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# To Bat or Not to Bat: An Examination of Contest Rules in Day-night Limited Overs Cricket

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**Abstract**

The tradition of tossing a coin to decide who bats first in a cricket match introduces a randomly-assigned advantage to one team that is unique in sporting contests. In this paper we develop previous work on this issue by examining the impact of the toss on outcomes of day-night one day international games explicitly allowing for relative team quality. We estimate conditional logit models of outcomes using data from day-night internationals played between 1979 and 2005. Other things equal, we find that winning the toss and batting increases the probability of winning by 31%. In contrast, winning the toss does not appear to confer any advantage if the team choose to bowl first.

**JEL Classification Codes**: L83

**Keywords:** cricket, contest rules, match results, competitive balance, outcome uncertainty

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## I. Introduction

The success of professional team sports from the point of view of participating teams and in terms of their general popularity is to a large extent determined by their organisational structure and their rules and regulations. The economic design of sporting contests, as they particularly appeal to active match attenders and more sedentary 'armchair' viewers and attract sponsorship and media revenue, has been the subject of detailed investigation; see Szymanski (2003) for an account of the manifold issues involved and a comprehensive review of the literature. However, while the key issue of competitive balance has been widely researched[1] the effect of specific rule factors remains largely neglected. In this regard the sport of cricket presents an interesting context for team sport study given its various, and continuing, attempts at product diversification and redesign, both domestically within the major cricketing nations and in international competition, and its peculiar match format involving sequential play between two teams as determined by one team's win of a pre-match toss of a coin.

The critical break with long standing cricketing tradition came in the 1960s with the introduction of single innings, limited overs cricket to complement the conventional form of the sport involving unlimited overs and two innings a side played over several days. This now well established one-day format encompasses many product variants, covering domestic leagues and knockout cup tournaments, and various forms of international competition including the prestigious four-yearly World Cup tournament combining mini-league pool stages with knockout matches culminating in a final. Although the actual specifications of one-day matches have

varied between competitions, with particular regard to the number of maximum overs allocated to each team, the pre-match toss of a coin to determine the order of batting remains a critical feature.

The potential importance of the toss rule in determining cricket match results has been the subject of some limited recent investigation, which is further advanced in this paper that utilises a dataset relating to the increasingly popular, but contentious, day-night form of limited overs cricket as played at international level. We employ binary-logit regression models to examine the effects of winning the toss and choice of batting order on the likelihood of a match victory, allowing for a variety of controls.

Following a description of limited overs cricket, we briefly review the relevant literature relating to cricket match performance and outcomes. The following section then describes our data and model, and presents and interprets the results of our investigation. We then consider the possible match result distortions arising from choice of batting order in day-night matches and the implications for the integrity or soundness of tournament outcomes in competitions that contain day-night matches. Our conclusion also discusses some policy issues.

**II. Limited Overs Cricket**

The one-day, limited overs format was originally designed and introduced as a product variant of conventional first class cricket. The latter has particular product features in the form of a high propensity for drawn (and inconclusive) matches and relative lack of concentrated action which limit its potential for growth (see Schofield (1982) for an economic analysis of the development of first class county cricket in England). Possessing the attributes of continuous action and excitement and (almost) guaranteed results produced in a single day, the basic aim was to make the sport of

cricket more attractive to more people, as attenders or television watchers, and generate increased revenue for individual teams as well as the sport in general. Quickly adopted worldwide across all the major cricketing nations the basic format has undergone several adaptations to maintain its popularity, variously involving the style of competitions, match dimensions in terms of maximum overs and individual bowling quotas and fielding restrictions, and more recently the introduction of 'power play' sessions during an innings. There have also been attempts to increase the theatricality of the occasion with the adoption of coloured clothing (replacing the traditional all white cricket kit) and emblematic names for teams.[2]

The first international day-night cricket match, involving the use of floodlights for its later stages, was played in November 1979 in Sydney, Australia. Following the idea's initially slow adoption, explained largely by limited floodlight facilities and general caution regarding its potential, this form has more recently proliferated as a popular variant of the one-day game.[3] As shown in Figure 1, by the end of 1989 only 86 day-night matches had been played, all but one (New Delhi, India) in Australia, while in 2004 alone a total of 49 matches were played in seven different countries.[4] By the end of 2005 over 700 day-night matches had been played across continents. These covered a variety of matches played within mini-series (or triangular tournaments) involving a home team playing 'visitors', or within world cup tournaments between several countries played in a single host country or mini-tournaments played at neutral venues, as well as a variety of one-off matches.

