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Are Attractive Female Tennis Players More Successful?
An Empirical Analysis

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Abstract

This study examines whether there is a relationship between physical attractiveness of professional female tennis players ranked in the top 100 of the tennis world ranking in 2011 and their sporting success in terms of earned prize money and winning probabilities. OLS-regressions reveal a significantly positive relationship between physical attractiveness and sporting success in terms of prize money for the years 2012 and 2013 as well as for the whole career. Furthermore, a logit-model shows that the larger the difference in physical attractiveness is, the higher is the winning probability for the more attractive player in individual matches.

JEL-Codes: J24, J31, J49, J71, L83, M52

Sind attraktive Tennisspielerinnen erfolgreicher?

Eine empirische Untersuchung

Zusammenfassung

Die vorliegende Studie untersucht, ob ein Zusammenhang existiert zwischen der physischen Attraktivität von professionellen Tennisspielerinnen in den Top 100 der Weltrangliste im Jahr 2011 und ihren erbrachten sportlichen Leistungen in Form von gewonnenem Preisgeldern und Siegchancen. OLS-Regressionen decken einen signifikant positiven Zusammenhang auf zwischen der physische Attraktivität und dem verdienten Preisgeld in den Jahren 2012 und 2013 sowie für die gesamte Karriere. Außerdem zeigt ein Logit-Modell, dass mit der Differenz der physischen Attraktivität die Siegchancen in einzelnen Spielen für die attraktivere Tennisspielerin entsprechend zunehmen.

Im Internet unter:

http://www.wiwi.uni-muenster.de/io/forschen/downloads/DP-IO_12_2014.pdf

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Are Attractive Female Tennis Players More Successful?

An Empirical Analysis*

1. Introduction

The former female tennis player Anna Kournikova is probably one of the most beautiful athletes and has got a lot of media attention although she never won a professional tennis tournament. Moreover, Kournikova's physical attractiveness is continually associated with her rather unsatisfactory sporting performance so that even a poker starting hand was named after her. The starting hand Ace/King was nicknamed after her, due to the same initial letters, but mainly because both "looks great but never wins" (Ace Nine, 2014).

By contrast, different studies find that (physical) attractive people have different advantages including more success, for example in job application situations, earning opportunities or election results, compared with less attractive ones (e. g. Dipboye/Arvey/Terpstra 1977; Efran/Patterson 1978; Hamermesh/Biddle 1994; Biddle/Hamermesh 1998; Jordahl/Biddle/Poutvaara 2010). Furthermore, research into physical fitness and health as well as happiness and self-confidence show that they are positively linked to physical attractiveness (e. g. Mathes/Kahn 1975; Shackelford/Larsen 1999; Woodman/Hardy 2003; Hönekopp/Bartholomé/Jansen 2004).

Thus, the question may occur whether there is a relationship between physical attractiveness and athletic performance or sporting success, and if so, in which direction. Therefore, the aim of this paper is to test the hypothetical relationship between physical attractiveness and athletic performance using the top 100 professional female tennis players (in one selected calendar week in 2011) as our sample. The contributions of this study are twofold. First, we go further into detail considering athletic performance and sporting success of professional female tennis players as well as its determinants by examining the earned prize money and winning probabilities of individual matches. Second, we contribute new insights to the discussion about physical attractiveness and its advantages by including the attractiveness of the players as an explanatory variable. To the best of our knowledge, no previous study has investigated the impact of physical attractiveness on athletic performance and sporting success for professional female tennis players.

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The paper is organised as follows: The second chapter gives an overview of the existing literature referring to our object of investigation. The third chapter presents theoretical background for explaining the link between physical attractiveness and athletic performance. The sample composition and descriptive statistics are presented in chapter four and the empirical results in chapter five. The paper ends with a discussion in chapter six and a conclusion as well as possible directions for further research in chapter seven.

2. Literature Review

The relationship between physical attractiveness and athletic performance is a relevant and important but under-researched issue. Moreover, there is a need for further research because the results of the few existing studies are inconclusive.

The direct effect between physical attractiveness and athletic performance has been investigated by Postma (2014). He uses data from elite professional cyclists that finished the Tour de France in 2012. The data is tested for a relationship between attractiveness and professional athletic performance. The findings show a significantly positive relationship between attractiveness of a cyclist and his performance. Furthermore, Postma points out that there is no link between performance and masculinity. However, a positive relationship is found between performance and likeability. These findings are consistent with the results of a study by Williams, Park and Wieling (2010), showing a positive link between athleticism and attractiveness for National Football League quarterbacks.

In the existing literature there are also contrary contributions. An empirical analysis by Rosar, Hagenah and Klein (2010) finds a negative relationship between athletic performance and physical attractiveness of professional soccer players. However, the study is about a team sport. Although the authors analyse individual athletes, these athletes depend on each other and have to work together for sporting success. Therefore, this research design seems less suitable to test the relationship between physical attractiveness and athletic performance for individual athletes. For this reason, we will test this relationship for individual professional female tennis players.

