia, 2008).

There is an extensive theoretical and empirical literature on uncertainty of outcomes of sports contests. The theoretical literature revolves around the uncertainty of outcome hypothesis, which states that uncertainty about the outcome of matches and championships enhances their appeal because spectators prefer close games and tight championship races to predictable or one-sided ones, *ceteris paribus*.⁴ This hypothesis implies that approximate equality in the playing strengths of the participating teams should stimulate spectator interest in matches and championships – a proposition that launched a large empirical literature on competitive balance in sports leagues (for reviews, see Cairns, Jennett & Sloane, 1986, pp. 17-21; Downward & Dawson, 1999, pp. 9-13; Borland & MacDonald, 2003, pp. 485-487; Szymansky, 2003, pp. 1155-1156). Econometric studies of the demand for sport, for example, usually include measures of one or more of the three dimensions of competitive balance: uncertainty about the outcomes of (i) specific matches, (ii) the championship race in a specific season, or (iii) championship races over time (the extent to which one or a small number of teams dominate the league in the longer run) (Szymansky, 2003, pp. 1155-1156).

The uncertainty of outcome hypothesis clearly has to do with the *ex ante* unpredictability of match outcomes: the decision to see a game (either live or televised) is influenced by prior assessment of how closely the two teams would be matched on the day. Studies of the demand for sports contests therefore use indicators such as the difference between the league standings or the winning percentages of the two teams on the day of play and various betting odds to proxy uncertainty about the outcomes of matches (Cairns, Jennett, & Sloane, 1986, pp. 17-19; Szymansky, 2003: p. 1156). Owen and Weatherston (2004a; 2004b), for example, used New Zealand Totalisator Agency Board (TAB) odds on home-win probabilities as an indicator of match uncertainty in studies of the determinants of attendance of New Zealand National Provincial Championship and Super 12 rugby games.⁵

When the objective is to measure the actual (as opposed to the expected) spectator appeal of matches, however, the equivalent of uncertainty of outcome is a close contest in the *ex post* sense. The drama of a sports contest is enhanced when its outcome remains in the balance until the final whistle, and this aspect of sporting competition should be captured in measures of the actual appeal of matches. The margin of victory (*i.e.* the difference between the numbers of points scored by the two teams) has obvious merit as a quantitative measure of this dimension of the attractiveness of rugby matches.

It is much less straightforward to capture the demonstration-of-skills dimension of attractive rugby in a simple quantifiable measure. There is no *a priori* basis for deciding which of the many skills on display during rugby union games should be included in measures of the spectator appeal of matches and how they should be weighted.⁶ Moreover, detailed data on displays of particular skills are not widely available. Hence, the indicators proposed in this paper use the total number of points scored in a match as a simple proxy for demonstration of skills, based on the assumption that skillful play creates opportunities for scoring points.⁷ Combining the victory margin and the total number of points scored in a single indicator of the attractiveness of rugby matches also makes sense from another angle: one would expect that spectators would derive more enjoyment from a close game in

⁴ Rottenberg (1956: pp. 254-255) and Neale (1964: pp. 1-3) first pointed out that the jointly produced outputs of sports teams – such as matches and championship races – are enhanced if the playing strengths of the participating teams are fairly equal.

⁵ The Super 12 (since renamed the Super 14 following the inclusion of two more teams) is a competition involving regional teams from Australia, New Zealand and South Africa.

⁶ These skills include elusive running, solid defensive tackling, accurate goal and field kicking, lineout jumping, strong scrumming and good handling and passing of the ball.

⁷ Such opportunities include winning penalties: teams often concede penalties when skillful play by the opposition creates sustained pressure, and good kicking skills are required to convert penalties into points.

which many points were scored (including several tries) than from a low-scoring game that produced few (if any) tries.

3. GRAVITY MEASURES OF THE ATTRACTIVENESS OF RUGBY MATCHES

This section outlines the proposed measures of the attractiveness of rugby matches. As indicated earlier, these measures combine the uncertainty of outcome and demonstration of skills dimensions of attractive rugby into one metric using the total points scored in a match and the points margin between the winner and the loser as indicators. These measures are based on Isaac Newton's "Law of Universal Gravitation" of 1687. The gravity equation has found application in other areas of economics as well, specifically in the estimation of trade flows and migration (Bergstrand, 1985).

Newton's theory held that the gravitation attraction force between two point masses is directly proportional to the product of their masses and inversely proportional to the square of their separation distance. Mathematically, it is shown as:

$$F_{ij} = G \frac{M_i M_j}{D_{ij}^2},$$

where F_{ij} is defined as the attractive force, M_i and M_j are the masses, D_{ij}^2 are the distance between the two objects and G is the constant.