*INSERT FIGURE I HERE*

While such matches have proved increasingly attractive to spectators, concern has also been expressed regarding their validity in producing a fair contest, with particular regards to the asymmetry involved in batting-fielding conditions

experienced by the two teams; *prima facie* evidence suggesting that the teams batting second under floodlights may be relatively disadvantaged. For example during the 2003 World Cup tournament played in South Africa, several teams expressed concern regarding the advantage given to teams batting first in day-night games.[5]

*Rules and regulations*

It is the particular peculiarity of cricket that matches involve a strict sequential order of 'play' between two teams, as determined by a team captain's choice to bat first or second following the successful call on a pre-match toss of a coin.[6] In the one-day format each team is allocated a maximum number of 'overs' in which to 'bat' for a single 'innings' while the other side bowls and fields. The win/loss result of a match is determined by a side scoring the most runs, whether losing all ten of its 'wickets' or not and regardless of the number of batters used, during its 'over' allocation. There is also the possibility of a 'tied' result where the two teams end the match having scored the same number of runs, regardless of the number of wickets lost. When matches are curtailed due to weather interruptions, prior to commencement or at any stage of either innings, results can still be achieved in contrived form following modification of the rules and since 1997 this has involved a specially designed method of determining results in the form of the Duckworth-Lewis method.[7]

Apart from wicket length, the overall playing area dimensions and arena/stadium facilities for cricket matches are potentially more variable than those in other outdoor and much more so than most indoor sports. The most critical aspect of a cricket pitch relates to the state of the playing area, particularly when affected by recent and prevailing weather conditions, which can dramatically affect results by favouring batsmen or bowlers of different kinds.[8] Some teams are better equipped to bat first and set a target to defend, while others prefer to chase targets depending,

other things being equal, on their relative batting/bowling/fielding strengths in comparison with their opponents. Further, certain weather and pitch conditions can provide particular advantages to batting or bowling first, irrespective of a team's preferred strategy. As such, and given the sequential nature of a cricket match, winning the pre-match toss of a coin, would seem to confer an advantage on a team. The day-night format introduces an additional dimension in terms of the relative advantages of batting or fielding second under artificial light. This advantage would appear to be compounded when the toss is won and match batting order determined by the home team, given its potentially better informed choice with regards to venue and playing conditions (Morley and Thomas, 2005).

While the winning of the toss in any sport involves a 50-50 probability for each team, it potentially assumes greater significance in determining the result of a cricket match compared to those team sport contests where it simply decides initial *direction* of field play (even allowing for the exercise of preferences in adverse weather conditions) as, for example, for the first half of an association football or rugby football match.[9] Although the outcome of the toss is random, the process does provide an opportunity for superior strategic decision-making (e.g. in reading weather and pitch conditions) to be rewarded. As argued above, the implications of cricket's rule feature of sequential batting order determined by a toss of a coin would appear to be a particularly significant issue for day-night cricket matches, and it is this possibility which provides the particular focus of this paper's investigation of international limited overs cricket.

*Previous research*

The nature of a limited overs cricket match makes it a prime candidate for analysing within-match strategies by batting and bowling teams, basically involving trade-offs

between aggressive batting run rates and wicket loss, and between aggressive/defensive bowling (and fielding) and wicket taking and/or conceding runs. The question of optimum batting strategies, or batting orders, has been explicitly treated by Clarke (1988), Preston and Thomas (2000) and Swartz *et al.* (2006), while Schofield's (1988) and Bairam *et al'*s (1990a, 1990b) production function studies also include treatment of strategic aspects.[10] Of those studies which have treated, either explicitly or incidentally, the influence of the pre-match toss on match results, de Silva and Swartz's (1997) statistical analysis of one-day international cricket matches showed that winning the toss does not provide a competitive advantage, as did Clarke and Allsopp's (2001) study of the 1999 (limited overs) cricket World Cup and Allsopp and Clarke's (2004) investigation of international one-day and five day Test Match cricket. While one of Morley and Thomas' (2005) three estimations of a logistical regression model of one-day match outcomes in English domestic cricket league suggests that winning the toss has a significant positive effect on match results, to the extent that it confers a particular advantage to the home team in choosing batting order, the effect is nullified when factors such as team quality and match importance are added to the specification. Forrest and Dorsey's (*forthcoming*) investigation of the effects of toss winning and match weather disruptions in determining end of season league outcomes in the English unlimited overs, two innings a side, County Championship indicates that the toss has a significant influence on match results, although statistical testing did not show that home teams were better able to exploit the winning of the toss.[11]

In the only study to examine explicitly international day-night matches (as a subset of all international one-day matches) Bhaskar (2006a) uses the cricket match context to utilize 'randomized trials' to examine the consistency of choices made by

teams with strictly opposed preferences and the effects of these choices upon the outcomes in the game. In addition to examining win toss-bat/field probabilities, Bhaskar (2006a) estimates a linear probability model for match results, with dummies for each pair of teams, and employing a dummy variable corresponding to each of the four win/lose toss – bat/field situations, distinguishing between home, away and neutral venues, and allowing for team quality.[12] He concludes that teams generally have a significant advantage from choosing to bat first in day-night matches (as compared to a significant disadvantage when choosing to bat first in matches wholly played in daylight).[13]

Given this background our paper attempts to extend the analysis of limited overs cricket matches by explicitly modelling the results of international day-night matches more formally. As well as controlling for match venue and batting order, this study includes the impact of curtailed matches and employs a direct measure of team quality based on International Cricket Council (ICC) rankings.

