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Long-run labour market and health effects of individual sports activities

Michael Lechner*

Swiss Institute for Empirical Economic Research (SEW), University of St. Gallen, Varnbüelstrasse 14, CH-9000 St. Gallen, Switzerland

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ABSTRACT

This microeconometric study analyzes the effects of individual leisure sports participation on long-term labour market variables, health and subjective well-being indicators for West Germany based on individual data from the German Socio-Economic Panel study (GSOEP) 1984–2006. Econometric problems due to individuals choosing their own level of sports activities are tackled by combining informative data and flexible semiparametric estimation methods with a specific way to use the panel dimension of the data. The paper shows that sports activities have sizeable positive long-term labour market effects in terms of earnings and wages, as well as positive effects on health and subjective well-being.

1. Introduction

The positive effect of physical activities on individual health is widely acknowledged both in academics and in the general public. Nevertheless, a substantial part of the population is not involved in individual sports activities. For example, in Germany about 40% of the population older than 18 does not participate in sports activities at all, which is about the average for Europe (see Deutscher Bundestag, 2006; Gratton and Taylor, 2000). A similar pattern appears in the USA (see Ruhm, 2000; Wellman and Friedberg, 2002). These non-activity figures are surprisingly high considering that many Western countries subsidize the leisure sports sector substantially (Gratton and Taylor, 2000, provide some details). The large subsidies are justified by considerable positive externalities participation in sports may have, for example by increasing public health and fostering social integration of migrants or other social groups, who deal with integration difficulties (for Germany, see Deutscher Bundestag, 2006; for Austria, see Weiss and Hilscher, 2003; for Belgium, Krouwel et al., 2006, are less optimistic).

Here, the focus is on the effects of individual participation in leisure time sports on individual long-run labour market outcomes. Intuitively, one might expect that such labour market effects usually result through one or several of the following three channels. The first channel relates to direct productivity effects. Improved health and individual well-being might lead to direct gains in individual productivity that is rewarded in the labour market. The second channel concerns social networking effects that are particularly relevant for sport activities performed in groups. As for a third channel sport activities might signal potential employers that individuals enjoy good health, are motivated and thus will perform well.

To be more precise, this paper addresses two issues that are important to both the individual as well as the public: The first issue is whether the health gains appearing in medical studies are still observable when taking a long-run perspective. It is conceivable that the health gains disappear, because the additional 'health capital' may be 'invested' in less healthy activities such as working harder on the job. This would put into question one of the main justifications for the public subsidies. Second, even if the direct health effects are absent in the long run, participation in sports may increase individual productivity. Such an increase would be observable in standard labour market outcomes like earnings, wages, and labour supply. Quantifying such effects leads to valuable information that could be used in public information campaigns to increase participation in leisure sports.

The following four strands of the literature are relevant for this topic. The first strand appears in labour economics and analyzes the effects of participating in high school sports on future labour market outcomes. Based on various data sets mainly from the USA and various econometric methods to overcome the problem of

* Tel.: +41 71 224 2320; fax: +41 71 224 2302.
E-mail address: Michael.Lechner@unisg.ch.
URL: http://www.sew.unisg.ch/lechner.

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self-selection into high school sports, this literature broadly agrees that participation improves future labour market outcomes.[1]

Next, the positive effect of sports activity on physical health is well documented in the medical and epidemiological literature.[2] There is recent microeconometric evidence of a positive relationship as well: Rashad (2007) analyzes the effects of cycling on health outcomes. Lakdawalla and Philipson (2007) find that physical activity at work reduces body weight and thus the probability of obesity.[3] Recent papers, for example Gomez-Pinilla (2008), also suggest that sports activities have a positive effect on mental health.

In addition, there exists a literature linking health and labour market outcomes: health is an important factor determining individual labour market productivity. If health declines, individual productivity is reduced and, as a consequence, individual wages and labour market participation declines. An important channel how this health effect materializes is the impact of body weight on labour market outcomes. In particular obesity is becoming wide spread (e.g., Andreyeva et al., 2005). It increases the risk of mortality, diabetes, high blood pressure, asthma, and other diseases, and thus drastically reduces labour productivity (e.g., Wellman and Friedberg, 2002, and the references given in Ruhm, 2007).

From a policy perspective, it is stressed (e.g., Deutscher Bundestag, 2006) that an important channel of how participation in sports, particularly team sports, may improve future labour market performance is by increasing social skills. These issues are analyzed in the sociological literature describing how social capital improves labour market performance (e.g., Aguilera and Bernabé, 2005) and how 'positive' extracurricular activities in youth lead to more successful labour market performance in later years (e.g., Eccles et al., 2003).[4]

Despite the large literature reviewed above, there appears to be no study on the effects of leisure sports on individual labour market outcomes. In that the effects of sports on labour market success take time to materialize, estimating long-run effects is particularly relevant in this case. Uncovering such long-run effects, however, comes with particular challenges: the first challenge is the data, which should record individual information over a sufficiently long time. This data should contain measurements of sports activities, labour market success and other outcome variables of interest, as well as the variables that jointly influence the outcomes of interest as well as the decision about participating in sports. It is argued below that the German Socio-Economic Panel Study (GSOEP) with annual measurements from 1984 to currently 2006 could be used for such an analysis.

The second challenge comes from individual self-selection into different levels of sports activity. For example, if individuals in well-paying jobs choose higher levels of sports activity, then a comparison of the labour market outcomes of individuals with low and high sports activity levels will not only contain the effects of different activity levels, but may also reflect differences of these groups with regard to other dimensions. This is called the problem of 'selection bias' in the econometric literature (see Heckman et al., 1999), and 'confounding' in the statistical literature (e.g., Rubin, 1974). The fact that selection into sports is not random is well documented.[5] However, solving this problem by conditioning on the variables that pick up these confounding differences may not work as the values of these conditioning variables may in turn depend on participation in sports. Here, this endogeneity problem of the control variables is approached using a flexible semiparametric estimator together with performing the analysis in strata defined by the level of past sports activity.

The paper intends to contribute to the literature in three ways: The first goal is to learn more about the correlates of sports activities by using the GSOEP data with its wealth of information. The second and main contribution of this study is to uncover the long-run effects of participation in sports on labour market success and several other socio-demographic and health variables. Indeed, there are sizeable effects. For example, active participation in sports increased earnings on average by about 1200 EUR p.a. over a 16-year period compared to no or very low participation in sports. Finally, a methodological contribution is attempted by adapting existing robust semiparametric econometric estimation methods to the specific data situation for such a panel study.

The paper is organized in the following way: in Section 2 the basic study design is explained and motivated on an intuitive basis. Section 3 describes the data on which the empirical analysis is based and provides some descriptive statistics. In Section 4 the determinants into sport activities are analyzed. I find that individual activity levels are related to many socio-economic variables, roughly indicating a positive relation between socio-economic status and activity level. Section 5 describes the econometric approach to estimate the effects of sports on the various outcome variables. The key ingredients into the proposed econometric estimation strategy, based on semiparametric propensity score matching methods, are the results from the analysis of the determinants of sports participation, because they can be used to correct for ex ante differences in characteristics of individuals observed with different sport activity levels. Bringing all components together, Section 6 contains the main empirical results and checks of their robustness. Section 7 concludes. Appendix A documents some data related issues. Appendix B describes details of the procedures used for estimation and inference.[6]

2. The basic idea of the study design

As already mentioned in Section 1, there are two key econometric challenges for studies attempting to uncover causal effects of an event or action, like the participation in sport activities, on some outcome variables. The first challenge is commonly called selection bias. This term means that comparing the outcomes of people with high and low sport activities will not do, if those two groups differ with respect to other characteristics that also influence the outcome variables. To overcome this problem, it is argued below that the data used in this study is informative enough so that 'controlling' for appropriate ('confounding') observable variables from the GSOEP will remove that selection problem. Simple

[1] See, for example, Barron et al. (2000), Ewing (1998, 2007), Henderson et al. (2005), Long and Caudill (2001), Persico et al. (2004), and Stevenson (2006) for the USA, and Cornelissen and Pfeifer (2007) for Germany. For a related analysis of the effect of high school sports participation on suicides, see Sabo et al. (2005); for the effects on drinking behaviour of girls, see Wilde (2006); and for the effect of school sports on short term educational outcomes, see Lipscomb (2007).

[2] See, for example, Hollmann et al. (1981), Lüschen et al. (1993), US Department of Health and Human Services (1996), and Weiss and Hilscher (2003).

[3] Bleich et al. (2007) look at the relationship of physical activity and the problem of obesity. They find that the international trend of increasing obesity is more related to changes in how and what people eat than to reductions in physical activity, a view that has been previously already entertained by Smith et al. (2004) in the sociological literature. This view is in contrast to previous findings in the medical literature suggesting a more important role of declining physical activity over time (e.g., Prentice and Jebb, 1995).

[4] Seippel (2006) and Stempel (2005) provide further analysis on the connection of sports participation and social and cultural capital.

[5] See, for example, Becker et al. (2006) and Schneider and Becker (2005) for Germany, and Farrell and Shields (2002) for England, and the growing sociological literature (e.g., Scheerder et al., 2005, 2006; Wilson, 2002).

