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**SOCIAL SCREENING AND COOPERATION AMONG EXPERT CHESS
PLAYERS**

by

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Abstract

This paper studies cooperation and social screening among expert chess players. It employs a large international panel dataset with controls for fixed effects, age, sex, nationality and playing strength where the latter accounts for productivity differences. With a female share below 15 percent both sexes screen women by cooperating more with men, especially professionals. With a female share above 15 percent, women cooperate more with women. Countrymen cooperate more than players of different nationalities, and language and geographic proximity also affect cooperation. The paper gives support to quota-based admission of women and minority groups in intellectually demanding professions.

Keywords: Gender, female share, costs, minority.

Classification codes: J16

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1 Introduction

It is a recognized fact that women are underrepresented in various fields of the labor market, particularly the top positions in politics, public and government administration, academia and corporate management. There are also other groups that are underrepresented in the labor market. These groups are often minorities which can be described as a group with a cultural background different from that of the dominant group. Broadly defined, cultural background may include language, religious beliefs, ethnic background, race, sex, sexual preferences, neighborhood upbringing, schooling, or membership of social organizations. Nepotistic behavior is a frequent explanation of why some groups are underrepresented in high-status positions. This follows as cultural background may have substantial influence on a recruiter's choice of employee. Underrepresentation of women in high-status positions has been observed in most industrialized countries, even in markedly equality-aware societies such as Sweden (Albrecht, Björklund and Vroman 2003; Booth 2006).¹ A similar pattern is seen for other groups. It has been shown that dominant groups have better access to social networks, which increases the probability of acquiring a job through personal contacts. The phenomenon of informal methods for job seeking may be as important as that of formal methods (Behtoui 2008; Calvó-Armengol 2004). Additionally, if the dominant group is overrepresented among the recruiters for high-status jobs and if these recruiters prefer to hire employees with a similar background to themselves, then they will act as gatekeepers, reducing the probabilities of other-group applicants obtaining high-status jobs. It is often suggested that taste or statistical discrimination are involved in such scenarios; see for instance Becker (1957) and Phelps (1972). Cornell and Welch (1996), however, developed a model that "can explain how discrimination, such as 'racism' – defined as the tendency to hire or fraternize with people where cultural backgrounds are similar to one's own – can

¹ For a discussion on the lack of women in academia see Jonung and Ståhlberg (2008) and references therein.

develop spontaneously even when all individuals are rational, have no preference for people of their own type, and believe, correctly, that there are no average differences between people of various types.” These assumptions distinguish the model from the work of Becker (1957), who assumes that individuals have racial preferences, and from Akerlof (1976) who shows that racism, once it exists, can be self-perpetuating but does not explain how it arises. The authors argue that, coming from a similar background, an interviewer can interpret verbal and non-verbal signals more efficiently and thereby infer the quality of the applicant with more accuracy. By screening applicants with different cultural backgrounds, the interviewer is more likely to find a person with higher-than-average quality among applicants with a similar cultural background.

This paper examines the social screening behavior when people choose with whom to cooperate. It addresses the question of whether certain background characteristics play a role in the decision process. By exploiting an extensive dataset from international chess games performed by expert chess players, it is possible to control for the background characteristics gender, nationality, and age. Moreover, the data offer a control for playing strength which accounts for differences in productivity.

To be able to measure cooperation on a metric scale I explore the existence of *pre-arranged draws* in chess, that is, draws agreed before the game is started. Both players must agree for an arranged draw to occur and therefore the concept of pre-arranged draws is a measure of cooperation between two players. Moul and Nye (2009) apply a similar method by considering pre-arranged draws in chess to establish the existence of “strategic draws”.

Previous studies have noted that there is a common set of skills appropriate for the learned professions, high-status professions, as well as for expert chess players. This holds not least because success in these different areas is associated with intelligence and expertise (Bilalić, McLeod and Gobet 2007, p. 460). Also, as chess is a game between two players, it

constitutes a highly competitive setting, thereby reflecting the nature of what is daily routine for many actors in the corporate and governmental arenas, and also in academia.

For a number of years strategic aspects of playing chess have become an established analytical tool in cognitive psychology. A landmark establishing chess as an analytical tool was the introduction of the so-called “Elo”-scale that made it possible to compare the strength of chess players on a metric scale. Following Elo (1978), it has become possible to measure skills on objective grounds, i.e. there are no “subjective assessments” (Chabris and Glickman, 2006, p. 1040).² In a study by Moul and Nye (2009) the authors write that:

“Chess has numerous strengths for the purposes of econometric analysis. First, the outcomes are clear and objective: a win, a draw, or a loss. Moreover, a perfect record of all games is available for virtually all important championship and high-level tournaments games of the modern era. Most important of all is that there exists a rating system that is a précis and accurate reflection of the performances of players and an excellent indicator of the relative strengths of players. These ratings are the best unbiased estimates of relative strengths and the differences in ratings correspond to the likelihood that the stronger player will defeat the weaker (cf. Elo, 1978). These Elo-style ratings have since been applied not only to other sports but also to studies of revealed preference rankings in college selection (cf. Avery et al., 2005).” (p. 11)

As argued by different scholars in the field, e.g. Gobet (2005), Ross (2006) and Roring (2008), chess even has the potential to be applied to questions that concern issues outside the world of chess. For example, one result found by chess research is that it takes about ten years

² The Elo-rating is calculated through an algorithm that starts out from the assumption of a normal distribution of the chess players’ strength. It takes into account the difference in current Elo between the two players (before the game) and the result of the game (1-0, 0-1 or ½-½). Elo-points are then added to or subtracted from the players’ Elo score. Consequently, the Elo-rating is a cardinal measure that evolves over time. An Elo rating that is superior to the rating of the opponent by 200 points corresponds to a winning probability of 75 percent.

of intense learning and hard work to become an expert, a time frame that also fits into “arts, sports, science, and the professions” (Gobet 2005, p. 185).

Undoubtedly, chess players constitute a select group which is not representative of the whole population. Nevertheless, one can argue that there is a common denominator between chess players and employees in intellectually demanding professions. Furthermore, it has recently become common practice to look at high-skilled athletes and sports competitions for the purpose of analyzing economic issues. For example, Duggan and Levitt (2002) assess corruption in the world of sumo wrestling by analyzing the frequency of arranged draws. The authors recognize that sumo wrestling in itself is not of much interest in terms of economics but that economists can learn about the impact of corruption by studying it. From a game theoretical perspective, Levitt, List and Sadoff (2009) use expert chess players in a lab experiment where they investigate whether it is reasonable to test backward induction through the centipede game.

Compared with sports economics, chess has the advantage that different groups can be compared more easily as there is no requirement of physical strength. Men and women can be compared on an equal basis, which is not always the case in sports economics. Indeed, chess is one of the few competitive events where men and women are in direct competition.³ Moreover, the rules of chess are the same all over the world, which facilitates comparisons even further.

