Different but stable – Gender-specific competitive behavior across age *

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April 1, 2021

Abstract

There is mixed evidence for gender differences in competing against the opposite sex. We analyze performance data from a sport where men and women can compete directly against each other. Our unique data consists of close to 600,000 observations from around 23,500 mixed-gender ninepin bowling games in Austria and the Czech Republic. To account for possible self-selection into competition against the opposite gender, we use the opponent team's sex composition as an instrument. We find almost no gender differences in Austria. In Czechia, men perform better against women and women worse against men. This pattern is stable across age.

Keywords: gender; gender gap in competition; sports economics

JEL Classification: J16, D90, Z22

*The authors would like to thank participants of the Hannover research seminar, ASSA meetings 2020, Annual Meeting of the German Economic Association 2020. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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1 Introduction

Gender gaps are a persisting problem in today's labor markets. Despite anti-discrimination laws and gender quotas, men still hold the majority of leadership positions, even in professions where gender ratios among graduates are balanced. It is unclear to what extend social and biological factors can explain these differences (Browne, 2006). The crude gender wage gap in the EU of 16.6% reduces considerably when accounting for relevant explanatory factors such as qualification, tasks, and working biography; 11.5% still remain unexplained (Eurostat, 2018). Even considering occupational choices and career paths expectations cannot fully explain the gap (Chevalier, 2007). Evolutionary differences in intergroup rivalries could lead to gender-specific competitive behavior (Vugt et al., 2007).

Personality and competitive behavior determine how people negotiate. Due to differences in social roles and role congruity, men perform slightly better in negotiations (Stuhlmacher and Walters, 1999; Stuhlmacher and Linnabery, 2013). Recent studies document lower female willingness to enter bargaining and worse outcomes. Women accept lower initial wages due to lower female self-perception (Dittrich et al., 2014) and lack of information (Rigdon, 2012). They are less likely to sort into companies paying higher premiums and only receive 90% of their male colleagues' premium (Card et al., 2016). Men prefer negotiable wages (Leibbrandt and List, 2015).Environment and framing are relevant for competitive behavior, e.g. for women, the gender of the counterpart significantly affects the willingness to initiate negotiations (Eriksson and Sandberg, 2012). When framed as an opportunity to ask rather than to negotiate, gender differences disappear (Small et al., 2007).

To better understand where these differences in negotiations come from, the literature analyzes gender-specific competitiveness in experiments and in professional sports. The experimental literature identifies three potential explanations for the persisting gender gap. First, men are more prone to select into competitive environments (Niederle and Vesterlund, 2007; Dohmen and Falk, 2011). Second, men are less risk-averse (Croson and Gneezy, 2009) and rather overconfident (Niederle and Vesterlund, 2007). Third, women perform worse when competing against men (Gneezy et al., 2003) although this seems to depend on stakes and age (Antonovics et al., 2009). The sports economics literature focuses on the competitive behavior of high performers and identifies risk behavior, environment, and stakes as important factors. First, men take more risks both when

risky behavior might pay off (Böheim et al., 2016) and when it does not (Gerdes and Gränsmark, 2010). Second, women perform better in a female environment (Booth and Yamamura, 2018). Third, men choke under pressure (Cohen-Zada et al., 2017).

While the literature building on data from professional sports provides interesting insights, there are three drawbacks. First, male and female competitive behavior are rarely directly comparable. Nearly all professional sports are gender-separated. Hence, men and women face different environments and incentives. To analyze whether there are systematic differences in competitive behavior between men and women, it is crucial to observe both genders in exactly the same environment competing against each other. Second, professional sports are extremely selective and representative only for top performers who sacrifice years of training before gaining ground in tournaments with high monetary rewards. This selection is especially important when analyzing gender differences because the distributions of "taste for competition" for men and women might be different (e.g. in terms of standard deviations). Self-selection into professional sports limits the extrapolation of results to the whole working population. To circumvent this problem, one would need to look at an environment which is representative for a larger share of the population, for example at non-professional sports without monetary rewards. While there is certainly some selection bias, it is much lower than in professional sports. Third, winning in professional sports is tied to high monetary rewards which incentivize men and women differently. Several studies document that gender differences in competitiveness vary across stakes (Antonovics et al., 2009; Ors et al., 2013). High stake situations are rare events, e.g. promotions and wage negotiations. Low stake situations occur frequently, e.g. whenever employees decide how much effort to put into a task. A single task alone is not relevant for promotion or wage decisions but the sum of those tasks shapes the supervisor's perception of the employee. Additionally, looking at a low stake environment comes closer to the "intrinsic" motivation to win a competition, which is still not entirely understood.

In a recent paper, we analyzed gender differences in competitive behavior in a non-professional sport with direct gender competition: ninepin bowling (Pikos and Straub, 2020). Using data from around 11,000 games from the German region Württemberg, we found that while men perform better against women on average, this is fully explained by differences in ability. Instrumenting for opposite gender using the sex composition

of the opponent team, we did not find any evidence for a significant causal effect of competing against the opposite gender on performance. There were also no significant gender differences in tight situations where the pressure to perform is higher. In the literature, there is mixed evidence for gender differences in competing against the opposite sex. In the present paper, we analyze two possible reasons for this: culture and age. First, previous studies found that boys and girls differ in their competitive behavior in Israel but not in Sweden (Gneezy and Rustichini, 2004; Dreber et al., 2011). Differences in competing against the opposite sex could be country specific. Second, our German data was not limited to a specific age group but comprised adolescents under 18 years of age and adults up to 60 years of age and older. Studies using experiments and data from professional sports are restricted to very homogeneous groups (schoolchildren, students; professional athletes). This is problematic considering that some aspects of personality develop during adolescence (e.g. for distributional preferences Fehr et al., 2013) and are stable over the working life (e.g. for BIG-5 personality traits Cobb-Clark and Schurer, 2012). So far, we have only limited knowledge about the heterogeneity of gender-specific competitiveness. Flory et al. (2018) conduct experiments in Malawi and the U.S. and find elderly women to have the same taste for competition as men. Czibor et al. (2019) document that women are more risk averse in a traditionally male environment of online card players and do not find significant age effects in a subsample analysis.