Corresponding to Newton's model, the following five measures of attractiveness are proposed:

$$\begin{array}{ccccc} (1) & (2) & (3) & (4) & (5) \\ A_{ij} = \frac{T_i + T_j}{D_{ij}}, & A_{ij} = \frac{T_i T_j}{D_{ij}^2}, & A_{ij} = \frac{(T_i + T_j)^2}{D_{ij}}, & A_{ij} = \frac{T_i T_j}{D_{ij}}, & A_{ij} = G \frac{T_i + T_j}{D_{ij}^2}, \end{array}$$

where A_{ij} is defined as attractiveness, T_i and T_j are the scores of Team i and Team j in each match, D_{ij} are the difference between the team scores calculated as the absolute margin and G is a constant. The full notation is included in the appendix.

All five metrics are versions of the gravity equation. For all of them, higher values of A_{ij} indicate more attractive matches. Equation (1) calculates the sum of the scores of the two teams involved in a match and divides this by the absolute difference of these scores. Equation (2) multiplies the team scores and divides this product by the squared absolute margin. A problem arises with this measure when one team scores zero points in a game, as this eliminates the numerator ($T_i T_j$). This is also true of Equation (4). Equation (3) squares the total points in a match ($T_i + T_j$) and divides the result by the absolute margin. Equation (5) divides total points by the absolute margin squared, and multiplies by a constant.

The measures assign different weights to the two components (the number of points scored in a match and the margin of victory). Equations (1) and (2) weigh the two components relatively equally, whereas Equations (3) and (4) give more weight to the total number of points scored. Equation (5) gives relatively more weight to the margin between the winner and the loser. The addition of a constant (G) increases comparability.

Table 1 contains nine hypothetical match scores that illustrate the calculation and interpretation of the five measures. One of the possible uses of the metrics is to determine the attractiveness of

individual matches in this manner. It should be noted, however, that the measures cannot be calculated for drawn matches, which have margins of zero. Section 4 illustrates alternative ways of employing the metrics, namely to gauge the attractiveness of matches in specific competitions during one or more seasons, or to compare the attractiveness of matches across competitions. Such analyses use averages of the total match scores and margins. By using averages, drawn matches are not eliminated from the calculations of season attractiveness measures.

TABLE 1: HYPOTHETICAL MATCH SCORES

	T_i	T_j	$T_i + T_j$	$T_i T_j$	D_{ij}	D_{ij}^2	(1)	(2)	(3)	(4)	(5)
(a)	100	0	100	0	100	10000	1	0	100	0	1
(b)	5	0	5	0	5	25	1	0	5	0	20
(c)	100	3	103	300	97	9409	1.06	0.03	109.4	3	1
(d)	5	3	8	15	2	4	4	3.75	32	8	200
(e)	10	9	19	90	1	1	19	90	361	90	1900
(f)	50	49	99	2450	1	1	99	2450	9801	2450	9900
(g)	25	20	45	500	5	25	9	20	405	100	180
(h)	30	15	45	450	15	225	3	2	135	30	20
(i)	40	5	45	200	35	1225	1.29	0.16	57.9	6	4

Compare hypothetical Match (a) (in which the winning team scored 100 points and the losing team 0) and hypothetical Match (b) (in which the scores of the winning and losing teams were 5 points and 0, respectively). Match (a) yielded far more points than Match (b) and therefore was more attractive in terms of demonstration of points-scoring skills. Match (b) was a much closer and more suspenseful game, however, and was the more attractive of the two viewed from the angle of uncertainty of outcome. Metric (1) gives equal weight to the demonstration-of-skills and outcome uncertainty properties of attractiveness; as such, it assigns similar match attractiveness scores of 1 to both matches. Metric (3) weighs points scored more heavily and therefore favours Match (a) over Match (b). Metric (5) weighs the margin of victory more heavily and indicates Match (b) as having been more attractive than Match (a). Metrics (2) and (4) also yield similar match attractiveness scores for the two matches, but this is because the numerator is zero. These measures should be used only when both team scored points (*e.g.* Matches (c) and (d)). Both metrics favour a match outcome of 5-3 (Match (d) over 100-3 (Match (c))).

Hypothetical matches (e) to (i) had more realistic scores. Match (f) was the most attractive game in terms of all five metrics. In general, the metrics prefer closer matches to high scoring matches with large differentials. Even metric (3), which is weighted heavily in favour of the total points scored, assign a higher match attractiveness score to Match (e) (with an outcome of 10-9) than to Match (h) (the score of which was 30-15).

