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How to reduce the service dominance in tennis? Empirical results from four years at Wimbledon

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ABSTRACT: This paper provides empirical results that will help the discussion on how to reduce the service dominance. Our extensive Wimbledon data set shows that the softer balls at the 1995 Wimbledon championships did not reduce the service dominance. Abolishing the second service, however, will reduce the dominance of service and make the server and receiver more equal. In addition, its implementation is easy and the data show that it will make matches more even. This will make tennis more attractive for spectators. In this sense, allowing for only one service is a good idea.

INTRODUCTION

The service is an important aspect in the game of tennis. In the past its main purpose was only to start a rally. However, nowadays the service is also an important way to win the rally, either directly through an ace, or indirectly through the advantage in the rally following a great serve. Hence, the dominance of the service has increased substantially.

It is often argued that the service dominance is too high, particularly for men's tennis on fast grass courts such as at Wimbledon. This would have a negative effect on the attraction of tennis for spectators. Hence, many proposals have been made to reduce the dominance of service. This paper contributes to this discussion by providing empirical estimates relating to the dominance of service. These are based on an extensive data set from Wimbledon 1992-1995.

Before we can discuss the reduction of service dominance, we need a measure for it. This is the first topic of the paper. We argue that one should use the probability of winning a point on service, not the probability of hitting the first (or second) service in, nor the probability of winning a point on service given that the first (second) service is in. Ironically, television broadcasts inform us about the latter two probabilities, but seldom about the probability of winning a point on service, the better measure.

Next, we discuss how to reduce the service dominance. Such a reduction would make tennis more attractive for spectators, it is hoped. One could make the net of a tennis court higher or the service court smaller. One could also use bigger or softer balls. Softer balls were used in the 1995 Wimbledon championships. However, we find that the use of softer balls had hardly any effect.

Another measure to reduce the service dominance is to abolish the second service, or, in other words, to allow for one service only. This measure is easy to implement and does, of course, lower the service dominance. From the data we can show how large this reduction will be. We find that the probability of winning a point on service will become close to 50%, so that server and receiver have about equal probability to win the point. Moreover, the quality difference between the top players and the others will decrease. These results hold for both men and women. Hence, matches will get more even and this may well make tennis more attractive for spectators.

All results in this paper are based on data from Wimbledon 1992-1995. It is an extensive point-to-point data set on 481 singles matches, resulting in 88,883 observations. In this respect our work differs from existing statistical papers on tennis. Most papers are theoretical and contain no data. If data are available, they are either point-to-point data of one match, as in Croucher (1995), or end-of-match results (6-4/6-3/6-3, say) of several matches (as in Jackson and Mosursky (1997)).

The existing statistical literature on tennis addresses a number of interesting issues relating to the service. Regarding the first/second service strategy, Gillman (1985) concluded that "missing more serves may win more points"; see also Gale (1971), George (1973), Hannan (1976), Norman (1985) and Borghans (1995).

A second category of papers deals with the computation of the probability of winning a game, set, tie-break or match. Such probabilities can be computed if one assumes that each player's probability of winning a point on service is constant during the match (see Hsi and Burych (1971), Kemeny and Snell (1976), and Pollard (1983), among others).

The assumption that the probability of winning a point on service is constant during the match is questionable. Klaassen and Magnus (1999) test this assumption by analysing whether points are independent and identically distributed and reject it. However, more surprisingly given the large data set that is used, the deviations from constancy are not very large. Evidence of dependence at set level is provided by Jackson and Mosurski (1997).

Another category of papers concerns the testing of tennis hypotheses. For example, are new balls an advantage to the server? These and many other hypotheses are considered in Magnus and Klaassen (1998a,b and 1999a,b,c).

In the next section of this paper we briefly describe the Wimbledon data. Then we propose a measure for the dominance of service. The section after that discusses the effectiveness of the use of softer balls and the abolishment of the second service in order to reduce the service dominance. The final section summarizes the results.

WIMBLEDON DATA

We have a data set consisting of 258 matches played in the men's singles and 223 in the women's singles championships at Wimbledon from 1992 to 1995 (the generality of our conclusions may thus be restricted by the fact that the data concern only Wimbledon, a tournament played on fast grass courts). For each match we have detailed information at point level. For instance, we know the winner of the point, whether the first service was in and, if not, whether the second service was in. This leads to a data set of 59,466 points for the men and 29,417 for the women (the reason why we have many more points for the men is that they play for three sets won and the women for two). See Magnus and Klaassen (1999b) for a more extensive description

of the data.