This paper adds to the literature by showing that background characteristics matter when we choose with whom to cooperate and that minorities/women choose to cooperate with the dominant group if the minority share is less than 15 percent. The findings also show that there is a productivity cost for the minority if the minority share is less than 30 percent but this cost disappears when the share is greater than 30 percent. Moreover, the screening

³ For a discussion about women’s situation in the chess world, see Shahade (2005).

effect is substantially stronger among professionals than among amateurs. Furthermore, countrymen cooperate more than players of different nationalities, and language and geographic proximity are important factors for cooperation across nations. The paper employs a large international and non-experimental panel dataset covering eleven years where the main advantage is the chance to hold constant for differences in productivity. In addition, the control variables for gender, age, nationality and individual fixed effects help to reduce the impact of confounders such as cultural differences.

The next section provides a theoretical background and Section 3 discusses the data and statistics. Section 4 presents the results of the estimations and Section 5 concludes.

2 Conceptual framework

It is well known that people are able to interpret a host of culturally intermediated signals such as dress and mannerisms, gestures, and style of speaking as well as spoken words.⁴ To give a concrete example, a recruiter at a job interview receives signals from the applicants through verbal communication but also from body language. If the applicant has the same background as the interviewer then more signals are received and the interpretation of the signals is facilitated. Cornell and Welch (1996) argue that by sharing a similar background an interviewer can interpret the signals more efficiently and is therefore able to infer the quality of the applicant with more accuracy. By screening the applicants, the interviewer can hire a person with higher-than-average quality.

⁴ See Schefflen (1971) and Mehrabian (1981).

The model

The theoretical framework builds on the model developed by Cornell and Welch (1996) where they focus on an interview situation between a recruiter and applicants. They assume that the quality (Q) of the applicants is distributed uniformly from zero to one. All other employee characteristics are held constant so that output only depends on the quality of the individual. The recruiter attempts to maximize the expected production of the prospective employee. A recruiter who receives no signals will infer the expected quality of each applicant to be $\frac{1}{2}$. The screening process provides the recruiter with a number of n signal(s) s about each applicant, where $s \in \{L, H\}$ (low, high). Signal and quality are assumed to be correlated in that the probability of observing the H signal is Q . For example, if the quality of an applicant is $\frac{2}{3}$, then the recruiter receives the signal H with probability $\frac{2}{3}$, and so on. When the recruiter receives more information about the applicants (more signals), the variance of the inferred quality increases. If the recruiter receives more signals when the applicant has a similar background, then the recruiter will benefit from choosing an employee with the same background.

The model is based on two premises: that screening of other people is routine in daily life and that people are able to distinguish between high- and low-ability individuals more accurately when the people being sorted are of a similar cultural type. The critical assumption is that it is easier to interpret signals from people with similar cultural background and that this reduces measurement error for an evaluator. In Cornell and Welch's model not only is information incomplete, but individuals can be strategically deceptive and the ability to detect deception is culturally limited. Their model predicts discrimination not only by majority group interviewers against minority group applicants but also by minority group interviewers against majority group applicants. Furthermore, it predicts that screening discrimination should occur primarily in sectors in which inferred quality is important and in which it is

more efficient to screen *ex ante* than to measure on-the-job performance *ex post*. This fits well with the high-status professions as the responsibility of the employee is usually higher with a greater potential damage in case of failure and on-the-job training is also more costly.⁵

Although Cornell and Welch discuss their model in an interview setting, it is applicable to various areas of life. This is so because one of their premises is that the signaling and interpretation of signals must be one of life's *daily routines*. A model similar to that of Cornell and Welch is the language model developed by Lang (1986):

“Language refers to all aspects of verbal and nonverbal communication by which individuals transmit information. Blacks and whites or men and women can be said to ‘speak’ different languages in this sense.”

He states that people will cooperate more if they “speak” the same language and that the competitive market will tend to minimize communication through segregation. He adds that those cooperation costs that cannot be eliminated will be borne by the minority group, through learning the majority “language”. Moreover, he assumes that there are only two states: having a common language (communication) and not having a common language (non-communication). He further requires that there must be communication for cooperation to take place.

Institutional chess background

There are three possible results in chess: a win, a draw or a loss which give one point, half a point and zero points respectively. A draw can be offered by a player and accepted or denied by the opponent at any time during the game. There are no rules regulating the minimum number of moves that have to be played before the players can agree upon a draw except that the game must have started. For obvious reasons, early draws are not very popular with spectators and organizers. In chess there is a concept called *pre-arranged draws* which

⁵ For a more complete explanation of the model, see Cornell and Welch (1996).

implies that the players informally agree upon a draw before the game starts. A *semi-arranged draw* implies that although the players did not consider a draw before the game started, they signaled early on in the game that they were satisfied with a peaceful outcome. In what follows I will refer to both pre-arranged and semi-arranged draws by simply calling them *arranged draws*. The purpose of agreeing to an arranged draw is that it gives time for recovery and preparation for the next game which may be more important. To play chess for about five hours a day for several consecutive days can be exhausting and a day's rest can be quite valuable in practice. Moul and Nye (2009) write that:

”...chess is not simply stressful but also notoriously tiring. We [they] hypothesize that very strong players /.../ can improve their performance against other players by agreeing to early or pre-arranged draws”. (p. 11)

To avoid the arranged draw being too obvious and to offer at least a minimum of play to the spectators, the players make a few moves before they shake hands and split the point. The position after the first twenty moves of a chess game between two equally strong players is still fairly balanced, in status quo. Thereafter the position will become more complicated and sooner or later there will be an advantage to one side or the other or the players will agree upon a draw. The implication is that an arranged draw typically *depends on the players*, not the position on the board, whereas a draw after more than twenty moves *depends more on the position* and less on the players. Accordingly, I define an arranged draw as a game that lasts for ten to nineteen moves and ends with a draw. The argument for this limitation is that the chess opening theory lasts for fifteen to twenty moves and to pass that number of moves would be both dangerous and laborious if the goal is to accomplish a draw. Moul and Nye (2009) write:

“Hard-fought games that end in draws are more likely to last longer than collusive or pre-arranged draws. The latter are more likely to be agreed to at an earlier stage when the position

on the board is still not fully resolved and it is not clear that one player should win. At a later stage the likelihood is much greater that the position will clearly favor one or the other player.”
(p.14)

Furthermore, the players tend to “play” more than ten moves to camouflage the arranged draw. There are situations in tournaments when both players could secure their respective final placement by agreeing to an arranged draw and where there is no payoff from trying to win. In these cases the players are *expected* to agree to an arranged draw. In such situations there is no use in “playing” more than just a few moves. For this reason the draws in one to nine moves are typically different from the ones in ten to nineteen moves. The first depends more on the tournament situation, and less on the background characteristics of the players. Thus, the critical interval in this study is the arranged draws agreed to in ten to nineteen moves. Of course, these intervals are somewhat arbitrary but in practical play they are probably sufficiently realistic. For an arranged draw to take place, the players must communicate and agree to the draw. As they are mutually dependent on each other, they must cooperate. The analytical approach in this paper is to compare the probability of cooperation if the background characteristics of the players are of same sex/opposite sex and same nationality/different nationality, respectively.