4. AN APPLICATION: RUGBY UNION COMPETITIONS

The invariance of the measures to structural aspects of leagues (such as the number of participating teams and the number of matches each play per season) makes them ideal for comparing the attractiveness of matches across competitions. This section provides an illustrative comparison of matches during the past three seasons in the following nine competitions in major rugby-playing nations: the Air New Zealand Cup, South Africa's ABSA Currie Cup, the EDF Energy Cup of England and Wales⁸, the European Challenge Cup, England's Guinness Premiership, the Heineken Cup in Europe, the Magners League of Ireland, Scotland and Wales, the Super 14 consisting of teams

⁸ In 2005/2006 this competition was known as the Powergen Anglo-Welsh Cup.

from Australia, New Zealand and South Africa, and the French Top 14.⁹ The dataset includes all round robin or pool matches, but excludes play-off matches (such as qualification matches, semi-finals and finals). Data were obtained from various sources, mostly from the official websites of the various competitions.

Table 2 shows the averages of match scores and victory margins for the nine competitions. The average number of points scored per match ranged from 39.34 in the Magners League to 57.88 in the Currie Cup. It is tempting to ascribe the low average total scores in the Magners League to British weather conditions, because wet playing fields encourage less expansive styles of play that often yield low-scoring matches. This explanation is inadequate, however: the average total scores of the Super 14 competition, which takes place in more congenial southern-hemisphere weather conditions¹⁰ and is known for expansive running rugby, are close to or even below those of some of the premier competitions in Europe (*e.g.* the Guinness Premiership).

TABLE 2: AVERAGE TOTAL SCORES AND AVERAGE MARGIN IN RUGBY UNION COMPETITIONS

	<i>Average total scores</i>				<i>Average margin</i>			
	2006	2007	2008	All	2006	2007	2008	All
Air New Zealand Cup	44.70	47.59	-	46.14	15.30	16.84	-	16.07
Currie Cup	60.66	55.11	-	57.88	23.16	22.75	-	22.96
EDF Energy Cup	45.17	46.15	44.15	45.15	16.00	15.63	13.85	14.74
European Challenge Cup	54.93	48.50	47.43	50.29	25.57	20.90	22.83	23.10
Guinness Premiership	42.08	40.89	42.13	41.70	9.43	10.08	11.63	10.38
Heineken Cup	47.04	45.81	42.88	45.24	16.51	17.39	14.51	16.14
Magners League	42.03	39.28	36.71	39.34	12.35	12.68	11.13	12.06
Super 14	46.21	43.97	43.96	44.71	12.27	14.16	12.57	13.00
Top 14	44.34	39.68	-	42.01	16.08	13.14	-	14.61

SOURCE:

The highest number of points a rugby union team can attain for each play is seven for a converted try. Seven, fourteen and twenty-one points therefore are important benchmarks in analyses of victory margins. Table 2 shows that the Currie Cup and the European Challenge Cup have extremely high victory margins: on average, the losing sides in matches in these competitions would have required more than three converted tries to reverse the result. By contrast, three competitions – the Guinness Premiership, the Magners League and the Super 14 – had average margins over the three seasons of fewer than 14 points (*i.e.* two scoring opportunities), while those of the French Top 14 and the EDF Energy Cup were slightly above this threshold.

Table 3 compares the attractiveness of matches in the nine competitions using three of the metrics proposed in Section 3 above. Metrics (1), (3) and (5) were used for the comparison, whereas metrics (2) and (4) were dropped because of their inability to handle matches where teams had scores of zero. The results are not comparable across metrics, but each metric can be compared across years and competitions. Higher values consistently indicate more attractive matches.

Metric (1), which weights the total score and the victory margin equally, suggests that the Guinness Premiership was the most attractive competition in all three seasons. On balance, matches in the Super 14 and the Magners League also were relatively attractive, whereas the Currie Cup and, especially, the European Challenge Cup obtained poor match attractiveness scores.

⁹ Appendix B summarises some of the key characteristics of each competition.

¹⁰ The Super 14 starts in February and ends in May – a period usually marked by warmer and drier weather than that during European winters.

Metric (3) weights the total score more heavily than the victory margin. The Guinness Premiership again came up tops in terms of this indicator in 2006 and 2007, but marginally lagged the Super 14 in 2008. The Currie Cup, the EDF Energy Cup and the Air New Zealand Cup also obtained good match attractiveness scores, while the European Challenge Cup again was the least attractive competition.

The Guinness Premiership also outperformed the other competitions in 2006 and 2007 in terms of Metric (3), which weights the margin more heavily than the total score. In 2008, however, it obtained a slightly lower score than the Magners League. Other attractive competitions according to this metric are the Magners League, Super 14 and EDF Energy Cup. In this comparison, too, the European Challenge Cup and the Currie Cup filled the bottom two spots.

