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SPECTATOR DEMAND FOR THE SPORT OF KINGS

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Abstract

Research question: For the case of Great Britain, we construct and estimate a model to capture influences on attendances at horserace meetings.

Research methods: Fixed effects regression analysis is employed in analysing a data set containing information on attendances at exactly 24,000 race-days between 2001 and 2018.

Results and findings: Patterns of demand are similar to those found for other sports. E.g., attendance is higher at weekends and in the warmer months and is sensitive to the quality of the racing on offer; it falls when competing with some televised sport of national significance. Controlling for a large number of characteristics, the pattern of results on year dummies included in the specification implies considerable decline in public interest in attending race-days over the data period.

Implications: The pronounced negative trend in attendance at race events suggests a need for modernisation of the sport including close attention to animal welfare issues, which might partly account for apparently growing public disillusion with the sport.

Introduction

Although thoroughbred horse racing has experienced significant decline in the United States since the 1980s (Riess, 2014), it remains an important sport in many jurisdictions, such as France, Ireland, Australia, South Africa, Hong Kong and Japan. Indeed, in Great Britain, the subject of our case study, it is second only to football in the number of spectators it attracts, 5.8m in 2018.[1] Moreover, in addition to serving a large consumer market, horse racing leaves a large economic footprint relative to many other sports, given the complex supply chain. In addition to the labour force of human athletes (jockeys), horses have to be bred, sold to owners, exercised, trained, stabled, fed, tended to by veterinarians and transported between scattered venues to compete in races. It is therefore unsurprising that horse racing in Great Britain has been claimed to generate as much as £3.5b per annum expenditure and to support 85,000 jobs.[2]

Curiously, despite the importance of the sport, academic research has almost entirely neglected the study of consumer preferences for horse racing. Thus, while attendance demand studies are a staple of sports economics, we were able to locate only one such paper focusing on horse racing. Thalheimer & Ali (1995) modelled time-series of annual attendance at three race-tracks near Cincinnati, examining the effects of changes in regional income, rescheduling of fixtures to the evening, the number of race-days offering high quality sport (defined by prize money exceeding a threshold), competition from other professional sports in the region and a particular change in racecourse ownership. We will explore some of these factors in our model of racecourse attendance in Great Britain but with the potential for richer insights because we will drill down to the level of the individual race-day and employ data from more than 60 tracks over a period of eighteen years.

Our purpose in presenting econometric models of race-day attendance in Great Britain is two-fold. First, our model could be employed or adapted by managers of individual racecourses, and racecourse groups, to predict the effect on ticket sales of varying the specification of their racing programmes, e.g. increasing prize money to attract more or higher quality horses or else shifting fixtures from afternoon to evening (subject to any restrictions imposed by the sport's governing body, which contracts with the bookmaker industry to ensure availability of horse races across the day). It could also be used to set a benchmark attendance figure for a race-day against which to judge a marketing intervention, such as providing a concert after the races as supplementary entertainment. Likewise, at a national level, the governing body, which allocates race-days between courses, could simulate the potential of different alternative fixture lists to increase aggregate attendance at the sport. Second, the findings on particular covariates in the model should contribute to better understanding of consumer preferences for horse racing in Great Britain and more generally. We were particularly interested to identify any trends in the underlying interest of the public to attend race meetings, which is hard to discern from time-series of aggregate attendances given significant changes over time in the amount of racing offered and in the pattern of the racing programme.

We will begin by describing the pattern of racing offered and trends evident since the Millennium. Then we will build an attendance demand model and present the results.

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[1] Horse racing attendances have consistently exceeded those for any other sport bar football; but an exception occurred in 2015 when rugby union overtook it consequent on England hosting the World Cup (https://uk.reuters.com/article/uk-horseracing-attendance/racing-leapfrogs-rugby-in-britains-popularity-stakes-idUKKBN1531J6).

[2] These figures were produced by PWC for the Thoroughbred Breeders Association, September, 2018, https://www.thetba.co.uk/wp-content/uploads/2018/09/TBA-Economic-Impact-Study-2018.pdf

Throughout we employ records of race-day attendances from the Horserace Betting Levy Board and a database, provided by the British Horseracing Authority (BHA), which records every run by every horse which took part in a race between 2001 and 2018. We aggregated these microdata to the levels of races, race-days and race meetings. A race-day is a set of races run at a particular course on a particular day. A race 'meeting' is a set of race-days held at a particular course on consecutive days. In the statistical modelling we employ data from the full period of the data, 2001-2018. However, in describing trends such as the quantity of racing and aggregate levels of attendance, we present graphs which begin at 2002. This is because aggregate data for 2001 were distorted by the suspension of racing in the first three months of the year, caused by restrictions on animal movements during an outbreak of foot-and-mouth.

Trends in British racing

Horse racing in Great Britain (absent weather disruption) takes place every day of the year except Christmas Day and the one or two days before, depending when in the week Christmas falls. There are currently sixty active venues, which vary considerably in how often they are used. E.g., in 2018 Liverpool raced on only eight days whereas Lingfield Park offered 82 days. We distinguish three genres of racing: flat racing on turf, flat racing on all-weather tracks[3], and National Hunt (jumps) racing. Some venues specialise in one of these but others will run some days on their flat course and on other days schedule jumps races. Traditionally flat racing was a summer sport and jumps racing took place in the winter, though with overlapping seasons. There is now more blurring of the seasons. Flat racing on turf is still possible only from March to November but the introduction of all-weather tracks (with floodlighting), the first of which appeared in 1989 and of which there are now six, permitted year-round racing. Again, the season for jumps racing has also extended to make it a year-round sport; but the number of fixtures in the summer months is still relatively low. Different sets of jockeys ride in the two codes and only up to 5% of all horses in training are entered in both types of race within the same year.

Perhaps the most striking change over our data period has been in the supply of race-days, which grew more or less steadily, 1,150 in 2002 and 1,433 in 2018.[4] The number of races grew faster still as seven-race cards became more common than the traditional six-race offering. Figure 1 charts the total number of race-days in each year from 2002 to 2018, with a break-down by code. It may be noted that the proportion of the fixture list accounted for by all-weather tracks is now markedly higher than at the beginning of the period but that most of the increase had occurred by 2008 as new all-weather tracks were introduced (however, a further step increase in the number of all-weather fixtures occurred in 2018). Some of the increase in the size of the wider fixture list may also be attributed to Sunday racing becoming more common over the data period.

However, the size of the active horse labour force has failed to grow proportionately with this significant increase in the number of race-days to be serviced. E.g., comparing 2018 with 2002, there was an increase of 26.5% in the number of fixtures but an increase of only 14.0% in the number of unique runners.[5] Further, the productivity of the racehorse population

[3] Jumps racing over hurdles was permitted in the early days of all-weather racing in Great Britain providing that the surface was sand. However, the incidence of horse fatalities proved unacceptably high and this form of racing was prohibited by the governing body before the start of the data set we examine.

[4] The upward trend in the amount of racing long predates our detailed data, e.g., the number of race-days in the years around 1960 was less than 400 and this grew to around 1,000 by the late 1980s.