The ICC One Day International (ODI) rankings are determined by a rating system which in turn is determined by a points system. As documented on the ICC website (http://www.icc-cricket.com), the number of points earned by a team in an ODI match depends on the result (win, loss or draw) and the difference between the ratings of the two teams prior to the match. A rating is obtained by dividing total points by number of matches played within the last three years (matches played within the last 12 months are given a weighting of one, matches played two years ago a weighting of two-thirds, and matches played three years ago a weighting of one-third). The system is "zero-sum", such that a higher rating for one team results in a lower rating for the other team. The general framework of the system is similar to those adopted in other major sports (see Stefani,1997, for a discussion).

The emphasis of this study therefore is to determine the effects of toss winning and the choice of batting order on match outcomes in day-night international cricket contests whilst controlling for the impact of home advantage and (relative) team quality. In addition we choose to employ conditional logit estimation techniques in preference to simple linear probability models (LPMs). This approach allows us to control for the dependence of outcomes within each pairs of teams playing in a match.

**III. Data, Model and Results**

Our dataset contains information on all 649 one-day international cricket matches involving ICC ranked teams played on a day-night basis between November 1979 and November 2005 which achieved some form of win/loss result.[14] These matches generated 1298 observations in stacked form, with two (one for each team) per match, with the data covering venue, win of toss, batting order, nature and context of fixture, and whether the result was contrived or not, as well as the pre-match team ranking indices as obtained from the ICC ODI Rankings. A full list of variables and their definitions is provided in Table I.

INSERT TABLE I HERE

Of the 649 matches in our full dataset 55.6% were won by the team winning the toss and 55.5% won by the team batting first. Teams that won the toss chose to bat first in 74.6% of all matches, with 77% of match wins by the team winning the toss achieved by batting first. Calculations based on the subset of 207 neutral venue matches generally produced similar figures as did those relating to the 442 matches involving a home team, with the only substantial differences noted in the percentages of first bat choices which resulted in wins by the home team (69%) and the 'away'

team (46%). In sum, these figures indicate *prima facie* evidence of the potential significance of the toss advantage in determining match results by enabling a preferred and rewarding choice of first bat, which appears particularly effective in the case of the home team. In line with the results of de Silva and Swartz (1977) and Allsopp and Clarke (2004), a clear home-field advantage effect is indicated by the fact that 62.4% of all home-away matches (i.e. excluding matches played at neutral venues) in our dataset are won by the home team.[15]

In our investigation of the data we employ a variety of conditional logit regression equations to examine the effects of winning the toss (TOSS) and batting order (BAT) on the likelihood of a victory, with controls for home advantage (HOME) and relative team quality (INDDIFF), indicating match competitive balance. The dependent RESULT variable is dichotomously defined in terms of team win (1) or loss (0). In the analysis we also take account of curtailed matches (CONRES) – and the Duckworth-Lewis (DUCLEW) method for matches played since 2001 - to allow for the effect of weather as well as result contrivance.

Our previous discussion suggests that both TOSS and BAT are expected to be positively signed, with the directional effect of HOME also assumed to be positive. We also expect a positive relationship between relative team quality and winning. The CONRES and DUCLEW dummy variables cannot be unambiguously assumed to have a particular directional effect on match results. To determine whether the side batting first has an advantage in such situations we interact BAT with CONRES and BAT with DUCLEW.

INSERT TABLE II HERE

Table II reports results based on conditional logit regression models on the full dataset of 1298 observations with MATCH as the grouping variable to deal with the problem of stacked data of paired observations where the dependent variable is linearly dependent within observations. Model 1 contains both TOSS and BAT as separate independent variables, neither of which are found to be significant. Home venue is highly significant (at better than the 1% level) with the positive sign indicating the assumed home-field advantage, and the control variable for relative team quality is similarly highly and positively significant. Due to the apparently problematic inclusion of both TOSS and BAT variables, given the observed preference for most toss winners to elect to bat first, model 2 omits the latter variable whereas model 3 omits the former variable. The results show TOSS and BAT to be significant at the 5% level in their respective models, with the expected positive signing, while HOME and INDDIFF both remain highly significant. To further allow for the relationship between winning the toss and choice of batting order, Model 4 explicitly incorporates interaction terms TOSS*BAT (batting first following win of toss) and TOSS*BOWL (bowling first following win of toss), with the former shown to be highly significant (at better than the 1% level) with the expected positive sign. In Models 5 and 6 we retain the variables used in Model 4 but now include the impact of result contrivance. Specifically Model 5 includes a term which interacts all curtailed matches with the variable BAT (CONRES*BAT) and in Model 6 we interact BAT with curtailed matches based on the Duckworth-Lewis method (DUCLEW*BAT). The coefficient attached to CONRES*BAT is positive and significant at the 5% level whereas it is positive and insignificant for DUCLEW*BAT. This may imply that any apparent biases inherent in previous metrics used to determine the outcome of games which have been curtailed by the