Initially it may sound strange that athletic performance can be influenced by physical attractiveness. However, several studies show a relationship between facial attractiveness and physical health or physical fitness. For example, a study by Shackelford and Larsen (1999) provides evidence that men and women with attractive faces are physically healthier than unat-

tractive people. In addition, Hönekopp, Bartholomé and Jansen (2004) discover that women who have a higher level of physical fitness also have more appealing faces. In another study, Hönekopp, Rudolph, Beier, Liebert and Müller (2007) show that the link between physical attractiveness of face as well as body and physical fitness can be supported for women only. These findings suggest that there is a link between facial attractiveness and physical health and fitness, at least for women. Therefore, it can be assumed that more attractive people are healthier and have a better physical fitness and may consequently show better athletic performance.

Apart from studies about athletic performance and physical health or fitness, there is some research about the relationship between physical attractiveness, happiness and self-esteem or self-confidence, which can also help to explain the expected link between physical attractiveness and athletic performance. For example, Mathes and Kahn (1975) show a positive relationship between physical attractiveness and happiness for women as well as men. In addition, they discover a positive correlation between physical attractiveness and self-esteem that just holds for women. For men, this correlation is negative. In contrast to these findings, Woodman and Hardy (2003) are able to confirm the result for women and identify a positive relationship between physical attractiveness and self-esteem for men with a meta-analysis. Their findings show a positive correlation between physical attractiveness and self-confidence that is even stronger for men than for women. Furthermore, there are many studies on the relationship between self-confidence or self-esteem and performance in sports. For instance, Taylor (1987) confirms that self-confidence is a significant predictor of performance in a variety of sports. Specifically, Mahoney and Avener (1977) confirm that better gymnasts have higher self-confidence. Furthermore, Gould, Weiss and Weinberg (1981) support this result in wrestling, whereas Burton (1988) points out a positive linear trend between self-confidence and swimming performance. Nelson and Furst (1972) show this positive relationship for motor sports. There are many other studies that confirm the relationship between self-confidence and performance (see e. g. Weinberg/Gould/Jackson 1979, Weinberg/Gould/Yuckelson/Jackson 1981 and Weinberg/Yuckelson/Jackson 1980). With respect to our research question this positive relationship could be one possible explanation why more attractive people achieve higher performance in sports.

In a nutshell, there is a lot of research about the relationship between physical fitness, physical attractiveness, self-confidence and athletic performance. However, there are only few studies that investigate the direct link between physical attractiveness and athletic perfor-

mance. Following the research idea by Postma (2014), the aim of this paper is to test whether a relationship exists between athletic performances and physical attractiveness for professional female tennis players.

3. Theoretical Background

There are several different theories, particularly in the field of psychology, explaining why more attractive people may have a higher athletic performance. In the following, a short overview over the most important theories and explanations is presented.

The research concerning physical attractiveness started with the assumption that attractiveness is an objective (or at least intersubjective) attribute of the person considered (Köhler 1984). Disagreements in the estimation of physical attractiveness are marginal and go back to differences in taste. In general, the agreement about a person's attractiveness predominates. This phenomenon is denoted as *Attractiveness Consensus* (Cunningham 1986, Rosar et al. 2010) and leads to different effects concerning the physical attractiveness. First of all, there is the so-called *Attractiveness Attention Boost* (Rosar et al. 2010). This means that more attractive persons receive higher attention from their social environment. Additionally, actions and statements from more attractive people are kept longer in mind than from less attractive ones (Maner et al. 2003). Second, the *Attractiveness Stereotype* leads to the general assumption that more attractive people would be more able-bodied, hard-working, intelligent and creative (Dermer/Thiel 1975, Eagly/Ashmore/Makhijani/Longo 1991, Feingold 1992). Third, the *Attractiveness Treatment Advantage* (Rosar et al. 2010) leads to a higher frequency of offered help and support from the social environment and interaction partners because of higher respect and esteem for the more attractive persons (Benson/Karabenic/Lerner 1976, Dion/Berscheid/Walster 1972). All these mechanisms lead to the conclusion that more attractive people have an advantage over less attractive ones. They enjoy the *Attractiveness Competition Advantage* (Rosar et al. 2010). With regard to the question why more attractive people show a higher athletic performance the mechanisms above induce that more attractive people get higher advancement and support. Related to professional tennis players it is possible that better-looking tennis players receive a higher and better sponsorship by their families at the beginning of their career followed by coaches and managers especially in the early age of the tennis career. This intensive boost leads in later years to a higher athletic performance and consequently to greater athletic success.

A related explanation is the so-called *Pygmalion Effect* (Rejeski/Darracott/Hutslar 1979). It describes the relation between performance increases and the expectation placed upon people. This effect can lead to the selection of higher competition levels, better quality coaching and the support of sponsors. Transferring this effect to the area of athletic performance, it is possible that coaches may have greater expectations about a person's ability to achieve the level of a professional player if the person is more attractive. The prospects of the coach consequently lead to higher support, which turns into better performances.

