12-1-2014

Gender differences in response to contingent rewards: Evidence from a natural experiment of junior tennis

Nejat Anbarci
Deakin University

K. Peren Arin
Zayed University, kerim.arin@zu.ac.ae

Jungmin Lee
Sogang University

Gender Differences in Response to Contingent Rewards: Evidence from a Natural Experiment of Junior Tennis

Abstract

We investigate gender differences in responding to contingent rewards by exploiting a natural experiment in junior tennis tournaments in Florida where the ranking point system is revised to increase players' incentives to play more doubles matches. We examine three types of potential rational responses to the new system; 1) a 'positive response' by players, who win their first match, to play doubles more, 2) a 'subversive response' by players, who lose their first singles match, to play doubles less, and 3) a 'slack response' by players, who win their first singles match, to play loosely in their doubles matches. We detect a 'positive response' among boys. Although there is no 'positive response' among girls overall, there is a 'positive response' by top-ranked girls to contingent rewards just like boys. We find no evidence for either a subversive or slack response by both genders.

JEL classification: D01, D03

Keywords: Gender differences, contingent rewards, positive response, negative response, subversive response

1. Introduction

Theoretical and empirical economic studies teem with findings that individuals respond to incentives, and especially to rewards that are contingent upon effective performance. Different genders, however, may exhibit different degrees of response to contingent rewards in a given activity.[1] Thus, gender may be another critical factor besides standard economic variables that one may have to consider regarding compensation schemes, motivation, and various other incentive mechanisms overall.[2]

In this paper, to shed more light on gender differences in response to contingent rewards, we exploit a natural experiment in junior tennis tournaments – a change in the point system instituted by the governing United States Tennis Association (USTA) Florida Section, which applied to 'Super Series' tournaments. Points are important for junior players' careers towards college scholarships, if not towards professional play later. Points determine rankings, and points earned at the local or state level tournaments are needed to qualify for higher national-level tournaments at each age group. The aim of the institutional change was to encourage junior players to play more doubles matches, as conveyed by the USTA-Florida on their website. Doubles matches were not very popular before, because singles' rankings points were not affected by winning or losing those matches. Under the new point system which started in 2005, if at least 2/3 of players in their sex-age group played doubles, the points earned from wins in singles matches increased by roughly 75%; otherwise, players received their base points.

Under the old point system, many players already had some incentive to play doubles regardless of the outcome of their singles matches - simply to hone their tennis skills because the tournament fee is a sunk cost once that tournament is entered and there is no additional fee for the

---

[1] See Croson and Gneezy (2009) (and the references therein) for the recent literature regarding gender differences in preferences. Differences in preferences, such as preferences for competition or risk aversion, may explain why men and women respond differently to incentives (Gneezy et al. 2003; Booth and Nolen 2012). According to the social psychology literature, human behavior can be provoked by intrinsic motivation (values or norms) as well as extrinsic motivations (James Jr. 2005). Observed behavioral differences between men and women may reflect differences in motivation.

2 For example, Cawley et al. (2013) find that at elementary school, for girls, additional physical education (PE) time crowds out participation in individual sports and playground activities. For boys, on the other hand, additional PE time increases structured sports activities, free-time physical activity, and aerobic exercise. They conclude that "PE time and other types of physical activity may be complements for boys, but substitutes for girls." This example shows that a policy regarding PE time can have different consequences between genders.

doubles part of that tournament.[3] This honing motivation to improve one's tennis skills exists in the new point system as well. The new point system, however, added new and more concrete incentives regarding playing doubles for players who won at least their first singles match. This is because, as always, players who lose their first singles matches are eliminated from the singles tournament without any points, and the ones who win at least their first singles match could earn higher points under the new regime than before and would continue playing in further rounds to earn even more magnified points - if at least 2/3 of players in their sex-age group played doubles, as mentioned above.