TABLE 3: THREE METRICS OF LEAGUE ATTRACTIVENESS IN NINE COMPETITIONS, 2006-2008

	<i>Metric (1)</i>			<i>Metric (3)</i>			<i>Metric (5)</i>		
	2006	2007	2008	2006	2007	2008	2006	2007	2008
Air New Zealand Cup	2.92	2.83	-	131	134	-	11.9	10.1	-
Currie Cup	2.62	2.42	-	159	133	-	6.2	6.4	-
EDF Energy Cup	2.82	2.95	3.19	128	136	141	12.8	14.6	13.6
European Challenge Cup	2.15	2.32	2.08	118	113	99	4.4	6.6	4.8
Guinness Premiership	4.46	4.05	3.62	188	166	153	25.5	22.4	17.7
Heineken Cup	2.85	2.63	2.95	134	121	127	11.7	8.7	12.4
Magners League	3.40	3.10	3.30	143	122	121	16.3	15.3	17.8
Super 14	3.76	3.10	3.50	174	136	154	17.5	11.6	16.3
Top 14	2.76	3.02	-	122	120	-	10.3	12.6	-

This comparison for the relatively short period of three seasons is provided for illustrative purposes only; longer-term analyses obviously would yield more meaningful results. A recent application of the metrics to all Currie Cup seasons from 1986 onwards (Siebrits and Fourie, 2008) indicates considerable variance in indicators of match attractiveness. The reality that two periods during which the quality of Currie Cup rugby was questioned by many also yielded low match attractiveness scores is encouraging (albeit tentative) evidence of the usefulness of the metrics.

5. CONCLUSIONS

Economic analyses of the demand for sport investigate the expected (*ex ante*) attractiveness of contests. The notion that uncertainty about the outcome increases the attractiveness of sports contests has long been one of the basic premises of such analyses. For some purposes, however, the actual (or *ex post*) attractiveness of matches is important, including determination of the optimal number of teams in leagues and the effects of rule changes. This paper proposes metrics of the actual attractiveness of rugby union matches that combine two dimensions of high-quality matches: a close contest (proxied by the points margin between the winning and losing teams) and skillful play (proxied by the total number of points scored). The closeness-of-the-result dimension of the indicators is the *ex post* equivalent of outcome uncertainty, while skillful play obviously constitutes another important dimension of the attractiveness of rugby matches (and other sports contests). The proposed metrics are simple to calculate, require no data apart from the final scores of matches, and are invariant to the structure of leagues. An illustrative application of three of the metrics for nine major rugby union competitions for the 2006, 2007 and 2008 seasons suggests that matches in the Guinness Premiership, Super 14 and Magners League were, on balance, the most attractive.

In principle, these metrics could be applied to other sports as well. A tight finish is likely to enhance the attractiveness of the vast majority of sports contests, and the major requirement for meaningful application of the metrics therefore would be that the number of points scored should be an adequate proxy of the degree of playing skills demonstrated. Candidate sports include rugby league, American football, basketball and netball.

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7. APPENDICES

APPENDIX A: GRAVITY
MEASURES OF LEAGUE
ATTRACTIVENESS

Equation (1):

$$\frac{\sum_{i=1}^n (x_i + y_i)}{\sum_{i=1}^n |x_i - y_i|}$$

Equation (3):

$$\frac{\sum_{i=1}^n (x_i + y_i)^2}{\sum_{i=1}^n |x_i - y_i|}$$

Equation (2):

$$\frac{\sum_{i=1}^n (x_i y_i)}{\sum_{i=1}^n (x_i - y_i)^2}$$

Equation (5):

$$\frac{\sum_{i=1}^n (x_i + y_i)}{\sum_{i=1}^n (x_i - y_i)^2}$$

APPENDIX B: AN EXPLANATION OF THE LEAGUE STRUCTURES

	<i>Number of teams</i>	<i>Format</i>	<i>Country</i>	<i>Play-offs</i>	<i>Relegation</i>
Air New Zealand Cup	14	Modified Round-Robin	New Zealand	Yes	No
ABSA Currie Cup	8	Play all	South Africa	Yes	Yes
EDF Energy Cup / Powergen Cup	16	Pool system	England and Wales	Yes	Yes
European Challenge Cup	20	Pool system	England, France, Wales, Ireland, Italy, Romania, and on some occasions, Spain and Portugal.	Yes	Yes
Guinness Premiership	12	Play all	England	Yes	Yes
Heineken Cup	24	Pool system	England, France, Ireland, Italy, Scotland and Wales	Yes	Yes
Magners League	10	Play all	Ireland, Scotland and Wales	No	No
Super 14	14	Play all	Australia, New Zealand and South Africa	Yes	No
Top 14	14	Play all	France	Yes	Yes

APPENDIX C: THE NUMBER OF MATCHES PER COMPETITION

	<i>2006</i>	<i>2007</i>	<i>2008</i>
Air New Zealand Cup	66	70	-
Currie Cup	56	56	-
EDF Energy Cup	24	27	27
European Challenge Cup	60	60	60
Guinness Premiership	132	132	132
Heineken Cup	71	72	72
Magners League	110	110	90
Super 14	91	91	91
Top 14	182	182	-