Some research concerning the link between athletic performances and attractiveness pointed out that facial attractiveness may signal endurance performance (Postma 2014). An evolutionary explanation is that high endurance performance could have been the target first of natural selection and then of sexual selection in early hominids. People with high endurance performance were able to cover long distances, which has resulted in more efficient hunting and was followed by a number of uniquely human adaptations (Bramble/Lieberman 2004). Transferring this theory into professional sports it is imaginable that athletes with a higher endurance performance have a greater chance to establish themselves in professional sport. Out of the group of all newcomers, the ones with higher endurance performance become accepted. In conjunction with the literature concerning the relationship between facial attractiveness and physical health as described above (Hönekopp et al. 2004), it is possible that more attractive people deliver a higher athletic performance because they are healthier and consequently have a better chance to become a professional athlete than less attractive people.

4. Dataset and Descriptive Statistics

The dataset for the following analysis contains the top 100 professional female tennis players of the Women's Tennis Association (WTA) single ranking at the 35th calendar week in 2011. Personal as well as career- and match-related data were collected from the official website of the WTA (www.wtatennis.com). On this website the individual tennis players' profile with information about the biography and results including earned prize money and rankings for each year of the suitable career can be found. The data of the tennis players' physical attractiveness were taken from former research of Kiefer and Scharfenkamp (2012), who had asked students to evaluate standardised pictures (see below). Table 1 gives an overview about the variables used in this study and their descriptive statistics.

Metric/ordinal variables	**Description**	**Obs.**	**Mean**	**SD**	**Min**	**Max**
PMC_2013	Earned prize money in the career at the end of 2013 (in million $)	98	4,60	7,13	0,42	51,50
PMC_2012	Earned prize money in the career at the end of 2012 (in million $)	100	4,10	6,18	0,39	39,50
PM_2013	Earned prize money in 2013 (in million $)	91	0,74	1,52	0,09	12,00
PM_2012	Earned prize money in 2012 (in million $)	98	0,65	1,23	0,13	7,31
LN_PMC_2013	Log of earned prize money in the career at the end of 2013	98	12.96	1.02	12.96	17.76
LN_PMC_2012	Log of earned prize money in the career at the end of 2012	100	14.57	1.06	12.89	17.49
LN_PM_2013	Log of earned prize money in 2013	91	12.59	1.40	9.09	16.30
LN_PM_2012	Log of earned prize money in 2012	98	12.64	1.12	9.45	15.81
Attractiveness	Physical attractiveness of tennis players	100	3.07	1.09	.99	5.36
Diff_Attractiveness	Difference between physical attractiveness of competing tennis players in a match	1946	-0.02	1.56	-4.37	4.32
BMI	BMI of tennis players	100	21.10	1.31	16.69	24.11
BMI_SQ	BMI squared	100	447.02	54.92	278.66	581.36
Diff_BMI	Difference between BMI of competing tennis players in a match	1946	0.10	2.02	-6.66	6.93
Pro_Years_2013	Number of years as professional tennis player in 2013	98	10.76	3.82	3	24
Pro_Years_2013_SQ	Pro_Years_2013 squared	98	130.14	91.95	9	576
Pro_Years_2012	Number of years as professional tennis player in 2012	100	9.82	3.82	2	23
Pro_Years_2012_SQ	Pro_Years_2012 squared	100	110.90	84.47	4	529
Diff_Pro_Years	Difference between years as professional tennis players of competing tennis players in a match	1946	.14	5.11	-16	17
ToursC_2013	Tournaments played in the career at the end of 2013	98	219.94	66.37	106	373
ToursC_2012	Tournaments played in the career at the end of 2012	100	201.34	65.81	97	357
Tours_2013	Tournaments played in 2013	91	20.14	6.69	4	33
Tours_2012	Tournaments played in 2012	98	20.78	6.17	1	34
Diff_LOG_Rank	Difference between world ranking place of competing tennis players in a match	1946	-0.16	2.18	-6.71	7.38
Home_Advantage	Home advantage of the competing players in a match	1946	0.00	0.35	-1	1
Dummy variable		**Obs.**	**percentage**			
Win	Winning the match (0=defeat, 1=victory)	1946	52.52			

Table 1: Descriptive Statistics

Dependent Variables

In the following empirical analysis, different performance-related variables serve as dependent variables. Furthermore, the analysis is divided into two parts. In the first part, we use the earned prize money as an indicator for athletic performance. To be exact, we estimate significant drivers of the earned prize money in the single seasons 2012 and 2013 as well as the earned prize money in the whole career at the end of 2012 and 2013. The earned prize money can be considered as an indicator of the athletic performance and thus of the success of each female tennis player. Due to injuries, retirement or other reasons two tennis players did not play a single tournament in 2012 as well as nine tennis players in 2013. Moreover, two tennis players are excluded from the analysis of the earned prize money in the whole career at the end of 2013 because they retired in 2012. In the case of the earned prize money in the whole career at the end 2012, we consider all of the 100 professional female tennis players. On average, the female tennis players earned about 0.65 million US dollars in 2012 and 0.74 in 2013. Concerning the earned prize money in the whole career at the end of 2012 and 2013, the mean values are 4.10 and 4.60 million US dollars. After collecting the prize money data, we have calculated the logarithm of the different prize money variables. For the present sample, we monitor an average amount of 12.64 for the logarithmised prize money in 2012 and 12.59 for 2013. The means of the logarithmised earned prize money during the whole career at the end of the year 2012 and 2013 are 14.57 and 12.96.

