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**Sports participation and social capital formation during adolescence**

**ABSTRACT**

*Objective:* National and international policies claim that young people's sports participation improves their social capital. This paper is the first to examine if sports participation has a causal effect on social capital formation during adolescence and whether such effects depend on the organizational format or the type of sports practiced. *Methods:* Propensity score matching is employed in the analysis with possible endogeneity removed by exploiting the information in, and the structure of, the German Socio-Economic Panel. *Results:* Regular sports participation positively impacts adolescents' social capital through volunteering, helping friends and civic involvement. Furthermore, these effects seem to develop predominantly in sports clubs (in contrast to other organizational formats). *Conclusion:* The empirical evidence of this study is suggestive of the relevant societal role of non-profit clubs as institutions for practicing sport.

JEL: C14, D12, I31, Z28

Keywords: adolescence, sports participation, social capital

**Sports participation and social capital formation during adolescence**

Recently, the United Nation’s (UN) working group “Sport for Development and Peace” started a campaign promoting sport as a platform for young people to develop transferable life skills, e.g. commitment to team-work or self-esteem, which “helps participants to realize their potential as productive employees and citizens” (UN, 2016). Such policy claims can be identified also at the national level. For instance in Germany, the Federal Ministry of the Interior (2016) claims that children, adolescents and adults who are active in sport and live by a “sporting spirit” stabilize and foster social life in the community. Moreover, it is often argued that non-profit sports clubs – a widespread organizational format to practice sport in Germany but also in other Western European countries – play a central role in this process. Such policy claims justify considerable sport related public expenditures to foster amateur and leisure sport. For instance, in Germany the total amount of these expenditures is estimated at around 10 billion Euros annually (Pawlowski and Breuer, 2012).

Despite the widespread belief in these policy claims, however, convincing quantitative empirical evidence verifying this causal claim is scarce and subject to certain shortcomings. First, most studies focus on children or adults. Adolescents are not explicitly examined, or are included only to the extent that they are part of broad age categories. However, transition from childhood to adulthood is an important and formative phase of life with regard to physical and cognitive as well as social and emotional development (Sawyer et al., 2012). In this phase, making friends as well as the reliance on them becomes more and more important. Second, in existing studies, the organization and type of sports is not clearly specified. This is problematic given the fact that governmental subsidies often do not target sports participation *in general* but more explicitly sport practiced in sports clubs, e.g. in Germany. In addition, research analyzing the impact of sport, e.g. on human capital, shows that it is important to distinguish between different type of sports (Leeds, Miller and Stull, 2007). Third, a significant limitation of the current literature is that potential endogeneity between sports participation and social capital formation is not considered to the extent that reverse causality can be ruled out. However, identifying a causal effect of sport on social capital is of central relevance for the justification of policy interventions promoting sport as vehicle for social capital formation.

This paper contributes to the existing literature in the following ways: First, it focusses on adolescents at the age of 17 and 18/19 to test whether regular sports[1] participation has an effect on social capital formation. Second, the data used contains detailed measures of sports behavior at the age of 17 such as the organizational format or the type of sports. Third, the paper provides a more robust causal analysis of the effects of sports participation on several indicators of social capital by employing a matching estimator analysis and exploiting the panel structure of the data.

The sample used is made up of repeated measures of 1,111 adolescents aged 17 and then 18/19 in Germany who are at school. Since selection into sport is not random, a selection-on-observables approach is performed. Endogeneity is controlled for by using a semiparametric estimator and by taking the control variables (including lagged outcomes) from the year previous to the year of the dependent variables of interest.

Matching results suggest that regular sports participation can indeed positively impact adolescents' social capital especially through volunteering, helping friends and civic involvement. Further analysis reveals that these effects seem to predominantly develop in sports clubs (compared to other organizational formats). These findings highlight the important societal role of non-profit clubs.

The structure of the paper is as follows: first, a review of the relevant studies examining the influence of sport on social capital is presented. This is followed by an introduction to the data in the third section. The fourth section outlines the identification and estimation strategies employed, before the fifth section discusses the results and robustness checks. Section 6 concludes the paper.

## Theoretical background and empirical findings

The paper's starting point is Putnam's work on social capital. For Putnam, social capital displays "the form of norms of reciprocity and networks of civic engagement" (Putnam, 1993: 167). He assumes that active participation in civic groups, e.g. neighborhood associations, choral societies or sports clubs, can facilitate the development of relationships. Further, regular interactions between individuals in a community can raise the reputation of individuals for being trustworthy, responsible, and cooperative which therefore fosters norms of reciprocity and trust within the civic community (Putnam, 1993: 173-174). Overall, Putnam's (2000) concept of social capital comprises three dimensions, i.e. *norms and values* (reciprocity, trust and altruism), *social engagement* (political, civic and religious participation), and *interpersonal networks* (workplace connections and informal socializing), which can be developed in two ways. The first mechanism is the development of new, and maintenance of existing, relationships within groups of people of similar background and outlook. The outcome is bonding social capital. The second mechanism is the process of bringing together people of different backgrounds. The outcome is bridging social capital. According to Putnam (2000) bonding capital allows individuals within close groups to stick together and provide mutual support but can also lead to social stratification and exclusion, whereas bridging reduces any potential friction between distinct groups and fosters cooperation.

Few papers so far examine the link between sport and the three dimensions of social capital identified by Putnam. While some studies reveal a positive association between sport and personal (Delaney and Kearny, 2005) as well as generalized *trust* (Seippel, 2006), a trans-national study finds that membership in sports associations reduces trust (Downward, Pawlowski, and Rasciute, 2014). Delaney and Kearny (2005) and Seippel (2006) find a positive association of sport and social engagement in terms of political commitment. Furthermore, Perks (2007) identifies a weak link between youth sport and formal volunteering as well as the number of organizational memberships in adulthood. Moreover, Frisco, Muller, and Dodson (2004) find a positive association of memberships, e.g. in religious youth groups or non-school team sports, and voter-registration status and participation in the young peoples' first national election. Finally, some studies examine the relationship between sport and *interpersonal networks*. It is found that participation in sports clubs is positively associated with informal socializing and fosters relationships (Becker and Häring, 2012; Perks, 2007; Ulseth, 2004). For children, participation in sports groups is important for friendship and peer relationships (Felfe, Lechner, and Steinmayr, 2016; Gerlach and Brettschneider, 2013; Pawlowski et al., 2016).