weather have been removed by the introduction of the Duckworth-Lewis method. However, a note of caution should apply because for our sample of day-night games the method has only been employed on 11 occasions. In all six models, the likelihood-ratio (LR) test indicates collective significance. The McFadden adjusted $R^2$ is consistently around the 0.13 – 0.14 mark and the count-$R^2$ suggests that the models correctly predict the outcome in about two-thirds of the contests.

What do the results imply about the importance of winning the toss and batting first? In order to answer this it is useful to convert the logit estimates into odds ratios. In doing this we focus on Model 5. Winning the toss and batting first increases the odds of winning the match by 31%, other things unchanged. Similarly, if the team is playing at home the odds of winning the contest increase by 69%, other things unchanged. Furthermore each one-unit increase in the pre-match ranking difference is associated with a 1% increase in the odds of winning the match.

INSERT FIGURE II HERE

It is also instructive to consider the implications these results have on predicted probabilities as INDIFF varies. Figure II displays predicted probabilities based on Model 5 under three different scenarios: (1) The team does not win the toss and is not playing at home (this means both TOSS*BAT and HOME are set equal to zero); (2) the team wins the toss and chooses to bat first (TOSS*BAT = 1) but is not playing at home (HOME = 0); (3) the team wins the toss and chooses to bat first (TOSS*BAT=1) and is playing at home (HOME = 1). INDIFF is the continuous variable (represented on the horizontal axis) with the remaining variable (CONRES*BAT) set equal to 0 in each case. As expected as INDIFF increases, the

probability of winning the contest increases. However it is clear that winning the toss and batting first and playing at home ratchet up the probabilities. For example, in a contest between two equally matched teams (INDIFF = 0), the team winning the toss and batting first has a 57% chance of winning the match. If this team is also playing at home, the probability increases to 69%. On the other hand Figure II also suggests that inferior teams, in terms of ICC ranking, may be able to compete if they are playing at home and / or win the toss and bat first: a team not playing at home with a ranking difference of minus 21 still has a 50% chance of winning the contest provided they win the toss and bat first. If the team is also at home then they have 50% chance of winning even with a ranking difference of minus 62.[16]

INSERT TABLE III HERE

To see whether the results hold up to closer scrutiny, sensitivity analysis in the form of different sample constructions was undertaken (Table III). These experiments are based on our preferred specification, namely Model 4 in Table II (Model 5 cannot be used because of the lack of observations on curtailed matches). Conditional logit estimates for samples which exclude matches played at neutral venues and excluding "dead rubbers" (where the result is not meaningful within a tournament) are consistent with the results provided in Table II. In the third model we restrict the sample to the post-1992 period to take account of innovations introduced during the 1992 Cricket World Cup, specifically the introduction of coloured clothing for teams and, more importantly, the use of a white ball (instead of the traditional red colour). The results provide some evidence to suggest that the importance of winning the toss and batting first has slightly increased in importance since 1992. Further investigation of this,

applying year dummies (interacted with BAT) for the period 1992-2005, indicates that most of the impact occurred during the 1992 and 1993 period.[17] We tentatively conclude from this that teams tended to modify their behaviour following these changes. Teams may have, for example, modified their batting strategies if, as was generally considered by commentators and players, the white ball induced more movement, thereby making batting more difficult at the start of the innings under floodlit conditions.

As a final check on the robustness of our findings, Table III also reports results based on an application of a standard logit model to a data subset constructed by a random sample of 649 observations and where the standard errors have been bootstrapped. Results are again consistent with our earlier findings. As found in Table II, the likelihood ratio tests suggest collective significance in each of the models estimated and similar McFadden adjusted $R^2$ and count-$R^2$ values.

Overall our investigations indicate that winning the toss and batting first are significant influences on the outcomes of day-night cricket matches. The results also show the importance of home-team advantage and team quality. These findings hold under a variety of specifications and sample constructions.