In the second part, we analyse single matches during the seasons 2012 and 2013, in which two of the selected 100 female tennis players played against each other. Strictly speaking, we examine factors that increase the probability of winning a match in a tennis tournament. To avoid a double consideration of each match, we created the dependent variable from the point of view of the first listed tennis player in each match schedule. We created the dummy variable Win, which is one if the first listed tennis player wins the match, otherwise the value is zero. Moreover, we excluded matches from the dataset that were not completed because one tennis player retired from the match. Considering all games played in 2012 and 2013 by two of the top 100 female tennis players, we get 1946 observations. The descriptive statistics show that 52.52 per cent of the regarded matches are won by the first listed tennis players.

Explanatory Variables

To quantify physical attractiveness as an explanatory variable we use data that were already collected for a former study by Kiefer and Scharfenkamp (2012). With the help of an online-

questionnaire the authors computed an average attractiveness scores for each female tennis player. They hereby identified portraits of each female tennis player of the top 100 WTA single ranking at the 35th calendar week in the year 2011. The pictures were either taken from the WTA website or from the German sport magazine Kicker. Importantly for the screen selection, the female tennis players have been pictured in a frontal position to see face and neck. To avoid distortion of the evaluation, the background and clothes were standardised and jewellery was deleted. The sample of 100 pictures was subdivided in five samples with 20 photographs. To control for distortions generated by the position that a picture had, the five questionnaires differed in four ways concerning the image position. Each picture popped up at the beginning, in the middle or at the end of a questionnaire. In sum, the authors created twenty different questionnaires (Kiefer/Scharfenkamp 2012). In order to measure physical attractiveness, Kiefer and Scharfenkamp used an eight point Likert scale, reaching from zero for very unattractive to seven for very attractive. The Likert scale without a midpoint was used to force a choice by the evaluators and to avoid getting a neutral or intermediate evaluation (Garland 1991, Kiefer/Scharfenkamp 2012). The online-questionnaires were activated from the 10th until the 24th of November 2011 and were sent to 925 students. In sum, 396 persons have participated in the online survey resulting in a return-rate of 42.81 percent. Every picture of the female tennis players was evaluated between 60 and 90 times. According to Rosar et al. (2010), two dozen evaluations are sufficient to reach a robust attractiveness rating score. The highest average score of a single female tennis player is 5.36 whereas the lowest average rating is 0.99. The mean of the physical attractiveness variable is 3.07.

Besides physical attractiveness, we collected the number of single tournaments in which each female tennis player has participated during 2012 and 2013 as well as in the whole career at the end of 2012 and 2013. The athletic performance, in terms of the variable prize money, has to be seen in the context of the number of tournaments participated in this year. A person with very high prize money may have received this rank with only a few tournaments whereas another player may have needed more tournaments to achieve the same amount. On average, the female tennis players played 20.78 tournaments in 2012 and 20.14 in 2013. In 2012 (2013), the maximum of tournaments is 34 (33) whereas the minimum is one (four). Concerning the number of tournaments in the whole career at the end of 2012 and 2013, the mean values are 201.34 and 219.94.

As a third explanatory variable we calculated the body mass index (BMI) that is defined by the formula $BMI = m/l^2$ with m being the body mass in kilogram and l being the body height

in meters. The needed data were collected from the individual players' profiles on the WTA website. The mean of the BMI is 21.10. A value between 18.5 and 24.9 implies normal weight for adults, under 18.5 signifies underweight (World Health Organization 2014). In our dataset, the maximum BMI value is 24.11 and the minimum 16.69. Moreover, we calculated the squared BMI to control for an (inverted) U-shaped relationship.

The last explanatory variable for our first analysis is the number of years as a professional tennis player in 2012 and 2013. This means that the variable measures the duration of the professional career. Descriptive statistics show that on average the career duration of the investigated tennis players is 9.82 in 2012 and 10.76 in 2013. In the year 2013, the longest professional career is 24 years and the shortest 3 years. Here again, we calculated the square in order to control for a possible (inverted) U-shaped relationship.

For our second analysis we determined differences between the explanatory variables above for the two competing tennis players in a match, except prize money and tournaments. As for the dependent variable Win we calculated the differences from the point of view of the first listed tennis player in the match schedule. Descriptive statistics show that the mean value of the difference between physical attractiveness is -0.02. On average, the difference between the BMI is 0.10 and the difference between the numbers of years as professional tennis player is 0.14. Moreover, we consider the home advantage (Home_Advantage) and differences in current world ranking places before the examined match (Diff_LOG_Rank). Following Koning (2011), we define the home advantage variable as 0 if none or both of the two players play at home, 1 if player 1 plays at home and player 2 doesn't, and -1 if it is the other way round. The differences of the world rank are calculated in accordance to research by Klaassen and Magnus (2001): $Diff\_LOG\_Rank = \log_2(Rank_1) - \log_2(Rank_2)$ where $\log_2$ stands for the logarithm to the basis two. Klaassen and Magnus (2001, p. 504) give as the reason for the transformation that the "direct use of the rankings is unsatisfactory, because quality in tennis is a pyramid; the difference between the top two players (ranked 1 and 2) is generally greater than between two players ranked 101 and 102". The descriptive statistics show that the average difference between the world ranking places is -0.16.