[6] Further background information for this study is provided in an appendix that is available on the internet (www.sew.unisg.ch/lechner/sports_GSOEP).

regression models can be used for such 'comparisons', but we will argue below that more robust estimators, like the matching estimators popular in labour economics, have considerable advantages as they are more flexible and more robust with respect to the statistical assumptions required. Simple versions of matching estimators also have an intuitive appeal as they can be seen as constructing two groups, one group of people who are active and a comparison group of people who are not active with both groups having the same distribution of characteristics important to remove the selection problem.

The next challenge is how to deal with confounders (e.g., earnings) that may already be influenced by, or jointly determined with sport activity. Controlling for such (endogenous) variables will 'mask' some of the effects of sport participation and, thus, lead to biased results for the determinants of sports participation. The first part of the solution to this problem is to use control variables that are dated prior to the particular individual decision about sport activity. However, this may not be enough if there are persistent components in sport activities, as is likely, because those components will still jointly determine 'past control variables' and current activity. To tackle this issue I stratify the data according to the activity level in the 'year before'. Apparently, in each stratum in the 'year before' everybody has the same activity level. Thus any differences in the covariates cannot be due to different activity levels in that year (as they are all the same), thus the endogeneity problem disappears when computing the effects within such a stratum. At a later stage, the stratum specific effects may be aggregated to obtain some broader average effects.

Although such a design appears to have many desirable properties, it is also very complex. Therefore, I consider only a few specific years to define such strata (1985, 1986, 1988, and 1990) and leave future sports status unrestricted. Therefore, it is also not necessary to control for 'future' confounders and no additional problems of reverse causality arise if the outcome variable is considered, e.g., 16 years after the determination of the relevant sport activity level.

In summary, the empirical strategies consist of using the panel structure of the data and the considerable information available to control for exogenous confounders in a so-called selection-on-observables framework with the goal of uncovering the causal effects of sports activities on various outcome variables.

3. The data

3.1. The German Socio-Economic Panel Study

The GSOEP is a representative German panel study with annual measurements starting in 1984. It contains individual data from 1984 to 2006. The GSOEP is interviewer based and recently switched to computer assisted personal interviews (CAPI). It started in West Germany. Since 1990 it includes East Germany as well. The GSOEP is one of the work-horses of socio-economic research in Germany, and beyond. More details on the survey can be found in Wagner et al. (2007) and on the GSOEP website (www.diw.de/gsoep). Details about key items used in the empirical analysis can be found in Appendix A.

3.2. Sample selection and variable definition

Concerning sample selection, it is required that in the year when sports participation is analyzed individuals should be aged between 18 and 45. The upper age limit is defined such that there is a considerable chance that individuals are still working at the end of the observation period for the outcomes, which lasts 16 years.[7] Again, in order to measure long-run outcomes as well as pre-decision control variables, the focus is on the West German subsample and on sports participation decisions in the years 1985, 1986, 1988, and 1990 only.[8] All variables are then redefined relative to the respective year of the decision (e.g., for a decision in 1990, the outcome '16 years later' would be taken from the 2006 survey, whereas the 'control' variables, including previous sports activity levels, would in most cases be taken from the 1989 survey). Investigating those four decision periods separately (conditional on the previous sports participation status) would lead to very imprecise estimate due to the small subsample sizes. Therefore, using the redefined variables, the four different starting cohorts are pooled. In other words, if the individuals have the same prior sports participation status (and gender) they are pooled irrespective of in which of the four periods they originate. Furthermore, only the results of a balanced panel are reported.[9] See Appendix A.2 for more details on the selection rules.

3.3. Sports participation

Usually participation in sports is measured in four different categories (at least every week, at least every month but not every week, less often than every month, none; see Part 1 of Appendix A for the specific questions used in the survey). Table 3.1 shows the development of that variable over time for the combined sample to get an idea about the dynamics of sports participations in general.

In 1985 35% of the men and 50% of the women did not participate in any sports, whereas 36% of the men and 26% of the women were active on a weekly basis. However, in 2005, these gender differences disappeared: although slightly more women than men did not participate in any activity (40% compared to 37%), fewer men than women (32% compared to 37%) are active at least on a weekly basis. Thus, while the women in the sample increased their activity levels, the activity levels for men remained fairly constant over time. Becker et al. (2006) find similar trends using GSOEP data starting 1992. However, the activity levels they observe are lower, because they base their analysis on a broader definition of the underlying population. It is also important to note that in some years the sports question is based on a five-point scale instead of the four-point scale. In those years, it appears that people avoid the 'extremes' of the scale more frequently. This pattern has also been observed by Breuer (2004), for example.

The empirical analysis will aggregate the four (to five) groups of information on sports activity into two groups for two reasons: (i) The subsamples within the four (to five) groups are too small for any robust (semiparametric) econometric analysis, which means that the lack of observations would require the reliance on functional form assumptions relating (and restricting) the different effects for the subgroups instead. In this paper, I want to explicitly avoid such restrictions and their undesirable impact on the results (see the dis-

[7] Many of these data related decisions have been subjected to a sensitivity analysis that is documented in Section 6.5. Generally, sensitivity is small, but sample size (and thus precision of the estimator) becomes an issue in several cases.

[8] For the West, the years 1987 and 1989 are omitted due to data limitations regarding the sports variable.

[9] To be precise, it is required to be observed in the years −1, 0, 1–16 (0 denotes the year of the participation decision, −1 the year before, etc.). The results for a corresponding unbalanced panel requiring only to be observed in the years −1 and 0 are available on request. They support the findings presented in this paper. Using the 'observability' of an individual up to 16 years after the sports participation decision analyzed as an outcome variable when evaluating the effects of sports activities does not reveal any effect of activity levels on observability, indicating that the analysis can be conducted on the balanced sample without having to worry too much about attrition bias.

Table 3.1
Trends of sports participation over time for men and women (balanced sample).

	Frequency of leisure sports activities (%)							
	Men				Women			
	Weekly	Monthly	<Monthly	None	Weekly	Monthly	<Monthly	None
1985	36	8	21	35	26	6	18	50
1986	38	7	19	35	27	6	17	50
1988	36	8	19	37	27	6	18	49
1990	38	11	26	25	32	9	23	36
1992	32	11	22	36	27	6	20	47
1994	31	9	23	36	26	7	20	47
1995	36	9	24	31	32	8	22	38
1996	32	9	24	35	27	7	21	44
1997	31	9	23	38	28	6	19	46
1998	33	11	25	31	32	7	24	37
1999	29	10	23	37	29	7	18	47
2001	30	9	21	40	32	5	17	46
2003	33	10	27	30	41	5	18	36
2005	32	9	21	37	36	6	18	40

Note: In 1990, 1995, 1998, and 2003 a five-point scale is used which splits the category *weekly* into *weekly* and *daily*. For those years the entries in the columns headed by *weekly* include the additional category *daily*.

cussion in Section 5). (ii) When the five-point scale is used instead of the four-point scale, different categories appear as extreme categories. The aggregation of all extreme categories into neighbouring categories should be very helpful to mitigate these problems. Thus, following the medical literature on analyzing sports participation from GSOEP data, which is also based on more substantive considerations (e.g., Becker et al., 2006), from now on, we differentiate between only two levels of activity, namely being active at least monthly and being active less than monthly.

3.4. *Definition of the strata based on past sport activities*

Based on this definition of sports activity, the empirical analysis uses two subsamples of the West German population. The *no-sports sample* consists of those individuals who did not participate in sports at least monthly in the year before the decision is analyzed (year '−1'). The *sports sample* is made up of all individuals reporting at least monthly involvement in sports activities.[10] Furthermore, since the literature suggests substantial differences between men and women, the empirical analysis is stratified by sex.

Using these definitions and sample restrictions, in the *no-sports sample* there are 2027 men and 2338 women, of whom 482 men and 448 women increased their sports activities in the next period above the threshold. In the *sports sample*, out of the 1471 men and 915 women, 339 men and 262 women reduced their sports activities in the next period below the threshold. It is already apparent from these numbers that in the period from 1985 to 1990, men are more likely to participate in sports than women.

4. Who participates in leisure sports activities?

This section attempts to better understand whether participants in sport activities differ a priori from non-participants. This is not only interesting for a better understanding of participation behaviour but also has consequences for the econometric estimation strategy, as the effects of such differences would have to be addressed econometrically.

Table 4.1 presents sample means of selected covariates for the eight different samples stratified according to sex, the sports status prior to the year analyzed and actual sports status (see the internet appendix for the full set of results). Thus, pair-wise comparisons of columns (2) vs. (3), (5) vs. (6), (8) vs. (9), and (11) vs. (12) allows to assess the covariate differences that come with the different sports participation statuses within each subsample. These differences can be interpreted as a measure of the unconditional association of those variables with the activity status. An additional measure to assess the relevance of specific covariates are the coefficients of a binary probit model with sports participation as dependent variable that are presented in columns (4), (7), (10), and (13).[11] These coefficients are a measure of the association of the respective variable with the activity status. Note that comparing columns (2), (3), (5), and (6) of the no-sports sample to the corresponding columns (8), (9), (11), and (12) of the sports sample also gives an indication as to variables *correlated* with sports participation.[12] The following interpretation will be based on taking all those possible different comparisons into account.