While this literature provides some support for the policy claim that sports participation can play a role in social capital formation, the studies have some considerable shortcomings. Most of the studies use cross-sectional data and do not take problems of endogeneity between sports participation and social capital formation into account (e.g. Becker and Häring, 2012; Delaney and Kearny, 2005; Gerlach and Brettschneider, 2013; Perks, 2007; Seippel, 2006; Ulseth, 2004). Therefore, it is not clearly established whether sports participation promotes the formation of social capital or whether people with a relatively higher stock of social capital have a higher probability of participating in sport (Theeboom, Schaillée, and Nols, 2011). So far, only three studies control for possible endogeneity and provide some evidence for a *causal* relation. Felfe et al. (2016) analyze the effect of sports club participation on cognitive and non-cognitive skill development of children in Germany aged 3 to 10 years using panel data. Matching estimation as well as instrumental variables are used to control for potential endogeneity between skill development and sports participation. A similar strategy is employed by Pawlowski et al. (2016) using panel data and matching estimation techniques to identify the causal effects of sports group participation during childhood in Peru. Finally, Downward et al. (2014) make use of instrumental variables to analyze the impact of associational behavior on trust.

Even though these studies allow for causal claims, they focus on children (Felfe et al., 2016; Pawlowski et al., 2016) or adults (Downward et al., 2014) rather than adolescents. Since, however, transition from childhood to adulthood is an important phase of life with regard to physical, cognitive, social and emotional development (Sawyer et al., 2012), it is of major policy relevance to test whether sports participation fosters social capital formation during adolescence. Moreover, no study previously considered the organization and type of sports practiced, although governmental subsidies often explicitly target sports participation in *clubs* (rather than sports participation *in general*) and research analyzing the impact of sport on human capital formation (Leeds et al. , 2007) suggests the importance of distinguishing between different type of sports.

Therefore, this study is the first to test whether sports participation effects social capital formation during adolescence. Moreover, the available data allows for testing whether such effects depend on the organizational format or the type of sports.

**Data and sample selection**

Data is drawn from the Socio-Economic Panel (SOEP), which is a representative household panel in Germany. It started in 1984 and interviews participants yearly about different aspects of life

(Wagner, Frick, and Schupp, 2007). The basis of this paper is the youth questionnaire (YQ) which was introduced in 2000 and is distributed to every 17-year-old adolescent who lives in a SOEP household one year before they enter the regular personal survey at the age of 18. The YQ includes questions on age-specific issues e.g. current education status, future plans regarding education and employment, relationship to parents and friends and leisure time activities (Weinhardt and Schupp, 2011). The latter is crucial for this research since (in contrast to the regular personal survey with respondents aged 18 or older) detailed questions on sport, such as the frequency of participation or the organizational format in which participation occurs, are included. Information on the household and the parents (from the SOEP personal and household questionnaires) is combined with the data of the YQ.

The paper focusses on indicators of social capital, that are surveyed in the personal questionnaire for 2005, 2007, 2009, 2011 and 2013.[2] Only adolescents who answered the YQ (birth cohorts 1986 to 1995) and the personal questionnaire at the age of 18 or 19 (2,602 observations) are considered. A two-period panel is built by taking control variables from the year the adolescents are 17 years old and using treatment and outcome variables from the year when the adolescents are 18 or 19 years old. To have a more homogenous sample[3], the paper focusses on those who are in school at the age of 17 and are still enrolled at the age of 18/19. The final sample comprises 1,111 adolescents.[4]

**Empirical strategy**

The aim of our empirical strategy is to compare indicators of social capital (called *outcome variables* below) between sport active and inactive adolescents (called *treatment* below). More precisely, the treatment used in Model 1 is regular sports participation at the age of 18 or 19 measured as a dummy variable, which takes the value one if the adolescent participates in sport at least every week. Irregular sports participation (less often than weekly) and no sports participation describe the counterfactual setting in this regard.[5] Further models are estimated with treatments measuring the level of sports participation on a more disaggregated basis by the organizational format (*sports clubs* vs. *other organizational formats*) and the type of sports (*team and group sports* vs. *individual sports and other activities*).[6]

**Outcome variables**

The outcome variables are indicators of social capital (see Table 1) and refer to the dimensions of social engagement and interpersonal networks, as discussed in the second section.[7]

“Table 1 about here”

The variables *voluntary work* and *civic involvement* are included as measures of social engagement and represent the mechanism of bridging social capital. Here, *voluntary work* indicates the frequency of voluntary work in clubs or social services, while *civic involvement* indicates how often someone is involved in a citizens' group, political party, or local government. Both measures display central parts of prosocial behavior and enhance the well-being of other members of society as a form of social capital generation (Downward and Rasciute, 2011). On an individual level these activities can generate social belonging, community spirit and specific skills (Walseth, 2006). The variable *helping friends* is an indicator of social capital referring to the dimension of interpersonal networks. This activity can be described as informal, i.e. unstructured and spontaneous, and displays social participation with friends or other social contacts of the people’s network. The outcome variable *helping friends* measures the frequency of helping friends, neighbors or relatives and is indicative of the strength of social networks, which can create overlapping ties within the community (Jones, 2006) and corresponds to the mechanism of bonding social capital. All outcome variables are taken from the personal questionnaire when the adolescents are 18 or 19 years old.

**Identification**

There are three assumptions that are essential for identifying causal effects (Imbens, 2004). First, the stable unit treatment value assumption (SUTVA) ensures that the treatment of one adolescent does not influence the outcomes of *other* adolescents in the sample. Second, the common support assumption ensures that the covariate distributions for the treated and untreated adolescents are similar. Third, the conditional independence assumption (CIA) ensures that the effect of sports participation on social capital formation is isolated from influences of other determinants, i.e. other variables that confound the treatment-outcome relationship. While more details on the aforementioned assumptions are presented in Appendix A, we will discuss in the following in detail how we proceeded to ensure that the critical CIA holds in our setting.

Since selection into sports is not random, just comparing treated and untreated adolescents will lead to biased estimates. The SOEP, however, comprises rich information on the adolescents and their environment, enabling us to model explicitly the selection into sports based on observable variables. Potentially relevant confounding variables are chosen based on theoretical considerations and previous empirical findings on factors associated with sports participation (see Cabane and Lechner, 2015; Cabane, Hille and Lechner, 2016). The variables used can be divided into three categories, i.e., socio-demographics and adolescent environmental characteristics, family and household characteristics, and leisure activities at the age of 17 (a summary of variables and their mean values in the subsamples is presented in the Appendix Table A.2).