5. Empirical Results

As described in the last chapter, our first analysis tests the link between physical attractiveness and the logarithmised earned prize money with the help of ordinary least square regressions (OLS-regressions). First, we regress the earned prize money for the year 2013 and 2012

against physical attractiveness, played single tournaments in 2013 and 2012, BMI and its square as well as the number of years as professional tennis player and its square. Second, we analyse the impact of physical attractiveness, BMI and its square, number of years as professional tennis players and its square as well as the number of played single tournaments during the whole career on the earned prize money during the whole career at the end of 2012 and 2013. The results of the OLS-regressions are presented in Table 2.

	LN_PM_2013	**LN_PM_2012**	**LN_PMC_2013**	**LN_PMC_2012**
Constant	70.812(3.009)**	54.460(2.800)**	52.811(3.251)**	51.863(3.244)**
Attractiveness	.364(2.957)**	.280(2.798)**	.213(2.519)*	.202(2.424)*
BMI	-5.784(-2.574)*	-4.245(-2.283)*	-3.872(-2.506)*	-3.816(-2.507)*
BMI2	.136(2.528)*	.102(2.287)*	.092(2.501)*	.091(2.503)*
Pro_Years	.095(.646)	.095(.853)	.319(2.561)*	.409(3.503)***
Pro_Years2	-.002(-.464)	-.002(-.462)	-.008(-1.740)$^{+}$	-.011(-2.403)*
Tours	.069(3.347)**	.039(2.212)*	-.003(-1.486)	-.004(-2.070)*
Significance	.000	.004	.000	.000
N	91	98	98	100
Adjusted R^2	.193	.131	.270	.343
Note. $^{+}p<.10$; *$p<.05$; **$p<.01$; ***$p<.001$; displayed are the unstandardised coefficients, *t*-values in parentheses. The variables Pro_Years, Pro_Years2 and Tours are accordingly adapted to the investigation period of the dependent variable in each model.				

Table 2: Summary of Regression Results for the Prize Money

All regression models show a significantly positive impact of physical attractiveness on the earned prize money. These findings indicate that the higher the physical attractiveness of a female tennis player is, the higher is the earned prize money in a single season as well as in the whole career. In other words, female tennis players with a higher attractiveness score show a higher athletic performance using the earned prize money as indicator. BMI has a significantly negative impact in all four models. In contrast, BMI squared influences the earned prize money significantly positive. These results reveal that the impact of BMI on earned prize money follows a U-shape with the minimum between 20.81 and 21.26. The number of years as a professional tennis player (Pro_Years) has a significantly positive impact on the earned prize money during the whole career at the end of 2012 and 2013 (LN_PMC_2012, LN_PMC_2013), whereas the impact of the square (Pro_Years2) is significantly negative. Thus, the impact of the career duration follows an inverted U-Shape with peaks at 19.93 and 18.59 years. The number of played single tournaments influences the earned prize money in the seasons 2012 and 2013 significantly positive whereas the influence is significantly negative for the whole career at the end of 2012.

Our second analysis examines winning probabilities of female tennis players and deals additionally with the question whether female tennis players with a higher attractiveness score have a higher chance to win a match against a less attractive female tennis player. To answer this question, we use in a first step a logit model with Win as the dependent variable and the differences (from the point of view of the first listed tennis player in a match schedule) of physical attractiveness (Diff_Attractiveness), world ranking places before the regarded match (Diff_LOG_Rank), numbers of years as professional tennis player (Diff_Pro_Years) and BMI (Diff_BMI) as well as home advantage (Home_Advantage) as explanatory variables. The results are presented in Table 3.

	Win (model 1)	**Diff_LOG_Rank**	**Win (model 2)**
Constant	.061(1.063)	-.164(3.453)***	.134(1.143)**
Diff_Attractiveness	-.011(.989)	-.357(-11.409)***	.149(1.161)***
Diff_BMI	.005(1.005)	.045(1.811)$^{+}$	-.015(.985)
Diff_Pro_Years	.007(1.007)	-.039(-4.125)***	.025(1.025)*
Diff_LOG_Rank	-.448(.639)***	-	-
Res_Diff_Log_Rank	-	-	-.934(.393)***
Home_Advantage	.239(1.269)	.231(1.666)$^{+}$	.135(1.145)
Significance	.000	.000	.000
N	1946	1946	1946
Cox & Snell	.161	-	.161
Nagelkerke	.215	-	.215
Adjusted R^2	-	.082	-
Note. $^{+}p<.10$; $*p<.05$; $**p<.01$; $***p<.001$; displayed are the unstandardized coefficients, odds ratios or *t*-values in parentheses.			