To contribute to this literature, we use almost 600,000 observations from twelve seasons of ninepin bowling. Our data comes from the Czech Republic and Austria and contains information on 8,800 players' gender and age and their performance in nearly 23,500 games. We find that men perform better against women and women worse against men in the Czech Republic but not in Austria. This is stable across age. The remainder of this paper is structured as follows: the next section introduces the data and descriptive statistics. Section 3 outlines the estimation strategy and presents the results. The last section concludes.

2 Data and Descriptives

We use data from Czech and Austrian ninepin bowling, a non-professional sport played in teams of four or six players. Individuals compete directly against one opponent to earn

points for their team. Own and others' performance is easily observable during the game. Since lower leagues at the county level can be mixed gender, we observe direct competition between men and women. Ninepin bowling is played in many European countries and purely non-professional as even World Cup players do not get paid. Since there are no financial incentives, we refer to the environment as "low-stakes". Nevertheless, ninepin bowling is competitive. During the game, team members cheer for each other. Teams compete for moving up to the next league, individuals strive for winning the players' ranking or being selected for a better team in their club. Ninepin bowling has an extensive set of rules that clearly differentiate it from a leisure activity. Team members wear homogeneous dresses, need to show their player passes at every match, and pay annual fees. There are several fines for infringements of the game rules, e.g. not showing up or not sending the results to the league coordinator on time. Game records are publicly available online.

Leagues usually comprise between six and twelve teams which consist of four or six players. Teams play home and guest games against all other teams in the league in the autumn round from September to December and the spring round from January to March. Players usually know each other and have an adequate expectation of their opponents' ability. In a game, each player completes 120 bowls on four lanes, i.e. 30 each. A series of 30 bowls is called a set. If the player knocks down more pins than her opponent, she receives a set point (0.5. if same score). The player with more set points after completing all sets receives a team point. The team with more team points wins (two additional team points are given for the higher total score). Mistakes, i.e. how often the player did not hit any pin, are also recorded. We code gender according to Wikipedia lists for given names. Many lower leagues allow mixed-gender teams. Game records do not include age information. The Czech Ninepin Bowling Association (Česká kuželkářská asociace, ČKA) publishes names, player number, and age of active players. For inactive players, we infer this information from team selection sheets for the Fall and Spring rounds of each season. The website of the Austrian Ninepin Bowling and Bowling Organization (Österreichischer Sportkegel und Bowling Verband, ÖSBV) includes player sheets with basic demographic information on players.

We restrict our sample to mixed-gender games defined as games with at least one player of each sex. This yields 597,000 observations from 8,800 individuals aged between

12 and 85. We observe 5,300 players in close to 15,500 games in the Czech Republic (326,000 observations in total) and 3,500 players in 8,000 games in Austria (271,000 observations). The female share amounts to 23% in both countries which forms a much less male-dominated environment than the online card game in (8.5% Czibor et al., 2019). Most encounters are male-male (59%), while 6% are female-female and 35% are female-male (table 1).

Table 1: Numbers of observations for own and opponent's gender

	opponent's gender					
own gender	male		female		Total	
	No.	%	No.	%	No.	%
male	354,818	59.4	103,773	17.4	458,591	76.8
female	103,773	17.4	34,544	5.8	138,317	23.2
Total	458,591	76.8	138,317	23.2	596,908	100.0

Notes: Cross tabulation of gender and opponent's gender. Data source: ČKA, ÖSBV.

Men slightly outperform women on average (appendix figure A.1). Women make slightly fewer mistakes than men which is consistent with higher female risk aversion. The average probability to win a set is 50.1% for men and 49.4% for women[1]. There do not seem to be large country differences in the age distribution. Most players are in their fifties to sixties (appendix figure A.2). For women, there is a small peak around the early twenties followed by a decline around late-twenties and early thirties which is likely due to sports interruptions during and after pregnancy.

3 Estimation Strategy and Results

3.1 Estimation strategy

Our outcomes of interest are the score per lane, the probability to win a set, and mistakes per lane. We run separate OLS regressions by gender and country according to equation (1). We regress performance outcomes y_{ijk} of individual i against opponent j

[1]The percentages do not sum up to 100% since there are more men than women.

in environment k on playing against the opposite gender (opp_gender_{ij}), environmental characteristics W_k' (containing dummy variables for *position*, *set*, and playing at *home*), and $Ability_{ij}'$, a vector of player i's, opponent j's and teams' ability measures.

$$y_{ijk} = \beta_0^{OLS} + \beta_1^{OLS} \times opp\_gender_{ij} + W_k'\gamma^{OLS} + Ability_{ij}'\delta^{OLS} + \epsilon_{ijk}^{OLS} \tag{1}$$

We validate our results implementing player fixed effects in case our individual ability measures do not fully capture idiosyncratic differences. This might be the case if, first, learning curves for bowling performance are gender-specific or, second, panel attrition differs for men and women as suggested by the age profiles in appendix figure A.2.

Another concern might be the potential endogeneity of competing against the opposite gender due to self-selection that would arise if players had a preference to compete against a specific gender. To consider this issue, we use the opponent team's female share as an instrument. In the first stage, we regress playing against the opposite gender on the opponent team's female share and the environmental and ability controls (W_k' and $Ability_{ij}'$). We believe our instrument to be exogenous in equation (2) since players cannot influence the number of women playing in the opponent team.[2] The raw first stage is illustrated in figure 1, regression output can be found in appendix table A.1. The first stage coefficient of the instrument is highly significant in both countries and for both genders and Montiel Olea and Pflueger (2013) F-statistics are large. The second stage is displayed in equation (3). We uses the estimated probability of playing against the opposite gender, with β_1^{IV} being the coefficient of interest.