Previous literature shows that the choice to play sport is related to socio-demographics and environmental characteristics. Therefore, we consider the following variables: *gender*; *born before 1990* (to control for cohort effects); *next year 18*; *size of town*; and *new states* (East Germany without Berlin). Further, family and household characteristics are included in the model: *sibling in data*; *household size*; *household income*; *A-levels* and *sports activity* of father/mother; *health mother* and *help with schoolwork* (indicator of parenting style). The third set of control variables includes leisure activities at the age of 17: *sport daily/weekly*; *activity index* including the sum of seven leisure activities and *playing music*. Further, the activities *extracurricular engagement* in school, *frequency of honorary work/ meeting friends/ meeting peers* and the *importance* of certain social contacts (best friend or peers) are also used as controls. These variables are lagged outcome variables as they are surveyed prior to the treatment. It is assumed that lagged outcomes control for unobservable influencing factors, e.g. genetics or behavioral and cognitive attributes, by capturing time constant effects of these factors on the treatment (regular sports participation) and the outcomes (indicators of social capital).

The confounding variables are taken from the YQ (age of 17) or from the household and personal questionnaires from the same year the adolescents answered the YQ and thus are collected from a time that is prior to the treatment and the outcome variables, which reduces possible endogeneity.

To sum up, a rich set of confounding variables is controlled for to remove (most of) the selection bias in this study. Furthermore, using pre-treatment control variables rules out reverse causality. Unobserved characteristics are captured by including lagged outcome variables (similar to fixed effects in panel data models). In addition, lagged activity information is accounted for. Thus, this strategy can be seen as a parametric approximation of the approach suggested by Lechner (2009) and Lechner and Sari (2015) where the analysis is performed in strata defined by the level of past sports activity.

**Estimation**

To calculate the consistent average population effect of the treatment (ATE) measured by the difference in the outcome variables, a propensity-score-radius-matching-estimator with bias adjustment as proposed by Lechner, Miquel and Wunsch (2011) is used. This estimator requires computing the probability of being regularly active in sport conditional on the confounding variables mentioned before. In other words, the individual propensity scores are calculated in a probit model, before adolescents are matched that only differ with regard to the level of sports practiced (Rosenbaum and Rubin, 1983). The advantage of this method is the explicit comparison of treated and untreated adolescents and the fact that the relation between the treatment (regular sports activity and its disaggregation), the outcomes (social capital indicators) and the confounders are left unspecified (non-parametric).

When using radius matching, each individual is matched to individuals of the other treatment status who lie within a certain radius of an individual’s propensity score. Since the samples in the disaggregated models differ with regard to observation numbers and other characteristics, we keep the ‘target’ distribution the same in each model to allow for comparisons between the different models (see Lechner and Wunsch, 2009). Inference in all models is based on bootstrapping pseudo t-statics (more details on the estimation procedure are provided in Appendix B).[8]

**Results**

Table 2 illustrates the average marginal effects (AME) of the estimation of the propensity score. The baseline model (Model 1) compares regular sport active adolescents with less active or inactive adolescents. The baseline model is further disaggregated by the organizational format and the type of sports (Models 2-5).[9]

With regard to the socio-demographics and adolescent environmental characteristics, *born before 1990* is negatively correlated with regular sports participation at the age 18/19 (and its disaggregation) in all five models. *Gender* has only a significant association in the “type of sports”–models. Being male is positively correlated with team or group sports and negatively with individual sports and other activities. This implies that males more likely engage in team and group sports instead of individual sports and other activities which is in line with previous research.

Looking at the influence of family and household characteristics, all models show a highly significant and positive association between *household income* and sports participation. In contrast, *household size* is negatively associated with sports participation in general (except in Model 4). Furthermore, the father’s sports activity is positively associated with sport in any other organization (Model 3) while the mothers’ activity is positively associated with sport being organized in a club (Model 4). Getting parental support with schoolwork is associated with a lower probability of regular sports activity (Model 1). This suggests that adolescents having problems in school also spend more time learning instead of playing sport.

Focusing on leisure activities at the age of 17, results show that *sport daily/weekly* at the age of 17 is significantly and positively associated with sports activity at the age of 18/19. Furthermore, frequent honorary engagement at the age of 17 is positively associated with regular sports activity in general at the age of 18/19 and in particular with being organized in a sports club and playing team or group sports.

In Model 1 and 3 meeting peers frequently is positively associated with regular sports activity and sports activity in any other organization (than sports clubs). However, the estimates also show that attaching particularly high importance to the peers has a negative influence on the probability of regular sports activity at the age of 18/19. This implies a substitution and peer effect. If the peers play sport, the adolescent also participates (to be around with friends), but inactivity of the peers can reduce the probability that the adolescent plays sport herself.

“Table 2 about here”

Table 3 displays the results for the ATE. With regard to regular sports participation at the age of 18/19 (Model 1) significant effects are found on the social capital indicators *civic involvement* and *helping friends*. The largest effect is found for the indicator of social capital referring to the dimension interpersonal networks *helping friends*. Adolescents who regularly participate in sport are 12% more likely than sport inactive adolescents to help friends, neighbors or relatives. Here, the mechanism of bonding social capital fits. Playing sport strengthens existing relationships in the form of readiness to help each other. Perks (2007) finds similar results where sports participation during youth is found to be associated with informal volunteering and socializing with family and friends as an adult, which helps to strengthen interpersonal networks (bonding). No direct comparison of the size of effect with previous studies is generally possible as the same social capital measures are not used. However, a similar outcome is examined and the size of effect is (almost) the same in Pawlowski et al. (2016) who find that sports group participation of children in Peru enhances the probability of perceiving support by friends during difficult times in life by 12%.

With regard to the indicators of social capital referring to the dimension of social engagement, the results show that regular sport active adolescents are 3% more likely to carry out civic tasks e.g. in regional politics or citizens groups. Engagement in these activities is more likely to foster relationships with others of a different social background (e.g. other ethnicity) and corresponds to the mechanism of bridging social capital. No comparable results are found in previous studies. Only Perks (2007) detect a small link between youth sport and adult community activities.