[5] More detailed figures show the mismatch to be significantly greater in jumps than in flat racing.

was close to constant throughout the period. The number of races run per horse was 4.85 in 2018 compared with 4.97 in 2002 and had never strayed outside the range 4.78-5.14 in the intermediate years (where no trend was evident).[6] Figure 2 illustrates that the mean number of runners per race across all race-days has exhibited a strong downward trend in all three genres of racing (albeit with a recent slight recovery in all-weather). One reflection of the fall in average size is that there has been an increase in the proportion of races with an unacceptably low field size (Frontier Economics, 2017, termed the provision of a race with fewer than six runners a 'service failure').

Racing considers falling field size as a major problem. Smaller fields tend to be associated with lower competitiveness and the spectator will tend to see less exciting racing and have a less satisfactory betting experience. In 2015, the BHA noted[7] that Great Britain was the only major racing jurisdiction experiencing a significant fall in field size and that mean field size was lower than in any of its comparators except the USA, e.g. about 2.9 lower than in Hong Kong and 1.5 lower than in France. Here, in our modelling, we will investigate the impact of field size on attendances. For the individual racecourses, attendances matter for ticket sales and associated race-day income (e.g. from catering and parking).

Aggregate attendance data present the impression of a robust sport. Aggregate annual attendance had reached 5m for the first time in 1998 (Frontier Economics, 2017). This level was maintained and increased during our data period, with the maximum recorded in 2015 (6.13m) and 5.71 m in the final year, 2018. But growth of attendance (and stability of wagering) at the aggregate level has been achieved only with the supply of considerably more racing. If one looks at an individual, typical race-day, an opposite picture emerges. Figure 3 shows, for each year between 2002 and 2018, the median attendances at flat, all-weather and jumps race-days. Comparing the first and last years, the medians fell by 25.4% and 28.9% for flat and jumps respectively. The chart shows that all-weather racing attracts considerably less spectator interest than race-days run on turf; here also median attendance fell significantly over the period.

Our raw data show that *mean* attendances are higher in every year than median attendances, reflecting that that the mean is raised by the presence of elite events attracting very large crowds. Between 2002 and 2018, mean attendances for flat and jumps codes declined by 'only' 6.8% and 12.4%. This contrast is suggestive of the possibility that public interest has been maintained or increased for the top events even while the bread-and-butter sport is in evident decline such that there may now be 'too many' fixtures and a saturation level of provision may now have been reached. Raw data show a contrast between attendance trends at the most prestigious meetings and the rest of the sport. We found that mean daily attendance at a small number of major racing festivals had been relatively stable (+0.9%) between 2002 and 2018. We will investigate this further in our statistical modelling (where we will define precisely the meetings we regarded as in the elite segment of the sport).

The statistical model

Our unit of observation is the race-day and we had a complete record of attendances at race-days for the period 2001-2018. We used almost all of these. The exception was that we

[6] Horses in flat racing tend to run a little more often than jumps horses, e.g. mean number of runs in 2017 was 5.21 for flat and 3.73 for jumps.

[7] https://www.britishhorseracing.com/wp-content/uploads/2014/03/2015-Fixture-List-Industry-Consultation.pdf

discarded 'mixed' race-days where both flat and jumps events were on the programme.[8] With these observations dropped, we had exactly 24,000 race-days. We divided these into the three genres, flat, all-weather and jumps, choosing to estimate a separate demand model for each. Since flat and jumps racing differ sufficiently strongly from each other that they could be classified almost as different sports (and have different sets of human and equine athletes) we judged it reasonable to allow for the possibility that attendances would respond in different ways to the various drivers of demand.

In each model the dependent variable is the natural log of attendance. It is an obvious choice to use the log transformation of the variable of interest because it (attendance) has a highly skewed distribution with a concentration of 'low' values (attendances in the hundreds or low thousands) but with some which are 'very high' (more than 70,000). Given the log-linear specification, coefficient estimates will be interpretable as showing the (approximate) proportionate impact on expected attendance of a change in the value of the predictor variable.

We estimated the models with racecourse fixed effects. This allows each racecourse to have its own constant term, the values of which will depend on time-invariant (or near time-invariant) factors which make some venues more popular than others. While fixed effects modelling allows each venue to have a different base level of attendance, it should be noted that it constrains the slope coefficients of the predictor variables to be the same, i.e. attendance is shown as responding to the drivers of demand in the same way at all courses. But, in practical application of the model by an individual racecourse, there would typically be sufficient observations for it to be viable for management to base the model only on attendance records at its own venue. Further, there are two racecourse groups (Arena and the Jockey Club) which each own about one-quarter of the venues. Given that fixtures are awarded to a racecourse owner, the model could be employed to explore switches of fixtures between courses within the same group.

Choice of covariates

We had no comparable published study of race-day spectator demand to draw on when deciding on the choice of predictor variables to be included in models. However, there is a large literature on attendance demand in other sports. We follow the taxonomy of Borland & Macdonald (2003) but adapting it to take into account that nearly all previous studies have related to team sports whereas racing is an individual sport.

In their survey, Borland & Macdonald (2003) represented the diverse set of influences on attendance as capable of being organised into five categories: consumer preferences; economic factors; quality of viewing; characteristics of the sporting contest; and supply capacity. The last reflects that demand modelling in sports often has to deal with many censored observations where the size of crowd equals the capacity of the stadium such that true demand is not observed. This is not a relevant factor in British racing, where sell-outs are very rare, partly because the layout of a racecourse leaves a lot of free land to absorb spectators. We therefore proceed by grouping our set of covariates according to the first four headings. We comment here on reasons for including particular covariates. Their detailed definitions are provided in Table 1.

'Consumer preferences' is a somewhat all-embracing heading. We already acknowledge that preferences may differ as between the three genres of racing by estimating

[8] We also discarded meetings at Lingfield Park where there were flat races on both turf and the all-weather course. No other venue offers this mix.

separate demand models for each of them. Preferences may also change significantly over time and we allow for this possibility by including seventeen *year dummies*. The results on each year dummy will capture shifts in demand (compared with the reference year, 2002) caused by non-observed factors, including consumer tastes for how they spend their leisure time.

'Economic factors' mentioned by Borland & Macdonald (2003) include consumer incomes and the availability of substitutes. Our model seeks to capture temporal variations in consumer income with the covariate *regional weekly wage*, which is the mean weekly wage in the standard economic region in which the racecourse is situated in the year in which the race-day took place. Wage data were obtained from the Office for National Statistics and we adjusted them for inflation using the Consumer Prices Index such that the variable is expressed in real terms (in 2018 prices). Year-to-year changes were generally upward before the Financial Crash but often downwards afterwards. In estimation, we use the log transformation of the regional weekly wage, allowing the coefficient estimate to be interpreted as an estimate of the elasticity of demand with respect to average income.

It is hard to know what goods or activities consumers view as relevant substitutes for attending sport. The attendance literature focuses on sports events taking place on the same day, which might be in the same or in other sports and which might be viewed in-person or on television. Direct competition between British racetracks is very limited because the fixture list tends to avoid clashes in the same region. Further, most racegoers patronise only one track. However, some prospective patrons will travel the distance to see the big race and others may choose to stay at home to watch it on television, with consequent loss of attendance at their home course. We include three dummy variables representing *big fixture same day* (three because we distinguish big fixtures by genre)[9].

We experimented with including variables representing potential competition from other sports, e.g. identifying race-days where professional football or cricket was taking place within a radius of the racecourse. We found no influence from these events. However, we found sufficient hints of effects from some major sports events (Table 1) shown on television for them to be represented in the final models.