An important detail is that, for practical logistical reasons such as court availability, in tennis tournaments doubles matches do not start until all the second-round singles matches are over, and players are allowed to have a significant rest time between their second-round singles match and their first-round doubles match if they decide to play doubles. Thus, players have a significant amount of time to decide or strategize whether to sign up to play doubles or not after their second-round singles matches are over.

We will examine three types of rational responses to the new point system. First, those players who win their first singles match (simply "winners" hereafter) would be more likely to participate in doubles to increase their earned points for their first match wins as well as their option values in the rest of their singles matches in the tournament – a "positive response" of winners to contingent rewards. Second, those players who lose their first singles match (simply "losers" hereafter) could refrain from playing doubles in order not to allow the winners to gain more grounds against themselves – a "subversive response" to contingent rewards. Third, since the singles ranking was the only ranking that really mattered for their career at that time, there is a potential incentive issue in that winners could put out much more effort in the dimension where it is rewarded and perform perfunctorily (to minimize effort) in the doubles matches they would play to increase their singles points by focusing more than further singles matches in the tournament – thus, the positive response of the winners could involve a "slack response" by them to contingent rewards as a negative by-product.

---

[3] As is generally agreed, "it's more interesting to play a match of doubles than to practice" (http://blogs.wsj.com/dailyfix/2009/09/05/doubles-tennis-more-fun-than-practice/). In addition, a typical tennis lesson for an hour involves a coaching fee of at least $70-75.

Using a novel data set on 3,887 players and their 10,405 decisions to play or not in doubles matches in 77 junior tournaments during the years of 2004 and 2005, we find a 'positive response' among boys regardless of their rankings. Although there is no 'positive response' by girls overall, top-ranked girls respond to contingent rewards just like boys. We find no evidence for either a boys respond to contingent rewards positively but not subversively. This is true regardless of their ranking.

2. Decision to Play Junior Tennis Doubles

Before proceeding to data and empirical analysis, we explain some details about the doubles' sign-up process. On the first day of a tournament, a sign-up sheet is posted for each age group which is visible to all players – i.e., the sheet is posted either on the main door of the facility or next to the draws board or placed at the tournament desk. A player, with the consent of his doubles partner, can sign up for both of them or both of the partners can sign up simultaneously or sequentially next to each other's name. Players without a partner are allowed to sign up alone as well, so that somebody else without a partner may add his/her name next to that player's name to form a doubles pair with him/her for that tournament. Players can withdraw their entry by crossing over their own names - and also their partner's name with the consent of their partner. Any withdrawal from the doubles tournament is observed by all other players if they glance at the sign-up sheet from time to time.

The doubles partners who have the intention to enter a doubles tournament strategically (i.e., contingent upon how many other pairs are also playing in that tournament) may withdraw or sign up in the last moments they are allowed to do so. Typically right before 5pm of the first day of the tournament when the second-round of singles matches are already done, first-round "byes" - those who advance to the second round without playing in the first round - also know whether they earned any positive points after their win or loss in the second round of singles (there are no second-round byes, so all players play finish at least one singles match by the end of the first day and know whether they have earned any points or not). Consequently, if some doubles partners who lost their first matches in singles do not want to be 'pivotal' in terms of helping the players who won their first singles matches reach the 2/3 threshold and obtain much higher points, then they can withdraw from the doubles tournament – i.e., if they were going to be pivotal by staying

on the sign-up sheet.[4]

How do doubles partners decide whether to enter doubles or not after their singles matches on the first day? The etiquette regarding that is not very complicated. Suppose that one partner loses and the other one wins in their first singles matches. The loser feels obliged to play doubles with the partner who won his/her first singles match especially if they already signed up for doubles.[5] On the other hand, if both players in a doubles partnership win or lose their first-round singles matches, then it may be likely that they reach the same decision in terms of what to do regarding doubles play.