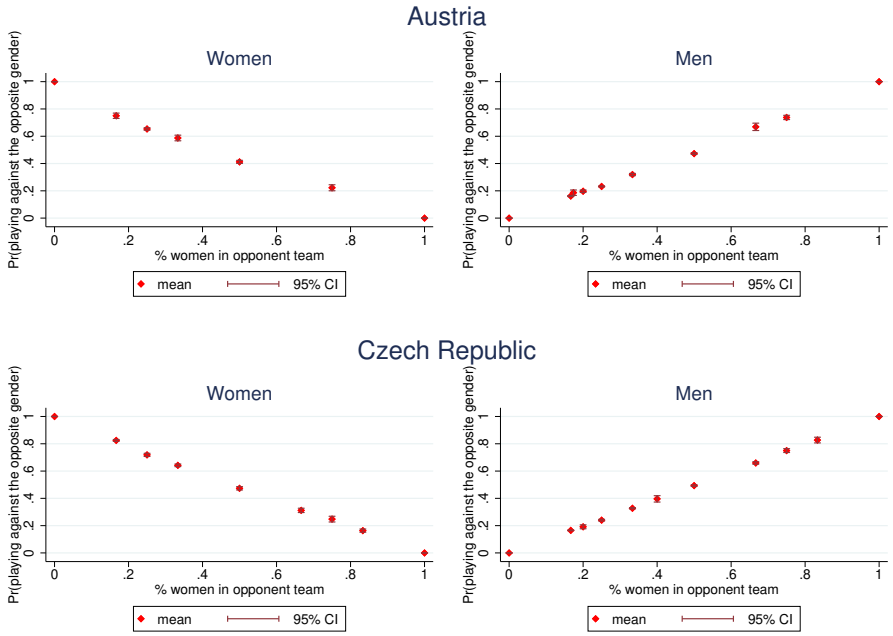
$$opp\_gender_{ij} = \alpha_0 + \alpha_1 \times female\_share\_opponent_k + W_k'\phi + Ability_{ij}'\psi + \mu_{ijk} \tag{2}$$

$$y_{ijk} = \beta_0^{IV} + \beta_1^{IV} \times \widehat{opp\_gender}_{ij} + W_k'\gamma^{IV} + Ability_{ij}'\delta^{IV} + \epsilon_{ijk}^{IV} \tag{3}$$

For our IV strategy to work, the opponent team's female share must not have a direct effect on individual i's performance. A direct effect would exist if players perceived a team with more women as weaker due to biased expectations about male and female ability. This could result in more confidence in own winning probabilities which might translate

[2]If teams were sufficiently large to draw from a pool of substitute players, they could adjust their gender composition to that of the opponent team. In the leagues we consider, however, teams are relatively small and mostly dispose of zero to two substitute players on each game day.

Figure 1: Probability to play against the opposite gender for men and women depending on opponent team composition



Pr(playing against the opposite gender): probability. Rounded values of opponent female share. Excluding games with substitutions. Data sources: ČKA, ÖSBV.

into better performance. It is unlikely that expectations are systematically biased because measures of individuals' and teams' past performance are easily observable as rankings are published online after each matchday. Even if novice players had gender-biased beliefs about ability, they would update them as they gain experience. If the opponent team is really weaker, this would be captured by the ability measures. In consequence, if such a direct effect existed, it is negligible.

3.2 Results

Austrian women seem to score slightly more pins and make fewer mistakes[3] when competing against men compared to competing against women (table 2).[4] This does not translate into significantly higher chances of winning because men do not seem to react

[3]In Austria, the information on mistakes is not available for each set but only for all four sets combined. This divides our number of observations by four.

[4]We run separate regressions by country and gender to make the OLS results comparable to our fixed effect and IV estimations which are gender-separated by design.

to the gender of their opponent. Czech women perform worse when competing against men and Czech men perform better when competing against women (table 3). The coefficients of fixed effects are comparable in signs and magnitudes (appendix tables A.2 and A.3).

The second stage IV estimates confirm our OLS and fixed effects results (table 4 and 5). While the signs are the same, IV estimates are larger suggesting that, if anything, OLS is biased downward. This might be driven by systematic setting of women against women in Austria which is reflected by first stage coefficients that deviate from one in absolute terms.[5] If a similar pattern exists in the Czech Republic, it is weaker.

To summarize, the effects are robust across all three specifications. In Austria, there is little evidence that players react to the gender of their opponent. While women seem to play slightly worse against other women, winning probabilities are not affected. Results are different in the Czech Republic where both men and women react to competing against the opposite gender: women perform significantly worse against men, men perform better against women. Whereas the Austrian results are in line with the ones from Southern Germany in Pikos and Straub (2020), the results from the Czech Republic differ. The reason might lie in cultural differences.

[5]First stage coefficients are -1.08 for women and 0.977 for men. The deviation is larger for women by a factor of four because there are four times more men in the sample.

Table 2: OLS estimates for pins, points, and mistakes in Austria

	pins		points		mistakes	
	women	men	women	men	women	men
opp. gender	0.028***	-0.004	0.005	-0.005	-0.003***	0.000
	(0.007)	(0.003)	(0.006)	(0.003)	(0.001)	(0.000)
home	0.064***	0.062***	0.086***	0.077***	-0.008***	-0.007***
	(0.008)	(0.004)	(0.005)	(0.003)	(0.001)	(0.000)
past ability	0.788***	0.719***	0.010	-0.003	-0.096***	-0.089***
	(0.029)	(0.016)	(0.025)	(0.012)	(0.004)	(0.002)
difference ability	-0.009	-0.001	0.459***	0.460***	0.001	0.001
	(0.014)	(0.007)	(0.015)	(0.007)	(0.002)	(0.001)
team ability	0.127***	0.136***	0.033	0.024*	-0.013***	-0.013***
	(0.029)	(0.016)	(0.026)	(0.012)	(0.004)	(0.002)
opponent team ability	0.091***	0.102***	-0.036	-0.023**	-0.008**	-0.005***
	(0.021)	(0.011)	(0.022)	(0.011)	(0.003)	(0.002)
position & set	✓	✓			✓	✓
Observations	57,976	209,781	57,976	209,781	14,769	53,270
Distinct players	635	2,948	635	2,948	635	2,948
Adj. R^2	0.210	0.170	0.101	0.088	0.329	0.292

Notes: This table shows the relationship between player's gender and the outcomes of interest in mixed gender leagues. The outcome *pins* is the average score per bowl; *points* are the set points obtained on one lane (0 if lost, 0.5 if tie, and 1 if won); *mistakes* denotes how often the player did not hit any pin (counted per game). *Opp. gender* are dummy variables if the player is female or plays against the opposite gender, respectively. *Difference ability* is the difference between *past ability* of the player and her opponent. *Team ability* and *opponent team ability* are measures for team's quality calculated as the average of *past ability* of other players in the team. *Position & set* are a set of dummy variables capturing the difference in *score* and *mistakes* compared to 1^{st} set and 1^{st} player; these are omitted for *points* due to the symmetry of the data. *Past ability* is the average *score* of the player per lane if more than 8 lanes are observable from past data. Robust standard errors clustered at the level of the player are in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively. Data source: ÖSBV.