Analysis at the disaggregated level shows that being organized in a sports club rather than being organized in any other organizational format has significant and positive effects on all three indicators of social capital (Models 2 and 3). Furthermore, the type of sports matters: while practicing team or group sports positively influences all three indicators of social capital, practicing individual sports does so only for volunteering and helping friends.

“Table 3 about here”

**Robustness checks**

To check the sensitivity of our results, a couple of robustness checks were employed (more details are provided in Appendix C). First, we re-specified our treatment variable by taking the value of one if sport is performed at least monthly. Second, we re-specified the propensity score by using a least absolute shrinkage and selection operator (LASSO) in our first stage estimation for variable selection (Tibshirani, 1996). The results from both re-specifications remain largely the same with minor deviations in the effect size of some estimates. Third, we tried to explore whether unobservable characteristics might exist that influence both treatment and outcomes and consequently bias our results – a common critique when employing propensity score matching (Winship and Morgan, 1999). While an instrumental variable is not available in our data, there are different ways for testing the sensitivity of our results with regard to the influence of possible unobservable factors. We employed a sensitivity test proposed by Ichino, Mealli, and Nannicini (2008) and Nannicini (2007). Overall, results of this test suggest that our main findings are robust with regard to the influence of unobservable confounders. Only the estimate for *helping friends* appears to be somewhat sensitive with regard to missing covariates (all tests as well as their results are presented in Appendix C.3).

**Conclusion**

Policy-makers increasingly rely on youth sport as a tool to foster social capital formation. Previous research has not addressed the questions of whether social capital, and what kind of social capital, are formed by sports participation during adolescence. This is surprising, given the fact that the transition from childhood to adulthood is an important phase in life where behavioral patterns, norms and values are developed and therefore the attitude towards social engagement is shaped. Therefore, in this paper the effect of regular sports participation on social capital formation during adolescence (age 17 to 18/19) is analyzed.

The results show that regular sports participation during adolescence has positive effects on different indicators of social capital when controlling for socio-economic variables, family and household characteristics as well as sports participation and leisure activities at the age of 17. The largest effect is found on the bonding indicator, i.e. to helping friends. In view of Putnam’s dimensions of social capital, this result suggest that interpersonal networks are an important form of social capital during youth. A small effect of sports participation on civic involvement is also detected. This activity directly benefits the whole society and might be, therefore, of greater immediate interest for politics and could be indicative of emergent effects that might develop over time. Evidence for this assumption is also represented in previous research. For example, Stern and Fullerton (2009) find that attributes of personal social networks (with family and friends) are related to civic participation. Finally, since these effects seem to develop predominantly in sports clubs (in contrast to other organizational formats) the empirical evidence of this study is suggestive of the relevant societal role of non-profit clubs as institutions for practicing sport. Overall, these results suggest support for policy-makers to use sport, in particular participation in sports clubs, as a tool to facilitate the generation of social capital during adolescence.

As argued above, our results are likely to have a causal interpretation due to the empirical strategy employed. Some data limitations, however, indicate a need for further investigation in future research. First, there are restrictions with regard to the generalization of the findings to the society because the focus is on a small and relatively homogenous group of adolescents who go to school. However, the sample still represents a large proportion of young people in Germany: according to the German Federal Statistical Office (2014), 46%/23% of adolescents are enrolled in school at the age of 17/18. Second, the focus is on the short time period when the adolescents are 17 to 18/19 years old. It would be interesting to explore the formation of social capital in the longer run. However, unfortunately this cannot be tested with the data available since the detailed information on sports participation (such as the organizational format in which participation occurs) is only available for respondents at the age of 17.

## Footnotes

[1] In this paper sport refers to all kind of sports activities, e.g. team sports (e.g. soccer), group sports (e.g. martial arts), individual sports (e.g. exercising in a fitness studio) or other activities (e.g. skateboarding).

[2] Only information of the survey waves including social capital related variables and starting from 2000 (after the YQ was established) is used. Since the social capital indicators are only surveyed every two years, the adolescents are aged 18 or 19 at the second observation time.

[3] Adolescents who changed educational or employment status or moved during the observation period are excluded as these transitions may influence the present level of activity (Hirvensalo and Lintunen, 2011) as well as the type of sports and the organizational format the sport is practiced in. Further, the sample is restricted to those who have German origin since there are very few immigrants in the sample.

[4] In the analysis weights are used provided in the SOEP to make generalized conclusions from the results to the corresponding population of private households in Germany. Important steps from the sampling of households to individual participation are considered in the calculation method of weights. The distribution of the different subsamples in the SOEP is aligned with appropriate information from the German Microcensus to guarantee generalization (Kroh, 2015).

[5] Previous research shows that most of the positive effects associated with sports participation, such as health (Corbin, Pangrazi, and Welk, 1994) or the development of social skills, attitudes and values (Bailey, 2005), unfold with higher frequency and intensity of participation. Therefore, we decided to use weekly sports activity as treatment. Robustness checks with models using (at least) monthly sports activity as treatment are reported in the results section and Appendix C.1.

[6] The type of sports are represented by categories where sports with similar characteristics are pooled, i.e. team or group sports and individual sports or other activities. The first category includes team sports and activities which are practiced in groups like badminton or martial arts. The second category comprises individual sports (e.g. bike riding or athletics) and other activities (e.g. fishing or dancing). Due to the limited sample size we were not able to conduct further disaggregated estimations.

[7] Norms and values could not be analyzed in the study since indicators of trust are only surveyed in the SOEP waves 2003, 2008 and 2013. This would considerably reduce the sample size.

[8] The benefits of the radius matching estimator and the validity of bootstrap as inference for radius matching is discussed in Huber, Lechner, and Wunsch (2013) and Bodory, Camponovo, Huber, and Lechner (2016).

[9] In the disaggregated models the treatments include information on sports activity at the age of 18/19 (regular sports activity) and information on the organizational format and type of sports at the age of 17: being organized in a sports club (Model 2), being organized in any other organizational format (Model 3), playing team or group sports (Model 4), and playing individual sports or any other activity (Model 5). The counterfactual is no sport (see Model 1).