Under the heading 'Quality of viewing', Borland & Macdonald (2003) considered not only factors such as the weather and the attributes of the stadium but also when the event is scheduled. We include dummy variables to represent day of week and time of day. *Bank holiday* and *month dummies* are also included. The other scheduling issue we address explicitly is the time between race meetings at a course. For English football, Forrest & Simmons (2006) demonstrated that attendances suffered when home matches were scheduled in rapid succession (e.g., two consecutive fixtures played at home). The explanation could be diminishing marginal utility or, more simply, affordability of frequent attendance. Hence, we include *days since last fixture*.

About 70% of race-days observed in our data set were at one-day meetings. But other meetings may be two or three days and a few major festivals last four or even five days. In the data set for all-weather, there is a small number of cases of meetings where there were up to eight days consecutive racing though these were due to abnormal circumstances, such as adverse weather having closed down the turf racing programme for a period. In our specification, controls include dummy variables, such as *1st day of four*. For flat racing only, these variables were generally positive and significant, reflecting perhaps that multi-day

[9] These fixtures are identified below when we discuss how we captured the quality of the subject race-day.

meetings could be regarded as similar to festivals. In all-weather, where tracks are generally used frequently, these variables were typically negative and significant. However, to conserve space we will not show results for these variables even though they were present in the modelling reported (and are not shown in Table 1): there were 33 dummy variables in this category.

To test for the effects of weather, we collected official data on rainfall at the nearest active weather station to the racecourse on the day of the fixture. As the network of reporting stations varies, this will not always have been the same location relative to the racecourse on any two dates. *Rainfall* and its square proved to be highly significant.

'Characteristics of the sporting contest' is the final set of influences on attendance according to the taxonomy of Borland & Macdonald (2003). We proxy the quality of the race-day by the *relative prize money* on offer, entering it as a quadratic to allow for diminishing returns. Prize money has proven to be an effective predictor of consumer behaviour (Thalheimer & Ali, 1995). High prize money in the race-day may, however, be consistent with there being some very routine individual contests: the bulk of the prize money may be allocated to a single feature race. Consumers' response to total prize money may therefore be modified by how the prize money is distributed. We, therefore, include *lowest prize money* (and its square) as additional regressors.

A small number of attendance papers have tested for a superstar effect whereby crowd size is boosted by the appearance of an exceptional player who attracts interest out of proportion to his level of talent. For example, a player might be only slightly more able than the rest but crowds are drawn by the presence of the very best. In team sports, it is likely to be relatively easy to identify a star player effect because the star player appears at each away stadium in turn, allowing the researcher to detect attendance gains. This approach is less feasible in horse racing. The highest-level jockeys tend to compete at the highest-level meetings and barring injury, always be present at those meetings, making it hard to discern an influence independent of our quality indicator (prize money). Moreover, over the data period we did not find many jockeys who stood out in terms of public recognition. On the other hand, we were able to test for an effect from there being a series of race-days when the local public had the opportunity to see a 'legend' for the last time. A.P McCoy was the most successful of all jumps jockeys, achieving the highest number of wins in every season of a twenty-year professional career. In February 2015, he announced that he would retire in April. We are therefore able to observe the impact on attendance of his 'farewell tour'. We include a dummy variable, *A.P. McCoy farewell*.

Although we refer to racing as an individual sport, competitors are in one sense a team because an equine as well as a human athlete is required. Equine superstars may also emerge and indeed individual horses occasionally seem to capture the public imagination, to the point even where highly successful films have been made to tell the horse's story. Over our data period, with advice from experts in the sport, we identified Black Caviar, Denman, Enable, Frankel, Kauto Star, Monet's Garden, Sea The Stars and Sprinter Sacre as potentially superstars. For each, we studied the career record of the horse and formed a judgement as to the race where the horse had made the leap to celebrity performer. Thereafter, any race-day where the horse appeared had a corresponding dummy variable set to 1. In the event, only one of these dummy variables was significant in preliminary analysis, so only *Frankel* appears in the final model. The first of the eight races for which *Frankel*=1 was run on June 14, 2011. In his immediately preceding race, he had won the classic 2,000 Guineas by 6 lengths, the largest margin of victory in the race since 1997. Newspapers greeted the style of his win as signalling the emergence of a "superstar" (*Racing Post*). *The Observer* report

declared that "In the 235-year history of English classic races, there can hardly have been a more dominating performance". Our results will show that this adulation was followed by significantly elevated attendances at race-days where he was subsequently on show.

In racing, unlike most sports, the entertainment offered may vary in quantity as well as quality. The large majority of race-days in the data set included either six or seven races. We wished to allow for the possibility that the extra contest would attract greater attendance. Nearly all observations with fewer than seven races had six; but there were rare cases of a smaller number of races, always explained by the abandonment of the day, e.g. because of adverse weather or-safety issues. Where there are more than seven races, this is usually explained by a race being 'divided': one race attracts a large number of entries and the racecourse management splits the entries to provide two races instead of one.

Attendance demand studies on team sports sometimes test for the importance of 'match significance', e.g., by including a metric to capture how much bearing the match is expected to have on the outcome of the league championship. Horseracing is not organised in the format of a league. Nevertheless there are prestigious events which feature races where the winner is recognised as a 'champion' in its class, e.g a hurdler or three-year-old flat racer. Jockeys riding the winner often describe it as the highlight of their career and obituaries of prominent jockeys will typically employ phrases such as 'three times Derby winner'. In that sense there are championship events. Such events always have high prize money but it is plausible that there will be an additional effect on attendance because of the prestige of the occasion. Hence, we designate some race-days as belonging to the category of *big meeting*. There is an element of subjectivity in any such list but we do not believe that our choices would be controversial among enthusiasts of the sport. In flat racing, 'big meeting' =1 for race-days which are part of the meetings where 'classics' are run: the Guineas Meeting (Newmarket), the Derby Meeting (Epsom) and the St. Leger Meeting (Doncaster). In addition, we include the festivals known as Royal Ascot and Glorious Goodwood, each of which has a programme thick with 'Grade 1 races'. In jumps racing, our designation covers the Cheltenham Festival and the Grand National Meeting at Liverpool, both held in the Spring, and the Christmas-time King George VI Meeting at Kempton.[10] All-weather racing has no events of anything like comparable prestige but we still recognise that the 'biggest event' may attract unusually high patronage. Since 2014, the all-weather tracks have promoted the All-Weather Championships with a Finals Day in the Spring, open to the most highly-rated horses from those which have run at least three all-weather over the Winter. The Finals Day features exceptional prize money and the project was intended to encourage more horse participation in all-weather racing. Finals Day is heavily promoted and is our designated 'big meeting' in this genre.

We suspect that racing fans will be drawn in greater numbers to race programmes where the events before them are expected to feature competitive intensity and this should be captured in the models. As noted above, the governing body itself regards field size as an indicator of the competitiveness of racing. And more runners also make for more spectacle. This could be regarded as a focus rather than a merely control variable to the extent that the BHA has identified increasing field size as a priority objective. Consequently, we include *mean field size* (and its square) in the specification.

[10] In the cases of Royal Ascot and the King George VI Meeting, there was one year in the data set where the venue was switched because of redevelopment work at the usual course. In each case, 'big meeting' was still set equal to one but, for the fixed effects, the venue was taken as the temporary host course.