Table 3: OLS estimates for pins, points, and mistakes in the Czech Republic

	pins		points		mistakes	
	women	men	women	men	women	men
opp. gender	-0.013***	0.013***	-0.013***	0.013***	-0.001	0.001**
	(0.004)	(0.002)	(0.004)	(0.002)	(0.001)	(0.000)
home	0.095***	0.063***	0.117***	0.115***	-0.011***	-0.008***
	(0.007)	(0.004)	(0.005)	(0.002)	(0.001)	(0.000)
past ability	0.736***	0.757***	-0.008	0.001	-0.103***	-0.096***
	(0.022)	(0.013)	(0.021)	(0.012)	(0.003)	(0.002)
difference ability	-0.003	-0.012*	0.540***	0.570***	0.000	-0.000
	(0.011)	(0.006)	(0.012)	(0.007)	(0.001)	(0.001)
team ability	0.103***	0.063***	-0.044*	-0.114***	0.001	0.005**
	(0.022)	(0.013)	(0.023)	(0.013)	(0.004)	(0.002)
opponent team ability	0.190***	0.167***	0.074***	0.103***	-0.011***	-0.010***
	(0.016)	(0.009)	(0.018)	(0.010)	(0.002)	(0.001)
position & set	✓	✓			✓	✓
Observations	79,673	246,033	79,673	246,033	79,673	246,033
Distinct players	1,212	4,082	1,212	4,082	1,212	4,082
Adj. R^2	0.348	0.263	0.105	0.093	0.400	0.294

Notes: This table shows the relationship between player's gender and the outcomes of interest in mixed gender leagues. The outcome *pins* is the average score per bowl; *points* are the set points obtained on one lane (0 if lost, 0.5 if tie, and 1 if won); *mistakes* denotes how often the player did not hit any pin. *Opp. gender* are dummy variables if the player is female or plays against the opposite gender, respectively. *Difference ability* is the difference between *past ability* of the player and her opponent. *Team ability* and *opponent team ability* are measures for team's quality calculated as the average of *past ability* of other players in the team. *Position & set* are a set of dummy variables capturing the difference in *score* and *mistakes* compared to 1^{st} set and 1^{st} player; these are omitted for *points* due to the symmetry of the data. *Past ability* is the average *score* of the player per lane if more than 8 lanes are observable from past data. Robust standard errors clustered at the level of the player are in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively. Data source: ČKA.

We next investigate whether the patterns observed in the two countries are stable over the life cycle. There are two reasons why competitive behavior might vary across age. First, attitudes towards competition could differ for young and old because some aspects of personality develop over time. Second, since culture seems to play a role, the political transition in the Czech Republic may provide interesting insights. In principle, both effects could cancel each other out in the Czech Republic but would be visible in Austria where the Fall of the Iron Curtain did not have a similar impact.

Since OLS and IV yield similar results, for simplicity we use OLS for analyzing age effects. Empirically, we estimate equation (1) separately for each age category and gender. Focusing on players aged between 15 and 80 years, we construct five-year-categories (15, 20, 25 etc.) and plot the *opposite_gender* coefficients with the corresponding 95% confidence intervals.

We do not find evidence for any heterogeneity of playing against the opposite gender over age (figures 2 and 3). The left panels show the results for women, the right ones for men. The upper panels depict the coefficients for pins as the dependent variable, the middle ones for points, and the lower ones for mistakes. In general, the point estimates for age categories confirm our previous results, i.e. Czech women play worse against men, while men perform better against the opposite gender. Due to smaller sample sizes, individual point estimates are rarely significant and especially female graphs are noisy. No clear pattern emerges and the signs of the coefficients are comparable to those in the whole sample. The same holds true for Austria. This suggests that neither the political transition in the Czech Republic nor the age effects after puberty matter for competing against the opposite gender.

Table 4: Second stage IV estimates by gender for Austria

	pins		points		mistakes	
	women	men	women	men	women	men
opp. gender	0.045***	-0.005	0.009	0.003	-0.007***	-0.001
	(0.012)	(0.008)	(0.010)	(0.006)	(0.002)	(0.001)
home	0.063***	0.062***	0.086***	0.077***	-0.008***	-0.007***
	(0.008)	(0.004)	(0.005)	(0.003)	(0.001)	(0.000)
past ability	0.785***	0.716***	0.009	-0.000	-0.099***	-0.091***
	(0.028)	(0.016)	(0.025)	(0.013)	(0.004)	(0.002)
difference ability	-0.007	-0.001	0.460***	0.457***	0.001	0.001
	(0.014)	(0.007)	(0.015)	(0.008)	(0.002)	(0.001)
team ability	0.124***	0.138***	0.033	0.024**	-0.010**	-0.011***
	(0.029)	(0.016)	(0.026)	(0.012)	(0.004)	(0.002)
opponent team ability	0.086***	0.102***	-0.037*	-0.023**	-0.006**	-0.005***
	(0.021)	(0.011)	(0.021)	(0.011)	(0.003)	(0.002)
position & set	✓	✓			✓	✓
Observations	58,012	209,918	58,012	209,918	14,529	52,619
Distinct players	636	2,949	636	2,949	633	2,946
Montiel-Pflueger F-stat	6115	39958	6056	40350	6071	39478
Adj. R^2	0.210	0.170	0.101	0.088	0.328	0.287

