

# Bonus Incentives and Team-Effort Levels: Evidence from the 'Field'

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## Our Paper

- We use data from professional sports, which demonstrates that introducing bonuses to encourage the most-difficult, highest-reward scoring mode (coveted by administrators), incentivizes teams to increase effort to earn a bonus, but at the cost of reducing subsequent production.
- Specifically, we test if the introduction of a bonus point in rugby's Heineken Cup from the start of the 2003-04 season had any impact on the number of tries scored.

# The Bonus Point

- In rugby, there are multiple scoring modes. Administrators attempt to adopt policies to encourage more tries.
- Consequently, most tournaments now award teams one 'bonus' point for scoring at least four tries, in addition to four points for a win.
- The Heineken Cup presents a natural experiment that allows us to consider the effect bonus points had on performance, following their introduction at the start of the 2003-04 season.

# The Heineken Cup

- The Heineken Cup was launched in the summer of 1995 (12 teams – 3 x 4 pools)
- Clubs from England and Scotland joined the competition in 1996–97 (20 teams 5 x 4 pools).
- Since 1999-2000 season the pool stage has had 24 teams (4 teams x 6 pools).



*Toulouse vs Cardiff – 6<sup>th</sup> January 1996*

PREVIOUS WORK...

## Previous Research

- It is well established how bonus schemes affect incentive structures at an individual level. For example, Bénabou & Tirole (2016) assess bonus pay along several labour-market dimensions.
- However, empirical evidence on how bonuses affect joint performance of teams of workers under competition is quite thin and predominantly centres on elements of individual behaviour within the team environment, such as free-riding (for instance, Kim & Vikander, 2013).

# Previous Sports Research

- Fernie & Medcalf (1999) find that incentive contracts in horse racing generate superior performance to non-contingent payment systems.
- Lenten & Winchester (2015) found *Super Rugby's* try bonus, raises a team's probability of scoring at least one try in the final 8 minutes of the match, when this try would secure the bonus.
- While Lenten & Winchester's methodology has greater dynamic precision by including minute of scoring, our more general form tests the bonus effect in ways permitting altered tactical behaviour in the first 72 minutes, through player-selection (and other) decisions before the match.

RUGBY DATA AND ILLUSTRATIONS...