Finally, we have referred to racing as an individual sport but the sport has in fact experimented with a team format. The dummy variable *Shergar Cup* references a race-day, held in most years since 1999, where the horses running in the various races belong to teams which compete with each other for points. Initially the teams were based on the geographical origin of horse owners (e.g. Middle-Eastern) but later the competition was based on the origin of the jockeys invited to participate. Currently the teams are Great Britain and Ireland, Europe, the Rest of the World, and 'the girls team' for female jockeys. The day includes entertainment and a pop concert follows the last race. It is timely to test the impact on attendance given proposals to experiment more extensively with team racing in the future.

Summary statistics for the variables are presented in Table 2 and estimation results in Table 3.

Results and discussion

Broadly, results in Table 3 show that racing is not very different from other sports in terms of the drivers of demand. E.g., weekend events are more popular than weekday, attendances are higher in the warmer months, crowd size responds to the quality of the talent on show (as proxied by prize money) and to how competitive the action is likely to be (as proxied by field size). The importance of quality in particular confirms that, in British racing, the sport is not merely an adjunct to gambling. While, for many, betting may be an important part of the race day out, there would be no reason to expect such sensitivity of attendance to quality if spectators typically saw horses merely as 'equine dice'.

Since one purpose of our exercise is to demonstrate how modelling could be used for prediction of attendances under different fixture list scenarios, there is a sense in which no element in the equation is more important than another. Nearly all contribute to predictive power. However, we also employ the model to draw out more general insights relevant for those who manage the sport whether centrally or at individual racecourses. In the discussion, we highlight issues which are or have been argued to be particularly important for the sport in the strategic choices it must make.

Income elasticity: There is limited evidence that temporal variations in average income in the region have any influence on a racecourse's admissions except in the case of jumps racing where an elasticity of +0.361 is estimated. This makes the demand for National Hunt racing somewhat pro-cyclical such that declines in real wage levels since the financial crash have likely contributed (to a limited extent, about 4% over a decade) to declining attendances at typical events.

Scheduling: The pattern of coefficient estimates contains no surprises. Crowds are much higher on Saturdays than any other time. The dominance of Saturday would be yet more evident in the raw data because the highest-grade races tend to be on Saturdays; but, even controlling for all the details of the specification of the racing programme, as a regression model does, the results show that an otherwise identical flat race-day run on Monday would be expected to reduce the crowd by about 60% compared with Saturday.[11] Effects for other days and for jumps programmes are smaller but still very large. A notable exception is that Friday evening flat and jumps programmes have proved popular. Though still statistically significantly lower than on Saturday, the demand for flat racing appears to be only 5% lower than for Saturday racing (about 11% in the case of jumps). This makes Friday evening more

[11] Given the log-linear specification, the estimated percentage impact on the dependent variable of a one-unit increase in a predictor (such as from 0 to 1) is given by $100(e^{\beta}-1)$ where β is the relevant coefficient estimate.

like the weekend than like midweek in its potential for attracting audiences.[12] Of interest is that *days since last fixture* has a strongly significant coefficient estimate for all three genres. Effect size is highest for all-weather, where, e.g., a decrease of one week in the gap since the last meeting is associated with a 3.9% fall in attendance.

Weather: Rainfall had a negative and non-trivial effect on attendance at flat and all-weather fixtures. There was still a statistically significant impact on jumps crowds but the effect size was appreciably lower. In the case of flat racing, a moderately wet day (10mm of rain rather than none) would depress expected attendance by 9.5%. This underlines the importance to organisers of promoting advance ticket sales to reduce the risk of losing revenue if the weather on the day is poor.

Prize money: Audience size proves sensitive to quality in all three genres with the effect highest in jumps. Here e.g., from the coefficient estimates on the variable and its square, doubling the prize money from that of an average race-day (relative prize money=1) to that of a better race-day (relative prize money=2) would increase expected attendance by about 22%. Note that the variable is measured in relative terms and results cannot be used to predict the effect of increasing prize money across the board. Increases in overall prize money may increase quality in the longer-run if it incentivises actors in the industry such that, on the margin, more higher quality horses end up based in Britain rather than other jurisdictions; but this effect cannot be tested here.

Field size: Results validate that audience size responds positively to mean field size in all three genres. However, given that the quadratic specification shows diminishing returns to increases in field size, results shows that additional horses have only very small effects on expected audience if field-size-per-race is already around, say, 10. However, at weak meetings, where field sizes are low, the proportionate effect on attendance of an extra horse-per-race becomes more telling, particularly at all-weather. From calculations based on the coefficient estimates, an increase from 6 to 7 in runners-per-race would raise expected attendance by a little more than 4% at flat and jumps race-days and by more than 9% at all-weather. During 2018, the BHA and individual racecourse attempted to address the problem of low field sizes at the lowest level of racing where low field size is more common. They did so by offering 'prize' money to all the runners in a race up to eight. Essentially this was 'appearance money', intended to induce owners and trainers to run their horses more often. The experiment will merit formal evaluation. Such evaluation would require going beyond the effect on attendances by modelling betting volume data. Changes in field sizes may have a larger impact on off-track betting volumes and therefore on revenue from the levy imposed on bookmaker winnings to support the sport.

Stars: We were able at least to detect a hint that, as in other sports, celebrity athletes may be an important factor in generating interest. Attendances at race-days at which the jockey A.P. McCoy competed in the two months between announcing his retirement and his last ride are estimated to have been elevated by an impressive 25.5%. Attendances at race-days where the horse Frankel appeared subsequent to his triumph in the 2,000 Guineas are estimated to have been elevated by 37.9%. That seems a genuine superstar effect. It is conceivable that public interest in Frankel may also have dragged up attendances across the whole sport but we cannot test this formally as effects will be subsumed in the year dummies. We can note that,

[12] It is clear that there is very low spectator demand on some days of the week. Nevertheless it may be worthwhile for the sport still to supply racing because this generates off-track betting turnover from which it extracts a share of bookmaker winnings.

from the pattern of coefficient estimates on the year dummies, 2011 was a relatively good year for horseracing attendances. Unfortunately for the sport, superstars cannot easily be manufactured and none of the other seven horses included in early estimation showed a superstar effect.

Number of races: On the margin, quantity as well as quality appears to influence attendance decisions, at least for flat and jumps race-days. Coefficient estimates on the relevant dummy variables are highly significant even if effect size is fairly modest. Adding a seventh race increases expected attendance by 2.5% for flat and nearly 6% for jumps.

Competition with other events: Big flat meetings appear to reduce the attendance at other flat meetings on the same day, by nearly 5%. Anomalously, jumps fixtures tended to be much better attended when they coincided with major jumps festivals elsewhere. This could be rationalised by imagining that many racegoers want to enjoy the big events in a racing and betting atmosphere (the major events will invariably be shown on big screens at other courses), much as some football fans prefer to watch televised games in a pub rather than at home; but then one would have to explain why the same effect is not observed for flat race festivals. We find that very important occasions in other sports can in some cases impact quite dramatically on racing. When a race-day competes with an England football match in one of the summer tournaments, the reduction in expected attendance in flat (nearly 20%) and all-weather (about 35%) racing is very adverse.[13] Flat racing, and to a lesser extent all-weather, seems to experience very much lower crowds when Six Nations rugby is scheduled. Across the board, racing seems to be negatively affected by Wimbledon. On the other hand, attendances at flat races were relatively high at the time of the London Olympics, an event which lasted sixteen days and perhaps induced a national party mood.