Next, the different groups of variables are considered in turn. The first block of variables is related to the socio-demographic situation. The results show that for the no-sports sample, younger individuals are more likely to be active, whereas for the sports sample no such relation appears. The relationship between sports activity and nationality is clear-cut for women: non-Germans are less likely to be observed as active participants in sports (confirming the findings by Becker et al., 2006, who analyze the 2003 cross-section of the GSOEP using a binary choice analysis[13]). For men, this relation seems to exist as well, but is less pronounced. In addition, being married is associated with lower sports activity in the no-sports

[10] To assess the sensitivity of these decisions, they have been varied to assess the sensitivity of the results with respect on how to define sports participation (see Section 6.3).

[11] When specific variables are omitted from the probit specification, it is usually because either they have been chosen as being part of the reference category (denoted by 'R'), the cell counts are too small, or they do not play a role in the specific subpopulation ('–'). To support these probit specifications, tests for omitted variables, as well as further general specification tests against non-normality and heteroscedasticity are conducted. These respective test statistics do not point to serious violations of the statistical assumptions underlying the probit model. They are available on request from the author.

[12] As the sport status used to define the subsamples and the control variables are measured at the same time, such a comparison is only informative about the correlation of sports participation with covariates, not about any causal connection.

[13] See also the related work by Schneider and Becker (2005) using a binary logit model and the German National Health survey with interviews between 1997 and 1999.

Table 4.1
Descriptive statistics and probit coefficients for selected covariates of the selection process into sports activities.

(1)	Sports activity before											
	Less than monthly						At least monthly					
	Men			Women			Men			Women		
	Mean in subsample		Probit	Mean in subsample		Probit	Mean in subsample		Probit	Mean in subsample		Probit
	Sport[a] (2)	No S.[a] (3)	S-NS[a] (4)	Sport[a] (5)	No S.[a] (6)	S-NS[a] (7)	Sport[a] (8)	No S.[a] (9)	S-NS[a] (10)	Sport[a] (11)	No S.[a] (12)	S-NS[a] (13)
Socio-demographic characteristics												
Age: 18–25 (dummy)	0.29	0.21	0.19	0.28	0.22	0.25*	0.31	0.31	0.08	0.27	0.29	−0.14
German nationality	0.76	0.75	−0.04	0.91	0.69	0.51**	0.85	0.75	0.10	0.98	0.90	0.82**
Married	0.57	0.65	0.01	0.58	0.72	−0.14	0.47	0.52	−0.08	0.56	0.56	−0.23
Divorced	0.03	0.03	0.15	0.06	0.05	0.03	0.04	0.04	0.05	0.05	0.06	−0.14
# of kids in household	0.9	1.1	−0.01	0.86	1.2	0.002	0.76	0.85	0.03	0.83	0.82	−0.01
Mother of kids age < 3	–	–	–	0.13	0.18	−0.20^{+}	–	–	–	0.08	0.17	−0.65**
Mother of kids age < 7	–	–	–	0.40	0.48	0.23*	–	–	–	0.33	0.38	−0.1
Mother of kids age < 10	–	–	–	0.54	0.70	−0.17**	–	–	–	0.51	0.53	0.26*
Education (%)												
Lower secondary school or no degree	45	50	R	42	57	R	39	42	R	56	61	R
Intermediate secondary school	34	29	0.13^{+}	37	32	0.22**	32	36	−0.06	42	40	0.11
Upper secondary school	23	21	−0.06	21	11	0.23^{+}	29	22	0.08	21	19	0.24
No vocational degree	22	24	0.02	17	38	−0.33*	15	23	−0.28^{+}	14	18	−0.13
Vocational degree below university	58	61	−0.06	64	54	−0.02	60	58	−0.04	66	63	−0.07
University	11	11	−0.14	10	4	0.28	15	10	0.17	10	11	−0.20
Income and wealth												
Monthly earnings in EUR	1815	1808	0.0001**	832	721	−0.00003	1737	1783	−0.00001	912	866	−0.0001
Net family income	2148	2029	–	2048	1970	−0.00003	2225	2214	–	2263	1999	0.0001^{+}
Owner of home/flat	0.34	0.34	−0.11	0.43	0.29	0.16*	0.42	0.36	0.06	0.50	0.40	0.11
Health and smoking												
Satisfaction with health high	0.30	0.26	0.13	0.23	0.25	−0.20*	0.26	0.27	−0.10	0.26	0.25	0.09
Satisfaction with health highest	0.40	0.38	0.01	0.37	0.34	−0.09	0.46	0.46	−0.06	0.43	0.39	0.18
Visits of MD last 3 months	1.5	1.7	−0.02^{+}	2.8	2.6	0.004	1.9	1.6	0.01	2.7	2.6	0.003
Chronical illness	0.11	0.11	0.05	0.17	0.16	−0.001	0.11	0.11	−0.07	16	11	0.28*
Days absent from work last year	4.1	4.6	0.002	3.4	3.4	−0.006	4.0	4.1	0.002	2.7	2.8	−0.005
Never smoked	0.43	0.38	0.10	0.55	0.54	0.09	0.49	0.40	0.17*	0.55	0.55	−0.01
General satisfaction with life (%)												
Medium	36	41	−0.27*	34	38	−0.12	35	36	0.21	31	40	−0.01
High	28	28	−0.24^{+}	26	26	0.27^{+}	31	28	0.33^{+}	33	28	0.29
Highest	29	25	−0.12	33	29	0.31*	29	29	0.27	29	24	0.24
# of observations; Efron's R^2 in %	482	1545	9	448	1790	14	1132	339	10	653	262	15

Note: The 'no-sports sample' consists of individuals with less than monthly participation in sports activities in the year before their decision is analyzed. The sports sample is made up of individuals participating in sports activities more frequently. The dependent variable in the probit is a dummy variable which is one if the individual participated at least monthly in sports activities in the relevant year when the decision is analyzed. Independent variables are measured prior to the dependent variable. '+' denotes probit coefficients that are significant at the 10% level. If they are significant at the 5% (1%) level, they are marked by one (two) '*'. Some variables in the table are not included in the estimation. They are either marked by R (reference category), or '–' (variable deleted for other reasons like too small cell size). The internet appendix contains the results for all variables used in the probit estimation.

[a] Characteristics.

sample. In the sports sample, however, such effects are smaller for men and absent for women, thus moderating the findings by Becker et al. (2006). The relationship between divorce and sports activities as reported for example by Gratton and Taylor (2000) appears to be absent as well.[14] Finally, the existence of young children in the household is related to a lower level of sports activities of women (as in Farrell and Shields, 2002 based on a probit analysis of the Health Survey for England of 1997).[15]

The educational information, which is known from other studies to play an important role, is described by several variables related to formal schooling as well as to vocational education. The results of Table 4.1 support the general finding that sports activities increase with education. This is also in line with a positive association of individual and family earnings with sports participation for women. The same pattern appears for the crude wealth indicator that is used for this analysis, namely whether the current apartment or house is owned or rented. Again, these relations seem to be almost absent for men casting some doubt on the findings of the literature.

For those who worked in the year before they started their sports participation, various variables in addition to earnings are also included to characterize the firm (size, sector) and the job (duration, earnings, hours, required vocational education, sector, type of occupation, prestige of occupation measured by the Treimann

[14] Gratton and Taylor (2000) use a logit analysis based on the British Health and Lifestyle Survey with interviews around 1984.

[15] Further socio-demographic information, such as immigration information, etc., has been considered in our estimation but not presented in Table 4.1, because they have no further explanatory power in the probit (conditional on the variables already included).

scale, 'autonomy' of occupation measured by a five-point scale, job position).[16] For individuals not working, their current status is known as well (unemployed, out-of-labour force, retiree, students, etc.). Furthermore, there is information on job histories, such as total duration in full-time or part-time employment, and so on. The results for these particular durations are however difficult to interpret as they are by definition positively correlated with age.

The clearest association is that for employed women who are more likely to be observed as being active. The effect of work intensity variables in general is small. By and large the different occupational variables confirm the general finding that individuals in 'better' jobs (having more responsibilities, requiring a higher level of training, etc.) as well as individuals with jobs in the public sector are more likely to be observed to be active in sports. It is also noteworthy that most of these differences are more pronounced for women than for men.

Health is measured by several variables. There is an input variable such as the number of visits of a medical doctor in the last 3 months. There are some 'objective' health measures, like the degree of disability (not presented), missing days of work due to illness in the last year, or whether the individual has any chronic diseases. Furthermore, there is a measure of self-assessed satisfaction with one's own health using an 11-point scale. Although, there is evidence that subjective health status is positively associated with sports participation, the link between health status and sports activities is weak. This weak link becomes even more questionable, for example, by the fact that being chronically ill is positively associated with sports participation in the female sports sample. It should however be recalled that individuals who are of particularly bad health were removed from the sample.

Smoking is known to be a possible important factor of participation in sports (e.g., Farrell and Shields, 2002). However, in the GSOEP it is observed only from 1998 onwards. This impedes its use as a control variable, because it might have already been influenced by previous sports participation. However, in 1999, 2001, and 2002, individuals are also asked whether they 'never smoked'. This variable is included in the probit estimation.[17] The results point in the expected direction for men, since never having smoked is positively associated with participation in sports. However, for women there appears to be no such association.

Variables measuring worries (not presented) and general life satisfaction are considered as well to capture further individual traits that may influence the decision to participate. Small differences appear in the sense that the satisfaction level of participants is higher than that of non-participants (as in Becker et al., 2006). Individual height is considered as well, but there are no apparent differences (not in table). Unfortunately, weight is measured only much later so that a pre-decision BMI could not be calculated. The same is true for alcohol and tobacco consumption.