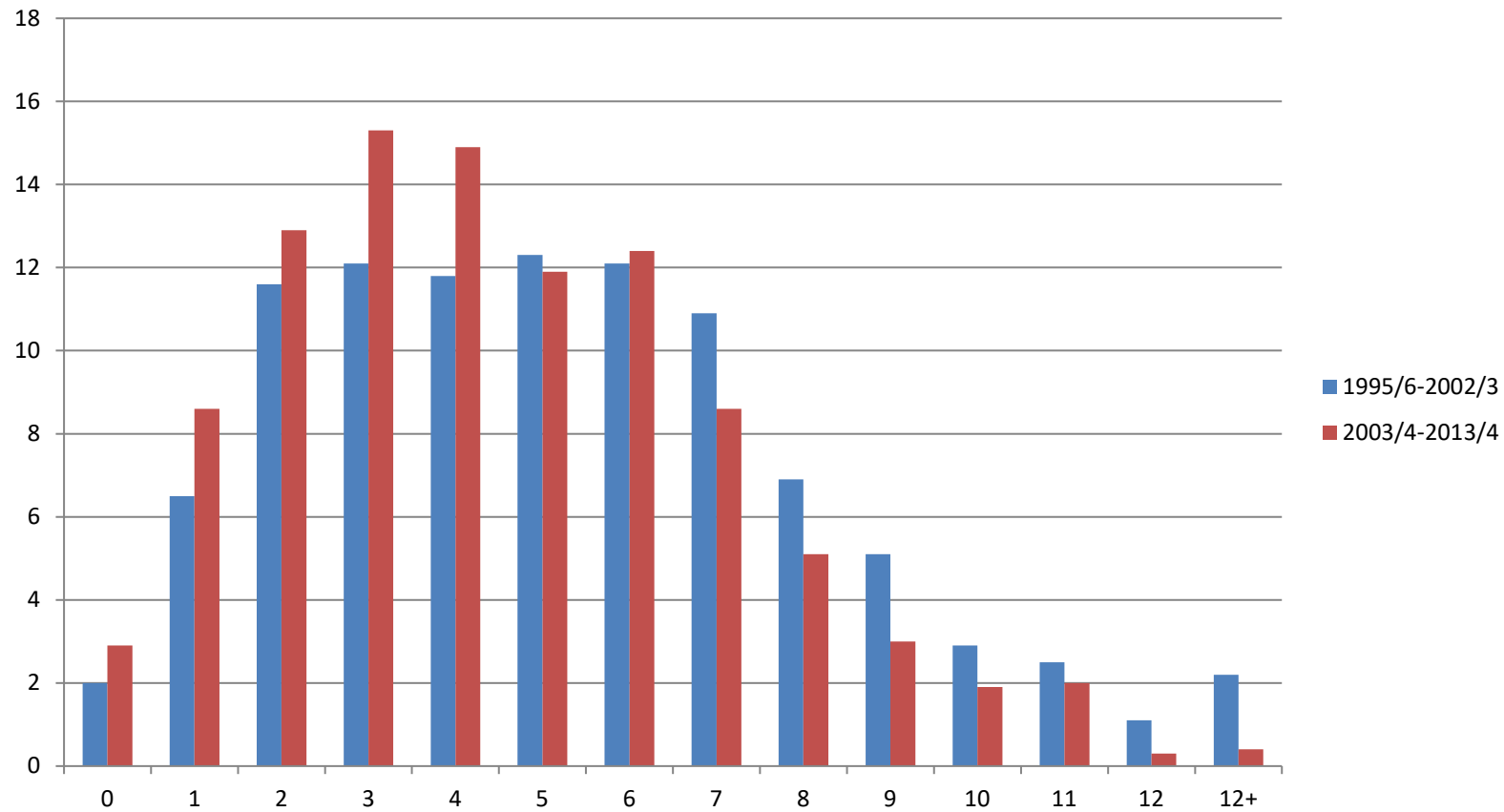


## Our Data

- Our data covers all 1,219 Heineken Cup group-stage matches (knockout stages do not apply bonuses) from the 1996/97 season to the last season of the competition (2013/14).
- Since the introduction of bonus points, the average tries per game actually decreased by 14.6%, from 5.28 to 4.51 per game.
- Home team mean tries reduced from 3.19 to 2.62, with the difference easily significant at the 1% level. For Away teams, the reduction was comparatively modest, from 2.09 to 1.89 – significant only at 10%. We henceforth examine these teams separately.

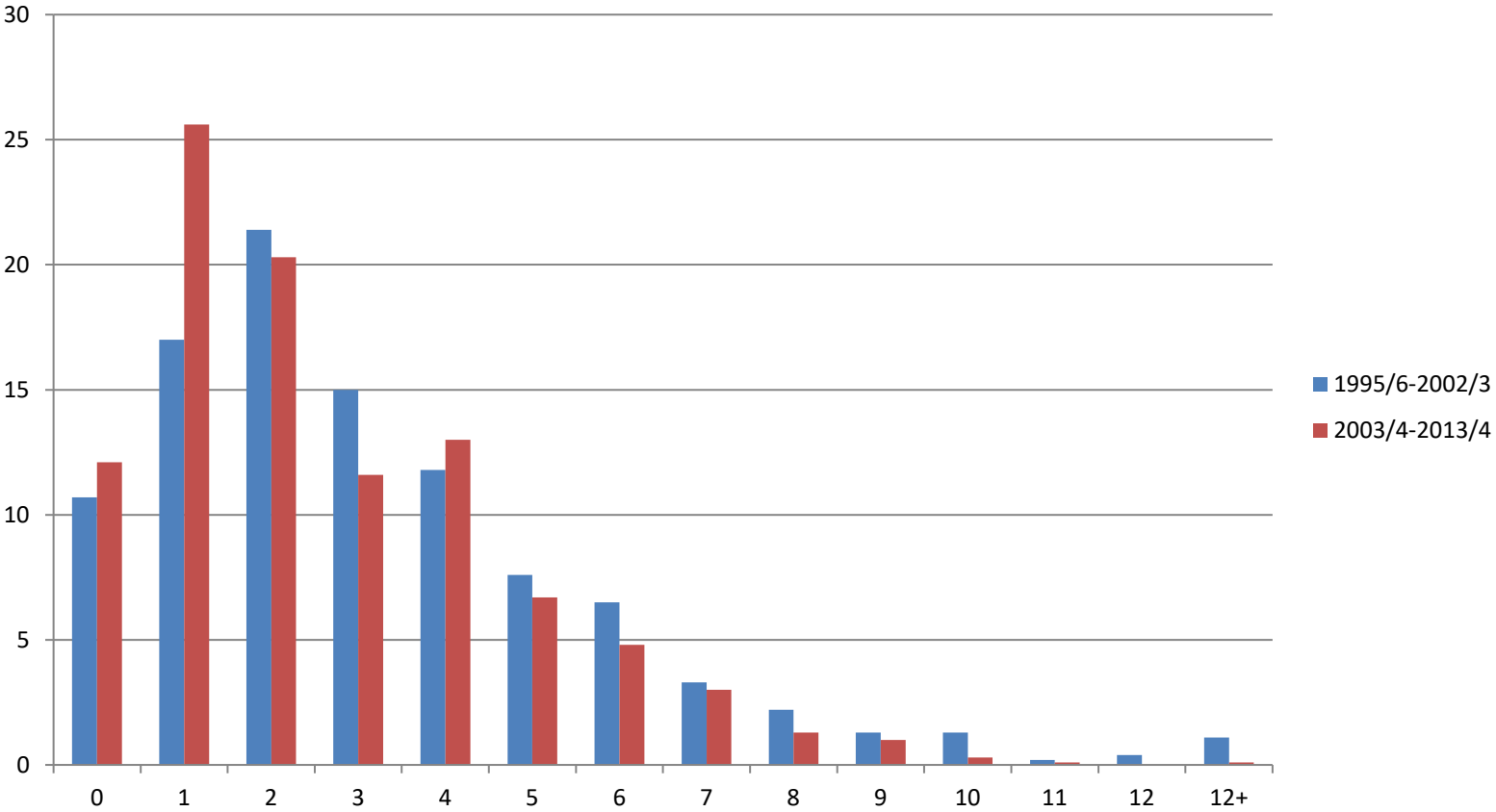
# Some Illustrations...