The data set accounts for almost one half of all singles matches played during Wimbledon 1992-1995. The matches in our data set are played on one of the five 'show courts': Centre Court and Courts 1, 2, 13 and 14. Usually matches involving top-players are scheduled on the show courts. This leads to an under-representation in the data set of matches with lower-ranked players. To account for this selection problem, we weigh the matches when we compute statistics; see Magnus and Klaassen (1999a) for further details.

MEASURING THE SERVICE DOMINANCE

In this section we discuss how to measure the dominance of service and we compare the measures for men and women. This is necessary for the discussion on the reduction of the service dominance in the next section.

Table 1 provides some characteristics of the service. As in the rest of this paper, we present standard errors in parentheses. To obtain the standard errors, we have treated all points as independent. This is not quite true (see Klaassen and Magnus (1999)), but it is sufficient as a first-order approximation for the purpose of this paper.

Table 1 Service characteristics

Percentage of ...	Men's singles	Women's singles
Points won on service	64.4	56.1
	(0.2)	(0.3)
Points won on 1st service	43.6	37.8
	(0.2)	(0.3)
Points won on 2nd service	51.4	46.6
	(0.3)	(0.5)
1st services in	59.4	60.8
	(0.2)	(0.3)
2nd services in	86.4	86.0
	(0.2)	(0.3)
Points won if 1st service in	73.3	62.2
	(0.2)	(0.4)
Points won if 2nd service in	59.4	54.1
	(0.3)	(0.5)

For the remainder of this paper it is important to get a clear understanding of the relations between the service characteristics. The percentage of points won on service is a combination of the percentage of points won on 1st and on 2nd service. The second part, however, becomes only relevant when the first serve is fault. This leads to:

%points won on service = %points won on 1st service + (1)

(%1st service fault) × (%points won on 2nd service).

For example, table 1 shows that 64.4% = 43.6% + (1-59.4%)×51.4% for the men.

The percentage of points won on 1st service depends on two elements, namely the percentage of 1st service in and the percentage of points won if the 1st service is in:

%points won on 1st service = (%1st services in) × (%points won if 1st service in). (2)

For example, table 1 shows that in the men's singles 59.4% of the 1st services is in, and, if the 1st service is in, the men win the point in 73.3% of the time. Hence, the probability of winning a point on the 1st service is 59.4% × 73.3% = 43.6%. A similar formula holds for the 2nd service.

Which statistic in table 1 should we use to measure service dominance? Service dominance is a combination of the dominance of the 1st service and the dominance of the 2nd service. Hence, let us first discuss how to measure the 1st service dominance? Clearly, one should not use the percentage of 1st services in, since this says nothing about the difficulty of the 1st service. Also the percentage of points won if the 1st service in is not appropriate, because this statistic tells us nothing about how often the 1st service is in. The best measure for the dominance of the 1st service is a combination of the two, as given by relation (2). Hence, we measure the 1st service dominance by the percentage of points won on 1st service. Similarly, our measure for the 2nd service dominance is the percentage of points won on 2nd service. Ironically, television broadcasts inform us about the percentage of 1st (or 2nd) services in and sometimes about the percentage of points won if the 1st (or 2nd) service is in, but seldom about the percentage of points won on 1st (or 2nd) service, the most appropriate measure for the 1st (or 2nd) service dominance.

We can now derive the measure for the (total) service dominance by combining the measures for 1st and 2nd service dominance. We use formula (1) for that. Hence, we propose to use the percentage of points won on service to quantify service dominance.

As table 1 shows, we find that the measure for service dominance is 64.4% for the men and 56.1% for the women. Hence, the difference is 8.3%-points. Since the standard error of this difference is 0.4%, the service dominance is significantly larger in the men's singles than the women's singles, as expected (in this paper 'significant' means that the estimate is more than 2 standard errors away from its target). This makes the men's singles a very different game from the women's singles.

HOW TO REDUCE THE SERVICE DOMINANCE?