3. Data and Empirical Model

We collected data on 3,887 players and their 10,405 decisions to play or not in doubles matches in a total of 77 junior tournaments in 2004, before the regime change, and 2005, under the new system.[6] The number of decisions is 5,191 in 2004 and 5,214 in 2005. There are 329 gender-age-tournament combinations in 2004 and 330 in 2005. Summary statistics are presented in Table 1. About 62% of players are boys. Players play tournament in each of five age groups; 10, 12, 14, 16 and 18. 27% of players are awarded with a bye (i.e., directly advancing to the second round). The proportion of players awarded with a bye is slightly higher for girls (32%).[7] Figure 1 shows the histogram of the number of singles matches played by a player per year. There is little difference

---

[4] If they are not pivotal (i.e., already more than 2/3 of players stay signed-up around the deadline or sufficiently fewer people than 2/3 of players signed up by then so that their signing up won't make the total number of players entering the doubles tournament reach the 2/3 threshold), then they would stay in the doubles sign-up sheet or add their names to that list if their names are not already there since it would be the dominant strategy for them given the practice/investment value of the doubles matches for themselves, unless they are the types of players who do not like playing doubles.

[5] If the loser does not want to play doubles with the pre-arranged on-going partner, then their long-term stability of that partnership would be in danger. Breaking such commitments may affect even these players' friendships outside the courts and these friendships are typically very valuable to these players who train in the same academy or have been hanging out together between matches in tournaments.

[6] As our data set includes all junior tennis tournaments in Florida in which singles and doubles matches are played together, we avoid having a sample selection bias. (We should also note that round-robin tournaments are excluded from our data, for obvious reasons.)

[7] The byes always go highest ranked players in a tournament: "The byes shall go to seeded players in descending order. … If there more byes than seeded players, then the byes shall be positioned on the lines opposite the lines where additional seeds would have been positioned had the draw been full and had the tournament seeded one in four players. (For example, in a draw of twenty five with 4 seeds and 7 byes, the first four byes would go on lines opposite seeds 1 through 4 and the next three byes would go on lines opposite the lines where seeds 5 through 7 would have gone" (USTA 2012, p. 87).

between boys and girls. There are a bit more frequent players among boys. For example, 16 percent of boys played more than three matches, while 13 percent of girls did.

The point system reform provides us a natural experimental setting in which we can estimate the causal effect of the new incentive by the difference-in-differences method. We compare players' decisions to play doubles in 2004 (before the rule change) with those in 2005 (after the change). And we compare those whose incentive to play doubles increased, i.e., the winners, with the losers. Our estimation model is therefore the following:

$$Y_{ikt} = \beta_1 D_{05} + \beta_2 W_{ikt} + \beta_3 D_{05} W_{ikt} + X_{ikt}\gamma + \phi_i + \alpha_k + \epsilon_{ikt} \quad (1)$$

where the dependent variable is the dummy variable which equals one if player *i* played doubles (contingent on playing singles) in tournament *k* in year *t* = 2004, 2005. We estimate the linear probability model, while Probit or Logit models give similar results (which we can provide upon request). D_{05} is the indicator for year 2005 (after the regime change). W_{ikt} indicates whether the player is the winner of his or her first-singles match. The interaction between the two explanatory variables will capture the effect of the regime change on the player's decision to play doubles.

We include some control variables in vector X_{ikt} such as the player's "age" (indicating not his physical age, which is kept confidential by the USTA, but in which age group the player played in a particular tournament) and whether the player has advanced to the second round without playing in the first round having a bye. These bye players are top players by the USTA rules, as mentioned before. We control for tournament-specific fixed effects (α_k) as well as individual-player-specific fixed effects (ϕ_i). The individual-player-specific fixed effect should absorb most of each player's ability.