## Total Tries % Distribution



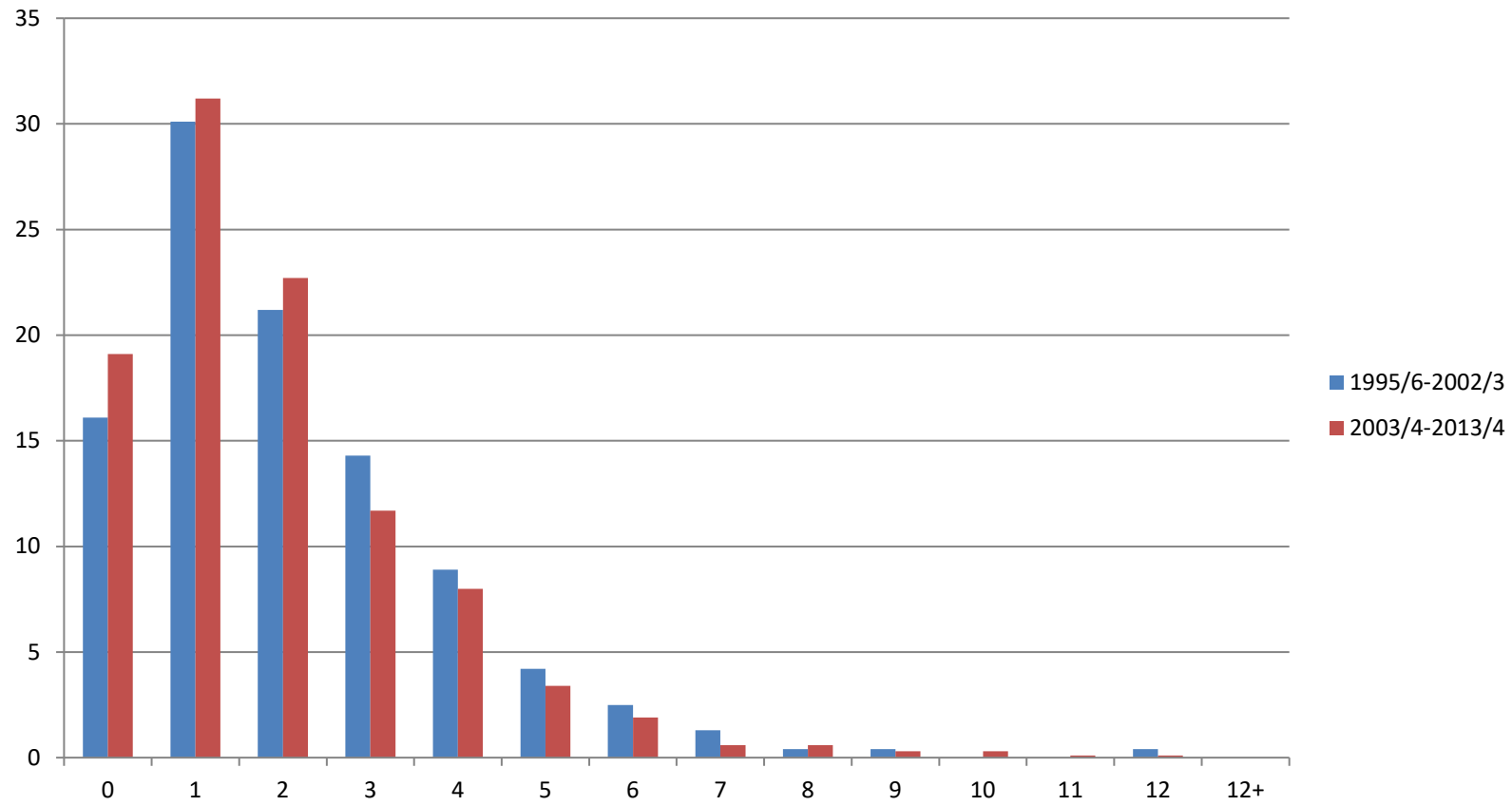
# Some Illustrations ...