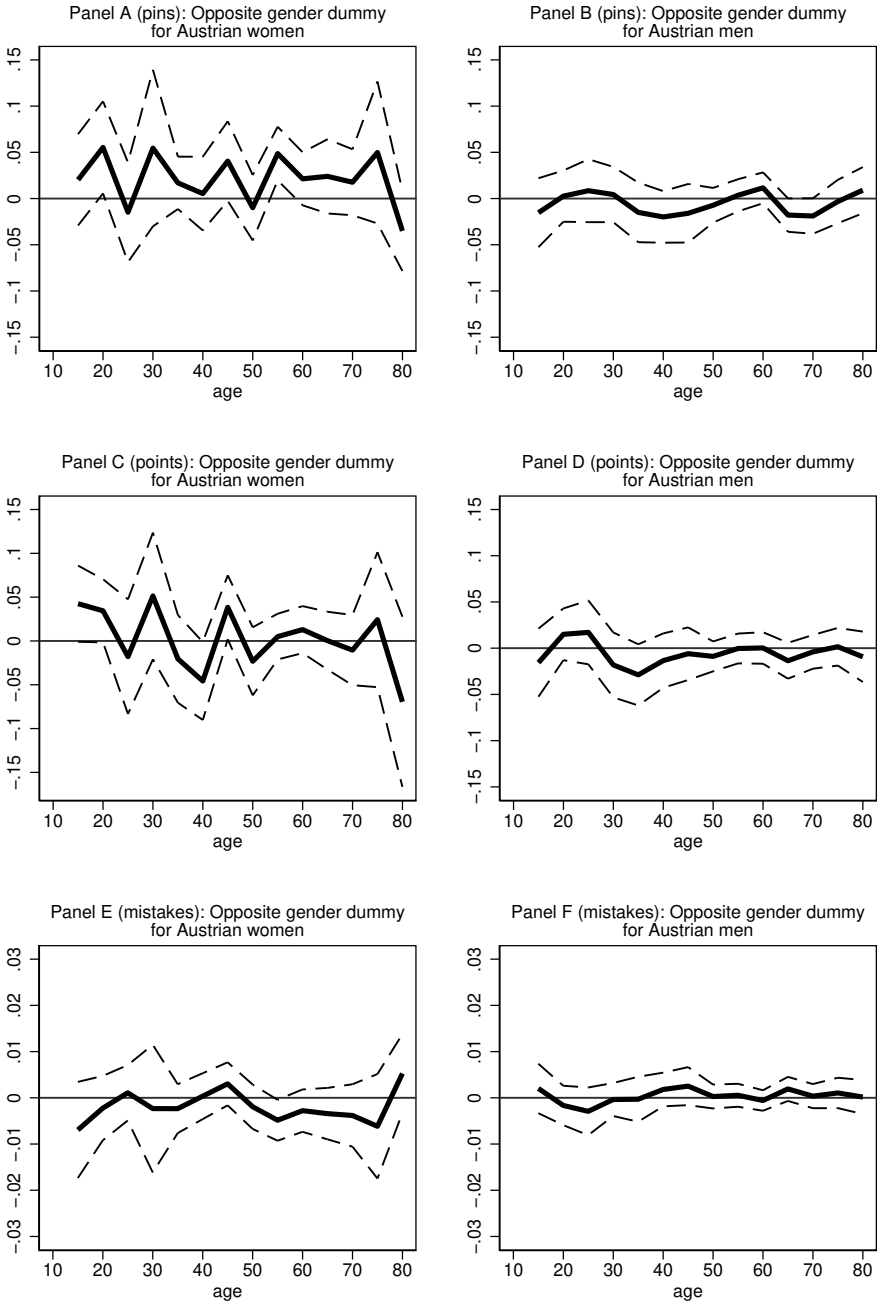
Notes: This table shows the second stage estimates for men and women in Austria. The outcome *pins* is the average score per bowl; *points* are the set points obtained on one lane (0 if lost, 0.5 if tie, and 1 if won); *mistakes* denotes how often the player did not hit any pin (per game in Austria). *Past ability* is the average *score* of the player per lane if more than 8 lanes are observable from past data. *Difference ability* is the difference between *past ability* of the player and her opponent. *Team ability* and *opponent team ability* are measures for team's quality calculated as the average of *past ability* of other players in the team. *Position & set* are a set of dummy variables capturing the difference in *score* and *mistakes* compared to 1^{st} set and 1^{st} player; these are omitted for *points* due to the symmetry of the data. Montiel-Pflueger F-statistics are calculated according to Pflueger and Wang (2015). Robust standard errors clustered at the level of the player are in parentheses. Control variables include the ***, ** and * denote significance at the 1%, 5% and 10% level, respectively. Data source: ÖSBV.

Table 5: Second stage IV estimates by gender for the Czech Republic

	pins		points		mistakes	
	women	men	women	men	women	men
opp. gender	-0.029***	0.052***	-0.012**	0.024***	-0.002*	0.001
	(0.008)	(0.005)	(0.006)	(0.004)	(0.001)	(0.001)
home	0.095***	0.063***	0.078***	0.075***	-0.011***	-0.008***
	(0.007)	(0.004)	(0.003)	(0.002)	(0.001)	(0.000)
past ability	0.742***	0.773***	0.003	0.007	-0.102***	-0.096***
	(0.022)	(0.013)	(0.015)	(0.009)	(0.003)	(0.002)
difference ability	-0.009	-0.025***	0.360***	0.367***	-0.000	-0.000
	(0.011)	(0.006)	(0.009)	(0.005)	(0.001)	(0.001)
team ability	0.099***	0.060***	-0.044***	-0.067***	0.000	0.005**
	(0.022)	(0.013)	(0.017)	(0.009)	(0.004)	(0.002)
opponent team ability	0.186***	0.165***	0.040***	0.064***	-0.011***	-0.010***
	(0.017)	(0.009)	(0.013)	(0.007)	(0.002)	(0.001)
position & set	✓	✓			✓	✓
Observations	79,673	246,033	79,673	246,033	79,673	246,033
Distinct players	1,212	4,082	1,212	4,082	1,212	4,082
Montiel-Pflueger F-stat	38506	47692	37623	48573	38506	47692
Adj. R^2	0.348	0.262	0.076	0.071	0.399	0.294