Next we estimate Equation (1) by separating bye players and non-bye players. We expect that the responsiveness to the new contingent rewards (i.e., to magnified singles points) should be different according to players' rankings. Top-ranked players should be more serious about their ranking points, so they may attempt to exploit the new point system more. To test for the hypothesis, we estimate the following equation:

$$Y_{ikt} = \beta_1 D_{05} + \beta_2^B Bye \cdot W_{ikt} + \beta_2^{NB} NoBye \cdot W_{ikt} + \beta_3^B D_{05} \cdot Bye \cdot W_{ikt} + \beta_3^{NB} D_{05} \cdot NoBye \cdot W_{ikt} + X_{ikt}\gamma + \phi_i + \alpha_k + \epsilon_{ikt} \quad (2)$$

where Bye indicates that the player got a bye at the first round, and $NoBye = 1 - Bye$ indicates that the player did not get a bye. In this specification, the triple interaction terms (β_3^B and β_3^{NB}) capture the treatment effects.

4. Empirical Results

A. Positive and Subversive Response to Rewards

Table 2 presents unconditional difference-in-difference estimates for all players and by gender. In 2004, before the point system reform, about 45% of the first-singles-match winners played doubles, while 34% of the losers did. That is, even under the old point system, the winners were more likely to play doubles. This is perhaps because the winners are better players and they want to improve more by playing more matches, be it singles or doubles. As expected, the gap between the winners and losers became larger in 2005 after the new point system was adopted. The winners are 7.4% points more likely to play doubles under the new system than before. This is the first bit of evidence for the positive response by players to contingent rewards.

It is surprising that losers also played more doubles in 2005. This implies that there is no subversive response. By a simple economic logic, the losers would be less eager to play doubles under this new regime, not to help the winners to earn more points and achieve an additional advantage over them (i.e., to subvert winners). In this natural experiment, however, it turns out that the positive response of male winners contingent rewards happens without an undermining response of losers to contingent rewards; i.e., there is no displacement of the former positive response by a latter-type negative response.[8] The unconditional difference-in-difference estimate based on Table 2 is 0.045, statistically significant at the 5 percent level. The middle and bottom panels show the same statistics, separated by gender. For boys, the new point system induces

[8] One reason for this lack of displacement could be that, as mentioned above, the USTA-Florida officials announced at their website that the new regime starting in 2005 was introduced in order to put more emphasis on doubles play. Junior players in Florida, first-round winners and losers alike, may have taken such an official goal/message seriously and internalized it to an extent.

winners to play doubles while there is no response from losers. For girls, there is no such a positive response from winners across-the-board while female losers played more doubles under the new point system, although the effect is statistically marginal.

Table 3 presents regression results after controlling for player characteristics, tournament and individual player fixed effects. Column 1 and 3 present the results for boys, and Column 2 and 4 the results for girls. In Column 1 and 2, we estimate Equation (1), and in Column 3 and 4, Equation (2), separating bye (and thus, supposedly top-ranked) players from non-bye players. Overall the results confirm our simple difference-in difference estimates in Table 2. In fact, after including control variables and fixed effects, the effects get larger. The results in Column 1 show that the new point system increases the propensity for male players to play doubles by 9.8 percentage points. On the other hand, there is no significant effect for girls overall.

The results detect that there is a clear gender difference. Boys and girls are different in their response to contingent rewards in that while overall all boys, regardless of their rankings, positively respond to these rewards positively only the top-ranked girls respond positively to such rewards. We cannot explore further as to why boys and girls respond differently to such rewards, but it is conceivable that boys overall are more serious about competition (Croson and Gneezy 2009).

The results in Column 3 and 4 are intriguing. We find that male bye players are 13 percentage points more likely to play doubles under the new point system. Even male non-bye players are 10 percentage points more likely to play doubles. Both effects are statistically significant.[9] On the other hand, for girls, we find no significant response from non-bye players. But, like male players, female bye players are 10 percentage points more likely to play doubles under the new point system. Our results suggest that top female players do respond to contingent rewards. In other words, the gender difference does not exist among top players.