**IV. Concluding Remarks**

The prominence of the toss in cricket carries with it several advantages. First the tossing event itself with its associated tension provides a spectacle which excites interest. Further, the fact that the captain winning the toss has to exercise judgement means that strategic decision making becomes a formal part of the sporting contest. Our result that, in day-night international matches teams winning the toss have an advantage only if they bat first means that, to all intents and purposes, the element of strategic decision-making has been eliminated. This would suggest that cricketing

authorities should seriously consider the implications at both international and domestic level. While the associated problems are generic they are particularly serious for knockout matches that determine team progress in high profile tournaments, or where the scheduling of day-night matches is not balanced between teams within a competition. The issue is further complicated by the potential for home-team advantage in matches played at non-neutral venues, where the simplistic 'solution' of offering choice of batting order to the visiting away team may be viewed as an unnecessary contrivance.[18] Given the constant tension in sport between, on the one hand, product attractiveness and the commercial pressures to maximise actual and 'armchair' television viewing and associated revenue sources and, on the other, the integrity of a sport's rules and regulations this cricketing issue appears particularly problematical, with the need to match the sequential single-innings nature of limited-overs cricket with an increasingly popular day-night format.[19]

One seemingly obvious policy recommendation would involve each team batting/bowling for two 'half-innings' of fixed overs during balanced sessions, with order determined by the toss of a coin, ensuring that both teams (potentially) experience both lighting conditions. While there has been some limited experimentation with this variant there are considerable doubts regarding its validity on a variety of grounds, including the very real possibility that matches could end prematurely with a result being achieved without one of the teams using its second 'half-innings'.[20] Given that our results suggest that the outcomes of seemingly one-sided day-night contests can potentially become more uncertain if the weaker team is automatically given the choice of batting first, another possibility might be to determine the choice of batting order according to pre-match rankings, and whether the weaker team is playing at home.

While it is currently undeniable that day-night cricket matches, especially as broadcast by satellite television, remain popular spectacles, the continuing attractiveness, and integrity, of day-night cricket requires assurance that results are not potentially, or largely, pre-determined by a successful win of the pre-match toss, which may effectively change the *ex ante* view of the likely result i.e. match uncertainty of outcome, and win probabilities - an effect which may be exaggerated when the toss is won by the stronger (higher ranked) team[21] - and distort overall tournament outcomes. On the other hand, when the toss is won by the weaker team, the effect is likely to be to bring about a contest in which there is greater uncertainty of outcome which may be seen as an attractive feature.

While there needs to be continuing debate regarding the possible implications of match format, the question of tournament organisation and structure appears to be a more immediate imperative.[22] At the very least there needs to be some balancing of opportunities for opposing teams in cricket day-night cricket matches. Unless key matches are to be played wholly in daylight, a major final (and possibly semi-finals) could be played over two legs (preferably at the same venue) with order of batting reversed from the first to the second, allowing both teams to experience batting first in a match. The batting/bowling choice would then be determined by the toss of the coin in the first match only.

**Footnotes**

1. A critical aspect of competitive balance involves 'uncertainty of outcome' at the individual match level, and with regards to tournament outcomes either within a single season or between seasons. See Borland and Macdonald (2003) and Szymanski (2003) for recent detailed reviews of the literature.

2. For international one-day contests the maximum number of overs is typically limited to 50. A recent innovation has been the introduction in 2003 of a shortened variant based on 20-overs per side. This format, known as Twenty20 cricket, which was developed to appeal to a new and youthful audience, is now a feature within the domestic game in most of the major cricketing countries. The first international twenty20 game was played between Australia and New Zealand in February 2005. Since then, and at the time of writing, there have been a further 13 international twenty20 matches. In September 2007 South Africa will host the first World Twenty20 Championship. Other innovations include the use of "countdown clock", third umpire (to adjudicate on run-out decisions) and speed guns to measure the speed of a bowler.

3. The use of floodlights has required the use of a white coloured ball in place of the traditional red one with dark 'sightscreens' replacing the conventional white ones.

4. The West Indies did not host an international day-night fixture until May 2006, partly in anticipation of the arrangements for the 2007 World Cup. In the event no day-night matches were scheduled for the tournament.

5. For example, the Board of Control for Cricket in India complained about the scheduling of one of the semi-final matches. The coach of Australia expressed his preference to avoid the day-night match in favour of the other semi-final that involved a day match, and earlier in the tournament the captain of Pakistan (knocked out in the

first round) had called for the both semi-finals to be played as day matches (India demand semi switch, Guardian Unlimited, 6 March 2003). These comments followed some notable batting collapses under floodlit conditions during the tournament: Pakistan were all out for 134 chasing a total of 247 to beat England, whereas India were the beneficiaries of playing under day conditions in their comprehensive win against England (England needing 215 to win collapsed to 107-8 and were eventually all out for 168).

6. This is in direct contrast with the games of baseball and softball where, although played sequentially, the rules involve the visiting team batting first with the home team allowed to have the last at-bat following a sequence of alternating half-innings between the teams; although the rule may be set aside in certain tournaments with batting order determined by other means including the toss of a coin. See Bray *et al* (2005).