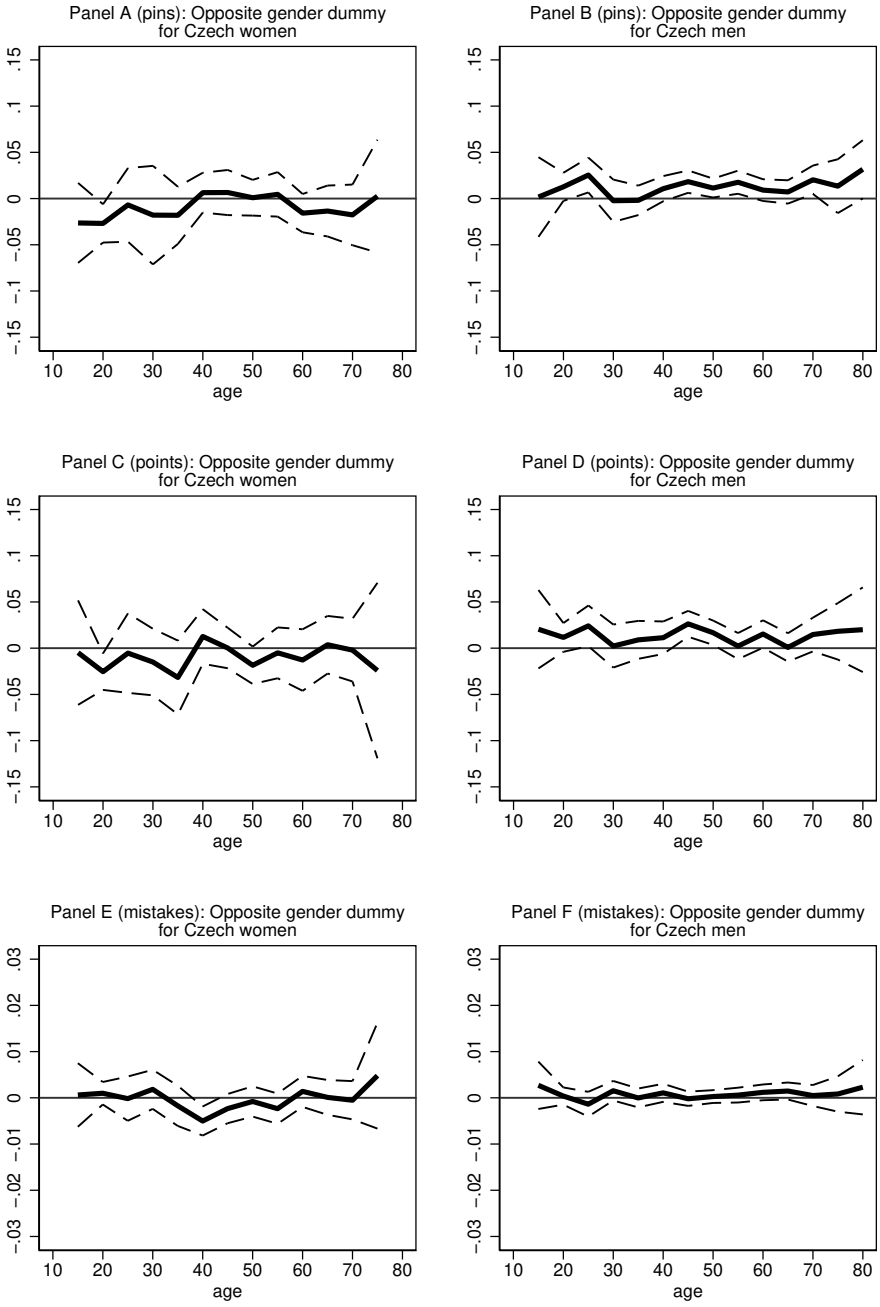
Notes: This table shows the second stage estimates for men and women in the Czech Republic. The outcome *pins* is the average score per bowl; *points* are the set points obtained on one lane (0 if lost, 0.5 if tie, and 1 if won); *mistakes* denotes how often the player did not hit any pin (per game in Austria). *Past ability* is the average *score* of the player per lane if more than 8 lanes are observable from past data. *Difference ability* is the difference between *past ability* of the player and her opponent. *Team ability* and *opponent team ability* are measures for team's quality calculated as the average of *past ability* of other players in the team. *Position & set* are a set of dummy variables capturing the difference in *score* and *mistakes* compared to 1^{st} set and 1^{st} player; these are omitted for *points* due to the symmetry of the data. Montiel-Pflueger F-statistics are calculated according to Pflueger and Wang (2015). Robust standard errors clustered at the level of the player are in parentheses. Control variables include the ***, ** and * denote significance at the 1%, 5% and 10% level, respectively. Data source: ČKA.

Figure 2: Performance against the opposite gender by age in Austria



Separate regressions by age. Data sources: ÖSBV.

Figure 3: Performance against the opposite gender by age in Czechia



Separate regressions by age. Data sources: ČKA.

4 Conclusion

To better understand how men and women differ in their "pure" motivation to win, we analyze competitive behavior in a low stake environment for a broad population. Our unique data comes from 8,800 ninepin bowlers from two neighboring Central European countries aged between 15 to 80 years. We observe individual performance against the opposite gender across this heterogeneous population in an environment where winning is not tied to monetary rewards. This allows us to generate insights whether there exist profound differences in male and female competitive behavior which would translate into dissimilarities in economic decisions.

Gender-specific competitive behavior varies between Austria and the Czech Republic. We do not find pronounced differences in the way men and women compete against the opposite gender in Austria which is in line with Pikos and Straub (2020) for Germany. This is not the case in Czechia where men perform better against women and women worse against men. Carrying out subgroup analyses, we find that the observed patterns are stable across age for both countries. This is consistent with Czibor et al. (2019) who do not find heterogeneity in risk taking over the life cycle.

The differences in competing against the opposite gender might be related to economic gender gaps. Even though unadjusted gender pay gaps are almost identical, the Czech Republic's adjusted gender pay gap is twice as large as Austria's (18.7% and 9.4% in 2014; Eurostat, 2018). With only two countries, the link between economic outcomes and gender-specific competitive performance is suggestive at best. A similar observation, however, can be made regarding differing results from field experiments analyzing the competitiveness of children in Israel and Sweden in Gneezy and Rustichini (2004) and Dreber et al. (2011). Israeli boys being more competitive than girls mirrors the country's large gender pay gap, while children compete equally in Sweden where the gender pay gap is small.

Future research should link country differences in gender-specific competitive behavior to economic outcomes. Potential endogeneity would complicate a causal interpretation, e.g. institutions affecting both competitive behavior and economic outcomes. If women are hindered to compete against men in some countries, this would have far reaching economic and social consequences. Understanding these country differences is crucial to facilitate gender equality.