Table 3: Summary of Regression Results for Winning a Match

The results show that only the difference between the world ranking places before the regarded match increase the winning probability significantly. However, there is a significant correlation (r=-.271) between the difference in the world ranking places and the difference in the physical attractiveness scores, that may cover up an effect of physical attractiveness. Hence, we built the variable (Res_Diff_LOG_Rank) that is no longer related to physical attractiveness (and the other explanatory variables). Therefore, we made an OLS-regression with the difference of the logarithmised world ranking places (Diff_LOG_Rank) as the dependent variable and saved the corresponding residuals (a methodological introduction is given by Wooldridge 2002). Residuals are the part of Diff_LOG_Rank which is not explained by the independent variables (Diff_Attractiveness, Diff_BMI, Diff_Pro_Years and Home_Advantage). Afterwards, we repeated the logit model with Res_Diff_LOG_Rank as a replacement for Diff_LOG_Rank. Then there is a positive and highly significant impact of the dif-

ference of physical attractiveness on the winning probability (third column of Table 3). Consequently a more attractive female tennis player has a better chance to win the match against a less attractive tennis player. Furthermore, the first as well as the second model show that the (residuals of the) difference of the logarithmised place in the world ranking is significantly negative. This indicates that an increasing difference in the world ranking places enhances the likelihood that the higher ranked female tennis player will win the match. The difference of the numbers of years as professional tennis players is significantly positive at the five per cent level in model 2, indicating that the larger the difference in the career duration is, the higher is the winning probability of the more experienced tennis player.

6. Discussion

The main goal of this paper is to the test the hypothetical relationship between physical attractiveness and athletic performance in terms of earned prize money and winning probabilities. Our findings confirm an impact of physical attractiveness of female tennis players on the earned prize money in two single seasons as well as for the whole career. Moreover, a logit model indicates that the higher the difference in physical attractiveness is, the higher is the winning probability for the more attractive one, although not directly but only after correcting for the influence of attractiveness on the world ranking places. These results are in accordance with the study by Postma (2014). He shows that more attractive professional (male) cyclists performed better during the Tour de France 2012 than less attractive ones. As summarised in chapter three, there are different possible theories for explaining this relationship. However, our findings cannot identify the exact reason for the effect of physical attractiveness.

In addition, we find a significantly negative (positive) impact of BMI (BMI2) on the earned prize money. These results indicate that the impact of the BMI follows a U-Shape with the minimum between 20.81 and 21.26. A possible reason could be that short and lightweight tennis players gain advantages through their agility and mobility whereas larger and heavier tennis players benefit from power and strength. For example, tennis players that are taller and stronger may be more able to deliver stronger and faster serves than other tennis players (Krumer/Rosenboim/Shapir 2014). The logit model shows no significant impact of the difference in BMI on the winning probability. However, this finding may support the idea of advantages by short and lightweight as well as large and heavy tennis players.

The number of years as a professional athlete has a significantly positive impact on the earned prize money during the whole career whereas the squares are significantly negative. Accord-

ing to these results, the impact of the number of years as professional tennis player follows an inverted U-Shape. The initial increasing effect is quite intuitive because a longer career duration means more time for winning prize money. A potential explanation for the negative trend after the peak could be that primarily less successful tennis players pursue long career durations in order to increase their prize money whereas more successful tennis players are already retired. Furthermore, differences in career duration influence the winning probability significantly. This result means that the higher the difference of the number of years as professional players is, the higher are the chances for winning the match for the tennis player with the longer career duration. This result can be explained by tennis players with longer career durations having more experience (Del Corral 2009). They are also time-tested.

The variables number of played tournaments in 2012 and 2013 have a significantly positive coefficient indicating that the higher the number of played tournaments in 2012 and 2013 is, the higher is the prize money in these seasons. The regression analysis for the earned prize money during the whole career at the end of 2012 shows a reverse effect. One possible explanation is that one can play a high number of tournaments in one season but not continuously over a long career due to the stress of too many exhausting matches and journeys. Thus, it could be the better strategy to play fewer tournaments but to concentrate on highly-prized ones to maximize the prize money during the whole career. Moreover, this could be the best strategy for the best players while weaker players rationally prefer some money from many tournaments without the chance to win any of them.

The impact of differences between world ranking places of competing tennis players in a match (Diff_LOG_Rank and Res_Diff_LOG_Rank) on winning probabilities is significantly negative. Thus, the higher the difference in the world ranking places is, the higher are the chances for winning the match for the favoured tennis player. Similar results were found by Del Corral (2009) and Krumer (2014). Del Corral (2009) demonstrates that the difference in ranking positions between two tennis players has a significantly negative impact on the winning probability of the underdog whereas Krumer (2014) shows that favoured judokas are more likely to win against underdogs if the fight is more unbalanced. This is not really surprising since a better ranking position means better performance in the past that is the best predictor for success in the immediate future.

The variable home advantage has no significant impact on the winning probability, indicating that tennis players playing in their home country have not better chances to win than their (foreign) opponents. These results are in line with findings on women's professional tennis (Koning 2011) and a study about men's table tennis (Klein-Soetebier/Senff/Weigelt 2014).