It would not be particularly controversial to claim that the verbal and non-verbal communication differs between age groups. Both verbal and non-verbal languages evolve over time and vocabulary and gestures may differ substantially across age. When a 25-year-old communicates with a 75-year-old the risk of misunderstanding is higher than when two 50-year-olds communicate. From this perspective, one could expect that cooperation is more likely within the same age groups than between people of different age groups.

There are two factors that have to be taken into account when we choose with whom to cooperate. First, it is important to be sure that the opponent will fulfill the draw agreement.

Second, if the opponent turns down the draw offer, then you have revealed that you would have preferred not to play and that you may not be totally fit for the fight. Consequently, a player can benefit from choosing to cooperate with an opponent of similar background as it is easier to predict their intention. By interpreting the signals (high or low reliability) the player tries to infer the quality of the opponent.

The econometric model

The econometric model employed in this paper is a *Linear Probability Model* (LPM) with a binary dependent variable which is estimated by OLS with individual fixed effects. A panel data approach over eleven years is applied. The model looks like this:

$$Y_{ij} = \alpha_j + \beta D_i + X'_{ij} \gamma + \varepsilon_{ij} \quad (1)$$

The fixed effects α_j controls for individual characteristics that are constant over time. i denotes the player and j the game (the observation). The dependent variable y takes on the value one if the game ended in a draw in ten to nineteen moves and zero otherwise. The critical interval 10-19 is compared with other intervals in a “difference-in-difference” approach. D_i is the variable of interest and measures the gender or nationality effects, respectively. It takes on the value one if the opponent is a female/same nationality, zero otherwise. X_i are control variables and ε_i the standard error. The model is estimated with robust standard errors, clustered at player level as an individual plays more than one game. The control variables included are: Elo, Elo difference, age, age-squared, age-teenager, age difference and four dummies controlling for the number of encounters between two players. Having met only once is the reference group and 2-4 encounters, 5-10 encounters and >10 encounters control for multiple encounters. I refer to these as the “encounter-dummies” and to some extent they control for networks effects, whereas the reference dummy (having met

only once) corresponds to the screening effect. A positive β implies that the marginal probability for a draw, given the move interval, is greater when two female players or countrymen meet than when players of different sex or nationality meet.

Figure 1a demonstrates the hypothetical pattern according to the theoretical model. In the critical interval 10-19 both groups prefer to cooperate with people of their own group. People of *background A* have a higher probability of cooperating with people of *background A* than *background B*. People of *background B* have a negative coefficient which indicates that the probability of cooperating with people of *background A* is lower than when cooperating with people of *background B*. Figure 1b, on the other hand, shows a pattern where both groups prefer to cooperate with people of *background A*. Such patterns are often discussed within migration economics in models of social identity in cases where people of a minority group prefer to act as if they were of the same background as the dominant group. This is more likely to occur when the minority share is relatively low.⁶

Figure 1 about here

Figure 1 reflects the fact that arranged draws typically depend on the players, not on the position on the board, and that “normal” draws (in more than twenty moves) typically depend on the position, not on the player characteristics. For this reason no differences are expected between different background characteristics except for the critical 10-19 interval.

⁶ For references on social identity, “acting white” and “token women”, see Akerlof and Kranton (2000), Fryer and Torelli (2010) and Gordon, Pipkin and Spangler (1978), respectively.

3 Data and statistics

The data in this study were obtained from ChessBase 10, a commercial database collection with more than two million chess games played in international chess events. It contains about 200,000 players from all over the world. Two levels of data are available, player-specific information and game-specific information. The name, year of birth, nationality and gender of a player are available. For every game there are data on the names and Elo-ratings of the two players, year of the game, number of moves and score. The years included in this study range from 1997 to 2007 and the minimum Elo-rating required is 2000, above which players are considered to be experts. Regarding the information on a player's nationality, I have grouped the countries in regions based on geographic lines and chess popularity. The regions with the highest number of chess players are Western Europe, East Europe and the former Soviet Union. These three regions account for about 90 percent of the expert chess players in the world. Western Europe alone accounts for 53 percent, East Europe for 24 percent and the former Soviet Union for about 13 percent.⁷ Latin America, North America, Africa and Asia account for less than 10 percent. Women have Elo-ratings about a hundred points lower than men averaged over the whole sample. The female share varies substantially across regions from about 5 percent in Western Europe to 10 percent in East Europe to 14 percent in the former Soviet Union (see Table 1). The female share has been rising constantly in the last two decades and consequently women are much younger on average than male chess players. The average male is 35 years old whereas the average female is ten years younger. In the former Soviet Union the mean age is much lower and the difference between the sexes is not as great as in Western Europe.

⁷ See Table 1 in Gerdes and Gränsmark (2010) for more information.

Table 1 about here

Table 1 gives the female share for each region and for two groups with different playing strength, Elo less than 2300 and Elo greater than 2300.⁸ Most players with an Elo-rating of more than 2300 are professionals or semi-professionals whereas those between 2000 and 2300 are expert amateurs. There are 125,369 games played by women and 1,423,567 games played by men. 111,020 games out of 1,548,936 end in a draw in 10-19 moves. This corresponds to 7.2 percent of all games. Of these, 5,194 females and 105,826 males draw in 10-19 moves. The share of female draws in 10-19 moves is $5,194/111,020=4.7$ percent. The share of male draws in 10-19 moves is $105,826/1,423,567=7.4$ percent.

4 Results

This section reports the estimation results for the cultural background characteristics *gender* and *nationality*. The gender effects are first analyzed from a general perspective and then for some subgroups. Estimation results for amateurs and professionals and for different regions are discussed. Regarding the nationality effects I first look at the overall pattern and then at some selected cases where my intention is to isolate, at least to some extent, the effects of geographic proximity and common language.

Gender effects

Figure 2 displays the *MEN/WOMEN vs. female opponent* coefficients for draws at different move intervals. Table 2 reports the coefficients, standard errors, and significance levels for

⁸ This cut-off gives roughly half the observations in each group. In the upper-rated group there are fewer players although the number of games played by each player is higher.

the results displayed in Figure 2. Recall that the move interval 10-19 is the critical interval where cooperation is measured. Figure 2a gives the coefficients corresponding to Column (1) in Table 2 where no encounter controls or individual fixed effects are included. Figure 2b shows the coefficients for the mainline model in Column (3) where controls for the number of encounters are included together with some additional controls and individual fixed effects. Subsequently, I refer to the latter approach as the mainline.