Team racing: Other sports have sought out new audiences through variation in format, cricket with spectacular success in the case of twenty-twenty leagues. The individual sports of golf and tennis have inserted occasional team competitions into their schedules and the Ryder Cup has indeed become golf's highest-profile event. In British racing, there has been tentative experimentation with a team format in the case of the annual Shergar Cup. We cannot detect any degree of success from this experiment to the extent that expected attendance fails to be significantly different from that predicted from the other descriptors of the day (venue, scheduling, prize money, etc.) included in the model. Perhaps the problem is that, in contrast to golf and tennis, the teams have been somewhat artificial constructs to which fans are unlikely to feel affinity.

A declining sport?

Perhaps unusually for panel-data analysis, our main interest was in the year dummies. Here coefficient estimates show the difference in expected attendance if a similar race-day was offered in the particular year rather than in the reference year, 2002. The pattern of coefficient estimates could be interpreted as revealing the trend in underlying interest in the sport in a context where stable aggregate attendance figures may have been achieved only by offering more and more race-days.

The results tell a discouraging story for the sport. By 2018, the cumulative decline was 19.9% in flat racing, 31.2% in all-weather and 25.2% in jumps. Most of the difference in overall decline between codes is accounted for by a particularly poor year for jumps and all-weather in the final year of the data set. The story of decline over the whole period has some

[13] we detect no effect on jumps attendances but it should be noted that the number of observations is low as the football is scheduled outwith the main jumps season.

other subtle differences between codes. Decline in flat appears not to have set in until 2008; in jumps, it is noticeable from 2006; and all-weather seems to have recovered to some extent in 2014-2015 before decline set in once more.

Raw attendance data appear to show a contrast in fortunes as between the flagship events in the sport and the more bread-and-butter programme. However, the weakness of the interaction term *big meeting x trend* suggests that the major festivals are little different in terms of the time path of underlying interest. The discrepancy between the pictures presented in the raw data and in the regression results may in large part be explained by the dramatic increase in the relative prize money allocated to big meetings over the period. In 2002, the mean race-day prize money at big meetings was 9.1 times that in the rest of the sport but the corresponding ratio in 2018 was 13.8 According to the models, this "should" have boosted attendance (and indeed it seemed to be successful in attracting more international participation, raising quality) and our results suggested that it did no more than it would be expected to do for attendance.

The extent and pattern of decline is revealed by the coefficient estimates on the year dummies; but of course these cannot explain *why* race-days struggled more and more to attract audiences. Any discussion must of necessity be speculative. Perhaps the lack of product innovation in a sport which is time-intensive and in which sporting action fills only a small proportion of the time required at the event was always going to make it vulnerable to changes in preferences over how leisure is spent. In the face of decline in attendances over a long period, cricket was able to unlock a latent demand for shorter but intense events, first through one-day, then through the twenty-twenty format. Again, it might be that the spectator demand for racing is declining because it is affected by a growing concern for animal welfare. Reiss (2014) identifies this as a source of decline in demand in America, quoting (from Congressional hearing) the image of racing as 'a cruel and dangerous sport with too much reliance on whips and too many catastrophic injuries in major races'.

In Great Britain and elsewhere, there appears to be a growing distaste for the use of animals for entertainment. E.g., no British circuses now include animal acts; and visitor numbers at London Zoo have declined in recent years.[14] Animal sports have not been exempt from the zeitgeist. In late 2018 elephant polo was abandoned as a sport in Thailand after the withdrawal of major commercial sponsors following revelations of cruelty. Also in 2018, a referendum called by animal welfare groups in Florida overwhelmingly backed a proposal to prohibit greyhound racing. This is likely to lead to the demise of the sport in America as the Florida industry was large and cross-subsidised the activity in other states (Anderson, 2018).

It is not clear that the general population in Britain takes any more favourable a view of horse racing than Florida voters did of 'the dogs'. In a large survey carried out for the industry (to which we were given access), about 60% of the general population agreed that the sport was 'cruel'. Given that animal welfare appears to be increasingly in people's minds, this is an unpromising background against which to attempt to develop new audiences for the sport.

Concern over welfare extends across all stages of horse careers, from breeding[15], to the whipping of horses at races, to their disposal after leaving racing. But probably the most

[14] https://www.statista.com/statistics/586861/zsl-london-zoo-visitor-numbers-united-kingdom-uk/

[15] for an activists' report, see https://www.animalaid.org.uk/the-issues/our-campaigns/horse-racing/bred-to-death/

debated issue is that of horse fatalities during races. Jumps racing, and steeplechasing especially, presents the highest risk although deaths also occur in flat races. According to the BHA, the fatality-rate in the British sport has been reduced to 0.4% of all horse runs in jumps and 0.1% in flat.[16] In jumps racing, taking the mean number of runners observed at race-days in our data set, this converts to a figure of about 0.3 of race-days with an expected death. Moreover, horses in all genres are more likely to die at higher-grade and therefore better-attended events, likely because of a faster pace and greater incentive to push horses to their limit (Rosanowski et al, 2018). Indeed, there were 62 deaths at the Cheltenham Festival over our data period. All this suggests that a single race-day attendance in jumps carries a rather high risk of exposure to a fatality, a factor likely to deter attendance and motivate against repeat attendance. And fatalities are not the only feature likely to discourage support of the sport, e.g. other equine events such as bleeding from the lungs after excessive exertion and routine whipping of horses towards the finish of a race (Winter & Frew, 2018) may cause distress among attendees.

While our suspicion that animal welfare may be a significant factor in diminishing race-day attendance is speculative, it seems that the BHA and governing bodies in other racing jurisdictions have begun to recognise that welfare concerns are an obstacle to public acceptance of the sport. E.g., in 2018, the BHA accepted recommendations (from a review it had commissioned[17]) to pursue a number of avenues for improving equine safety, including modification of fences and the development of analytical models to help assess whether it was too risky for some horses to run. Also in 2018, South Africa trialled races where the use of the whip was prohibited, acknowledging that seeing people hit animals was a reason for the public turning away from the sport.[18] Of course change always runs the risk that attempts to woo new audiences alienate the old. However, the risk in this case may be lower than traditionalists admit. E.g., there is evidence (Evans & McGreevy, 2011) that whipping towards the conclusion of a race does not in fact tend to affect its outcome and, from survey evidence from Australia, McGreevy et al. (2018) reported that relatively few racegoers (or bettors) would give up engagement with the sport if use of the whip were banned (those who supported the whip were disproportionately likely to be male).

> The definitive history of American racing, published in 1964, began by asserting that Horse racing has grown astoundingly in scope and in popularity since the early settlers brought to these shores a native love for such contests of speed and stamina, and so permanently injected it into our way of life that today racing is America's number one spectator sport (quoted by T. Baynham in 2017[19])

But this love proved not to be permanent after all. Baynham went on to note that racing had not even registered in a recent survey where Americans were asked to name their favourite sport. British racing is not in the same sad state as its US counterpart. It still attracts a large total audience, still generates significant media coverage, very few racecourses have closed and some have opened. And yet, notwithstanding that the American experience may be

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[16] Georgipoulus & Parkin report a fatality-rate of 0.19% among 1.89m runners in flat races in the USA and Canada over 2009-2013.