Another study finds only little evidence for home advantage in tennis and golf by examining four Grand Slam tournaments in tennis and four major tournaments in golf (Nevill et al. 1997). To be exact, the authors can find a home advantage effect in one Grand Slam tournament in tennis (Wimbledon) and in the US Open golf championship. However, other studies find more evidence for home advantage in professional sports, e. g. in men's and women's speed skating (Koning 2005), in professional men's tennis (Koning 2011) as well as in professional men's and women's judo (Krumer 2014). These different findings indicate that there is no consistent evidence for home advantage in individual sports.

7. Conclusion and Outlook

While there are several studies concerning the relationship between physical attractiveness and physical health, fitness or self-esteem, there are only a few comparable investigations on the link between physical attractiveness and athletic performance. Moreover, previous research about this relationship did not exist for professional female tennis players. Therefore, this paper investigates female tennis players, which are ranked in the top 100 of the WTA single ranking in the 35th calendar week in 2011, to estimate whether physical attractiveness of professional female tennis players has an impact on their athletic performance. Regression analyses show that there is a relationship between physical attractiveness and athletic performance in terms of prize money. After separating the variables difference in the world ranking place and difference in physical attractiveness, we can find that the larger the difference in physical attractiveness between two players is, the higher is the winning probability of the more attractive one. In sum, physical attractiveness of professional female tennis players has an influence on their athletic performance and sporting success.

Nevertheless, this study has some limitations that represent avenues for future research. Our findings cannot clarify the reason for the relationship between physical attractiveness and athletic performance. Therefore, it would be interesting to investigate possible explanations and to discriminate between different theoretical approaches. Moreover, given that our study is limited to professional female tennis players, future research may consider amateur and/or male tennis players as well as other kinds of (individual) sports. Another limitation of this study is the relatively small sample size concerning the prize money regression models, so that further research could enhance the size of the investigated sample.

References

Ace Nine (2014): "Hand Nicknames", retrieved 9th December 2014 from http://www.texasholdem-poker.com/hand_nicknames.

Benson, P. L./Karabenic, S. A./Lerner, R. M. (1976): "Pretty Pleases: The Effects of Physical Attractiveness on Race, Sex and Receiving Help", *Journal of Experimental Social Psychology* 12 (5), pp. 409-415.

Bramble, D. M./Lieberman, D. E. (2004): "Endurance Running and the Evolution of *Homo*", *Nature* 432 (7015), pp. 345-352.

Burton, D. (1988): "Do Anxious Swimmers Swim Slower? Reexamining the Elusive Anxiety-Performance Relationship", *Journal of Sport and Exercise Psychology* 10 (1), pp. 45-61.

Cunningham, M. R. (1986): "Measuring the Physical in Physical Attractiveness: Quasi-Experiments on the Sociobiology of Female Facial Beauty", *Journal of Personality and Social Psychology* 50 (5), pp. 925-935.

Del Corral, J. (2009): "Competitive Balance and Match Uncertainty in Grand-Slam Tennis: Effects of Seeding System, Gender, and Court Surface", *Journal of Sports Economics* 10 (6), pp. 563-581.

Dermer, M./Thiel, D. L. (1975): "When Beauty May Fail", *Journal of Personality and Social Psychology* 31 (6), pp. 1168-1176.

Dion, K. K./Berscheid, E./Walster, E. (1972): "What is Beautiful is Good", *Journal of Personality and Society Psychology* 24 (3), pp. 285-290.

Eagly, A. H./Ashmore, R. D./Makhijani, M. G./Longo, L. C. (1991): "What is Beautiful is Good, but…: A Meta-Analytic Review of Research on the Physical Attractiveness Stereotype", *Psychological Bulletin* 110 (1), pp. 109-128.

Feingold, A. (1992): "Good-Looking People are not What We Think", *Psychological Bulletin* 111 (2), pp. 304-341.

Garland, R. (1991): "The Mid-Point on a Rating Scale: Is it Desirable?", *Marketing Bulletin* 2 (1), pp. 66-70.

Gould, D./Weiss, M./Weinberg, R. (1981): "Psychological Characteristics of Successful and Unsuccessful Big Ten Wrestlers", *Journal of Sport Psychology* 3 (1), pp. 69-81.

Hönekopp, J./Bartholomé, T./Jansen, G. (2004): "Facial Attractiveness, Symmetry, and Physical Fitness in Young Women", *Human Nature* 15 (2), pp. 147-167.

Hönekopp, J./Rudolph, U./Beier, L./Liebert, A./Müller, C. (2007): "Physical Attractiveness of Face and Body as Indicators of Physical Fitness in Men", *Evolution and Human Behavior* 28 (2), pp. 106-111.

Kiefer, S./Scharfenkamp, K. (2012): "The Impact of Physical Attractiveness on the Popularity of Female Tennis Players in Online Media", Discussion Paper of the Institute for Organisational Economics 6/2012, Münster. Retrieved 10th December 2014 from http://www.wiwi.uni-muenster.de/io/forschen/downloads/DP-IO_06_2012.html

Koning, R. H. (2008): “Home Advantage in Speed Skating: Evidence from Individual Data”, *Journal of Sports Sciences* 23 (4), pp. 417-427.