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**TABLE 1**
Description of outcome variables

| Variable | Label | Scale |
| --- | --- | --- |
| *Indicators of social capital referring to the dimension social engagement* | | |
| Voluntary work | Frequency of volunteer work in clubs or social services | *dummy:* 0 – less often or never; 1 – weekly or monthly |
| Civic involvement | Frequency of involvement in a citizens' group, political party, local government | *dummy:* 0 – never, 1 – weekly, monthly or less often |
| *Indicator of social capital referring to the dimension interpersonal networks* | | |
| Helping friends+ | Frequency of helping out friends, neighbors or relatives | *dummy:* 0 – less often or never; 1 – weekly or monthly |

*Notes:* Outcome variables are taken from the waves 2005, 2007, 2009, 2011 and 2013.
+ This outcome was not questioned in 2013. Therefore, we have no information on this outcome for the last two cohorts born in 1994 and 1995. The sample size for the outcome *helping friends* is n=920.

**TABLE 2**
Probit models (average marginal effects)

| | **Baseline model** | **Sports organizations** | | **Type of sports** | |
|---|---|---|---|---|---|
| **Variable** | **Model 1** Sport vs. no sport | **Model 2** Club vs. no sport | **Model 3** Other org vs. no sport | **Model 4** Team/ group vs. no sport | **Model 5** Indiv/ other act vs. no sport |
| *Socio-demographics and adolescent environmental characteristics* | | | | | |
| Sex | 0.0200 (0.0395) | 0.0420 (0.0467) | -0.0278 (0.0544) | **0.1180**** (0.0500) | **-0.0953*** (0.0526) |
| Before 1990 | **-0.1112**** (0.0389) | **-0.1011**** (0.0446) | **-0.0944*** (0.0556) | **-0.1261***** (0.0458) | **-0.0885*** (0.0481) |
| Next year 18 | -0.0014 (0.0370) | 0.0252 (0.0411) | 0.0058 (0.0512) | 0.0451 (0.0417) | -0.0063 (0.0514) |
| Middle town | -0.0605 (0.0481) | 0.0049 (0.0553) | -0.0863 (0.0553) | -0.0362 (0.0546) | -0.0267 (0.0643) |
| Large town | -0.0282 (0.0456) | -0.0530 (0.0536) | -0.0843 (0.0556) | -0.0563 (0.0566) | -0.0555 (0.0549) |
| New states | -0.0423 (0.0439) | 0.0158 (0.0581) | -0.0063 (0.0518) | 0.0331 (0.0540) | -0.0698 (0.0599) |
| *Family and household characteristics* | | | | | |
| Sibling in data | 0.0249 (0.0404) | **0.1201**** (0.0498) | 0.0025 (0.0601) | 0.0675 (0.0463) | 0.0380 (0.0555) |
| Household size | **-0.055***** (0.0162) | **-0.0636***** (0.0195) | **-0.0429**** (0.0216) | -0.0293 (0.0186) | **-0.0921***** (0.0228) |
| Household income | **0.0814**** (0.0260) | **0.0890***** (0.0282) | **0.0793***** (0.0302) | **0.0954***** (0.0280) | **0.1029***** (0.0299) |
| A-levels father | 0.0234 (0.0497) | 0.0140 (0.0615) | 0.0189 (0.0673) | -0.0397 (0.0611) | 0.0372 (0.0637) |
| A-levels mother | -0.0636 (0.0456) | -0.0729 (0.0571) | -0.0189 (0.0587) | -0.0738 (0.0545) | -0.0299 (0.0565) |
| Sport father | 0.0587 (0.0402) | 0.0252 (0.0509) | **0.1236**** (0.0584) | 0.0545 (0.0493) | 0.0850 (0.0537) |
| Sport mother | 0.0311 (0.0393) | **0.1226**** (0.0507) | -0.0191 (0.0516) | 0.0325 (0.0484) | 0.0345 (0.0516) |
| Health mother | -0.0603 (0.0498) | -0.0525 (0.0683) | -0.0226 (0.0694) | 0.0026 (0.0637) | -0.0809 (0.0698) |
| Help with schoolwork | **-0.0751*** (0.0397) | -0.0782 (0.0503) | -0.0626 (0.0638) | -0.0722 (0.0497) | -0.0870 (0.0600) |
| *Leisure activities at the age of 17* | | | | | |
| Sport daily/weekly | **0.2798***** (0.0463) | **0.4494***** (0.0400) | **0.1878***** (0.0465) | **0.4261***** (0.0441) | **0.2952***** (0.0529) |
| School engagement | -0.0101 (0.0437) | -0.0341 (0.0538) | 0.0561 (0.0560) | 0.0437 (0.0568) | -0.0179 (0.0582) |
| Frequency honorary | **0.0871*** (0.0451) | **0.1172**** (0.0513) | 0.0404 (0.0694) | **0.1696***** (0.0532) | 0.0562 (0.0641) |
| Frequency friend | -0.0535 (0.0507) | -0.0054 (0.0692) | 0.0636 (0.0712) | -0.0770 (0.0669) | 0.0652 (0.0715) |
| Frequency peers | **0.0940*** (0.0064) | 0.0891 (0.0701) | **0.1168**** (0.0562) | 0.0844 (0.0682) | 0.0828 (0.0627) |
| Importance friend | 0.0359 (0.0626) | 0.0144 (0.0749) | -0.0586 (0.0784) | 0.0453 (0.0722) | 0.0377 (0.0788) |
| Importance peers | **-0.122***** (0.0432) | -0.0567 (0.0609) | **-0.2130***** (0.0756) | -0.0501 (0.0610) | **-0.1199*** (0.0706) |
| Activity index | 0.0011 (0.0065) | 0.0018 (0.0261) | -0.0009 (0.0282) | 0.0001 (0.0253) | -0.0265 (0.0274) |
| Frequency music | -0.0158 (0.0430) | 0.0505 (0.0529) | -0.0186 (0.0546) | -0.0391 (0.0525) | **0.0860*** (0.0522) |
| Observations | 1,111 | 748 | 539 | 732 | 646 |
| Efron's R | 0.164 | 0.242 | 0.125 | 0.266 | 0.209 |

*Notes:* Bootstrap standard errors in brackets. Significance levels are indicated as *** ≡ $p \leq 0.01$; ** ≡ $p \leq 0.05$; * ≡ $p \leq 0.1$; Significant effects are displayed in bold letters.