[17] https://www.britishhorseracing.com/wp-content/uploads/2018/12/Cheltenham-Review-2018-Recommendations.pdf

[18] https://www.bbc.co.uk/sport/horse-racing/46138474

[19] https://medium.com/@tpbesq/the-decline-of-americas-first-pastime-horse-racing-s-descent-into-irrelevance-bdd6866f3e24

attributed to particular contextual factors (and that British racing has not been discredited by a failure to control doping), the history of the sport across the Atlantic illustrates that a decline in public interest can move precipitously towards constituting an existentialist threat. The negative trend in the sport's spectator appeal we have identified in Great Britain underlines that the British sport could become non-sustainable at its present scale. The industry in other European jurisdictions faces similar issues. Radical modernisation may be needed if the sector is to avoid shrinkage in the medium-term.

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Figures

Figure 1. Number of race days each year, 2002-2018

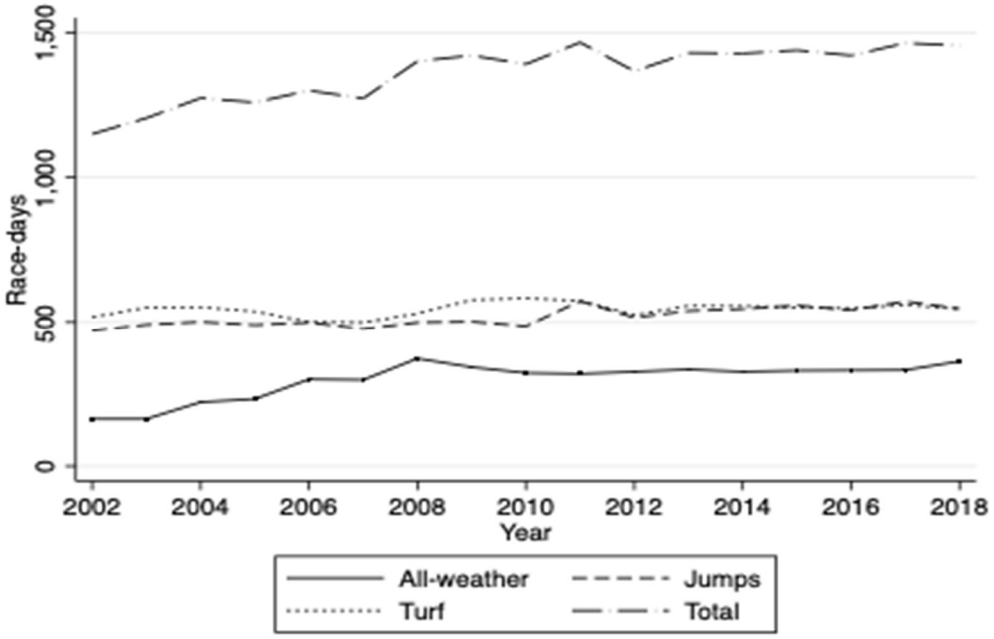


Figure 2. Mean of average field size across race-days, 2002-2018

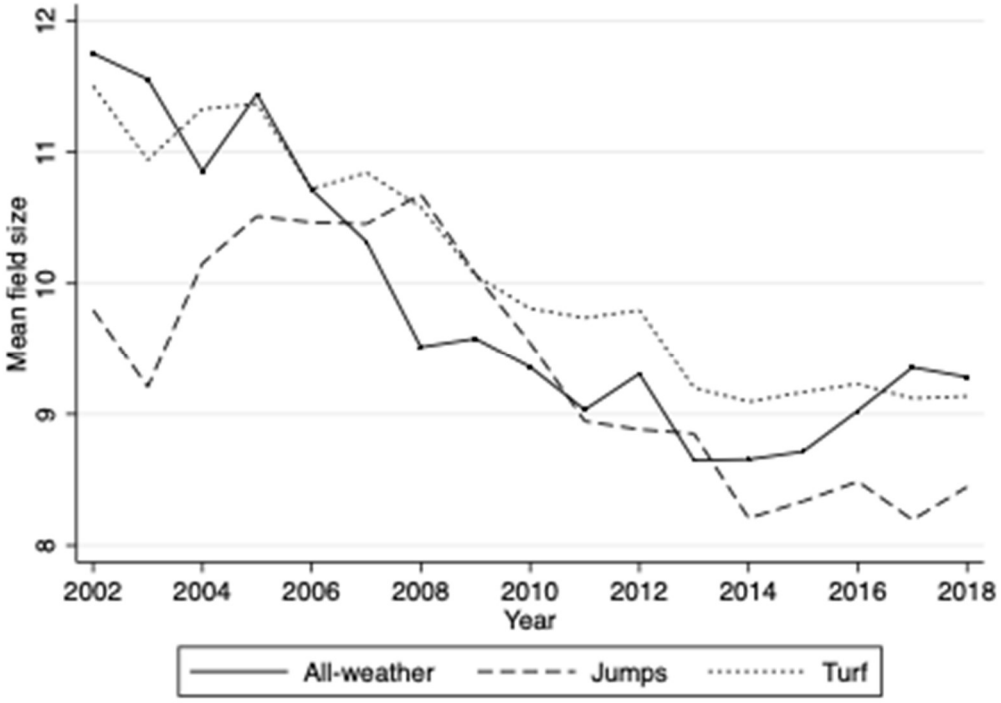
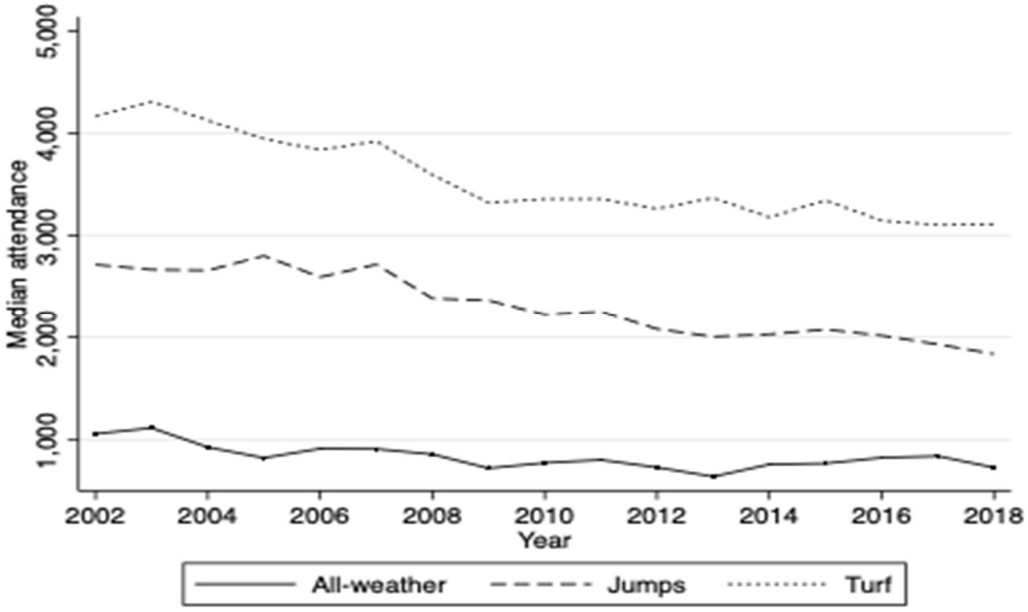