7. The Duckworth-Lewis method (1998) was presented as a fairer method than others for determining the result of weather interrupted matches forcibly shortened at any time after their commencement, and basically involves setting (and resetting) revised target scores for the team batting second. de Silva *et al* (2001) employ the system to quantify the margin of victory in one-day cricket matches, with particular regard to the problem posed when victories are achieved by teams batting second. See also Clarke and Allsopp (2001).

8. It is also arguable that cricket match results are particularly susceptible to vagaries of officiating decisions by the 'umpires' who rule on a variety issues including batting dismissals. See Ringrose (2006) for an example of umpiring decisions with respect to leg before wicket decisions.

9. The implications of the toss feature is also different in nature to that which determines alternating order of play in a wide range of individual sports such as tennis, squash and snooker. Perhaps one of the most famous sporting examples of a potentially crucial result-determining choice relying on the toss of a coin is that enabling choice of favoured 'station' in the annual Cambridge v Oxford University Boat Race held on a stretch of the River Thames in England. It may also be observed that the choice enabled by the toss of a coin at the beginning of a match of lawn bowls may have a potentially significant effect on controlling the course of the game.

10. The earliest academic research on cricket matches and scores may be dated back to Elderton (1945) and Wood (1945) with most research since then largely, but not exclusively, statistical in nature typically including Kimber and Hansford's (1993) approach to calculating a more refined measure of player batting averages. In addition to production function studies (Schofield (1988), Bairam *et al* (1990a, 1990b), the economic research on cricket has contributed to the study of sports' attendance demand; see Schofield (1983), Hynds and Smith (1994), Bhattacharya and Smyth (2003), Paton and Cooke (2005) and Morley and Thomas (*forthcoming*). See also Brooks *et al*'s (2002) analysis of international (unlimited overs) test match cricket outcomes using an ordered probit model.

11. Forrest and Dorsey's *(forthcoming*) study specifically focuses on the cumulative effects of 'toss winning', and match weather disruptions, on eventual end of season league outcomes.

12. Rather than explicitly including some independent variables in his regression framework as controls, Bhaskar (2006a) uses them as part of a matching process to isolate the effects of winning of the toss and of batting order. Although he refers to the

adoption of a number of different specifications to control for team ability he does not explicitly show or describe these.

13. See also Bhaskar's (2006b) analysis of Test Match cricket.

14. Our dataset excludes 33 matches which did not produce a result due to abandonment and 7 completed matches which produced a 'tied' result.

15. This clear indication of home-field advantage accords with Morley and Thomas' (2005) reporting of a figure of 57% for their study of English one-day cricket matches, and Forrest and Dorsey's (*forthcoming*) and Pollard's (1986) figures for English county championship (unlimited overs) cricket; 56.8% and 58% respectively. It should be noted that while home team venues may be more variable for international matches compared with domestic matches, the home–field effect remains potentially significant with particular regard to familiarity with pitches and atmospheric conditions and the various forms of crowd effects, both direct and indirect. Courneya and Carron (1992) provide a quantitative synthesis of studies that examined home advantage in various major team sports, and Carron *et al* (2005) revisit the conceptual framework and provide a comprehensively referenced review of research since carried out.

16. We also experimented with the inclusion of team-specific and/or stadium-specific effects in place of the ICC ranking. This had very little impact on the results.

17. Results available from the authors on request.

18. Forrest and Dorsey (*forthcoming*) note that teams competing in the County Cricket Championship had rejected a proposal that would have awarded the rights of a toss winner to the away team. While they concede that 'traditionalists' may be reluctant to forego the ritual of the toss the authors recommend that the suggestion be reconsidered in the light of their conclusion that eliminating variance in toss wins over

a league season should make determination of league seasonal outcomes less arbitrary.

19. While structured limited overs leagues are currently restricted to domestic competition within each of the major cricket playing countries, Preston *et al.* (2000) have speculated upon and suggested a new international club cricket league to run alongside Test Match cricket and the variant forms of one-day international tournaments. The organisation of such a competition would inevitably have to address the problems associated with the scheduling and play of day-night fixtures.

20. This split-innings format has been experimented with in a small number of unofficial matches, including its first appearance in English county cricket in July 1997 (Lancashire vs. Yorkshire, at Old Trafford, Manchester).

21. This can affect match betting odds, with implications for a range of gambling related issues. See work by Forrest and Simmons (2003) and Preston and Szymanski (2003).

22. It is interesting to note that no day-night matches were scheduled for the recently completed 2007 World Cup tournament in the West Indies, with all matches commencing at 09.30 local time.