## Home Team Tries % Distribution



# Some Illustrations ...

## Away Team Tries % Distribution



UNCONTROLLED TESTS...

# Uncontrolled Comparisons of Try-Scoring

- Rather than means, the most likely influence of the bonus is inducing a non-convexity into the try-frequency distribution around the bonus threshold itself.
- This is because it explicitly weights scoring the fourth try in the primary standings-ranking criterion – league points.
- Prior to bonuses, the marginal incentive to score each try (disregarding its match-result impact) was that tries scored merely formed the secondary criterion.
- We test various hypotheses via before/after comparisons of scoring outcomes around ( $x = 4$ ), where  $x$  denotes the number of tries scored after 80 minutes of play (end of match).

# Testing Try Thresholds

- The first pair of null hypotheses is unconditionally based (suitable for modelling pre-match decisions) – that teams will target the try bonus hence

$Pr(x = 4)$  is higher when  $BP = 1$

$Pr(x \geq 5)$  is lower when  $BP = 1$

- The second pair of null hypotheses are conditional on how try scoring evolves during the game. We test

$Pr(x = 4|x \geq 3)$  is higher when  $BP = 1$

$Pr(x \geq 5|x \geq 4)$  is lower when  $BP = 1$



*Peter Stringer*  
*Heineken Cup Final - 20<sup>th</sup> May 2006*

# Uncontrolled Comparison Results

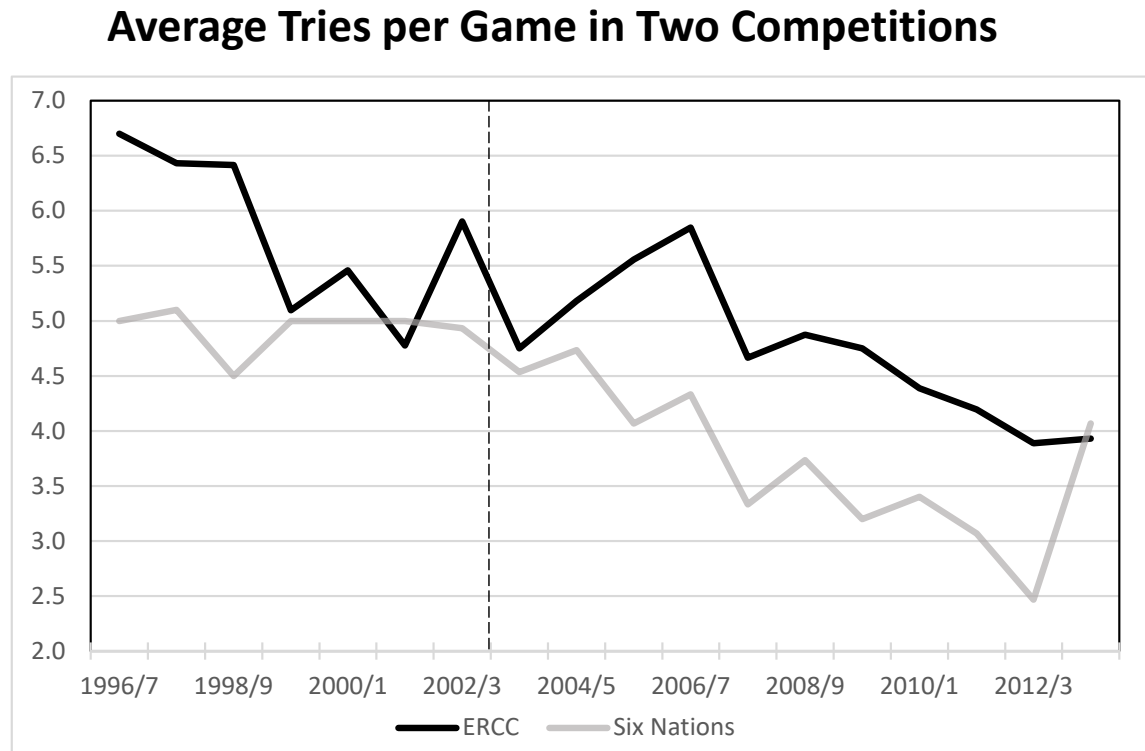
Pre-match Decisions	$\Pr(x = 4)$				$\Pr(x \geq 5)$			
	Home		Away		Home		Away	
	<i>BP=0</i>	<i>BP=1</i>	<i>BP=0</i>	<i>BP=1</i>	<i>BP=0</i>	<i>BP=1</i>	<i>BP=0</i>	<i>BP=1</i>
Mean	0.121	0.130	0.089	0.078	0.243	0.173	0.089	0.073
Variance	0.107	0.113	0.081	0.072	0.184	0.143	0.081	0.068
<i>t(p)</i> value	0.440	(0.660)	-0.621	(0.535)	-2.821	(0.005)	-0.932	(0.352)
<i>n</i>	428	791	428	791	428	791	428	791