Figure 2 about here

The coefficients for the encounter-dummies are all positive and rising with the number of meetings. Thus, the more times the players have met in a chess confrontation the higher is the probability that they agreed to an arranged draw. I interpret this as a social networks effect. These coefficients are larger for men than for women. The *MEN vs. female opponent* coefficient is negative and significant, revealing that the probability for men to accept arranged draws is greater when playing against male opponents than against female opponents. The coefficient for the mainline model in Column (3) is -0.016 (see Table 2). The coefficients should be interpreted as the marginal probability to cooperate being 1.6 percent lower when a man is playing against a woman than when playing against a man.⁹

⁹ The econometric model in this paper is an LPM where “success” in the dependent variable (arranged draws) occurs in only 7.2 percent of the cases. This will typically result in seemingly low coefficients. In relative terms the size of the gender difference corresponds to about 20-25 percent which is a substantial difference.

Table 2 about here

The *WOMEN vs. female opponent* coefficient for the 10-19 interval is non-negative when the encounter-dummies are not included as controls (see Columns (1) and (2)). This means that females have better (or at least equally good) social networks *within* the female sex. When, however, we include the encounter-dummies the *WOMEN vs. female opponent* coefficient turns negative, implying that women screen *women* and choose to cooperate with men more than with women. The models in Columns (4) and (5) are identical to that of Column (3) but for different move intervals, 20-29 and 30-39. The coefficient of interest and the encounter-dummies decrease substantially in later intervals reflecting the fact that later in the game it is the position, not the players, which matters the most. The coefficients for the control variable *Age difference* contain some additional information. The coefficients are strictly negative and highly significant implying that cooperation decreases when the age difference increases.

According to the theoretical screening model in section 2, the *WOMEN vs. female opponent* coefficient is expected to be positive, that is, women communicate easier *within* the female sex than *across* sexes and can benefit from screening the opposite sex (see Figure 1a). Having the same gender characteristics is assumed to facilitate cooperation. When a woman plays against a female opponent the marginal probability of an arranged draw is 0.5 percent *less* than when she plays against a male opponent. This finding is the opposite of what is predicted by the theoretical model. The pattern could perhaps be explained by a social identity model (see Figure 1b). This finding makes it tempting to hypothesize that the pattern could be correlated with the female share. To understand the underlying mechanisms I analyze the estimation results for some subgroups with varying female share.

Figure 3 displays the results from estimations for amateurs and professionals, respectively. The female share is 12 percent among the amateurs and 5 percent among the professionals (see Table 1). The screening and networks effects are substantially weaker in the lower-rated group where the female share is higher. For the professionals, however, there is a much stronger pattern where both sexes screen women.

Figure 3 about here

In further analysis of the counter-intuitive female behavior Figure 4 presents the estimation results at regional level.¹⁰ Figure 4a displays the *WOMEN vs. female opponent* coefficients for the whole population and Figure 4b gives the coefficients for the amateurs, i.e. $Elo < 2300$. The purpose is to be able to observe the female cooperative behavior in a subgroup where the female share is substantially higher.

Figure 4 about here

The female share in Western Europe is only 5 percent, but 10 percent in Eastern Europe and 14 percent in the former Soviet Union. The *WOMEN vs. female opponent* coefficient in the critical interval is considerably lower for Western Europe, which has the lowest female share. The *WOMEN vs. female opponent* coefficient for the former Soviet Union, with the highest

¹⁰ The three main regions correspond to 90 percent of the observations.

female share (14 percent), is also the highest, close to zero. In Figure 4b I show the *WOMEN vs. female opponent* coefficients for each region for the amateurs. For the amateurs the female share in Eastern Europe is 15 percent and the coefficient is zero. The female share in the former Soviet Union for the amateur players is 32 percent and the corresponding coefficient is *positive*. Women cooperate more with *male* opponents if the female share is *less* than 15 percent. If the female share is *greater* than 15 percent women cooperate more with *female* opponents than with male opponents. This is relevant because it shows that women will screen men and choose to cooperate with women if the female share is high enough.

As stated in section 2, Lang (1986) writes that the competitive market will tend to minimize cooperation through segregation and those costs that cannot be eliminated will be borne by the smaller group. Figure 3 demonstrates that, when competition rises, the male screening of women increases and female players increase their cooperation with men compared with women. The fact that women learn to “speak the male language” when the female share is low can be considered to be a cost for women. In continuation, I will refer to this cost as the *language cost*. There is also a second cost related to the fact that the female share of arranged draws is lower than for men. As stated in section 3, the share of male arranged draws is 7.4 percent whereas the share of female arranged draws is only 4.7 percent. Given that men and women have the same preference for arranged draws, one can see the difference between 7.4 and 4.7 as a cost for women.¹¹ I will refer to this cost as the *productivity cost*.

Figure 5 displays the female shares for each of the three major regions together with the productivity cost. The shares are given for five Elo intervals, 2000-2100, 2100-2200,... 2400-2900. The productivity cost is defined as the female share of arranged draws minus the male share of arranged draws, i.e. a negative productivity cost indicates that there is a

¹¹ The female and male preferences for arranged draws will be discussed below.

productivity cost for women as they achieve fewer arranged draws than desired. The female share displayed in Figure 5 has been divided by ten for ease of comparison.

Figure 5 about here

The productivity cost for the former Soviet Union displays an important feature. The gender difference of arranged draws is zero when the female share is above 30 percent, that is, *there is no productivity cost*. This suggests that women and men *do* have the same preferences for arranged draws but that women have to settle for fewer arranged draws than desired when the female share drops below 30 percent. Above an Elo of 2300 in the former Soviet Union the productivity cost increases (negatively) when the female share drops. A similar pattern is seen for Eastern Europe. The female share in Western Europe is relatively low from the outset and it does not drop much with increasing playing strength. Nevertheless, for all three regions the productivity cost increases when the female share decreases.

To see if these visual findings persist after a regression analysis I regress the productivity cost and the language cost, respectively, on the female share. To obtain subgroups with different levels of female shares I divide the players into Elo groups where each Elo point represents one group, i.e. an Elo of 2000, 2001, 2002, etc. represents different groups.¹² The results are reported in Table 3. Thus, the purpose of Regression 1 is to see if the productivity cost for females increases when the female share decreases. The purpose of Regression 2 is to see if the language cost increases when the female share decreases.

¹² It might seem more natural to use countries rather than Elo groups but in many countries there are not enough pre-arranged draws between female players. Using Elo groups instead gives more than 600 observations.