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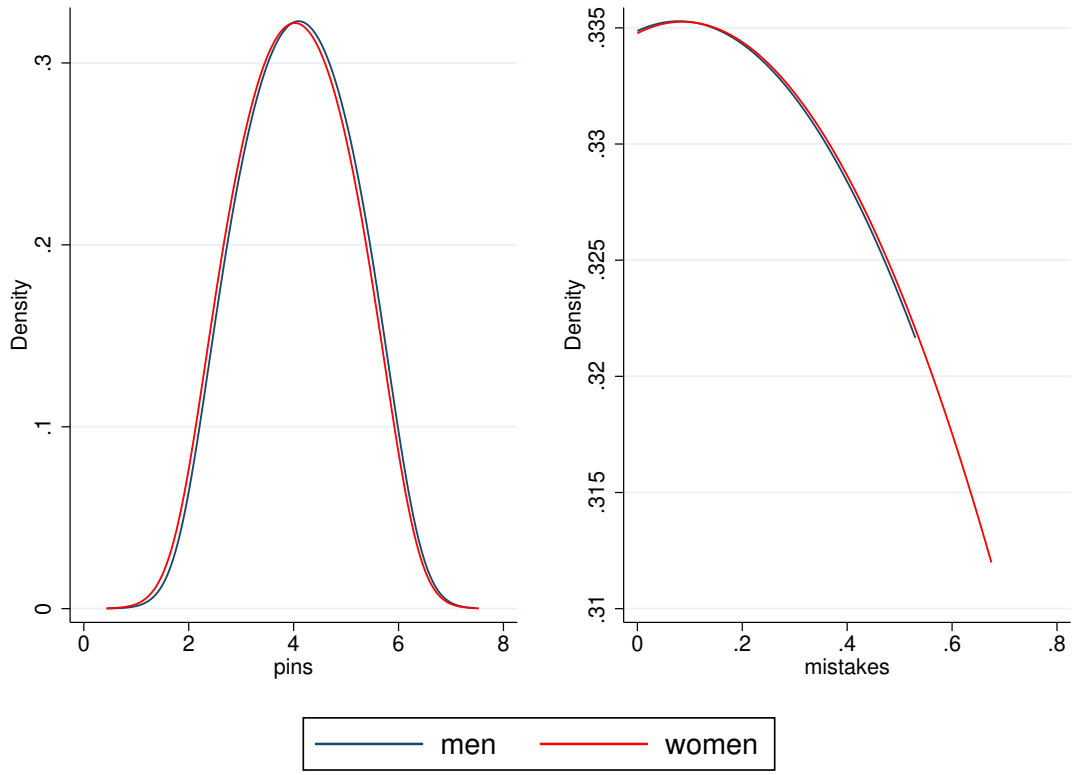
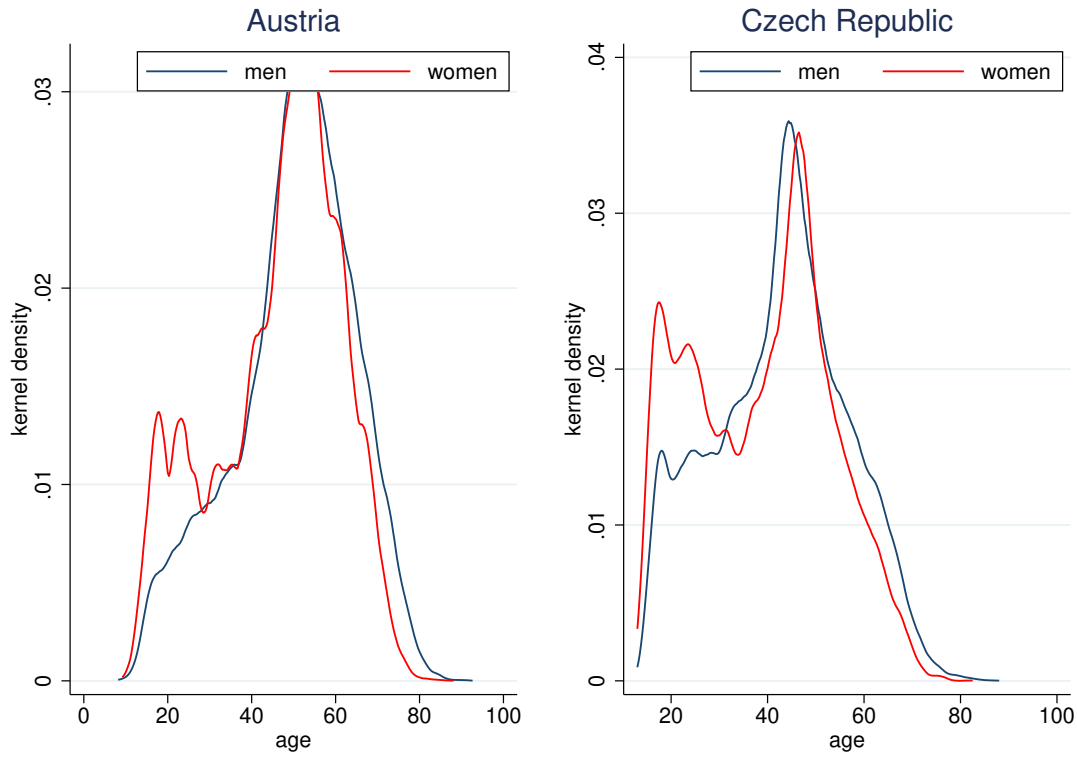
Appendix Figures

Figure A.1: Distribution of outcomes



Kernel density estimates. Data sources: ČKA, ÖSBV.

Figure A.2: Age distribution of observations



Kernel density estimates. Data sources: ČKA, ÖSBV.