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FIGURE I: *Day-Night Cricket Contests 1979-2005*

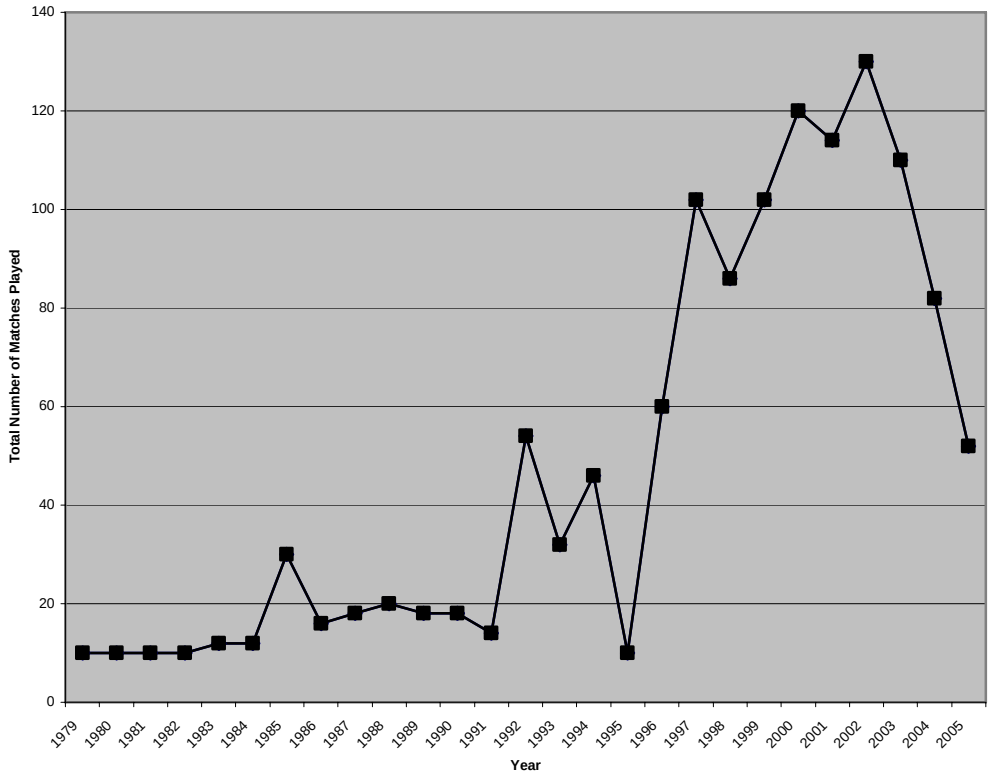


FIGURE II: *Predicted Probabilities (Based on Model 5)*

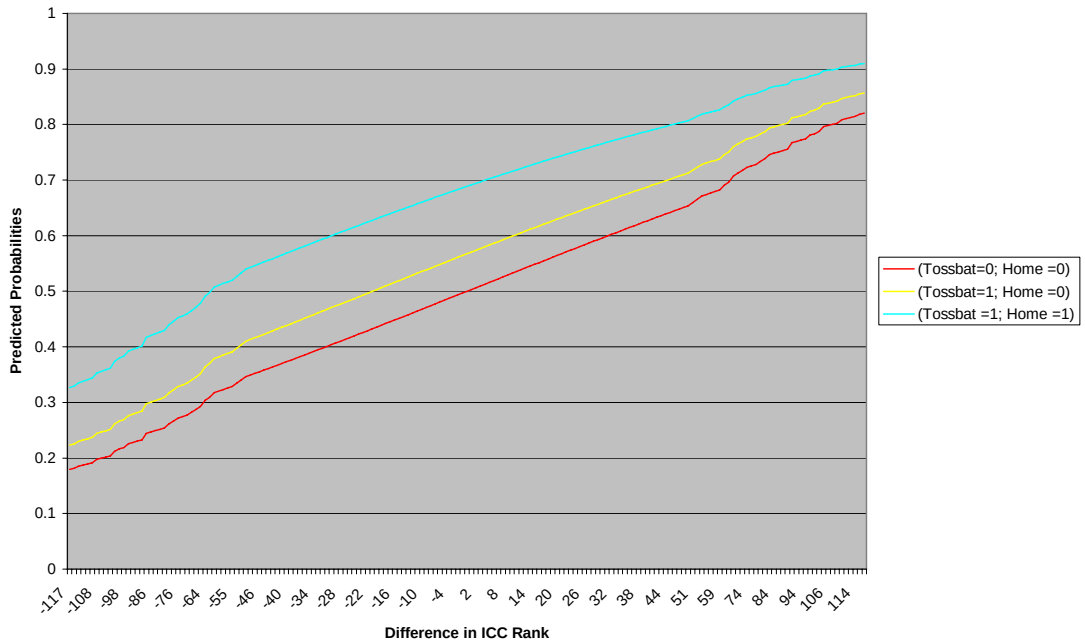

TABLE I: *Definitions of variables*

| Variable | Definition |
|---|---|
| RESULT | 1 for win, 0 for loss |
| TOSS | 1 for team winning toss, 0 otherwise |
| BAT | 1 for team batting first, 0 otherwise |
| HOME | 1 for home venue, 0 otherwise |
| INDDIFF | Observed team's pre-match ODI ranking index (OWNIND) *minus* Opposing team's pre-match ODI ranking index (OPPIND)[a] |
| CONRES | 1 for Contrived result, 0 otherwise [b] |
| DUCLEW | 1 for Contrived result based on Duckworth-Lewis Method, 0 otherwise |