It is often argued that the service dominance is too high, particularly for men's tennis on fast grass courts such as at Wimbledon. This would lower the attractiveness of tennis for spectators. Hence, many proposals have been made to reduce the dominance of service: making the net higher or the service court smaller, using bigger or softer balls, abolishing the second service. The first subsection discusses the use of softer balls. Then we discuss the abolishment of the second service.

SOFTER BALLS

This measure was implemented at the 1995 Wimbledon championships. The question is whether this has reduced the service dominance. Before we can address this question, we need to know something about the weather, since the weather may also affect the service dominance. The Wimbledon weather has been documented by Little (1995). Because the weather has not been very different in the four years of our observations, the effect of the weather on comparisons between 1995 and the three years before seems negligible.

In the previous section we have explained how to measure the service dominance. In terms of probabilities, this measure is Pr(point won on service). One could estimate this probability for 1995 and compare the estimate with the three estimates based on 1992-1994. However, there may be a downward sloping trend in the probabilities over the years. If one does not correct for that, one may well find that the probability for 1995 is the lowest, even in case of no effect of the softer balls in 1995. Since we are interested in the additional effect of the softer balls, we correct for the time trend in our analysis. More specifically, we use a simple logit model in which the systematic part is a linear function of the year of tournament (year= 92,93,94 or 95) and a dummy for 1995:

$$\Pr(\text{point won on service}) = \Lambda\,(\beta_0 + \beta_1 \times \text{year} + \beta_2 \times \text{dummy95}), \qquad (3)$$

where Λ is the logistic distribution function, $\Lambda(x) = \exp(x) / (1+\exp(x))$.

Table 2 Service characteristics depending on the year of the tournament

Probability of ...	Men's singles		Women's singles	
	year	dummy 95	year	dummy 95
Point won on service	-0.022	0.022	-0.033*	0.030
	(0.012)	(0.031)	(0.016)	(0.042)
Point won on 1st service	-0.033*	0.000	-0.017	-0.043
	(0.011)	(0.030)	(0.017)	(0.043)
Point won on 2nd service	-0.051*	0.045	-0.019	0.049
	(0.018)	(0.046)	(0.027)	(0.068)
1st service in	-0.066*	-0.004	0.021	-0.117*
	(0.011)	(0.030)	(0.017)	(0.043)
2nd service in	-0.125*	0.154*	-0.020	0.013
	(0.026)	(0.067)	(0.038)	(0.097)
Point won if 1st service in	0.029	0.013	-0.049*	0.048
	(0.016)	(0.045)	(0.021)	(0.054)
Point won if 2nd service in	-0.020	0.003	-0.016	0.053
	(0.019)	(0.051)	(0.029)	(0.073)

The top row in table 2 presents the maximum likelihood estimates for β_1 and β_2, along with the standard errors; an asterisk denotes significance at the 5% level. There is no evidence that the softer balls used in 1995 had a negative effect on the service

dominance.

This, however, does not mean that the service dominance was equal to the dominance in the years before. From the estimated negative effect of the time trend variable, we observe a gradual decrease in the service dominance over time (significant for the women and almost significant for the men).

Next, we analyse the reasons for this gradual decline. In other words, we examine whether and how the way servers win their points has evolved from 1992 to 1995. Combining relations (1) and (2), we can split up the probability of winning a point on service as

$$\begin{aligned} &\Pr(\text{point won on service}) \\ &\quad = \Pr(\text{point won if 1st service in}) \times \Pr(\text{1st service in}) + \\ &\qquad \{1-\Pr(\text{1st service in})\} \times \Pr(\text{point won if 2nd service in}) \times \Pr(\text{2nd service in'}). \end{aligned} \tag{4}$$

For each probability we estimate a similar logit model as in (3). Table 2 contains the results.

For the women the reason for the gradual decline in the service dominance is the decrease in the probability of winning a point on service if the first service is in. This may be caused by an improvement in the return of service by professional players, as is sometimes claimed.

The improvement-of-return hypothesis is also supported by the results for the men in table 2. The significantly negative time trend in both the probability of first service in and second service in shows that the men seem to take more risk on their first and second services. Are they pushed to hit more difficult services, because of the better returns? Nevertheless, the services are still not difficult enough to increase the probability of winning a point on service if the service (1st or 2nd) is in, as table 2 shows. This is again in line with the improvement-of-return hypothesis. Hence, we see this as the main reason behind the gradual decrease in the service dominance.