Within-match Decisions	$\Pr(x = 4   x \geq 3)$				$\Pr(x \geq 5   x \geq 4)$			
	Home		Away		Home		Away	
	<i>BP=0</i>	<i>BP=1</i>	<i>BP=0</i>	<i>BP=1</i>	<i>BP=0</i>	<i>BP=1</i>	<i>BP=0</i>	<i>BP=1</i>
Mean	0.235	0.310	0.273	0.291	0.667	0.571	0.500	0.483
Variance	0.181	0.215	0.200	0.207	0.224	0.246	0.253	0.252
<i>t(p)</i> value	1.959	(0.051)	0.360	(0.535)	-1.933	(0.054)	-0.226	(0.821)
<i>n</i>	221	332	139	213	156	240	76	120



## Further Tests...

- Caution should be exercised at these results, as no account is taken for possible selection biases in the data.



- The Six Nations had no bonuses until after the sample period.
- To overcome this, we estimate binary-response regression models, specifically logit, for the four hypotheses on home and away teams in each match, with various controls for crucial within-match factors.

# Additional Control Variables

- In conjunction with the match data (date, venue, score, tries, penalties, referee, etc.) we also gathered data on the following...

		Definition
Ground Advantage	<b>BP</b>	<b>Match Played under Bonus Points Rules</b>
	AT	Match Attendance in Thousands
	LD	Log of Distance (miles) Traveled by Away Team
Relative Team Ability	SD	Net (Home Team - Away Team) Seeding
	PB	Net Points Behind Current Group Leader
	WR	Net Win Ratio in Current Season
Altered Incentives	GR	Net Current Group Rank
	QK	Net Dummy for Team Mathematically Qualified for Knockout Stage
Weather Conditions	EL	Net Dummy for Team Mathematically Eliminated from Knockout Stage
	DG	Game Played During Daytime
	RF	Rainfall (mm) in City on Match Day
	WS	Average Wind Speed (km/h) in City of Match

\* All models include unreported fixed effects for nationality of the referee, home team (consequently venue), and away team; as well as season of the match – this accounts for trends in tactical evolution and other rule changes (also coaches' responses to these) occurring over the sample period.