Finally, to account for regional differences, the information on the German federal states and the types of urbanization is supplemented with regional indicators reported in the special regional files of the GSOEP allowing for an extensive socio-economic characterization of the region the individual lives in. However, it is hard to detect any systematic patterns, and thus the details are again relegated to the internet appendix.

To conclude, the results confirm most of the findings that exist in the literature so far with some pronounced exceptions. Furthermore, considerable heterogeneity between men and women appeared. Generally, the differences in characteristics for sport participants and non-participants are more pronounced for women than for men. Therefore, it is not surprising that the Pseudo-R^2's of the probit in the two samples of women (10–15%) are higher than in the two samples of men (9–10%). However, the descriptive statistics as well as several significant variables together with non-negligible values for the Pseudo-R^2 show that even for men it would be incorrect to assume that selection into different sporting levels is random.

5. Econometrics: identification, estimation, and inference

The previous section showed that participation in sports activities is not a random event. Based on this analysis, comparing earnings of sports participants and non-participants is expected to result in a positive earnings effect for the sports participants simply because better educated individuals are more likely to participate in sports (although Table 4.1 shows that this earnings–education relation shows up only in three of the four strata). Therefore, such crude comparisons lead to biases for the 'causal effects' of sports participation that have to be corrected. Such biases can be traced back to different distributions of variables related to sports participation and outcomes (e.g., earnings 16 years later). Therefore, these variables, which may or may not be observable in a particular application, are called confounding variables or confounders in the statistical literature (e.g., Rubin, 1974). The presence of observable confounders can be corrected with various econometric methods, if these confounding variables are not affected by sports participation, i.e. if they are exogenous in this sense.[18]

Section 5.1 tries to identify those variables that could be considered as confounding and argues that (almost) all relevant ones can be observed in the GSOEP, or approximated by other GSOEP variables. Having established that controlling for observable confounders is a reasonable strategy, Section 5.2 describes the matching estimator used to exploit this result. Section 5.3 reviews some alternative identification and estimation strategies and concludes that they are less attractive for the current study.

5.1. Identification

The first source for identifying potentially confounding variables is the empirical literature referred to in the previous section: almost all groups of variables mentioned in that literature are covered in our data in considerable detail. The variables that are problematic as they are covered in this data are life-style related variables measuring eating and drinking habits. They are measured in the GSOEP, but only in recent years. Thus, they cannot be used directly, because the later measurement renders them likely to be affected by sports participation. The literature (e.g., Farrell and Shields, 2002) suggests that drinking may in fact be related to higher sports participation and could also be related to earnings, although probably in a non-linear manner (e.g., Hamilton and Hamilton, 1997; French and Zarkin, 1995). Thus, a downward bias appears to be likely.

[16] As these features are captured by many different variables that are somewhat difficult to interpret one by one, they are omitted from the table altogether and readers interested in the detailed results is referred to internet appendix.

[17] This variable relates to the past as well as to the present and is thus less influenced by current sports participation. To avoid ignoring this important selection variable, it is included despite the endogeneity problem. However, sensitivity analysis has been performed when this variable was omitted from the specification. These results indicate that none of the conclusions depend on the inclusion of this variable.

[18] It has been explained above how this endogeneity problem of confounders is handled in this study. A remaining problem could be that people anticipate that they will start sports activities next year and change behaviour already today in anticipation of that. However, such long-term planning for a leisure activity seems to be unlikely.

On the other hand, excess weight is related to lower sports participation and lower labour market outcomes which leads to an upward bias. There are several reasons why these biases might not be too severe: First, the missing life-style variables are correlated with other socio-economic variables that are controlled for, in particular labour market histories, earnings, type of occupation, and education, among others. Second, the biases plausibly go in different directions so some of them are likely to cancel. Third, it is reassuring that no significant effect of sports participation could be detected when treating weight, drinking and smoking formally as outcome variables in the estimation process.[19]

An alternative route to analyze the selection problem is to consider sports participation from a rational choice perspective comparing expected costs and benefits from this activity (see for example Cawley, 2004, who used this approach to analyze eating and drinking behaviour). The expected cost consists of direct monetary costs (e.g., buying equipment, fees for fitness studio, travel expenses to sports facilities, injuries costs). Furthermore, foregone earnings, foregone home production, and foregone utility from other leisure activities (assuming that sports activity is a substitute for work or leisure, or both) are relevant. Some types of (unpleasant) sports activities may have direct disutility. The benefits of leisure sports comes as direct utility from sports activities (fun, relaxing after an exhausting working day, etc.), as well as from the role of sports as an investment in so-called health capital. The latter can be seen as a part of human capital as it enhances productivity and the value of leisure (see Grossman, 1972).

What implications do these issues have for the variables that are required as controls for the empirical analysis to have a causal meaning? In fact, they are the same variables as already discussed. For example, direct costs depend on location, because sports participation is typically more expensive when living in inner cities than in suburbs or in small villages. Furthermore, opportunity costs depend on the value of the alternatives to sports, which are work, household production, and leisure (for an attempt to quantify such costs, see Taks et al., 1994). The value of these alternatives is in turn highly correlated with (and determined by) the socio-demographic variables discussed above (type of occupation, education, household composition, health, age, gender, etc.). Furthermore, they are related to the conditions in the local labour market. The concept of health capital appears to suggest that individuals with higher returns (or lower investment costs) should invest more in such capital. Again, it could be conjectured that the socio-demographic variables that determine the returns from work are also related to the stock of health capital. However, this remains somewhat speculative as there is not much empirical research on how to measure the returns from health capital. Furthermore, the individual discount factors should play some role because individuals who value the future relatively more should invest more in their health capital. However, such preferences are notoriously hard to measure in a survey.

The methodological approach taken to the empirical analysis in this paper can be summarized as follows: the previous section showed that some groups of individuals are more likely to participate than others. If we were able to observe all characteristics characterising these groups that also influence the outcomes of interest, we can use the fact that these variables are usually not perfect predictors for the activity levels, i.e. there are other random variations of sports participation not influencing our outcomes of interest, to compare the outcomes of members of the same group with different sports participation statuses. Obviously, for such an approach to lead to reliable results, it is crucial that all important variables jointly influencing outcomes and sports activities are observable in the data. It follows from these considerations that using the homogenous initial sample approach allows conditioning on most of the relevant exogenous variables. Thus, it will most likely remove most of the selection bias and does not require further restrictive statistical modelling assumptions about the relation of the outcomes, the confounders, and sports activity.

5.2. Estimation methods

As explained above, the identification and estimation problem can be tackled using an approach that exploits the panel structure of the data by performing the analysis in subsamples defined by sports activities in the previous year. The analysis is then based on analyzing the effects of the movements in or out of sports activities. Before getting into any more details, it is worth pointing out how all possible parametric, semi- and nonparametric estimators of (causal) effects that allow for heterogeneous effects are implicitly or explicitly built on the principle that for finding the effects of being in one state instead of the other (here sports activity vs. no-sports activity), outcomes from observations from both states with the same distribution of relevant characteristics should be compared. As discussed above, characteristics are *relevant* if they jointly influence selection and outcomes. Here, an adjusted propensity score matching estimator is used to produce such comparisons. These estimators define 'similarity' of these two groups in terms of the probability to be observed in one or the other state conditional on the confounders. This conditional probability is called the propensity score (see Rosenbaum and Rubin, 1983, for the basic ideas). To obtain estimates of the conditional choice probabilities (the so-called propensity scores) used in the selection correction mechanism to form the comparison groups, the probit models presented in the previous section are used.

The matching procedure used in this paper incorporates the improvements suggested by Lechner et al. (2005), and for example applied by Behncke et al. (forthcoming).[20] These improvements tackle two issues: (i) To allow for higher precision when many 'good' comparison observations are available, they incorporate the idea of calliper or radius matching (e.g., Dehejia and Wahba, 2002) into the standard algorithm used for example by Gerfin and Lechner (2002). (ii) Furthermore, matching quality is increased by exploiting the fact that appropriately weighted regressions that use the sampling weights from matching have the so-called double robustness property. This property implies that the estimator remains consistent if either the matching step is based on a correctly specified selection model, or the regression model is correctly specified (e.g., Rubin, 1979; Joffe et al., 2004). Moreover, this procedure should reduce small sample as well as asymptotic bias of matching estimators (see Abadie and Imbens, 2006a) and thus increase robustness of the estimator. The exact structure of this estimator is shown in Table B1.

There is an issue here on how to draw inference. Although Abadie and Imbens (2006b) show that the 'standard' matching estimator is not smooth enough and, therefore, bootstrap based inference is not valid, the matching-type estimator implemented here is by construction smoother than the estimator studied by Abadie and Imbens (2006b). Therefore, it is presumed that the bootstrap is valid. The bootstrap has the further advantage in that it allows the direct incorporation of the dependency between observations generated by the specific sampling design in which some individuals may appear as several observations due to the pooling of decision windows. It is implemented following MacKinnon (2006)

[19] The exceptions to this finding are some subgroups of men for which a weight reduction can be detected.