*Notes:*
[a] As calculated from the official rankings provided by the International Cricket Council.
[b] Contrived results include those explicitly determined by the Duckworth-Lewis method since 1998.

TABLE II: *Conditional Logit Model Estimations: Full Sample (dependent variable is RESULT)*

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| TOSS | 0.130 | 0.208 | | | | |
| | (1.33) | (2.41)** | | | | |
| BAT | 0.166 | | 0.227 | | | |
| | (1.71)* | | (2.64)** | | | |
| HOME | 0.507 | 0.509 | 0.500 | 0.507 | 0.523 | 0.518 |
| | (4.79)*** | (4.84)*** | (4.75)*** | (4.79)*** | (4.92)*** | (4.89)*** |
| INDDIFF | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 |
| | (7.97)*** | (7.92)*** | (8.01)*** | (7.97)*** | (7.90)*** | (7.94)*** |
| CONRES*BAT | | | | | 1.359 | |
| | | | | | (2.52)** | |
| DUCLEW*BAT | | | | | | 1.146 |
| | | | | | | (1.63) |
| TOSS*BAT | | | | 0.296 | 0.267 | 0.287 |
| | | | | (2.94)*** | (2.67)*** | (2.83)*** |
| TOSS*BOWL | | | | -0.036 | 0.056 | 0.001 |
| | | | | (-0.22) | (0.33) | (0.00) |
| *Log-likelihood* | -391.190 | -392.657 | -392.086 | -391.190 | -387.598 | -389.901 |
| *LR-test* | 117.326 | 114.391 | 115.534 | 117.326 | 124.509 | 119.903 |
| *McFadden* $R^2$ | 0.130 | 0.127 | 0.128 | 0.130 | 0.138 | 0.133 |
| *McFadden Adj* $R^2$ | 0.122 | 0.120 | 0.122 | 0.122 | 0.127 | 0.122 |
| *Count* $R^2$ | 0.666 | 0.669 | 0.659 | 0.666 | 0.667 | 0.664 |

*Notes:*

[a] 11 teams included in the analysis: Australia, Bangladesh, England, India, Kenya, New Zealand, Pakistan, South Africa, Sri Lanka, West Indies and Zimbabwe

Robust standard errors used. z-statistics are in parentheses; * significant at 10%, ** significant at 5%, ***significant at 1% (all two-tailed tests). N = 649.

TABLE III: *Sensitivity Analysis (dependent variable is RESULT)*

| Variable | Conditional Logit (Excluding Neutral Matches) | Conditional Logit ("Live" Matches only) | Conditional Logit (Post 1992) | Random Logit Model |
|---|---|---|---|---|
| HOME | 0.524 | 0.484 | 0.561 | 0.934 |
| | (4.85)*** | (4.46)*** | (4.67)*** | (5.15)*** |
| INDDIFF | 0.014 | 0.012 | 0.014 | 0.026 |
| | (7.09)*** | (7.19)*** | (7.54)*** | (7.50)*** |
| CONRES*BAT | 1.401 | 1.165 | 1.837 | 2.582 |
| | (2.31)** | (2.19)** | (2.82)*** | (3.58)*** |
| TOSS*BAT | 0.271 | 0.276 | 0.306 | 0.670 |
| | (2.10)** | (2.63)*** | (2.76)*** | (3.62)*** |
| TOSS*BOWL | 0.074 (0.36) | 0.085 (0.49) | 0.151 (0.77) | 0.130 (0.47) |
| *Log-likelihood* | -253.298 | -367.03 | -319.480 | -384.495 |
| *LR test* | 106.147 | 103.271 | 123.501 | 129.235 |
| *McFadden* $R^2$ | 0.173 | 0.123 | 0.162 | 0.144 |
| *McFadden Adj* $R^2$ | 0.157 | 0.111 | 0.149 | 0.131 |
| *Count* $R^2$ | 0.699 | 0.659 | 0.693 | 0.686 |
| *n* | 884 | 1208 | 1100 | 649 |

*Notes:*
As Table II. The standard errors in the random logit model have been bootstrapped (100 replications).