Appendix Tables

Table A.1: First stage estimates by gender

	Austria (pins)		Czech Republic (pins & mistakes)	
	female	male	female	male
opponent female share	-1.082***	0.976***	-1.011***	0.990***
	(0.014)	(0.005)	(0.005)	(0.005)
2^{nd} set	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
3^{rd} set	-0.000	-0.000	-0.005	-0.011**
	(0.000)	(0.000)	(0.004)	(0.004)
4^{th} set	-0.000	0.000	-0.005	-0.011**
	(0.001)	(0.000)	(0.004)	(0.004)
2^{nd} player	0.018**	-0.044***	-0.021***	0.012***
	(0.009)	(0.005)	(0.006)	(0.004)
3^{rd} player	0.028***	-0.043***	-0.009	0.032***
	(0.008)	(0.005)	(0.006)	(0.004)
4^{th} player	0.046***	-0.053***	-0.005	0.016***
	(0.009)	(0.005)	(0.006)	(0.004)
5^{th} player	0.049***	-0.060***	-0.007	0.006
	(0.015)	(0.006)	(0.007)	(0.004)
6^{th} player	0.080***	-0.054***	0.032***	-0.029***
	(0.012)	(0.006)	(0.009)	(0.004)
home	0.000	-0.000	-0.001	-0.001
	(0.005)	(0.003)	(0.004)	(0.002)
past ability	0.190***	-0.294***	0.388***	-0.413***
	(0.027)	(0.015)	(0.019)	(0.012)
ability difference	-0.188***	0.246***	-0.336***	0.361***
	(0.020)	(0.011)	(0.015)	(0.009)
team ability	-0.023	0.064***	-0.050***	0.061***
	(0.025)	(0.014)	(0.017)	(0.011)
opponent team ability	-0.182***	0.254***	-0.320***	0.366***
	(0.027)	(0.015)	(0.019)	(0.012)
constant	1.018***	-0.065	0.934***	-0.064**
	(0.095)	(0.050)	(0.040)	(0.028)
Observations	58,012	209,918	79,673	246,033
Distinct players	636	2,949	1,212	4,082
Adj. R^2	0.443	0.331	0.513	0.314
Montiel-Pflueger F-stat	6115	39958	38506	47692

Notes: This table shows the first stage determinants of playing against the opposite sex in mixed gender games. The models control for *set* and *player*, and *home*. *Past ability* is the average *pins* of the player per lane if more than 8 lanes are observable from past data. *Ability difference* is the difference between *past ability* of the player and her opponent. *Team ability* and *opponent team ability* are measures for team's quality calculated as the average of *past ability* of other players in the team. Montiel-Pflueger F-statistics are calculated according to Pflueger and Wang (2015). Estimates for *mistakes* in Austria and *points* as the second stage dependent variable are similar and available on request. Robust standard errors clustered at the level of the player are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Data source: ČKA, ÖSBV.

Table A.2: FE estimates for pins, points, and mistakes in Austria

	pins		points		mistakes	
	women	men	women	men	women	men
opp. gender	0.017***	-0.005	-0.003	-0.005	-0.002*	0.001**
	(0.006)	(0.003)	(0.006)	(0.003)	(0.001)	(0.000)
home	0.060***	0.060***	0.085***	0.076***	-0.008***	-0.007***
	(0.009)	(0.004)	(0.006)	(0.003)	(0.001)	(0.000)
difference ability	0.024	0.050***	0.429***	0.437***	-0.004*	-0.006***
	(0.015)	(0.008)	(0.014)	(0.007)	(0.002)	(0.001)
team ability	0.196***	0.219***	0.002	0.023*	-0.021***	-0.027***
	(0.032)	(0.017)	(0.028)	(0.013)	(0.005)	(0.002)
opponent team ability	0.107***	0.154***	-0.067***	-0.055***	-0.011***	-0.012***
	(0.019)	(0.011)	(0.021)	(0.011)	(0.003)	(0.002)
position & set	✓	✓			✓	✓
Observations	57,976	209,781	57,976	209,781	14,769	53,270
Distinct players	635	2,948	635	2,948	635	2,948
Adj. R^2	0.249	0.201	0.115	0.101	0.415	0.371

Notes: This table shows the relationship between player's gender and the outcomes of interest in mixed gender leagues. The outcome *pins* is the average score per bowl; *points* are the set points obtained on one lane (0 if lost, 0.5 if tie, and 1 if won); *mistakes* denotes how often the player did not hit any pin (counted per game). *Female* and *opp. gender* are dummy variables if the player is female or plays against the opposite gender, respectively. *Difference ability* is the difference between *past ability* of the player and her opponent. *Team ability* and *opponent team ability* are measures for team's quality calculated as the average of *past ability* of other players in the team. *Position & set* are a set of dummy variables capturing the difference in *score* and *mistakes* compared to 1^{st} set and 1^{st} player; these are omitted for *points* due to the symmetry of the data. Robust standard errors clustered at the level of the player are in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively. Data source: ÖSBV.

Table A.3: FE estimates for pins, points, and mistakes in the Czech Republic

	pins		points		mistakes	
	women	men	women	men	women	men
opp. gender	-0.010**	0.008***	-0.010***	0.010***	0.001	0.000
	(0.004)	(0.002)	(0.003)	(0.002)	(0.001)	(0.000)
home	0.093***	0.061***	0.078***	0.074***	-0.010***	-0.008***
	(0.007)	(0.004)	(0.003)	(0.002)	(0.001)	(0.000)
difference ability	0.060***	0.039***	0.330***	0.342***	-0.006***	-0.004***
	(0.012)	(0.007)	(0.009)	(0.005)	(0.001)	(0.001)
team ability	0.329***	0.229***	-0.047***	-0.049***	-0.029***	-0.023***
	(0.027)	(0.017)	(0.015)	(0.010)	(0.003)	(0.002)
opponent team ability	0.273***	0.243***	-0.001	0.015**	-0.016***	-0.012***
	(0.018)	(0.010)	(0.012)	(0.007)	(0.002)	(0.001)
position & set	✓	✓			✓	✓
Observations	79,673	246,033	79,673	246,033	79,673	246,033
Distinct players	1,212	4,082	1,212	4,082	1,212	4,082
Adj. R^2	0.379	0.295	0.089	0.082	0.484	0.403

Notes: This table shows the relationship between player's gender and the outcomes of interest in mixed gender leagues. The outcome *pins* is the average score per bowl; *points* are the set points obtained on one lane (0 if lost, 0.5 if tie, and 1 if won); *mistakes* denotes how often the player did not hit any pin. *Female* and *opp. gender* are dummy variables if the player is female or plays against the opposite gender, respectively. *Difference ability* is the difference between *past ability* of the player and her opponent. *Team ability* and *opponent team ability* are measures for team's quality calculated as the average of *past ability* of other players in the team. *Position & set* are a set of dummy variables capturing the difference in *score* and *mistakes* compared to 1^{st} set and 1^{st} player; these are omitted for *points* due to the symmetry of the data. Robust standard errors clustered at the level of the player are in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively. Data source: ÖSBV.