Koning, R. H. (2011): “Home Advantage in Professional Tennis”, *Journal of Sports Sciences* 29 (1), pp. 19-27.

Köhler, B. (1984): “Physische Attraktivität und Persönlichkeitsmerkmale”, in Amelang, M./Ahrens, H.-J. (Eds.): “Brennpunkte der Persönlichkeitsforschung”, Volume 1, Göttingen: Verlag für Psychologie Hofgrefe, pp. 139-153.

Klaassen, F. J. G. M./Magnus, J. R. (2001): “Are Points in Tennis Independent and Identically Distributed? Evidence from a Dynamic Binary Panel Data Model”, *Journal of the American Statistical Association* 96 (454), pp. 500-509.

Klein-Soetebier, T./Senfft, A./Weigelt, M. (2014): “Kein Heimvorteil in der 1. Tischtennisbundeliga der Herren”, *Sportwissenschaft* 44 (2), pp. 71-77.

Krumer, A./Rosenboim, M./Shapir, O. M. (2014): “Gender, Competitiveness, and Physical Characteristics: Evidence From Professional Tennis”, *Journal of Sports Economics* (in press), DOI: 10.1177/1527002514528516.

Krumer, A. (2014): “On Winning Probabilities, Weight Categories, and Home Advantage in Professional Judo”, *Journal of Sports Economics* (in press), DOI: 10.1177/152700 2514560576.

Mahoney, M. J./Avener, M. (1977): “Psychology of the Elite Athlete: An Exploratory Study”, *Cognitive Therapy and Research* 1 (2), pp. 135-141.

Maner J. K./Kenrick, D. T./Becker, V. D./Delton, A. W./Hofer, B./Wilbur, C. J./Neuberg, S. L. (2003): “Sexually Selective Cognition: Beauty Captures the Mind of the Beholder”, *Journal of Personality and Social Psychology* 85 (6), pp. 1107-1120.

Mathes, E. W. /Kahn, A. (1975): “Physical Attractiveness, Happiness, Neuroticism, and Self-Esteem”, *Journal of Psychology*, 90 (1), pp. 27-30.

Nelson, L. R./Furst, M. L. (1972): “An Objective Study of the Effects of Expectation on Competitive Performance”, *Journal of Psychology* 81 (1), pp. 69-72.

Nevill, A. M./Holder, R. L./Bardsley, A./Calvert, H./Jones, S. (1997): “Identifying Home Advantage in International Tennis and Golf Tournaments”, *Journal of Sport Sciences* 15 (4), pp. 437-443.

Postma, E. (2014): “A Relationship Between Attractiveness and Performance in Professional Cyclists”, *Biology Letters* 10 (2).

Rejeski, W./Darracott, C./Hutslar, S. (1979): “Pygmalion in Youth Sport: A Field Study”, *Journal of Sport Psychology* 1 (4), pp. 311-319.

Rosar, U./Hagenah, J./Klein, M. (2010): “Physische Attraktivität und individuelles Leistungsverhalten oder: warum und wann unattraktive Männer die besseren Fußballer sind”, *Soziale Welt* 61 (1), pp. 51-68.

Shackelford, T. K./Larsen, R. J. (1999): “Facial Attractiveness and Physical Health”, *Evolution and Human Behavior* 20, pp. 71-76.

Taylor, J. (1987): “Predicting Athletic Performance with Self-Confidence and Somatic and Cognitive Anxiety as a Function of Motor and Physiological Requirements in Six Sports”, *Journal of Personality* 55 (1), pp. 139-153.

Weinberg, R. S./Gould, D./Jackson, A. (1979): “Expectations and Performance: An Empirical Test of Bandura’s Self-Efficacy Theory”, *Journal of Sport Psychology* 1 (4), pp. 320-331.

Weinberg, R. S./Gould, D./Yukelson, D./Jackson, A. (1981): “The Effect of Preexisting and Manipulated Self-Efficacy on Competitive Muscular Endurance Task”, *Journal of Sport Psychology* 3 (4), pp. 345-354.

Weinberg, R. S./Yukelson, D./Jackson, A. (1980): “Effects of Public and Private Efficacy Expectations on Competitive Performance”, *Journal of Sport Psychology* 2 (4), pp. 340-349.

Williams, K. M./Park, J. H./Wieling, M. B. (2010): “The Face Reveals Athletic Flair: Better National Football League Quarterbacks are Better Looking”, *Personality and Individual Differences* 48 (2), pp. 112-116.

Woodman, T./Hardy, L. (2003): “The Relative Impact of Cognitive Anxiety and Self-Confidence upon Sport Performance: a Meta-Analysis”, *Journal of Sports Science* 21 (6), pp. 443-457.

Wooldridge, J. M. (2003): “Introductory Econometrics – A Modern Approach”, Cincinnati, OH: Thomas South-Western.

World Health Organization (2014): “BMI classification”, retrieved 10th December 2014 from http://apps.who.int/bmi/index.jsp?introPage=intro_3.html

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