# Unconditional Probability Logit Models

**Marginal Effects from Simple Probability Logit Models**

	Pr( $x = 4$ )		Pr( $x \geq 5$ )	
	Home	Away	Home	Away
<i>BP</i>	<b>0.096*</b> (0.051)	<b>0.026</b> (0.040)	<b>-0.139**</b> (0.057)	<b>-0.061</b> (0.042)
<i>AT</i>	0.001 (0.002)	-0.005* (0.003)	0.003 (0.002)	-0.002 (0.002)
<i>LD</i>	0.075* (0.046)	-0.005 (0.035)	0.026 (0.046)	0.007 (0.031)
<i>SD</i>	-0.018*** (0.007)	0.021*** (0.006)	-0.033*** (0.007)	0.024*** (0.006)
<i>PB</i>	-0.004** (0.002)	0.003 (0.002)	-0.012*** (0.002)	0.006*** (0.002)
<i>WR</i>	-0.027 (0.035)	-0.041 (0.030)	0.060* (0.035)	0.023 (0.020)
<i>GR</i>	-0.003 (0.012)	-0.001 (0.010)	0.022* (0.012)	0.014* (0.008)
<i>QK</i>	-0.057 (0.055)	-0.027 (0.457)	-0.081 (0.060)	-0.017 (0.043)
<i>EL</i>	-0.025 (0.029)	0.016 (0.024)	0.019 (0.028)	-0.021 (0.021)
<i>DG</i>	-0.011 (0.028)	0.020 (0.020)	0.038 (0.029)	-0.005 (0.021)
<i>RF</i>	-0.002 (0.002)	-0.002 (0.001)	-0.004** (0.002)	0.001 (0.001)
<i>WS</i>	-0.001 (0.001)	$-3.6 \times 10^{-4}$ (0.001)	0.002 (0.001)	0.001 (0.001)
<i>Ps-R<sup>2</sup></i>	0.078	0.185	0.304	0.288

Note: we denote 1, 5 and 10% significance levels with \*\*\*, \*\* and \*; and figures in parentheses are standard errors.

# Conditional Probability Logit Models

**Marginal Effects from Conditional Probability Logit Models**

	Pr( $x = 4 \mid x \geq 3$ )		Pr( $x \geq 5 \mid x \geq 4$ )	
	Home	Away	Home	Away
<i>BP</i>	<b>0.285<sup>***</sup> (0.101)</b>	<b>0.216<sup>*</sup> (0.129)</b>	<b>-0.347<sup>***</sup> (0.127)</b>	<b>-0.218 (0.171)</b>
<i>AT</i>	-1.1×10 <sup>-5</sup> (0.001)	0.001 (0.008)	0.005 (0.005)	0.011 (0.013)
<i>LD</i>	0.105 (0.084)	-0.034 (0.106)	-0.036 (0.101)	0.093 (0.156)
<i>SD</i>	-0.006 (0.015)	0.031 <sup>*</sup> (0.018)	-0.021 (0.018)	0.007 (0.028)
<i>PB</i>	4.2×10 <sup>-4</sup> (0.004)	-0.001 (0.005)	-0.007 (0.005)	0.010 (0.008)
<i>WR</i>	-0.089 (0.073)	-0.134 (0.100)	0.099 (0.085)	0.229 (0.145)
<i>GR</i>	-0.023 (0.024)	-0.007 (0.032)	0.039 (0.029)	0.054 (0.046)
<i>QK</i>	-0.088 (0.103)	-0.134 (0.142)	0.009 (0.127)	0.120 (0.202)
<i>EL</i>	-0.050 (0.054)	0.055 (0.074)	0.058 (0.065)	-0.128 (0.114)
<i>DG</i>	-0.069 (0.056)	0.011 (0.063)	0.027 (0.005)	-0.040 (0.097)
<i>RF</i>	-2.5×10 <sup>-5</sup> (0.004)	-0.003 (0.004)	-0.004 (0.005)	0.007 (0.005)
<i>WS</i>	-0.002 (0.003)	-0.003 (0.003)	0.002 (0.003)	0.003 (0.005)
<i>Ps-R<sup>2</sup></i>	0.073	0.131	0.169	0.184
<i>n</i>	553	352	396	196

Note: we denote 1, 5 and 10% significance levels with <sup>\*\*\*</sup>, <sup>\*\*</sup> and <sup>\*</sup>; and figures in parentheses are standard errors.

# Conclusion

- The try bonus is extraneously effective in producing greater try-scoring outcomes, by encouraging teams to score an above-average number (four) of tries.
- However, the unintended effect – of teams scoring less tries beyond the bonus threshold – proves to be stronger than foreseen beforehand by administrators.
- This factor is responsible for much of the decrease in average tries scored in the bonus points era, rather than an increasing incidence of teams scoring low numbers of tries.
- Given this, it is arguable that since large numbers of tries are typically correlated with heavily asymmetric contests, this frequency reduction signals an improvement of average match quality through its effect on competitive balance.

Thank You

*Questions and comments welcome*