[20] See Imbens (2004) for a survey on recent developments in matching estimation.

by bootstrapping the *p*-values of the *t*-statistic directly based on symmetric rejection regions.[21]

5.3. Alternatives for identification and estimation

In principle, once the data have been reconfigured to correspond to the set-up described above, a linear or non-linear regression analysis could be used with future labour market and other outcomes as dependent variables and sports participation as well as all the other control variables as independent variables (measured in the last period when all individuals are in the same state). Such methods have been heavily used, but they suffer from potential biases when the implied functional form assumptions are not satisfied. This is particularly worrying as these assumptions in turn imply that the effects have to be homogeneous in the population or specific subpopulation (see for example Heckman et al., 1999). Such assumptions are not attractive in this context.

Another alternative to the proposed approach are fixed effects linear panel data models. They appear to be attractive at first sight because they allow for some unobserved heterogeneity related to the selection process.[22] However, these models rely on assumptions that are unattractive in this context. First, generally, only the linear version of the fixed effects models identifies the required effects. As many of the outcome variables are binary, this is clearly unattractive. Second, the assumption of strict exogeneity of the time varying control variables used in the estimation (i.e. the assumption that the part of last years' outcome measurement not explained by the regressors does not influence next years' measurement of the regressors) is very unlikely to hold. Third, the key assumptions that the fixed effect, i.e. the part of the error that is allowed to be correlated with the regressors and captures potentially unobservable confounders, has a constant effect on the outcomes over more than 16 years is very hard to justify in this context. Finally, the assumption mentioned above that the effects of sports have to be homogenous in the population is also an unattractive feature.

A further alternative to identify the effects would be to use an instrumental variable approach (e.g., Imbens and Angrist, 1994). Such an approach requires a variable that influences the outcomes under consideration only by influencing sports participation (any direct effect is ruled out). In the present context such a variable does not appear to be available.

6. Results from matching estimation

6.1. Introductory remarks

Below, the effects of sports participation on various outcome measures are presented. The outcomes considered relate to success in the labour market, like earnings, wages, and employment status, as well as to various objective and subjective health measures, additional socio-demographic outcomes, and a direct measure of satisfaction with life in general. For each group of outcome variables, only a few specific variables are presented for the sake of brevity. Results for additional outcome variables are available in the internet appendix. As before, the four decision years with respect to sports participation status (1985, 1986, 1988, and 1990) are pooled to increase precision. For all outcome variables the mean effects of sport participation are estimated annually over the 16 years after the respective decision year allowing some potential dynamics to be uncovered. The exceptions are some health measures that were added to the GSOEP only recently: the effects of sports on these variables could only be estimated for one point in time. Finally, the effects presented are those for the group of individuals remaining or becoming active (so-called average treatment effects on the treated).[23] To acknowledge the considerable sex specific heterogeneity in the selection process and to uncover interesting heterogeneity, sex specific results are reported.

Before discussing the effects of sports participation on various outcome measures in detail, it is useful to precisely define the 'treatment', i.e. sports participation. It is the comparison of the low activity sports states (less than monthly; denoted as 'not active' below), compared to a higher level of sports activity (at least monthly; denoted as 'active'). This contrast is conditional on the pre-decision activity state that is defined in the same way and measured 1 year (for decision years 1985 and 1986) or 2 years earlier (for decision years 1988 and 1990 as no sports information is available for the years 1987 and 1989). The resulting strata are called 'no-sports sample', and 'sports sample', respectively. In the matching estimation, the results for the two strata are averaged to increase precision.[24]

Over the 16 years for which the effects on the outcomes are estimated, there is no guarantee that the sports statuses within the two groups remain constant.[25] Using sports participation 1–16 years after the decision year as outcome variables shows that the activity levels narrow over time. However, there is still a persistent and highly significant effect of the respective sports participation in the decision year on future sports participations, which is similar in all strata (see the internet appendix for details).

6.2. Labour market effects of sports participation

Fig. 6.1 shows the earnings and wage effects of sports participation in EUR. The effects are computed by subtracting from the sport participants' earnings (or wages) the adjusted earnings (or wages) of the comparison groups. These adjustments are based on the matching approach described in the previous section.[26]

Monthly earnings are measured as gross earnings in the month before the interview. *Accumulated average earnings* are the average monthly earnings until the year in question. They capture the total earnings effect over time and have the additional advantage of the averages being smoother and more precise than yearly snapshots. *Wages* are computed by dividing monthly gross earnings by weekly hours (×4.3). These variables are coded as zero when the individual is not employed. Furthermore, they are de- or inflated to year

[21] The *p*-values for the non-symmetric confidence intervals are typically smaller (and some are reported in the internet appendix). Bootstrapping the *p*-values directly as compared to bootstrapping the distribution of the effects or the standard errors has advantages because the '*t*-statistics' on which the *p*-values are based may be asymptotically pivotal whereas the standard errors or the coefficient estimates are certainly not.

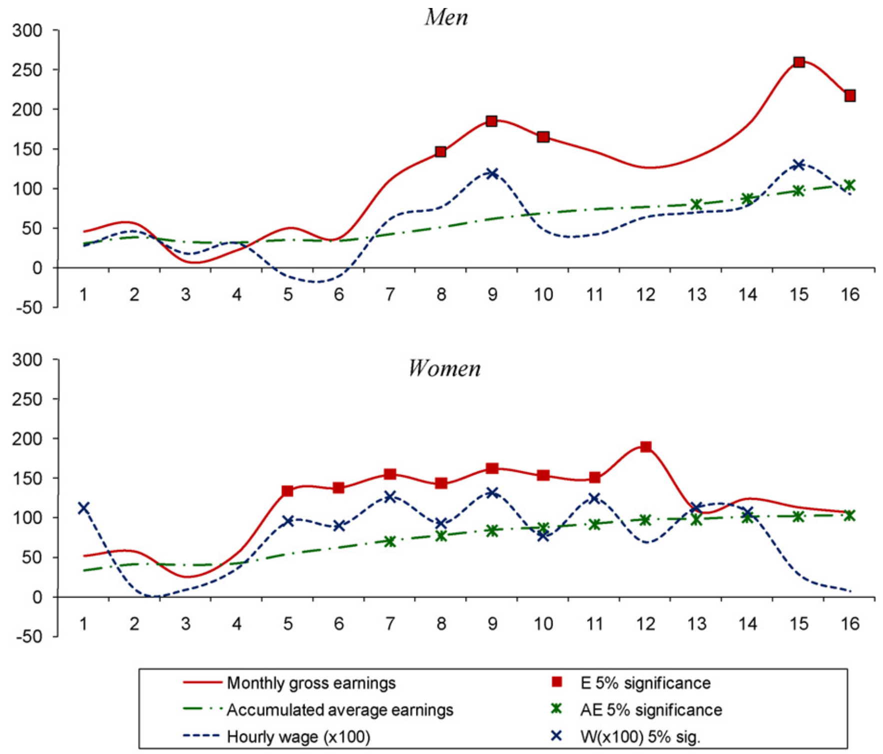
[22] The comparison made here is made for fixed effects models, as random effects models require strictly stronger assumptions than the methods proposed below, because random effects models do not allow for any unobservables to be correlated with the regressors (see Lechner et al., 2008).

[23] The results for the groups becoming or remaining inactive are not presented for the sake of brevity. They are very similar for women. For men, the effects are qualitatively similar as well, but in several cases about 20–40% smaller.

[24] This is implemented by running the estimation in the strata defined by sex. Within these two strata, the selection model is fully interacted with respect to the sports status. Results by activity level are available in the internet appendix.

[25] Keeping the sports status constant over this long period would raise the endogeneity problems discussed before because time varying covariates would have to be included to correct for dynamic selection problems. Flexible selection corrections in such a dynamic framework would require dynamic treatment models of the sort discussed by Robins (1986) or Lechner (2009). However, such models are too demanding with respect to sample size to be applicable in this context.

[26] The matching estimator has been tested for the specification of propensity score as well as whether important covariates are balanced in the treated and control sample. Results are available from the author on request.



Note: Effects of sport participation at least monthly for the population of individuals who are active in the decision period. A symbol on the line of the mean effect indicates significance at the 5% level based on a two-sided t-test (symmetric bootstrapped p-values based on 499 bootstrap replications). *Monthly gross earnings* are measured as gross earnings in the month before the interview. *Accumulated average earnings* are monthly earnings summed up year by year until the year in question divided by the number the valid interviews up to the respective year. Earnings and wages are coded as zero if individuals are not employed. Wages are multiplied by 100 to be presentable on the same scale as earnings. All monetary measures are in year 2000 EUROs.

Fig. 6.1. Effect of sports activity on earnings. *Note*: Effects of sport participation at least monthly for the population of individuals who are active in the decision period. A symbol on the line of the mean effect indicates significance at the 5% level based on a two-sided *t*-test (symmetric bootstrapped *p*-values based on 499 bootstrap replications). Monthly gross earnings are measured as gross earnings in the month before the interview. Accumulated average earnings are monthly earnings summed up year by year until the year in question divided by the number of valid interviews up to the respective year. Earnings and wages are coded as zero if individuals are not employed. Wages are multiplied by 100 to be presentable on the same scale as earnings. All monetary measures are in year 2000 EUROs.

2000 Euros to facilitate comparisons over time and entry cohorts. The figures show mean effects of sports activity compared to no or low activity over 16 years for men and women. A symbol on the respective line indicates an effect significant at the 5% level based on bootstrapped *p*-values.