[9] Both singles and doubles draws can accommodate 32 players at most. As mentioned above, in 2004, before the point system reform, about 45% of the first-singles-match winners played doubles while 34% of the losers did. Thus, most doubles draws involved significantly lower numbers of players than singles draws. In 2005, when 10+% more male singles players played doubles, consequently the number of players in doubles draws came marginally closer to the number of players in singles draws but the former number never converged to the latter number.

B. Slack Response to Rewards

Another prediction of standard economic logic is that those players who choose to play doubles to increase their singles points could try less hard in their doubles matches. They have singles matches to play ahead, thus could minimize their efforts in doubles matches which simply may not mean much to them beyond their participation in the first doubles match to have higher points.

To test for this hypothesis, we estimate the same empirical model replacing the dependent variable with the indicator of whether they won their first doubles match. According to the slack response hypothesis, we expect that the coefficient of the interaction term should be negative. That is, those players who are induced to play doubles by the new system should be less likely to win their first doubles matches. Since the dependent variable is now an outcome of performance rather than players' decisions, it is critical to control for players' ability. For example, it is conceivable that singles winners are better players and therefore they should be better at doubles as well. In this sense, controlling for individual player fixed effects is crucial.

The results in Table 4 do not support the hypothesis. In the previous section we found that boys played more doubles under the new system. The results here indicate that, once they choose to play doubles, they do not shirk and try hard in doubles as well. One possible explanation is that these young players still respect norms of sportsmanship and, as a result, a positive response of the boys winners to contingent rewards does not lead to a weak effort (or slack) response in their doubles matches.

5. Conclusion

In this paper, using a natural experiment, we investigate whether teenage tennis players respond to contingent rewards and whether different genders respond differently. After controlling for unobserved heterogeneity at the player and tournament levels, we find significant gender differences that male junior players positively respond to contingent rewards to play more doubles. This response can be found regardless of male players' rankings. The results for girls are more complicated and interesting. Only top female players respond to these rewards like male players. In terms of similarities between two genders, we found that the positive response of winners to contingent rewards is not accompanied by any subversive response from losers. In fact, female losers played more doubles after the point system reform. Also there is no evidence for a slack response of winners in doubles for boys and girls.

Our findings suggest that an incentive system can work for men and women differently. It is difficult to understand why they respond differently to an incentive. In our study, boys might be more competitive and may try harder to achieve a higher ranking. Boys might be more serious about reaching a future college career with a sports scholarship. Or it could be parents or coaches who push boys to respond more to contingent rewards (in which case the observed gender differences would actually be resulting from adults' different treatments of boys and girls). Clearly, further evidence on gender differences in responses to incentives would be warranted.

References

Booth, A., Nolen, P., 2012. "Choosing to Compete: How Different Are Girls and Boys?" *Journal of Economic Behavior and Organization* 81, 542-555.

Cawley, J., Frisvold, D., Meyerhoefer, C., 2013. "The Impact of Physical Education on Obesity among Elementary School Children." *Journal of Health Economics*, forthcoming (doi: 10.1016/j.jhealeco.2013.04.006).

Charness, G., Gneezy, U., 2012. "Strong Evidence for Gender Differences in Risk Taking." *Journal of Economic Behavior and Organization*, 83(1), 50-58.

Croson, R., Gneezy, U., 2009. "Gender Differences in Preferences." *Journal of Economic Literature*, 47, 1-27.

Eckel, C., Gossman, P., 2008. "Men, Women and Risk Aversion: Experimental Evidence." *Handbook of Experimental Economics Results*, Elsevier.

Gneezy, U., Niederle, M., Rustichini, A., 2003. "Performance in Competitive Environments: Gender Differences." *Quarterly Journal of Economics* 118, 1049-1074.

James Jr., H. 2005. "Why Did You Do That? An Economic Examination of the Effect of Extrinsic Compensation on Intrinsic Motivation and Performance." *Journal of Economic Psychology*, 26(4), 549–566.