Table 3 about here

The regression results of Regression 1 in Table 3 show that the productivity cost increases as the female share decreases. The coefficient for the female share is positive and statistically significant which implies that the higher the female share the lower the productivity cost for women. The negative *Female share squared* indicates that the correlation is concave. Regression 2 shows that the language cost for women increases when the female share decreases. The coefficient is significant at the 5 (10) percent level. As Regression 2 considers both the player in focus and the opponent, I can restrict the sample to include only the first encounter between two players as I want to examine the screening effect, not the networks effect. This means that women cooperate more with women when the female share increases.

Thus, women seem to have the same preferences for arranged draws as men do but they are faced with a productivity cost in the shape of fewer arranged draws than desired. This cost is negatively correlated with the female share. If a low female share causes costs for women then there will be a disincentive for women to participate which will lower the female share even further. Such a self-perpetuating scenario was explained by Akerlof (1976). Furthermore, it has been stressed in the literature that having a minority status can produce performance deficits, decreased well-being and reduced self-confidence (Inzlicht and Ben-Zeev (2000)).¹³

¹³ Jennifer Shahade (2005) writes that “the category of women’s chess does not refer to some intrinsically female way of playing chess but rather to being a minority in the chess world, which can affect the way a woman plays”. (p. 6)

Nationality effects

An interesting question is whether the findings of the gender analysis are specific to inter-gender behavior or are rather an effect resulting from the fact that female chess players are a minority in a men's world. For this reason I also study nationality effects. Table 4 reports the estimation results when the players have the same nationality compared with when they are of different nationalities. The marginal probability for an arranged draw is 1.7 percent greater when the players are from the same country. The encounter-dummies show a similar pattern to that in the gender model, implying that there are social networks among countrymen that increase with the number of encounters. Column (1) gives the results for the whole population whereas Column (2) gives the results for males.

Table 4 about here

In Figure 5, cooperation between countrymen is compared with cooperation between people of different nationalities. Results for Germany and Russia are presented. The coefficients in Figure 5 should be interpreted as *the probability of cooperation when a Domestic/non-Domestic player respectively plays against a Domestic opponent compared with playing against a non-Domestic opponent*. A positive coefficient is expected when a German plays against a German. A negative coefficient is expected when a non-German plays against a German; see Figure 1a for the hypothetical example. The estimation results for Germany and

Russia show that cooperation between players of the same nationality is more likely than cooperation across nationality.¹⁴

Figure 6 about here

Figure 6 shows that the marginal probability for an arranged draw is about 1.5 percent greater when a German/Russian plays against a countryman than when they play against an opponent of another nationality. The *non-German vs. German opponent* coefficient is approximately -.012, i.e. there is 1.2 percent *less* probability of an arranged draw. The *non-Russian vs. Russian opponent* coefficient is -.004. Most players participate in chess events in their home countries which create an environment where they belong to the dominant group, that is, the share of domestic players is greater than the share of non-domestic players.¹⁵

The dataset employed in this paper originates from international chess defined as games with Elo status, that is, the rating recognized by the International Chess Federation (FIDE). As the USA applies a different rating system, games played within the USA, where the US rating is used instead of the Elo-rating, are not included in the dataset. This fact creates an interesting experiment as practically all games played by Americans are played outside the USA. As a consequence, Americans act as “a minority group” and never as a dominant group, which would be the case when playing in the home country. The share of Americans compared with non-Americans is comparable to the female share in the analysis of

¹⁴ A similar pattern to that of Germany and Russia was found for all major chess countries in the world such as Spain, Argentina, Israel, India, Hungary and others.

¹⁵ This goes for practically all chess events except, naturally, for the absolute world elite. Traveling costs and foregone labor income may be relatively high for lower-rated players.

the gender effects. The coefficients for Germans and Russians were positive, implying that people cooperate more with countrymen than with others so, hypothetically, we would expect a *positive* sign for the *American vs. American* coefficient. Figure 7 shows the pattern for *Americans vs. American opponents* and the coefficient is *negative* just as it was for women when the female share was low. Americans living or playing abroad cooperate more with non-Americans than with Americans (see Figure 1b).

Figure 7 about here

The marginal probability for an arranged draw when an American plays against an American opponent is about 0.6 percent *less* than when s/he plays against a non-American. The implication is that American players have to bear a language cost in line with women in the gender analysis. The non-American share of arranged draws is 7.2 percent (7.4 for men) whereas the American share of arranged draws is 6.0 percent (4.7 for women).¹⁶ This means that Americans also face a productivity cost. This behavior by the American players is important as it is similar to the behavior by women when the female share is low. This suggests that the female behavior is not determined by intrinsic gender differences alone but to some extent is a result of the demographic composition of the population.

So far, nationality has been analyzed from a general perspective. The concept of nationality also includes aspects such as language, geographic proximity and religious beliefs.

¹⁶ The non-American share of arranged draws is calculated as $109,119/1,517,343=7.2$, i.e. the number of arranged draws divided by the total number of games played by non-Americans. The corresponding numbers for Americans are $1,901/31,593=6.0$. The share of American players is $31,593/1,548,936=2$ percent although there are probably regional differences. The female share among American players is only 0.2 percent.

In the following, I aim to isolate to some extent the influences of language and geographic proximity. Figure 8a shows the coefficients for German vs. German opponents compared with playing against a specific nationality. Cooperation is expected to be at its highest when the opponent is German but also to be relatively high when the opponent comes from a neighboring country and especially when s/he has German as a native language. Figure 8b shows the corresponding pattern for Russian players.

Figure 8 about here

In Table 5 the coefficients for each interval are given when Germans play against Germans compared with playing against players of four other nationalities (French, Spanish, Austrian, and Dutch). France, Austria, and the Netherlands are neighboring countries but Spain is not. In Austria, the official language is German, as in Germany. Hypothetically, one could expect the screening against Spanish players to be the highest whereas Austrian players, who speak the same language as the Germans and come from a neighboring country, are expected to be less screened. The results confirm the expected pattern. Germans cooperate equally with Germans and Austrians (there is no significant difference) but significantly less with the French and Dutch, and least of all with Spaniards.

Table 5 also gives the coefficients for each interval when Russians play against Russians compared with playing against players from Belarus, Ukraine, Poland, and the Czech Republic. In Belarus, Russian is an official language and is also widely spoken in Ukraine. Belarus and Ukraine are also neighboring countries to Russia. Poland and the Czech Republic are close but not precisely neighboring countries and Russian is not an official

language (although Polish, Czech, and Russian are all Slavic languages). Russian players choose to cooperate more with opponents from Belarus and Ukraine than with players from Poland or the Czech Republic; see Table 5 for significance levels.¹⁷

Table 5 about here

5 Conclusions

The findings reveal that men screen women by cooperating more with men than with women. With a female share greater than 15 percent, women screen men by cooperating more with women, which is in accordance with the screening model in section 2. With a female share below 15 percent, however, women cooperate more with men than with women. One interpretation is that this has to do with social identity where people identify themselves with those they encounter the most, i.e. the dominant group. Moreover, with a female share below 30 percent there is a productivity cost for women as they do not achieve the same share of arranged draws as men do. Thus, when the female share drops below 30 percent, women are faced with a productivity cost, and when the female share drops below 15 percent, there is also a language cost as women have to learn the male language. Furthermore, the social

¹⁷ Similar patterns are seen for the French who prefer to cooperate with French-speaking Belgian players more than with other neighboring nationalities. The pattern is also seen for England although the English prefer to cooperate with Americans and Danes rather than with the Irish. The explanation may be owed to religious differences or other forms of rivalry (history of conflicts).

screening of women increases substantially with increasing competition, i.e. screening is more common among stronger players but is rather weak at lower levels.