**TABLE 3**
Radius matching results

| | Baseline model | Sports organizations | | Type of sports | |
|---|---|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 5** |
| | Sport vs. no sport | Club vs. no sport | Other org vs. no sport | Team/ group vs. no sport | Indiv/ other act vs. no sport |
| **Outcomes** | **Average treatment effect** | | | | |
| *Indicators of social capital referring to the dimension social engagement* | | | | | |
| Voluntary work | 0.0508<br>(0.0253) | **0.0684***<br>(0.0230) | 0.0092<br>(0.0279) | **0.0905****<br>(0.0237) | **0.1287*****<br>(0.0273) |
| Civic involvement | **0.0347*****<br>(0.0127) | **0.0345***<br>(0.0114) | 0.0019<br>(0.0143) | **0.0534****<br>(0.0122) | 0.0255<br>(0.0155) |
| *Indicator of social capital referring to the dimension interpersonal networks* | | | | | |
| Helping friends | **0.1246*****<br>(0.0348) | **0.1429*****<br>(0.1370) | 0.0689<br>(0.0360) | **0.1840*****<br>(0.0306) | **0.1617*****<br>(0.0325) |
| No. of treated; Common support (share) | 750;<br>1,015<br>(91%) | 387;<br>1,023<br>(92%) | 178;<br>1,009<br>(91%) | 371;<br>1,023<br>(92%) | 285;<br>1,009<br>(91%) |

*Notes:* Number of observations is 1,111. Effects presented are average treatment effects for the target population. Inference is based on 4.999 or 1.999 (Model 2-4) bootstrap replications. Significance levels are indicated as *** ≡ p≤0.01; ** ≡ p≤0.05; * ≡ p≤0.1; Significant effects are displayed in bold letters. Linear bias correction (weights used for inference take bias adjustment into account).

## Online Appendix

## Appendix A: Identification strategy

### A.1 Assumptions to identify causal effects

According to Imbens (2004) three assumptions have to hold to identify a causal effect.

The first assumption is the stable-unit-treatment-value assumption (SUTVA) which assumes that the treatment status of any individual does not affect the potential outcomes of other individuals in the sample. Further, no unrepresented treatments are allowed. Every individual is either in state zero or one. In the paper’s setting, every adolescent is active in sport or not, hence there are no unrepresented treatments.

The second assumption is the common support or overlap assumption, which requires similarity of the distribution of the confounding variables for the treated and untreated subsamples (Imbens and Wooldridge, 2009). Further, it forecloses perfect predictability of treatment by given confounding variables and ensures that any individual can be observed with or without treatment. This testable assumption holds in the analysis of the paper as results show common support for 91-92% of the samples (the remaining 8-9% of observations are removed from the analysis).

The third assumption ensures that potential outcomes are conditionally independent of the treatment. It is known as the no confounding or conditional independence assumption (CIA) (Imbens and Wooldridge, 2009). This assumption maintains that enough confounding variables are observable (ideally measured before treatment and outcome) so that, conditional on these variables, the assignment of an individual to receive the treatment or not is as good as random.

## A.2 Description of covariates

**TABLE A.2**
Description of covariates and subsample means

| **Variable** | **Label, Scale** | **Sport active adolescents** (at least weekly sport) Mean | **Sport inactive adolescents** (less frequent or no sport) Mean |
|---|---|---|---|
| *Socio-demographics and environmental characteristics* | | | |
| Sex | Gender, d_1=male | 0.51 | 0.43 |
| Before 1990 | Born before 1990, d_1=yes | 0.43 | 0.52 |
| Next year 18 | Age, d_1=18 | 0.56 | 0.55 |
| Middle town | Grew up in middle town, d_1=yes | 0.21 | 0.19 |
| Large town | Grew up in large town, d_1=yes | 0.21 | 0.20 |
| New states | Living in new states (East Germany), d_1=yes | 0.16 | 0.16 |
| *Family and household characteristics* | | | |
| Sibling in data | Sibling in data (same mother), d_1=yes | 0.49 | 0.46 |
| Household size | Household members, metric | 4.10 | 4.08 |
| Household income | Net household income per month, metric | 4683.17 | 3969.66 |
| A-levels father | Father has A-levels, d_1=yes | 0.38 | 0.28 |
| A-levels mother | Mother has A-levels, d_1=yes | 0.32 | 0.27 |
| Sport father | Current sports activity, d_1=at least monthly | 0.46 | 0.32 |
| Sport mother | Current sports activity, d_1=at least monthly | 0.60 | 0.45 |
| Health mother | Current health status, d_1= good/satisfactory | 0.86 | 0.87 |
| Help with schoolwork | Parents help with schoolwork, d_1=yes | 0.74 | 0.78 |
| *Leisure activities at the age of 17* | | | |
| Sport daily/weekly | Daily/weekly sports participation, d_1=yes | 0.85 | 0.60 |
| School engagement (L) | Extracurricular engagement in school, d_1=yes | 0.81 | 0.74 |

| | | | |
|---|---|---|---|
| Frequency honorary (L) | Frequency of honorary work, d_1=daily/weekly | 0.23 | 0.15 |
| Frequency friend (L) | Frequency of meeting best friend, d_1=daily/weekly | 0.84 | 0.83 |
| Frequency clique (L) | Frequency of meeting clique, d_1=daily/weekly | 0.77 | 0.70 |
| Importance friend (L) | Best friend is important, d_1=yes | 0.89 | 0.87 |
| Importance clique (L) | Clique is important, d_1=yes | 0.77 | 0.73 |
| Activity index | Index of leisure activities (sum of 7 leisure activities scaled 0 – never to 4 – daily), metric | 16.35 | 15.65 |
| Frequency music | Frequency of playing music, d_1=daily/weekly | 0.41 | 0.37 |
| | | N=750 | N=361 |

*Notes:* (L) – Lagged outcomes (variables including at least dimensions of one of the outcome variables); d_1 – dummy variable takes the value one if…

**Appendix B: Estimation strategy**

To calculate the unbiased average population effect of the treatment (ATE) measured by the difference in the outcome variables, we used a propensity score radius matching estimator with bias correction as proposed by Lechner, Miquel, and Wunsch (2011) and compared to many other matching estimators by Huber, Lechner and Wunsch (2013). The basis of such semi-parametric estimators is a parametric model (here a probit model) for the probability of being regularly active in sports, conditional on the confounding variables. The relation between the treatment (regular sports activity and its disaggregation), the outcomes (social capital indicators) and the confounders are, however, left unspecified (non-parametric). This semi-parametric technique requires support for the treated individuals among the non-treated population (common support assumption) and avoids potential misspecification of the outcome equation. Moreover, it allows for arbitrary heterogeneity in the causal effects.