Jianakoplos, N., Bernasek, A., 1998. "Are Women More Risk Averse?" *Economic Inquiry*, 36(4), 620-30.

Roberts, B.W., DelVecchio W.F., 2000. "The Rank Order Consistency of Personality Traits from Childhood to Old Age: A Quantitative Review of Longitudinal Studies." *Psychological Bulletin* 126, 3-25.

USTA, 2012. *The USTA handbook of tennis rules and regulations 2012.* http://www.catalogsgate.com/gamerules/tennis/index.html#/1/zoomed.

Table 1. Summary Statistics

	All	Boys	Girls
Boy	0.62	--	--
	(0.49)		
Age	14.1	14.1	14.0
	(2.5)	(2.5)	(2.5)
Year 2005 (the new point system)	0.50	0.49	0.51
	(0.50)	(0.50)	(0.50)
Singles matches played per year	3.20	3.40	3.00
	(2.20)	(2.30)	(1.90)
First singles match won	0.52	0.53	0.52
	(0.50)	(0.50)	(0.50)
Bye	0.27	0.24	0.32
	(0.45)	(0.43)	(0.47)
Played doubles	0.43	0.44	0.32
	(0.50)	(0.50)	(0.41)
Number of players	3,887	2,354	1,534
Number of tournaments	77	77	73
Number of observations	10,405	6,427	3,978

Notes: Standard deviations are in parentheses.

Table 2. Probability of Playing Doubles: Simple Difference-in-Differences Estimate

A. All Players

	First singles match		
	Winner	Loser	Difference
Before	0.446	0.338	0.108***
	[0.497]	[0.473]	(0.016)
After	0.520	0.367	0.153***
	[0.500]	[0.482]	(0.016)
Difference	0.074***	0.029*	0.045**
	[0.016]	[0.016]	(0.022)

B. Boys

	First singles match		
	Winner	Loser	Difference
Before	0.444	0.349	0.095***
	[0.477]	[0.477]	(0.020)
After	0.552	0.371	0.182***
	[0.498]	[0.483]	(0.020)
Difference	0.109***	0.022	0.087***
	[0.020]	[0.019]	(0.028)

C. Girls

	First singles match		
	Winner	Loser	Difference
Before	0.449	0.316	0.133***
	[0.498]	[0.465]	(0.027)
After	0.464	0.361	0.103***
	[0.499]	[0.481]	(0.026)
Difference	0.015	0.045*	-0.030
	[0.027]	[0.026]	(0.038)

Notes: Standard deviations are in brackets. Standard errors are in parentheses. *** 1% significant; ** 5% significant; * 10% significant.

Table 3. Decision to Play Doubles after First Singles Match

	(1) Boys	(2) Girls	(3) Boys	(4) Girls
Year 2005	-0.021	0.022	-0.022	0.025
	(0.036)	(0.045)	(0.036)	(0.045)
First singles won	0.099***	0.059*		
	(0.025)	(0.032)		
First singles won×Year 2005	0.098***	0.053		
	(0.034)	(0.043)		
First singles won×Bye			0.111**	0.007
			(0.044)	(0.050)
First singles won×No Bye			0.097***	0.090**
			(0.027)	(0.037)
First singles won×Bye×2005			0.130**	0.102*
			(0.052)	(0.057)
First singles won×No Bye×2005			0.086**	0.021
			(0.036)	(0.048)
Bye	0.046**	-0.003	0.024	0.022
	(0.023)	(0.023)	(0.033)	(0.035)
# singles played per year	0.0004	-0.0005	0.0002	0.0001
	(0.0084)	(0.0110)	(0.0084)	(0.0109)
Constant	0.305***	0.005	0.316***	-0.004
	(0.107)	(0.123)	(0.107)	(0.123)
Age group fixed effects	Yes	Yes	Yes	Yes
Tournament fixed effects	Yes	Yes	Yes	Yes
Individual player fixed effects	Yes	Yes	Yes	Yes
Observations	6,427	3,978	6,427	3,978
Adj. R-squared	0.273	0.315	0.274	0.316

Notes: Robust standard errors, corrected by clustering for individual players, are in parentheses. × represents multiplication (interaction term). *** 1% significant; ** 5% significant; * 10% significant.