In summary, we find that the service dominance has decreased over time even without special measures. The use of softer balls had hardly any effect on the 1995 Wimbledon championships. If a faster decrease in the dominance of the service is deemed necessary, then stronger measures are called for.

ABOLISHING THE SECOND SERVICE

An alternative and obvious measure to reduce the service dominance is to abolish the second service, in other words, to allow for one service only. This change in the rules of tennis is easy-to-implement and involves no extra costs, in contrast to measures that change the tennis court, for instance. One can also take this measure for specific tournaments and keep the existing rules for others. For instance, at Wimbledon one could allow for only one service, whereas on the clay courts of Roland Garros or at tournaments for amateurs one could use the existing rule of two services. Finally, abolishing the second service does not directly affect the rally following a service, in contrast to many other measures such as making the net higher or changing the balls.

Although abolishing the second service has appealing effects, it is not clear to what extent it will affect the service dominance. To answer this question it is important to realize that a player having only one service can be seen as equivalent to a player having two services who has missed his/her first service. Hence, with only one service, a player will use his/her current second service. In the language of game theory, the

current situation (two services) has an equilibrium which is "subgame perfect" (Selten, 1975, p. 33) and the new situation (one service) is a subgame of the current situation. Hence, the proposed change to one service amounts to actually abolishing the first service, so that for each player the probability of winning a point on service under the new rules equals the probability of winning a point on the second service in the existing situation. (We abstract here from training effects: under the new rule of one-service-only, the players will only have to practice a single service. This will eventually lead to a somewhat better service than the current second service.) The conclusion is that we can use our Wimbledon data set to calculate the effect of abolishing the second service on the service dominance.

To compute the service dominance under the new rule, we could use the estimates for the probability of winning a point on the second service in table 1. These are 51.4% for the men and 46.6% for the women. A note of caution, however, is appropriate. The two percentages of winning a point on the second service in table 1 are only based on points at which the second service occurs (first service is fault). Hence, there is an over-representation of players with a risky first. This is no problem if the percentages are used as estimates for the probability of winning a point on the second service for a random point at Wimbledon for which the second service occurs. After all, such a point indeed often concerns risky servers. However, there is a problem if the percentages of table 1 are used as an estimate for the probability of winning a point on service under the new rule of one service only. After all, under the new rule, *all* players have to hit the single service, not only the risky servers. Hence, using the two percentages of table 1 in the present context of a rule change involves a selection bias.

To avoid the selection bias, we start from the fact that for each player individually the new situation of a single service amounts to the situation of the second service under the existing rule. So, for each player individually we estimate the probability of winning a point under the new rule by the observed percentage of points won on the second service. Then, our estimate of interest is the average of all individual players' estimates. This approach does not suffer from the selection bias discussed above.

The data show that abolishing the second service will reduce the probability of winning a point on service from 64.4% to 51.7% (0.4%) for the men and from 56.1% to 47.3% (0.8%) for the women. (The new percentages do not differ much from the biased ones given above, so the selection effect appears to be small.) The consequence of the change of rule will thus be that the service dominance becomes very much smaller (in the women's singles the service advantage will turn into a service disadvantage!). Furthermore, both percentages get closer to 50%, making the server and receiver more equal.

There is one other appealing consequence of having only one service. Magnus and Klaassen (1999b) demonstrate that top players distinguish themselves from the others particularly by having a better first service. Since it is actually the first service that is abolished by the change of rule, as argued above, the difference between the top players and the others will decrease. Therefore, matches will become more even and thus more attractive for spectators.

CONCLUSION

This paper provides empirical results on the service dominance, more specifically on the question how to reduce the service dominance. We propose to measure the service dominance by the probability of winning a point on service. The data show a gradual

decline in the dominance of service over time, probably because the return on service gets better. The softer balls at the 1995 Wimbledon championships did not reduce the service dominance significantly. Abolishing the second service, however, will reduce the service dominance and make the server and receiver more equal. In addition, its implementation is easy and flexible and it will make matches more even. This will make tennis more attractive for spectators. In this sense, allowing for only one service is a good idea.

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