By controlling for the number of encounters between two players it is possible to distinguish between social networks effects and first-encounter screening. Both sexes have better social networks *within* the sex than *across* as cooperation increases with the number of encounters between two players.

As regards nationality, this paper finds that countrymen cooperate more than players of different nationalities and speaking the same language and geographic proximity are important factors for cooperation across nations. In the case of the USA, an interesting “experiment” shows that Americans, when in a complete minority, cooperate *less* with countrymen than with other nationalities. As this pattern coincides with the findings of female cooperation when in a complete minority, this behavior may be more general than restricted to one specific country. Moreover, cooperation is more likely to occur between agents of similar age. The greater the age difference between the agents, the less the degree of cooperation.

One objection that could be raised against this study is that it focuses on a non-representative selection of people. For this reason we should be careful not to generalize the results too far. Also, as the female share among chess players is low it is possible that the motivation that drives women to play chess is different from the motivation that drives men. On the other hand, similar conditions may be present for high-status professions. The dataset also has various strengths as it contains international register data with a large number of observations in a panel data structure which allows us to control for individual fixed effects, age, sex, nationality and playing strength. The fact that it permits controlling for possible gender differences in productivity, thanks to the Elo-rating, makes the findings very strong.

Having such powerful econometric tools at hand in a two-agent game is rather rare in practice.

In the introduction I sought to establish a link between expert chess players and employees in the high-status or intellectually demanding professions by claiming that there are similarities in skills, intelligence, and dedication to work and training. As a policy implication, this paper gives support to quota-based admission of women and minority groups for these sections of the labor market. This follows because if women cooperate more with men than with women then the fall of the female share will be self-perpetuating, as explained by Akerlof (1976). For this reason the female share may have to be stimulated until it reaches a certain level. The findings should also be taken into account when new theoretical models on the subject are developed as the behavioral change by the smaller group when the share of that group decreases has still not been modeled.

The results of this paper give some support to the screening model by Cornell and Welch (1996) which states that interpretation of verbal and non-verbal signals between two people is facilitated when they have a similar cultural background. The screening model does not, however, explain why women choose to cooperate more with men when the female share is low. The concept of social identity may play a role as an underlying explanation of the findings. An alternative explanation is offered by *the theory of the two queens* which implies that if a woman cannot be the best of all players, she will at least be the best of her subgroup, in this case the best among women. Thus, the smaller the female share, the higher the rivalry among the remaining women. Such a theory could also explain the behavior of the American players.

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Table 1 – The female share for different regions and playing strengths.

<i>female share</i>	<i>in %</i>	<i>Elo<2300</i>	<i>Elo>2300</i>	<i>all</i>
Former Soviet Union		32	9	14
Eastern Europe		15	5	10
Western Europe		6	3	5
All		12	5	8

Table 2 – MEN/WOMEN vs. female opponent coefficients and controls.

Regression 1: MEN vs. female opponent					
	move 10-19			move 20-29	move 30-39
	(1)	(2)	(3)	(4)	(5)
Female opponent	-.0189 (.0012)***	-.0191 (.0011)***	-.0160 (.0011)***	-.0105 (.0011)***	-.0051 (.0011)***
2-4 encounters	No	No	.0336 (.0008)***	.0116 (.0006)***	.0062 (.0005)***
5-10 encounters	No	No	.0710 (.0025)***	.0262 (.0015)***	.0075 (.0012)***
>10 encounters	No	No	.0898 (.0089)***	.0367 (.0036)***	.0170 (.0030)***
Age difference	-.0006 (.0001)***	-.0006 (.00002)***	-.0007 (.00002)***	-.00008 (.00002)***	.0001 (.00002)***
Indiv. fixed effects	No	Yes	Yes	Yes	Yes
Number of obs.: 1,423,567					
Regression 2: WOMEN vs. female opponent					
	move 10-19			move 20-29	move 30-39
	(1)	(2)	(3)	(4)	(5)
Female opponent	.0010 (.0015)	.0006 (.0015)	-.0053 (.0015)***	.0033 (.0016)**	.0075 (.0016)***
2-4 encounters	No	No	.0178 (.0017)***	.0081 (.0018)***	.0038 (.0016)**
5-10 encounters	No	No	.0468 (.0055)***	.0148 (.0031)***	.0121 (.0033)***
>10 encounters	No	No	.0551 (.0188)***	.0153 (.0109)	.0012 (.0102)
Age difference	-.0006 (.0001)***	-.0006 (.0001)***	-.0006 (.0001)***	-.0002 (.0001)***	-.0001 (.00002)***
Indiv. fixed effects	No	Yes	Yes	Yes	Yes
Number of obs.: 125,369					

Notes: One encounter is used as a reference group. Robust standard errors, clustered at player level. Additional controls: age, age-squared, age-teenager, age difference, elo, elo difference, number of encounters and individual fixed effects. Standard errors within parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3 - Dep. Var in Regression 1: productivity cost and Regression 2: language cost.

<i>Dependent variable</i>	<i>Regression 1: dep var: prod. cost</i>		<i>Regression 2: dep var: lang. cost</i>	
	Weighted OLS	OLS	Weighted OLS	OLS
Female share	.536 (.170)***	.554 (.147)***	.754 (.322)**	.499 (.290)*
Female share squared	-1.660 (.760)**	-1.852 (.623)***	-2.838 (1.402)**	-1.641 (1.177)
First encounter	-	-	yes	yes
Number of observations	677	677	628	628

Notes: The weighted OLS has been weighted by the number of games played at each Elo level. Robust standard errors, clustered at player level. Standard errors within parentheses. * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

Table 4 – Dep. var.: arranged draws in 10-19 moves, estimated with OLS and fixed effects.

<i>Dep var arr draws 10-19 moves</i>	<i>all</i>		<i>males</i>	
		(1)		(2)
Same nationality	.0173	(.0007)***	.0173	(.0008)***
Age difference	-.0007	(.00002)***	-.0007	(.00002)***
2-4 encounters	.0293	(.0008)***	.0309	(.0008)***
5-10 encounters	.0620	(.0023)***	.0650	(.0025)***
>10 encounters	.0801	(.0082)***	.0831	(.0087)***
Individual fixed effects	Yes	-	yes	-
Number of observations:	1,548,936		1,423,567	

Notes: additional controls are: Elo, Elo difference, age, age-sq, teenage, number of moves. One encounter is used as reference. Robust and clustered standard errors. Standard errors within parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5 – Coefficients and standard errors corresponding to Figure 8.