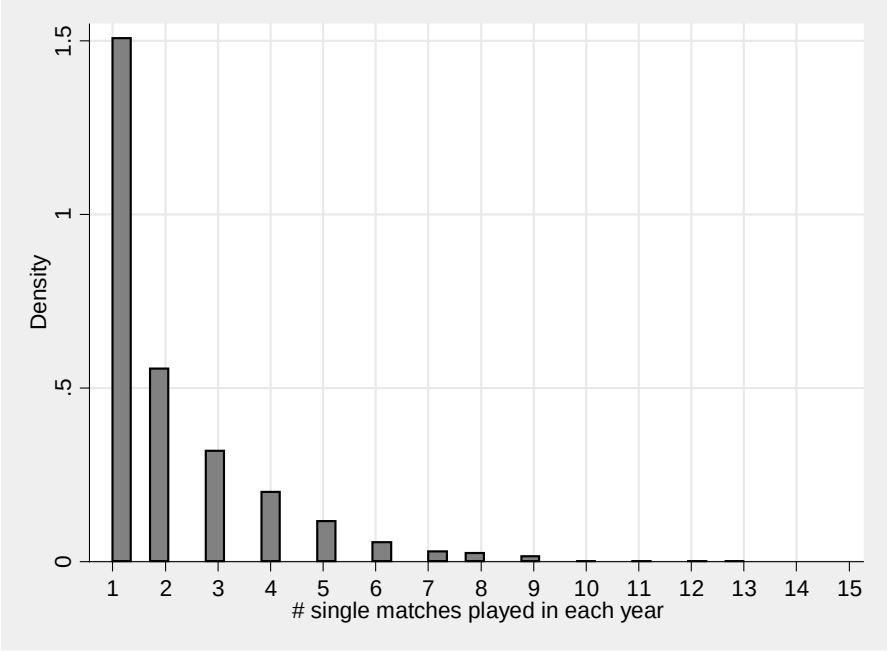
Table 4. Winning at First Doubles Match

	(1) Boys	(2) Girls	(3) Boys	(4) Girls
Year 2005	0.106	0.150	0.104	0.147
	(0.072)	(0.104)	(0.072)	(0.103)
First singles won	0.081	0.049		
	(0.053)	(0.081)		
First singles won×Year 2005	-0.034	0.025		
	(0.069)	(0.098)		
First singles won×Bye			0.074	0.149
			(0.088)	(0.113)
First singles won×No Bye			0.086	-0.017
			(0.059)	(0.093)
First singles won×Bye×2005			0.019	0.027
			(0.097)	(0.115)
First singles won×No Bye×2005			-0.054	0.030
			(0.073)	(0.111)
Bye	0.039	0.035	0.019	-0.079
	(0.043)	(0.058)	(0.075)	(0.091)
# singles played per year	-0.0001	0.0012	-0.0005	0.0021
	(0.0161)	(0.0251)	(0.0162)	(0.0248)
Constant	0.049	0.268	0.0674	0.2957
	(0.227)	(0.239)	(0.2270)	(0.2391)
Age group fixed effects	Yes	Yes	Yes	Yes
Tournament fixed effects	Yes	Yes	Yes	Yes
Individual player fixed effects	Yes	Yes	Yes	Yes
Observations	2,850	1,628	2,850	1,628
Adj. R-squared	0.183	0.182	0.183	0.186

Notes: Robust standard errors, corrected by clustering for individual players, are in parentheses. × represents multiplication (interaction term).

Figure 1. Number of Singles Matches Played Per Year

A. Boys



B. Girls