Although, estimates of the monthly earning gains are somewhat volatile, on average after 16 years for men as well as for women there is a monthly gross earnings gain of about 100 EUR (leading to a total gain over 16 years of approximately 20,000 EUR). In most cases, these gains are at least significant at the 10% level after about 4–6 years (this significance level is not indicated in the figure). They appear to increase over time. Similarly, positive average wage effects of almost 1 EUR per hour are present. Note that for women there is a surprising decline of the wage effects at the end of the observation period. It may either be due to some volatility of the hours measure (wages are computed as monthly earnings divided by hours worked), or it may be due to a selection effect coming from more active lower wage women enter the labour market in those years. This raises the question of employment and labour supply effects that is addressed in Fig. 6.2.

Fig. 6.2 presents the labour supply effects of sports participation using the categories full-time work, part-time work, unemployed, and out-of-the labour force. No significant long-run labour supply effects appear for men. However, for women there is an increase in the probability of full-time employment that goes along with a decline in the share of women considered as being out-of-the-labour force.

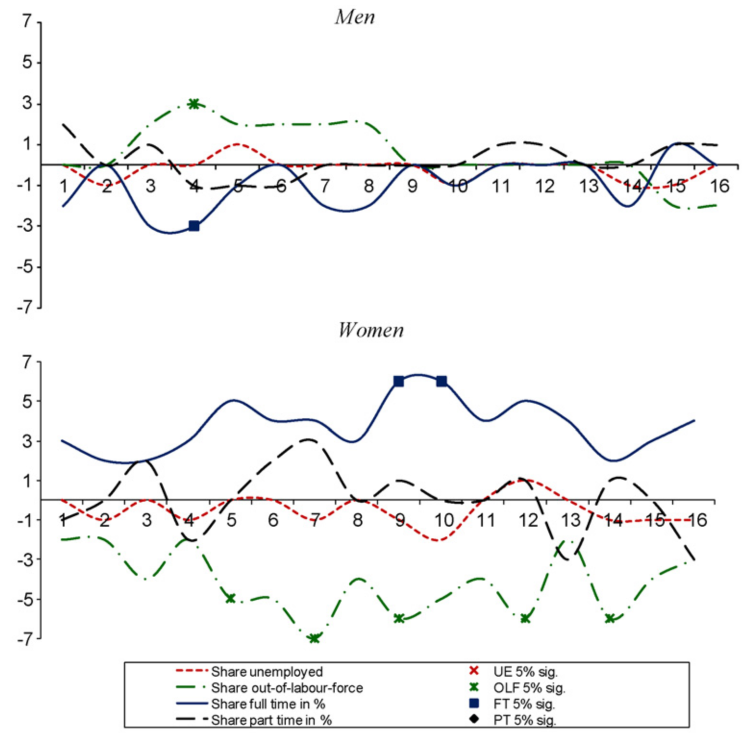
The question arises where these positive earnings and wage effects come from, as they are not much related to differences in labour supply, at least for women. Therefore, other outcome variables are considered below that may influence productivity as well.

6.3. Other outcome measures

6.3.1. Health effects of sports activities

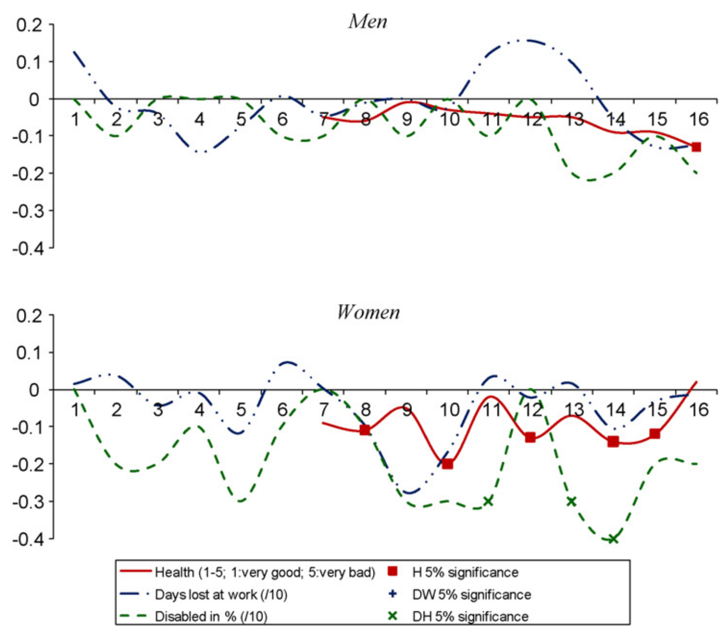
Individual health is assessed with both objective and subjective measures. The degree of disability (i.e. a reduction in the capacity to work on a scale from 0% to 100%), the days unable to work because of illness in the year before the interview, as well as whether the actual case of somebody dying. These measures are supplemented by two subjective health measures: (i) individuals state their health on a five-point scale from very good to very bad (available from year 7 onwards), and (ii) they indicate their general satisfaction with their health status on an 11-point scale.[27]

[27] Generally, it is not considered to be good econometric practice to use ordinal scales directly as outcome measures. However, since using (many) indicators for the



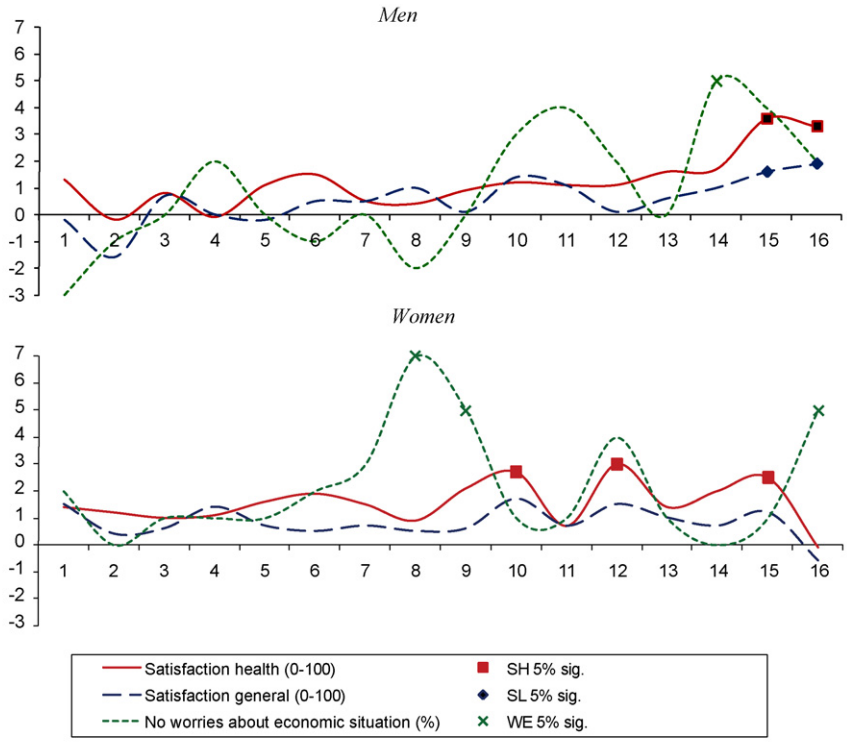
Note: Effects of sport participation at least monthly for the population of individuals who are active in the decision period. A symbol on the line of the mean effect indicates significance at the 5% level based on a two-sided t-test (symmetric bootstrapped p-values based on 499 bootstrap replications). Effects are changes in the shares of the different employment categories (in %-points).

Fig. 6.2. Effect of sports on employment status. *Note*: Effects of sport participation at least monthly for the population of individuals who are active in the decision period. A symbol on the line of the mean effect indicates significance at the 5% level based on a two-sided *t*-test (symmetric bootstrapped *p*-values based on 499 bootstrap replications). Effects are changes in the shares of the different employment categories (%-points).



Note: Effects of sport participation at least monthly for the population of individuals who are active in the decision period. A symbol on the line of the mean effect indicates significance at the 5% level based on a two-sided t-test (symmetric bootstrapped p-values based on 499 bootstrap replications). All health indicators are defined such that a negative value implies that sports participation led to an improved health situation. The general health measure is only available beginning with period 7.

Fig. 6.3. Effects of sports participation on health. *Note*: Effects of sport participation at least monthly for the population of individuals who are active in the decision period. A symbol on the line of the mean effect indicates significance at the 5% level based on a two-sided *t*-test (symmetric bootstrapped *p*-values based on 499 bootstrap replications). All health indicators are defined such that a negative value implies that sports participation led to an improved health situation. The general health measure is only available beginning with period 7.



Note: Effects of sport participation at least monthly for individuals who are active in the decision period. A symbol on the line of the mean effect indicates significance at the 5% level based on a two-sided t-test (symmetric bootstrapped p-values based on 499 bootstrap replications).

Fig. 6.4. Effects of sports participation on satisfaction with life and health and worries about the economy. *Note*: Effects of sport participation at least monthly for individuals who are active in the decision period. A symbol on the line of the mean effect indicates significance at the 5% level based on a two-sided *t*-test (symmetric bootstrapped *p*-values based on 499 bootstrap replications).

Since all health indicators show a similar pattern over time, Fig. 6.3 presents only three of them, namely the days lost at work (as a measure of direct productivity loss due to bad health), the share of individuals reporting any disability, as well as the individually perceived state of health using the five-point scale (1: very good; 5: very bad). Thus, negative values in Fig. 6.3 indicate a positive health effect of sports participation. Detailed results for the other health indicators are available in the internet appendix. The indicator of the satisfaction with health is presented in Fig. 6.4.