<i>Country</i>	<i>1-9</i>	<i>10-19</i>	<i>20-29</i>	<i>30-39</i>	<i>40-49</i>
Germany vs. Ger/France	.0047***	.0168***	.0147***	-.007	.007
Germany vs. Ger/Spain	.0052*	.0355***	.0293***	-.0132*	.0087
Germany vs. Ger/Austria	.0005	.0049	.0059	-.0007	.0122***
Germany vs. Ger/Netherlands	.0056***	.0195***	.0091***	-.0037	-.0046
Russia vs. Rus/Belarus	.0051*	-.001	.0111*	.0029	.0067
Russia vs. Rus/Ukraine	.0041**	-.0085**	-.0145***	-.0047	.0007
Russia vs. Rus/Poland	.0076***	.0327***	.003	-.0133**	.0000
Russia vs. Rus/Czech Rep	-.001	.0254***	.0032	.0033	-.0053

Notes: Control variables are: Elo, elo difference, age, age-sq, age-teenager, age difference, number of meetings, fixed effects. Robust and clustered standard errors are used but not reported. Separate regressions are run for each pair of countries and for each interval (1-9, 10-19...). The significance level is instead indicated by: * significant at 10%; ** significant at 5%; *** significant at 1%

Figure 1 – Two groups with different cultural backgrounds: (a) where both groups prefer to cooperate with people of the same background, (b) where both groups prefer to cooperate with background A.

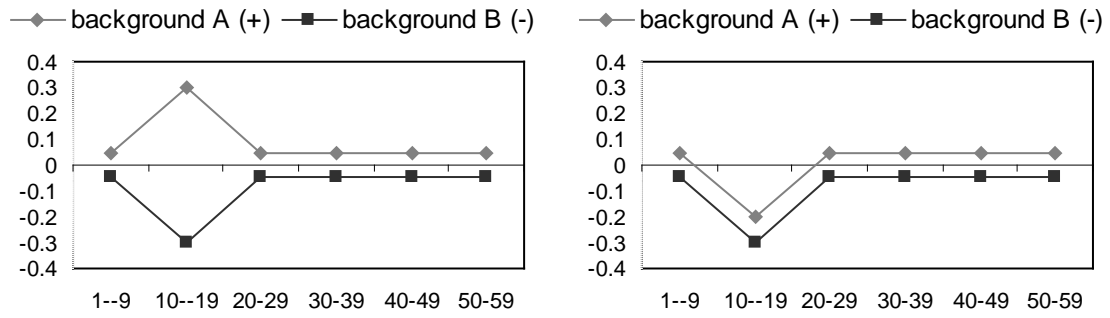
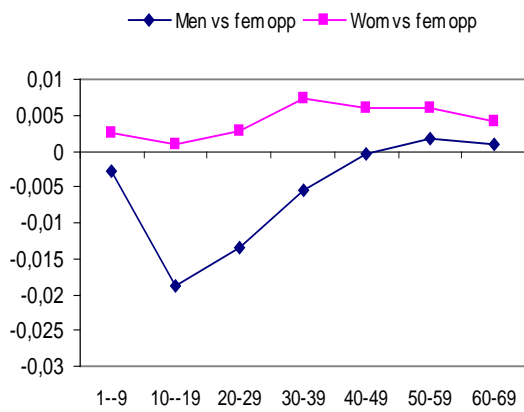
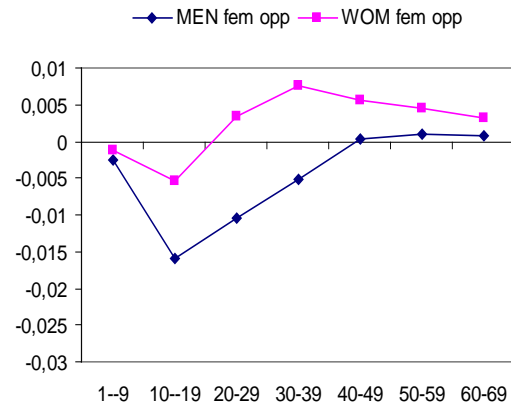


Figure 2 – *MEN/WOMEN vs. female opponent* coefficients. (a) Without encounter-dummies and fixed effects (Col. 1). (b) Mainline with encounter-dummies and fixed effects (Col. 3).

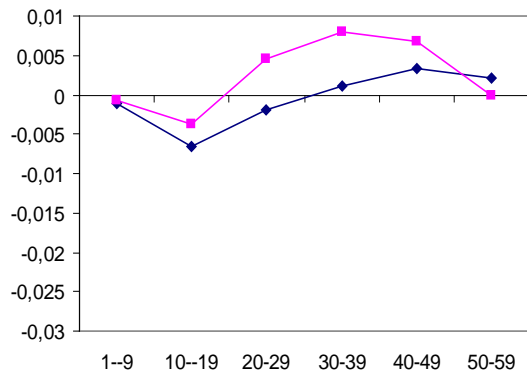


(a) Without encounter-dummies and FE.

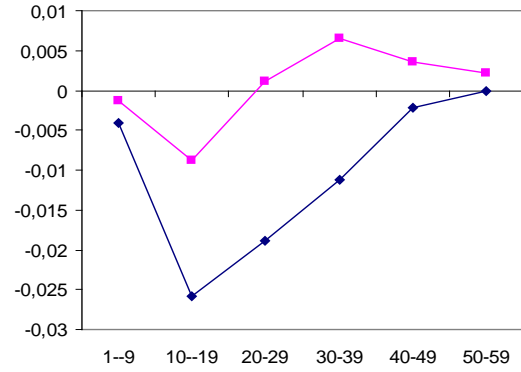


(b) Mainline with encounter-dummies and FE.

Figure 3 – *MEN/WOMEN vs. female opponent* coefficients. (a) Amateurs – mainline.
(b) Professionals – mainline.