Figure 3. Median attendance at race-days, 2002-2018



Tables

Table 1. Description of covariates

Economic factors	
regional weekly wage	log of mean weekly wage in the standard economic region in which the racecourse is situated in the year in which the race-day took place. Wage data were obtained from the Office for National Statistics and adjusted for inflation using the Consumer Prices Index and is expressed in 2018 prices.
big flat fixture same day; big all-weather fixture same day; big jumps fixture same day	*big flat fixture same day* =1 when there is a 'big flat meeting' on the same day as the subject meeting. *The big jumps/ all-weather fixture same day* dummy variables are similarly constructed. A list of 'big meetings' is provided lower in this table.
Wimbledon, Six Nations on tv; *London Olympics*, *Ashes tests*; *FIFA World Cup, EURO Championship*.	*Wimbledon* is a dummy variable to signify that the race-day coincided with the tennis tournament; *Six Nations on tv* refers to televised international rugby matches; *London Olympics* covers the period of the 2012 Games; *Ashes tests* to capture potential influence from the final two tests of the summer-long series against Australia in 2005[1]; *FIFA World Cup* and the football *EURO Championship* are dummy variables for race-days taking place at the same time[2] as the England football team was playing a match in the respective tournament.
Quality of viewing	
Monday afternoon start, *Tuesday afternoon start*, etc, and time of day (*Mon.-Thu. evening start*, *Friday evening start*	We include dummy variables to represent day of week (*Monday afternoon start*, *Tuesday afternoon start*, etc) and time of day (*Mon.-Thu. evening start*, *Friday evening start*). Here, 'start' refers to the time of the first race and the race-day is counted as evening if the scheduled time of the first race is 5 p.m. or later. The reference day is Saturday.
bank holiday	*Bank holiday* =1 if the race-day is a public holiday and this is not defined to be mutually exclusive with the day of week variables.
month dummies	We also include *month dummies*, with October as the reference, chosen because there are full programmes in all three genres at that time. This might reflect expected weather and length of day conditions but the pattern of month coefficients might also reflect simply the stage of the season. Given that the seasons for flat and jumps racing are not the same, the pattern of coefficients on the month dummies might prove different across the models.
days since last fixture	The number of days between the start of the current meeting and the previous fixture held at that racecourse.
rainfall	The number of millimetres of rainfall recorded on the day of the race fixture (source: Met Office Integrated Data Archive System (MIDAS)). This is a somewhat inexact measure of conditions at the racetrack (and during the time when potential spectators have to decide whether to set out) since it will include rain which fell after the event. We include its square to capture its non-linear effect.
Characteristics of the sporting contest	
relative prize money	The total prize money divided by the mean prize money for all race-days in that genre in that year. If relative prize money = 2 for a flat race-day in 2006, the day's racing offered twice the total purse of the average flat day in 2006.
lowest prize money	The lowest prize money at the race-day divided by the mean of the lowest prize in each race-day in that genre in that year. We include its square as an additional regressor.
A.P. McCoy farewell	*A.P. McCoy farewell* equals 1 for any race-day where he competed during his pre-retirement period.
Frankel	Dummy variable set to 1 for race-days subsequent to Frankel winning the 2,000 Guineas.
fewer than seven races; more than seven races	'seven races' is the reference category.
big meeting	For flat, race-days which are part of the Guineas, Derby or St. Leger Meetings or Royal Ascot or Glorious Goodwood; in jumps, the Cheltenham Festival or the Grand National or King George VI Meetings[3]; for all-weather, the All-Weather Championships Finals Day
big meeting x trend	*big meeting* × year trend.
mean field size	The mean field size across all races at a given race-day
Shergar Cup	This dummy variable references a race-day, held in most years since 1999, where the horses running in the various races belong to teams which compete with each other for points.

Table 2a. Summary statistics for the continuous variables.

	mean	standard deviation	minimum	maximum
	FLAT (9,745 observations)			
attendance	6150.887	7844.453	289	78790
log regional weekly wage	6.408	0.103	6.201	6.624
days since last fixture	22.006	39.164	2	608
relative prize money	0.999	1.874	0.027	32.853
relative prize money squared	4.510	33.196	0.001	1079.313
lowest prize money	1.000	1.764	0	84.467
lowest prize money squared	4.112	105.738	0	7134.637
big meeting x trend	0.387	2.169	0	18
mean field size	10.176	2.334	4	20.857
rainfall	2.043	4.559	0	64.700
	ALL-WEATHER (5,147 observations)			
attendance	1111.994	1089.223	111	18598
log regional weekly wage	6.446	0.105	6.207	6.624
days since last fixture	5.411	7.707	2	327
relative prize money	0.996	0.839	0.121	22.715
relative prize money squared	1.695	13.072	0.015	515.953
lowest prize money	1.000	0.731	0.515	34.360
lowest prize money squared	1.535	22.640	0.265	1180.629
big meeting x trend	0.017	0.519	0	18
mean field size	9.679	1.763	4.714	16.167
rainfall	1.936	3.971	0	65
	JUMPS (9,108 observations)			
attendance	4107.209	6845.529	79	71293
log regional weekly wage	6.384	0.090	6.190	6.624
days since last fixture	25.328	37.457	2	1390
relative prize money	0.998	1.552	0.061	25.213
relative prize money squared	3.404	21.151	0.004	635.695
lowest prize money	0.999	1.182	0	16.729
lowest prize money squared	2.394	13.129	0	279.852
big meeting x trend	0.147	1.348	0	18
mean field size	9.368	2.295	3.333	22.667
rainfall	2.294	4.707	0	72.300

[1] These were the final games in a series of fluctuating fortunes and 'cricket fever' was such that it was claimed that falls in football attendances were attributable to fans watching the cricket. During these games, television audiences reached 8m. That these contests generated abnormal interest may be gauged from the fact that, the next time England played Australia at home, in 2009, the television audience never reached 2m (https://www.bbc.co.uk/sport/cricket/33407465).

[2] The events were defined as taking place at the same time if any part of the scheduled time for the football match overlapped with a period from one hour before to one hour after the racing programme at the relevant race-day.

[3] In the cases of Royal Ascot and the King George VI Meeting, there was one year in the data set where the venue was switched because of redevelopment work at the usual course. In each case, 'big meeting' was still set equal to one but, for the fixed effects, the venue was taken as the temporary host course.

Table 2b. Mean values for the dummy variables.