All in all, there are positive health effects on the subjective scale, although they are rarely significant at the 5% level for men. Concerning satisfaction with one's own health (Fig. 6.4), there is some evidence that satisfaction increases. However, these subjective health effects do not lead to a reduced number of lost days at work due to (temporary) illness. However, the share of people certified as having some degree of permanently reduced work ability due to disability is decreased in the longer run. The estimate of this decrease is however volatile and only significant for women.

Whereas these variables are observable over a longer period, for recent years the GSOEP also contains variables describing the subjective impact of health on the tasks of daily life (see Appendix A for more details) as well as body weight. The effects on these variables, presented in Table 6.1 seem to confirm the findings for the subjective health measures. There are robust and significantly positive effects for women and men (significance levels are indicated with '+' for 10%, '*' for 5%, and '**' for 1%). However, in some cases these effects are too small to be significant at conventional levels.

With respect to weight, there is a significant weight reduction for men of almost 2 kg, but no significant effect for women.[28]

6.3.2. *Effects of sports participation on worries, and life satisfaction, and marital status*

The next step goes beyond the direct health indicators and considers three different indicators for different aspects of general well-being in Fig. 6.4. The indicators measure whether the individual is worried about the economic situation, his/her general satisfaction with life (10-point scale: 0, very low; 10, very high), as well as the general satisfaction with health (already discussed).

In both samples there is some evidence that worries about the economy in general are reduced, although estimates are volatile and significance levels vary. For men, there is also some indication that satisfaction with life in general is significantly increased in the long run. For women the effect goes in the same direction (with the exception of the last period), but appears to be too small and too noisy to become significant.

6.4. *On the channels creating the earnings effects*

One might speculate on the channels by which the gains in wage and earnings are transmitted. One channel could be health, i.e. gains in earnings just reflect the increased productivity due to better

specific values of the scales qualitatively leads to the same results as when using the scales directly, the effects on the ordinal scales are good summary measures in this case.

[28] However, pre-decision weight is not available as control variables. This fact renders the results for these variables less reliable. Note also that 'height' is used as a control variable in the propensity score.

Table 6.1
Effects of sports participation on health after 16 years, weight and drinking.

Outcome variable	Men		Women	
	Effect	*p*-Value (%)	Effect	*p*-Value (%)
Mental health (summary measure)	0.8	9	0.9	11
Vitality	0.5	42	0.9	12
Social functioning	1.1*	3	0.6	25
Role emotional	0.6	20	0.8	21
Mental health	0.9+	7	1.1*	3
Physical health (summary measure)	0.8+	8	0.6	20
Role physical	1.1*	1	0.7	21
Physical functioning	0.9+	9	1.3**	0
Bodily pain	0.3	56	0.6	22
General health	1.4*	1	0.3	61
Weight (kg)	−1.8*	3	−0.34	52

Note: The health measures are based on a standardized scale from 0 to 100 with standard deviation 10. 100 denotes the best and 0 the worst health status. See Appendix A.1 for details. One (two) '*' denotes significance at the 5% (1%); + denotes significance at the 10% level. Significance levels are based on two-sided *t*-test (symmetric bootstrapped *p*-values based on 499 bootstrap replications). Drinking is measured on a four-point scale (4: never, . . ., 1: regularly).

health. To check that possibility, various long-run health variables are included in the analysis as additional control variables. If the effects originate from the health effects only, then it is expected that conditional on health, the effects will disappear. Doing so reduces the long-run effects for men and women by about 15–20%.

When we condition in addition on general life satisfaction, worries, number of kids, and family status, then for women the earnings effects are halved. However, for men the effects are only reduced by a further 20%. These results suggest that although health and other subjective variables contribute substantially to the effects of sports activity, there remains a unobserved and unexplained component, which is more important for men than for women. Thus, other channels, perhaps relating to social networking, are relevant as well.

6.5. Sensitivity checks

Several checks are performed to better understand the sensitivity of the results with respect to arbitrary specification and variable choices and to discover further heterogeneity.

The first set of checks concerns socio-demographic variables influencing outcomes and selection that do not come as a surprise but can be planned or anticipated. Thus, the individual may take into account events that materialize in these variables 1 or 2 years later. If this is true, these future values of such variables should be included in the probits or sample selection rules as they indicate current or past decisions that have not yet materialized. Here, children and being married (2 years ahead) are included in the probits. Furthermore, individuals with days in the hospital in the current and the following year (1 year ahead) were removed from the sample. However, the results are robust to both changes. In a similar attempt several ways to specify the health variables (different functional forms, different sets of variables) are explored, but the final results are not sensitive to different (reasonable) ways to measure health. The health variables are also used to select the sample in different ways, but again no sensitivity was detected.

The second set of checks concerns the definition of the sports variable. The following checks are performed: (i) comparing the two most extreme categories (1 & 2) to the no-sports category (4); (ii) comparing (1) to (3 & 4); (iii) comparing (2 & 3) to (4) motivated by the consideration that too much sports may be not good either; (iv) comparing (1 & 2 & 3) with (4). However, these changes did not change the results much, although it should be noted that the sharper definitions (i)–(iii) reduce the number of observations and thus leads to noisier estimates. In another check, estimation was conducted without conditioning on the previous sports status. This results in more precise estimates of the effects. In particular further health variables are significant (in the expected direction). Nevertheless, this specification remains dubious because of the endogeneity problems discussed above.

To understand the robustness with respect to enforcing the balanced panel structure, the effect of sports participation on being in the balanced part of the sample has been estimated using an unbalanced panel design. It turned out that there is no such effect and thus it appears innocuous to require a balanced panel over such a long horizon.

The age restriction may also be of concern as some fairly young individuals are included when requiring a lower age limit of 18 year, some of them may still be in the education system. Restricting the sample to individuals 24 years old and older leads to an efficiency loss due to the smaller sample, but otherwise to similar results. Increasing the upper age limit to 50 years instead of 44 years increases precision but some of the individuals are now 65 years old at the end of the follow-up period. Therefore, more observations withdraw from the labour market and it is much harder to detect any earnings effects.

There is a trade-off between sample size and the length of the observation window. Since the 2006 survey is the last one available, using 16 years allows analyzing sports activities until 1990. Increasing the observation period further would require using activity information prior to 1990 only and thus reducing sample size further. Since Section 4 will show that the precision of the estimates is already an issue, it appears that any further reduction of the sample size comes at a high price.

Furthermore, the sample has been restricted to those working full-time in the relevant period to get the 'pure' earnings effects. The results point in the same direction as those for the overall sample. However, the samples are reduced considerably and the additional noise made it very hard to obtain enough precision to obtain significant estimates.

In conclusion, the results appear to be robust to reasonable deviations from the specifications underlying the conclusions drawn in the previous sections.

7. Conclusion

This microeconometric study described the correlates of sports participation and analyzed the effects of participation in sports on long-term labour market variables, on socio-demographic variables, as well as on health and subjective well-being outcomes for West Germany using individual data from the German Socio-Economic Panel Study (GSOEP) 1984–2006. The issue that people choose their level of sports activities and, thus, participants in sports may not be comparable to individuals not active in sports, is approached by using informative data, flexible semiparametric estimation methods, and by a specific utilization of the panel dimension of the GSOEP.

The analysis of the selection process into leisure sports activities suggests that sports activities are higher for men than for women, and much lower for non-Germans, particularly for non-German women. Activities increase with education, earnings, and 'job quality'. Marriage, children, and older age are associated with lower sports activities.

The analysis of the effects of sports activities on outcomes revealed sizeable labour market effects. As a rough estimate, active sports increases earnings by about 1200 EUR p.a. over a 16-year period compared to no or very low sports activities. These results translate into returns on sports activities in the range of 5–10%, suggesting similar magnitudes as for one additional year of schooling. Increased health and improved well-being in general seem to be relevant channels to foster these gains in earnings.

Future research should focus on improving data quality in longitudinal studies to better understand how the channel from sports participation to labour market outcomes. Such improved data should include not only more detailed health and life style data, but also more information on the intensity and type of sports activity. It would also be important to increase the sample sizes, as the current analysis was frequently confronted with the problem that samples were too small to investigate interesting heterogeneity issues. Apparently, even if such a database is initiated now, it would take a long time before it could be used for any empirical analysis. Until then, it is hoped that this paper provides valuable information about the effects of leisure sports participation on labour market and socio-demographic outcomes.

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Appendix A. Data issues

A.1. Definition of some important variables

This section provides some additional information on key variables, such as the variables defining sports participation, outcomes, and covariates. Discussing all of the latter variables would go beyond the space constraints of this paper, so the discussion is restricted to some variables that are important as well as non-standard, such as the health information as well as further subjective indicators of the quality of life.

A.1.1. Sports participation in the GSOEP

The information on leisure sports activity differs over the years. For example, in the initial survey of 1984, the relevant question asked in three categories whether people do sports in their free time ("How often do you engage in the following activities in your free time? Active sports: never/rarely; occasionally; often/regularly"). Individuals answering 'never/rarely' and 'occasionally' constitute the *no-sports sample* with respect to the sports decision in 1985, whereas the remaining group constitutes the *sports sample*.