As described in the main text the populations in the disaggregated models have different observation numbers and therefore different population characteristics. To keep the 'target' distribution of the characteristics the same an additional matching step has to be employed in which the implied weighting scheme leads to a covariate distribution in the treated and non-treated sample in all models that equal those in the 'target' population. The target population includes all adolescents who are sport active and inactive.

Finally, inference is drawn by weighted probability bootstrapping a pseudo-t-statistic that performs well for the matching algorithm used here (see Bodory et al., 2016).

## Appendix C: Robustness checks

### C.1 Alternative specification of the treatment variable

**TABLE C.1.1**
Probit model (average marginal effects)
Alternative treatment

| **Variable** | **Model 1**<br>Sport (at least monthly) vs. no sport |
|---|---|
| *Socio-demographics and environmental characteristics* | |
| Sex | -0.0123 (0.0355) |
| Before 1990 | **-0.0623*** (0.0321) |
| Next year 18 | 0.0052 (0.0331) |
| Middle town | -0.0484 (0.0465) |
| Large town | 0.0239 (0.0406) |
| New states | -0.0497 (0.0393) |

| *Family and household characteristics* | |
|---|---|
| Sibling in data | -0.0210 (0.0362) |
| Household size | **-0.0398*** (0.0146) |
| Household income | **0.0328*** (0.0199) |
| A-levels father | 0.0576 (0.0457) |
| A-levels mother | -0.0549 (0.0418) |
| Sport father | **0.0586*** (0.0354) |
| Sport mother | 0.0563 (0.0359) |
| Health mother | -0.0048 (0.0477) |
| Help with schoolwork | -0.0256 (0.0368) |
| *Leisure activities at the age of 17* | |
| Sport daily/weekly | **0.2823*** (0.0455) |
| School engagement | -0.0196 (0.0376) |
| Frequency honorary | **0.1117*** (0.0346) |
| Frequency friend | **-0.0816*** (0.0404) |
| Frequency clique | 0.0701 (0.0466) |
| Importance friend | 0.0089 (0.0572) |
| Importance clique | **-0.105*** (0.0344) |
| Activity index | 0.0155 (0.0170) |
| Frequency music | -0.0133 (0.0359) |
| Observations | 1,111 |
| Efron's R | 0.207 |

*Notes:* Bootstrap standard errors in brackets. Significance levels are indicated as *** ≡ p≤0.01; ** ≡ p≤0.05; * ≡ p≤0.1; Significant effects are displayed in bold letters.

Table C.1.1 shows the results of the probit model using a different specification of the treatment variable, i.e. sports participation at least monthly. The Average Marginal Effects (AMEs) of the covariates are similar to the ones estimated in baseline model 1 with the original specification of the treatment variable. Table C.1.2 reports the corresponding matching results. While the estimated standard errors are similar to the ones estimated in the baseline Model 1, the effect sizes slightly vary yielding differences with regard to the level of significance for *voluntary work* and *civic involvement*.

**TABLE C.1.2**
Radius matching results
Alternative treatment

| | **Model 1**<br><br>Sport (at least monthly) vs. no sport |
|---|---|
| Outcomes | **Average treatment effects** |
| *Indicators of social capital referring to the dimension social engagement* | |
| Voluntary work | **0.0796**** (0.0287) |
| Civic involvement | 0.0110 (0.0119) |
| *Indicators of social capital referring to the dimension interpersonal networks* | |
| Helping friends | **0.1465***** (0.0399) |
| No. of treated;<br>Common support (share) | 861;<br>1,008 (91%) |

*Notes:* Number of observations is 1,111. Effects presented are average treatment effects for the target population. Inference is based on 499. Significance levels are indicated as *** ≡ $p \leq 0.01$; ** ≡ $p \leq 0.05$; * ≡ $p \leq 0.1$; Significant effects are displayed in bold letters. Linear bias correction (weights used for inference take bias adjustment into account).

### C.2 Alternative specification of the propensity score (LASSO)

In our models, we chose the covariates for the estimation of the propensity score based on theoretical approaches and previous findings in the literature. However, we wanted to verify the specification of the propensity score by making use of the current progress in machine learning techniques. Therefore, we employed a least absolute shrinkage and selection operator (LASSO) to calculate the propensity scores in the first stage. LASSO is a method that performs variable selection and regularization to improve the prediction and interpretability of the model (Thibshirani, 1996). We employed a version of the LASSO that turns out to have better variable selection properties – the adaptive LASSO (Zou, 2006). The LASSO identifies variables specifying the selection into the treatment (the so-called *oracle property*). These variables are then used in the radius matching estimation. As indicated by Table C.2.1, the LASSO identifies similar variables for the selection equation as done manually in our baseline Model 1.

**TABLE C.2.1**
Probit model (average marginal effects)
Post LASSO estimation

| **Variable** | **Model 1**<br>Sport vs. no sport |
|---|---|
| *Socio-demographics and environmental characteristics* | |
| Sex | 0.0216 (0.0381) |
| Before 1990 | **-0.1097***** (0.0397) |
| Next year 18 | 0.0007 (0.0372) |
| Middle town | -0.0460 (0.0492) |
| New states | -0.0472 (0.0422) |
| *Family and household characteristics* | |
| Sibling in data | 0.0214 (0.0441) |
| Household size | **-0.0583***** (0.0167) |
| Household income | **0.0740***** (0.0255) |
| A-levels father | 0.0036 (0.0496) |
| Sport father | 0.0608 (0.0388) |
| Help with schoolwork | **-0.0786*** (0.0415) |
| *Leisure activities at the age of 17* | |
| Sport daily/weekly | **0.2879***** (0.0457) |
| School engagement | -0.0093 (0.0445) |
| Frequency honorary | **0.0924**** (0.0463) |
| Importance clique | -0.0675 (0.0413) |
| Observations | 1,111 |
| Efron's R | 0.152 |

*Notes:* Bootstrap standard errors in brackets. Significance levels are indicated as *** ≡ p≤0.01; ** ≡ p≤0.05; * ≡ p≤0.1; Significant effects are displayed in bold letters.