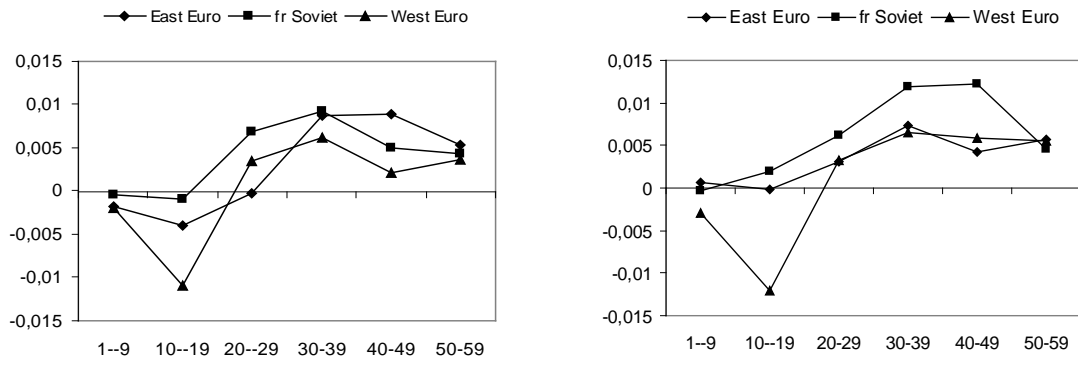


(a) Amateurs, Elo < 2300



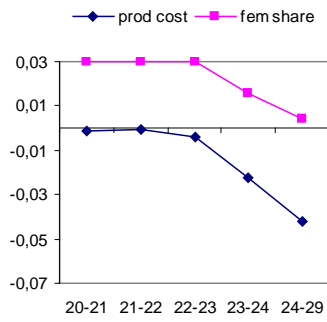
(b) Professionals, Elo > 2300

Figure 4 - WOMEN vs. female opponent coefficients for separate regions. Same controls as in the mainline model in Column 3 in Table 2. (a) Whole population. (b) Amateurs.

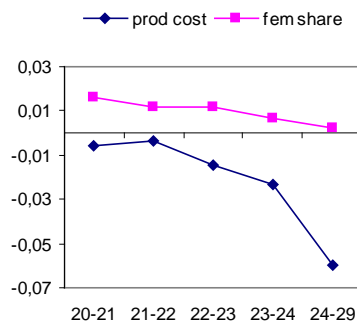


(a) Women vs. female opponents– all Elo-ratings (b) Women vs. female opponents– Elo<2300

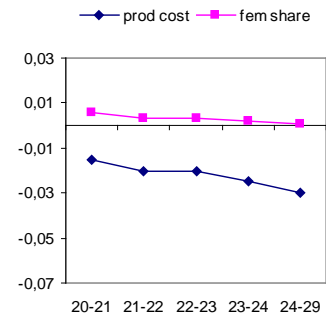
Figure 5 – The female share divided by ten for each region and the productivity cost. Note: “20-21”=2000-2100 in Elo. (a) Former Soviet Union. (b) Eastern Europe. (c) Western Europe.



(a) Former Soviet Union



(b) Eastern Europe



(c) Western Europe

Figure 6 – Germany, Russia: playing against their own respective nationality compared with playing against other nationalities.

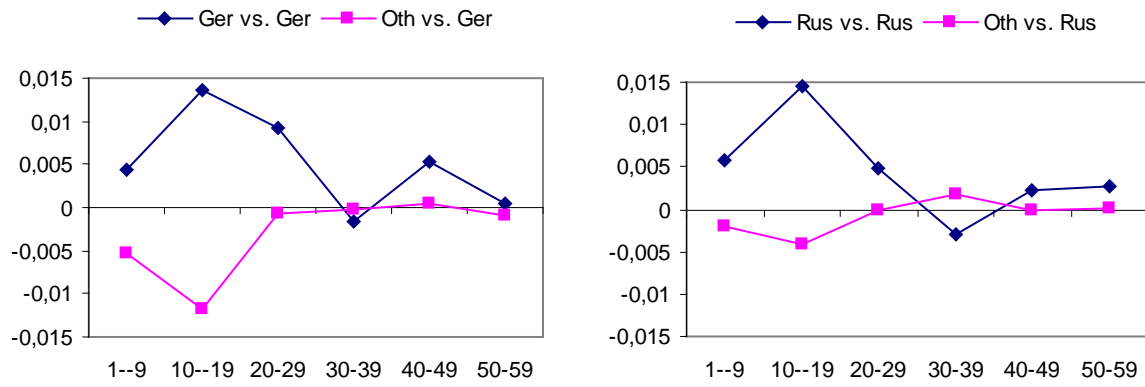


Figure 7 – Americans/non-Americans playing against Americans compared with playing against non-Americans.

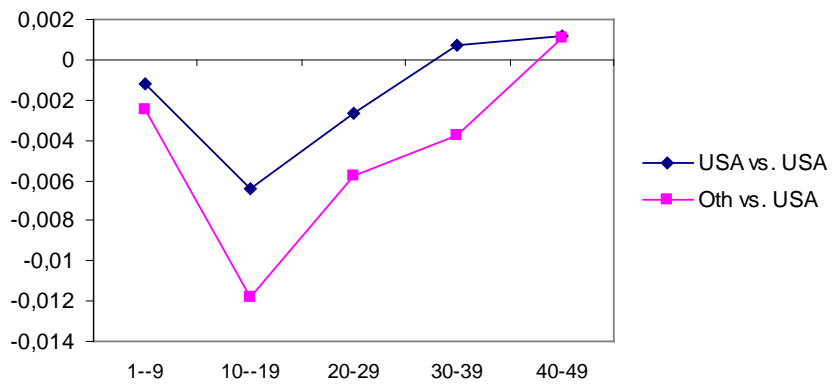
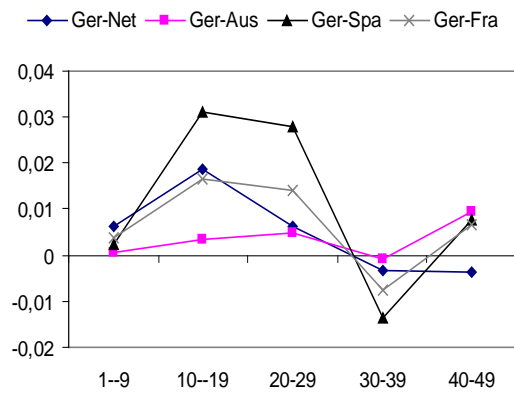
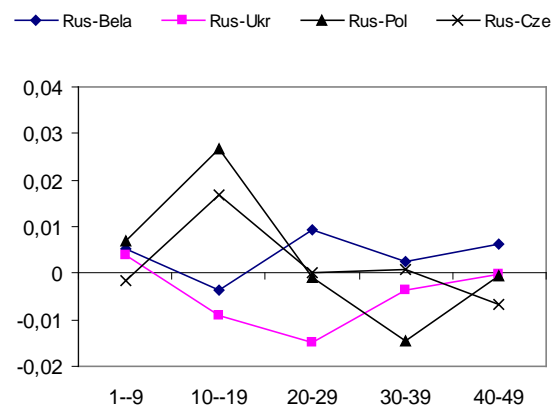


Figure 8 – (a) Germans when playing against Germans compared with opponents from France, Spain, Austria and the Netherlands. (b) Russians playing against Russians compared with opponents from Belarus, Ukraine, Poland and the Czech Republic.



(a) Germans



(b) Russians