In 1985 and thereafter there were two types of questions. Both are more precise than the 1984 version: The first type says "Which of the following activities do you do in your free time? Please enter how often you practice each activity. . . . Active sports participation: each week; each month; less often; never". This question was posed in 1985, 1986, 1988, 1992, 1994, 1996, 1997, 1999, 2001, and 2005. The alternative formulation used in 1990, 1995, 1998, and 2003, was "How frequently do you do the following activities? . . . do sports: daily; once per week; once per month; less than once a month; never". Although, the wording is not exactly the same, once the extreme categories (daily, once a week as well as never, less than monthly) of the second type of the questions are aggregated, both types of questions appear to be sufficiently similar to be used in combination. This is also corroborated by a comparison of the respective descriptive statistics over time (see Table 3.1 and the discussion in Section 3.3). A more serious problem is that for the years 1987, 1989, 1991, 1993, 2000, 2002, and 2004 no such information is available. When required for the definition of the pre-participation status and the outcomes, the missing information is taken from the previous year.

A.1.2. Health information

Health is measured by several variables. One of the health questions uses a five-point scale and the following wording: "How would you describe your health at present? Very good; good; satisfactory; poor; very poor." Further variables for satisfaction with health are based on the following wording "How satisfied are you today with the following areas of your life? Please answer by using the following scale, in which 0 means totally unhappy and 10 means totally happy. If you are partly happy and partly not, select a number in between. How satisfied are you . . . with your health?".[29]

There may be an issue with the quality of the content of the subjective health information. Although recent work suggests that the quality of self-assessed health data may have some random component that may be related to other socio-economic variables (i.e. Crossley and Kennedy, 2002), the fact that a panel data set is used and that many socio-economic characteristics are conditioned on in the empirical analysis suggests that these issues are not particularly relevant for this analysis.

Nevertheless, these subjective, qualitative measures are supplemented by more objective health measure as the degree of disability (0–100%), whether the individual experiences any chronic diseases, as well as the number of days unable to work in the last year. All of these variables are available since the beginning of the survey. Therefore, they can be used to control for 'pre-sports-decision' health conditions and used as outcome variables. In 2002, the GSOEP biannually added information based on how health status is impairing daily life (based on the SF-12x2 battery).[30] Since

[29] All translations of the questions from the (German) questionnaires are taken from the official website of the GSOEP (http://panel.gsoep.de/soepinfo2006).

[30] The internet appendix contains the English translation of the respective questions.

Table B1
Matching protocol for the estimation of the average effect for sports participants.

Step 1	Estimate a probit model to obtain the choice probability conditional on covariates for all observations: $\hat{P}(X_i)$
Step 2	Restrict sample to common support: Delete all observations with probabilities larger than the smallest maximum and smaller than the largest minimum of both subsamples defined by sport participation status. In each of the 4 strata no more than 20 observations had to be removed.
Step 3	*Estimate the respective (counterfactual) expectations of the outcome variables.* The following steps are performed in each of the strata: **Standard propensity score matching step (binary treatments)** a-1) Choose one observation in the subsample defined by participation in sports and delete it from that pool. b-1) Find an observation in the subsample of non-participants that is as close as possible to the one chosen in step a-1) in terms of $\left[\hat{P}(x), \tilde{x}\right]$. 'Closeness' is based on the Mahalanobis distance. Do not remove that observation, so that it can be used again. c-1) Repeat a-1) and b-1) until no participant in sports is left. **Exploit thick support of X to increase efficiency (radius matching step)** d-1) Compute the maximum distance (d) obtained for any comparison between treated and matched comparison observations. a-2) Repeat a-1). b-2) Repeat b-1). If possible, find other observations in the subsample of non-participants in sports that are at least as close as $R * d$ to the one chosen in step a-2) (to gain efficiency); we choose R to be 90%. Do not remove these observations, so that they can be used again. Compute weights for all chosen comparisons observations that are proportional to their distance (calculated in b-1). Normalise the weights such that they add to one. c-2) Repeat a-2) and b-2) until no participant in sports is left. d-2) For any potential comparison observation, add the weights obtained in a-2) and b-2). **Exploit double robustness properties to adjust small mismatches by regression** e) Using the weights $w(x_i)$ obtained in d-2), run a weighted linear regression of the outcome variable on the variables used to define the distance (and an intercept). f-1) Predict the potential outcome $y^l(x_i)$ of every observation in l (no sports) and m (*sports)* using the coefficients of this regression: $\hat{y}^l(x_i)$ f-2) Estimate the bias of the matching estimator for $E(Y^l \mid S=m)$ as: $\sum_{i=1}^{N} \frac{\underline{1}(S=m)\hat{y}^l(x_i)}{N^m} - \frac{\underline{1}(S=l)w_i\hat{y}^l(x_i)}{N^m}$. g) Using the weights obtained by weighted matching in d-2), compute a weighted mean of the outcome variables in *the non-active*. Subtract the bias from this estimate. **Final estimate** h) Compute the treatment effect by subtracting the weighted mean of the outcomes in the comparison group of non-active from the weighted mean in the group of sports participants.

Note: When a particular outcome variable *Y* is binary, binary logits estimated by weighted maximum likelihood (see Manski and Lerman, 1977) are used instead of weighted linear regressions. However, since all these regression type adjustments are post-matching and thus strictly local, using regressions or logits does not change the results in any significant way (for the binary variables).

the measurements relate to 2002 and later, these variables do not play any role as control variables, but are used as outcome variables only. The empirical analysis uses these variables, the subscales that relate to different types as well as the overall state of mental and physical health.

In addition to these variables, there is also information on body weight and height (and thus BMI) which are used as outcome variables. Furthermore, since height is (almost) time constant, it is used as control variable as well.

A.1.3. Further subjective variables

The questions about worries are phrased in the following way: "How about the following areas? Do they worry you? . . . general economic development: . . . Very worried, slightly worried, not worried". The variable used in the empirical analysis is an indicator for 'very worried'.

Finally, the question about satisfaction with life in general is worded in the following way: "At the end we would like to ask you for your satisfaction with your entire life. Please answer by using the following scale, in which 0 means totally unhappy and 10 means totally happy. How happy are you at present with your life as a whole? . . .".

Of course, similar concerns as those related to the subjective health measured may be raised with regard to subjective well-being measures.[31] Again, note that this issue would only be relevant, if

[31] However, Krueger and Schkade (2007) study the reliability of such measures and conclude optimistically that "While reliability figures for subjective well-being measures are lower than those typically found for education, income and many other microeconomic variables, they are probably sufficiently high to support much of the research that is currently being undertaken on subjective well-being, particularly in studies where group means are compared (e.g., across activities or demographic

there was a systematic difference in the reliability between participants and non-participants in sports activities. It is very hard to see why this should be the case.

A.2. Sample selection rules

The motivation and construction of the sports and no-sports sample, as well as the pooling of the different sport-participation decisions are already discussed in the main part of the text. The following additional sample selection rules are applied: (i) Individuals without valid sports information in the relevant years of and before the participation decision are not taken into consideration. (ii) The analysis is based on a balanced panel over up to 19 years so that the long-term outcome variables as well as the covariates have meaningful measurements. (iii) Individuals are restricted to be aged between 18 and 44. The lower age limit is to avoid analyzing individuals still in school, whereas the upper limit is imposed to avoid that retirement issues become too important, as individuals will not be older than 60 when their long-term outcomes are measured. (iv) Only individuals not disabled in the years of and before the participation decision are considered. (v) It is required that during the year of the decision as well as the year after the decision the individual must not have stayed in a hospital. Both restrictions are imposed to be able to concentrate on the healthy part of the population. (vi) Due to very small cell sizes, individuals in agriculture and mining, etc., both physically demanding occupations, are removed.

Appendix B. Further information on the econometric methods used

B.1. Details of the matching estimator

For the sake of completeness, the matching protocol for the estimator used here is reproduced in Table B1. For further details the reader is referred to Lechner et al. (2005).

B.2. Details of the implemented bootstrap procedure

Having estimated the effect ($\hat{\theta}$), its standard error ($\widehat{std(\hat{\theta})}$), and the 'normal' t-statistic ($\hat{t} = \hat{\theta}/\widehat{std(\hat{\theta})}$) for the hypothesis that the effect is zero in the data, the bootstrap is implemented using the following steps:

(1) Draw a random (bootstrap) sample from the initial population in the GSOEP.
(2) Impose all sample selection rules and pool data over the four starting periods.
(3) Estimate the effect ($\hat{\theta}_r$) and its standard error ($\widehat{std(\hat{\theta})_r}$) in the bootstrap sample. Compute the t-statistic for each bootstrap replication ($\hat{t}_r = \hat{\theta}_r/\widehat{std(\hat{\theta})_r}$).
(4) Repeat (1) to (3) R times (R = 499) and obtain $\{\hat{t}_1, \ldots, \hat{t}_R\}$. As we are interested in the 5% level of significance (α = 0.05), 499 fulfills the criterion given by MacKinnon (2006), namely that $\alpha(R+1)$ should be equal to an integer (*100* in our case).
(5) Compute the symmetric p-value as: $\hat{p}^* = (1/R)\sum_{r=1}^{R} \underline{I}(|\hat{t}_r| > |\hat{t}|)$. $\underline{I}(\cdot)$ denotes the indicator function which is one if its argument is true.

groups)." (last sentence of their abstract).

Appendix C. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jhealeco.2009.05.003.

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