With regard to the matching results, we find similar effects with regard to effect size and standard errors for the outcomes *civic involvement* and *helping friends* (see Table C.2.2). With regard to *voluntary work* the effect size increases by 0.034 leaving the overall effect statistically significant at a 1 percent level.

**TABLE C.2.2**
Radius matching results
Post LASSO estimation

| | **Model 1**<br><br>Sport vs. no sport |
|---|---|
| Outcomes | **Average treatment effects** |
| *Indicators of social capital referring to the dimension social engagement* | |
| Voluntary work | **0.0843*** ** (0.0250) |
| Civic involvement | **0.0318** ** (0.0130) |
| *Indicators of social capital referring to the dimension interpersonal networks* | |
| Helping friends | **0.1200*** ** (0.0323) |
| No. of treated; | 750; |
| Common support (share) | 1,015 (91%) |

*Notes:* Number of observations is 1,111. Effects presented are average treatment effects for the target population. Inference is based on 499. Significance levels are indicated as *** ≡ p≤0.01; ** ≡ p≤0.05; * ≡ p≤0.1; Significant effects are displayed in bold letters. Linear bias correction (weights used for inference take bias adjustment into account).

### C.3 Sensitivity tests of unobservable confounders

One major concern of matching is that the estimators rely on the conditional independence assumption to identify treatment effects. The adjustment of treated and non-treated observations via matching is, however, only based on observable confounders and does not account for confounders that are not measured or observed. For assessing the sensitivity of the results with regard to potentially unobserved confounders, different tests are available.

An early approach for sensitivity analysis was developed by Rosenbaum and Rubin (1983). In this approach sensitivity of the average treatment effect is assessed with respect to assumptions about an unobserved binary covariate that is associated both with the treatment and the outcome. Basically, the idea is that the treatment is confounded given the set of observable covariates but would be unconfounded given the set of covariates and an unobservable covariate *U*. Based on different sets of assumptions about the distribution of *U* and its association with the treatment and the outcomes, sensitivity checks are possible. Imbens (2003) suggests a similar approach but formulates the sensitivity in terms of partial $R^2$s which makes the interpretation easier. However, since both approaches use a parametric model as basis for estimating ATEs, the general advantage of matching as a non-parametric method is restricted.

A further test proposed by Dehejia (2005) examines the sensitivity of the treatment effects by small changes in the propensity score specification (i.e., inclusion or deletion of high order terms, interactions, etc.). We do not apply this test since we are interested in the sensitivity of the results by a given set of control variables which are chosen based on theory and previous findings.

A third test is proposed by Altonji, Elbers and Taber (2005) and assesses how strong the selection on unobservables has to be to imply that the estimated effect of the matching is assigned to selection bias. However, their test is also restricted to a specific parametric specification, i.e., the Heckman selection model based on the assumption of joint normality of the error terms in the selection and outcome equations (see Ichino, Mealli, and Nannicini, 2008).

We employ a sensitivity test conducted by Ichino et al. (2008) and Nannicini (2007) where parametrization is not required. In this test, the inclusion of an additional confounder which is related to the potential outcomes and the treatment is simulated. Comparing the estimates obtained with and without matching on this simulated binary variable shows, to what extent the estimator is robust to this unobserved confounder. The advantage of this test is that the simulated confounder is modelled based on already existing variables. Therefore, it is possible to assess the robustness of the estimates with respect to deviations from unconfoundedness. In the following, the test and its implementation is described in more detail (see Lechner and Downward (2016) for a detailed description).

In a first step, a binary confounding variable *U* is calculated, which is independent of all included covariates. Different scenarios are created where the values of parameters that characterize the distribution of *U* vary. In these scenarios *U* is included in the set of covariates. Comparing the results with and without this confounding variable indicates the sensitivity of the adapted matching specification to missing confounders. The parameters for simulating *U* are its probability for taking a value of one that varies for the four strata defined by outcome and treatment, i.e. $p_{ij} = P(U = 1|Y = i, D = j)$, $i, j \in \{0,1\}$ with Y denoting the outcome and D denoting the treatment. Based on the parameters the value of the confounding variable *U* is predicted for each treated and non-treated individual and then the treatment effect is estimated including the simulated *U* in the set of covariates. The simulations are repeated so that for each observation *i* the realization of *U* will be random (see Ichino et al., 2008). The mean effects over the simulations are taken.

Four different scenarios are chosen to estimate the sensitivity of the ATE. The first one is the baseline scenario where the additional covariate *U* is not confounding ($p_{01}$ = 0.5). It provides the benchmark with which to compare the other scenarios. For the second scenario a parameter of $p_{01}$ = 0.2 is used, for the third scenario it is $p_{01}$ = 0.639 and for the fourth $p_{01}$ = 0.335. Results are provided in Table C.3 and present the deviations of the different scenarios (2-4) from the baseline scenario (1). Overall, the results of the sensitivity test show that the main findings are robust with respect to confounders that are in the range of what might be expected for missing confounders. There is one exception, though, the effects for the outcome *helping friends* appears to be more sensitive with regard to missing covariates.

**TABLE C.3**
Sensitivity analysis

| | | Tests against baseline scenario | | |
|---|---|---|---|---|
| | 1. Scenario (baseline)<br><br>$p_{01}$ = 0.5 | 2. Scenario<br><br>$p_{01}$ = 0.2 | 3. Scenario<br><br>$p_{01}$ = 0.639 | 4. Scenario<br><br>$p_{01}$ = 0.335 |
| **Outcomes** | **ATE** | **Difference of ATE** | | |
| *Indicators of social capital referring to the dimension social engagement* | | | | |
| Voluntary work | 0.0548 | 0.0009 | 0.0003 | -0.0017 |
| Civic involvement | 0.0243 | -0.0011 | 0.0014 | 0.0000 |
| Indicators of social capital referring to the dimension social engagement | | | | |
| Helping friends | 0.1168 | -0.0213 | -0.0178 | 0.0045 |

*Notes:* Since we are only interested in the average treatment effect (ATE) we only present the sensitivity parameters (*U* = 1|Y = *0*, D = *1*) and the respective results. Bootstrap is used for inference with 199 replications. Linear bias correction is used and weighted logits for binary outcomes. The number of draws of *U* is set to 20.

**References in the Appendix**


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