	FLAT	ALL-WEATHER	JUMPS
big flat fixture same day	0.107	0.031	0.037
big all-weather fixture same	0.0004	0.0007	0.0001
big jumps fixture same day	0.004	0.034	0.023
London Olympics	0.006	0.002	0.001
Wimbledon	0.088	0.020	0.017
Six Nations on tv	0.002	0.030	0.039
fourth Ashes test (2005)	0.001	0.000	0.000
fifth Ashes test (2005)	0.001	0.000	0.000
FIFA World Cup	0.003	0.001	0.001
EURO Championship	0.002	0.001	0.000
Monday afternoon start	0.075	0.122	0.089
Tuesday afternoon start	0.099	0.112	0.096
Wednesday afternoon start	0.100	0.122	0.119
Thursday afternoon start	0.105	0.093	0.132
Friday afternoon start	0.116	0.101	0.116
Mon.-Thu. evening start	0.137	0.180	0.066
Friday evening start	0.065	0.055	0.016
Sunday	0.064	0.031	0.131
Bank Holiday	0.027	0.013	0.040
January		0.135	0.086
February		0.119	0.089
March	0.007	0.108	0.117
April	0.072	0.080	0.101
May	0.152	0.047	0.101
June	0.179	0.049	0.053
July	0.192	0.044	0.044
August	0.185	0.054	0.044
September	0.125	0.062	0.038
November	0.009	0.106	0.131
December		0.117	0.110
A.P. McCoy farewell			0.005
Frankel	0.001		
fewer than seven races	0.361	0.228	0.301
more than seven races	0.175	0.361	0.055
big meeting	0.040	0.001	0.015
Shergar Cup	0.002		
2002	0.053	0.032	0.052
2003	0.057	0.032	0.054
2004	0.057	0.043	0.055
2005	0.055	0.045	0.054
2006	0.051	0.058	0.055
2007	0.051	0.058	0.052
2008	0.054	0.072	0.055
2009	0.059	0.066	0.055
2010	0.060	0.063	0.053
2011	0.059	0.062	0.063
2012	0.054	0.063	0.057
2013	0.057	0.065	0.059
2014	0.057	0.063	0.060
2015	0.057	0.064	0.061
2016	0.056	0.064	0.060
2017	0.057	0.065	0.063
2018	0.056	0.070	0.060

Table 3. Regression results, dependent variable ln (attendance).

	FLAT		ALL-WEATHER		JUMPS	
	coeff. estimate	|z|	coeff. estimate	|z|	coeff. estimate	|z|
log regional weekly wage	0.0019	0.01	0.4416*	1.75	0.3607**	2.53
big flat fixture same day	-0.0467***	3.74	0.0289	0.78	0.0111	0.56
big all-weather fixture same day	0.1887	1.07	0.0952	0.46	0.4479	1.42
big jumps fixture same day	-0.0851	1.38	0.0331	0.98	0.2685***	11.03
London Olympics	0.1226**	2.56	-0.1207	1.01	-0.1337	1.32
Wimbledon	-0.0435***	3.10	-0.1741***	3.74	-0.1271***	4.40
Six Nations on tv	-0.2492***	2.68	-0.1142***	3.01	-0.0234	1.18
fourth Ashes test (2005)	-0.1851*	1.89	0.0861	0.21	-0.0659	0.36
fifth Ashes test (2005)	-0.0289	0.29	-0.9891**	2.45	-0.1187	0.53
FIFA World Cup	-0.2247***	3.24	-0.4533***	2.94	-0.0810	0.68
EURO Championship	-0.1940**	2.51	-0.4259**	2.08	-0.2546	1.39
rainfall	-0.0103***	7.11	-0.0096***	3.95	-0.0053***	4.23
rainfall squared	0.0003***	5.03	0.0002**	2.12	0.0001	1.52
Monday afternoon start	-0.9535***	54.61	-0.9857***	41.19	-0.5998***	37.38
Tuesday afternoon start	-0.9205***	57.84	-0.8730***	35.19	-0.6228***	39.26
Wednesday afternoon start	-0.8173***	50.72	-0.7942***	34.08	-0.6133***	43.07
Thursday afternoon start	-0.8713***	56.60	-0.8375***	32.95	-0.5869***	41.49
Friday afternoon start	-0.7288***	46.91	-0.7058***	28.49	-0.4140***	28.61
Mon.-Thu. evening start	-0.6631***	43.43	-0.8678***	36.57	-0.5577***	30.53
Friday evening start	-0.0521***	2.81	-0.4666***	15.13	-0.0988***	3.32
Sunday	-0.2293***	13.31	-0.3610***	9.85	-0.1285***	9.52
Bank Holiday	0.0149	0.59	0.5259***	9.29	0.3536***	16.97
January			-0.2648***	9.58	-0.4481***	26.04
February			-0.2348***	8.12	-0.2864***	16.39
March	0.0492	1.06	-0.1402***	4.79	-0.1867***	11.58
April	0.0431**	2.09	0.0063	0.20	-0.0274*	1.69
May	0.1073***	6.22	0.1205***	3.52	0.0312*	1.83
June	0.3392***	19.39	0.3542***	9.43	0.2255***	10.64
July	0.4689***	26.60	0.5092***	14.08	0.2958***	12.98
August	0.4228***	24.43	0.4874***	14.70	0.3706***	17.14
September	0.2067***	12.13	0.1788***	5.91	0.1233***	5.78
November	-0.0059	0.15	-0.1692***	6.28	-0.1159***	7.55
December			0.0454*	1.67	-0.0881***	5.40
days since last fixture	0.0012***	11.19	0.0055***	7.33	0.0008***	8.28
relative prize money	0.0907***	14.91	0.0821***	4.69	0.2197***	23.32
relative prize money squared	-0.0033***	13.18	-0.0036**	2.31	-0.0073***	15.07
lowest prize money	0.0711***	8.96	0.1311***	3.50	0.0273**	2.05
lowest prize money squared	-0.0009***	8.39	-0.0027***	2.97	-0.0022**	2.15
A.P. McCoy farewell					0.2271***	4.73
Frankel	0.3212**	2.47				
fewer than seven races	-0.0280***	2.89	-0.0486***	2.94	-0.0279***	3.31
more than seven races	0.0246**	2.24	-0.0145	0.98	0.0563***	3.61
big meeting	0.1869***	3.90	-0.5932	0.60	0.5496***	6.66
big meeting x trend	-0.0019	0.52	0.0231	0.33	0.0185***	3.05
mean field size	0.0681***	6.17	0.1796***	6.01	0.0686***	7.01
mean field size squared	-0.0022***	4.42	-0.0066***	4.34	-0.0019***	3.85
Shergar Cup	-0.0001	0.00				
year==2001	-0.0570**	2.45	-0.1002*	1.77	-0.0718***	3.05
year==2003	0.0659***	3.06	0.0316	0.71	-0.0101	0.50
year==2004	0.0149	0.66	-0.0505	1.17	-0.0213	1.02
year==2005	0.0192	0.82	-0.1724***	3.92	-0.0330	1.52
year==2006	-0.0196	0.80	-0.1622***	3.61	-0.0734***	3.19
year==2007	-0.0118	0.47	-0.1846***	3.94	-0.0789***	3.33
year==2008	-0.1104***	4.52	-0.2183***	4.79	-0.1576***	6.84
year==2009	-0.1738***	6.84	-0.3890***	8.49	-0.1846***	7.98
year==2010	-0.1394***	5.88	-0.2764***	6.24	-0.2074***	9.15
year==2011	-0.1186***	5.35	-0.1920***	4.48	-0.1407***	6.90
year==2012	-0.1841***	7.91	-0.2855***	6.71	-0.2000***	9.69
year==2013	-0.1773***	7.91	-0.3213***	7.47	-0.2567***	12.60
year==2014	-0.1638***	7.28	-0.2382***	5.56	-0.1993***	9.79
year==2015	-0.1489***	6.48	-0.1607***	3.72	-0.1727***	8.30
year==2016	-0.1761***	7.47	-0.1922***	4.42	-0.1981***	9.50
year==2017	-0.2103***	9.14	-0.2236***	5.21	-0.2030***	9.96

year==2018	-0.2091***	8.92	-0.3743***	8.78	-0.2902***	14.12
Constant	7.9688***	7.22	3.5331**	2.17	5.4320***	6.01
Observations	9745		5147		9108	
Adjusted R^2	0.628		0.606		0.653	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$