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The monetary value of the demonstration effect of professional sports

Felix Mutter[a]* and Tim Pawlowski[b]

[a]*Institute of Sport Economics and Sport Management, German Sport University Cologne, Am Sportpark Müngersdorf 6, Cologne 50933, Germany;* [b]*Chair for Sport Economics, Sport Management and Sport Media Research, University of Tübingen, Wilhelmstraße 124, Tübingen 72074, Germany*

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Research question: Professional sports fulfil important societal functions. Previous studies have already attempted to quantify the intangible benefits of successful national athletes or hosting major sporting events. This study chooses an alternative channel of quantification. Based on the theoretical framework of sporting role models, it analyses whether the individual relevance of professional sports increases the frequency of sport participation. To quantify this effect, it subsequently analyses whether the increased sport participation increases sport-related expenditure.
Research methods: A quantitative research design based on primary data of approximately 500 German amateur tennis players was chosen. Unfortunately, the econometric identification of the effect of the relevance of professional sports on sport participation behaviours is aggravated by a selection bias. To circumvent this issue, instrumental variables were constructed based on the starting year of the surveyed amateurs' sport participation, which is considered to be exogenous.
Results and findings: The results of the instrumental variable estimations show that amateurs with a higher relevance of professional tennis spend between 21.5% and 24.4% more time playing tennis. In addition, 1% more participation per week increases the yearly sport-related expenditure by approximately 0.45%. Consequently, approximately 200 million euros of the tennis-related expenditure of German amateur tennis participants could be attributed to professional tennis in Germany.
Implications: The results of this study provide evidence for positive external effects of professional sports in Germany. These external effects could act as an additional rationale for the use of public funds to promote professional sports.

Keywords: demonstration effect; professional sport; sport participation; instrumental variables; expenditure

Introduction

Professional sports fulfil important societal functions. Previous research has indicated that both hosting a major sporting event and the success of national athletes could produce feelings of happiness and life satisfaction (Allison & Monnington, 2002; Hallmann, Breuer, & Kühnreich, 2012; Kavetsos & Szymanski, 2010; Maennig & Porsche, 2008), national cohesion (Hong, 2011; van Hilvoorde, Elling, & Stokvis, 2010) and pride (Breuer & Hallmann, 2011; Denham, 2010; Hallmann et al., 2012) – though the latter is subject to some critical discussion (Pawlowski, Downward, & Rasciute, 2013). Recently, economists have attempted to measure these positive external effects with the intention of

*Corresponding author. Email: felix.mutter@gmx.de

partly legitimising the substantial public funding of professional sports (Atkins, Mourato, Szymanski, & Ozdemiroglu, 2008; Pringle, 2001). Employing a contingent valuation method, previous research has found that a country's population is willing to spend considerable amounts of money on both hosting major sporting events (Atkins et al., 2008; Preuß & Werkmann, 2011; Süssmuth, Heyne, & Maennig, 2010) and promoting the success of national athletes (Humphreys, Jason, Mason, & Whitehead, 2011; Wicker, Hallmann, Breuer, & Feiler, 2012; Wicker, Prinz, & van Hanau, 2012).

This study intends to quantify the economic value of professional sports through another channel. The so-called demonstration effect of professional sports assumes that professional sports stimuli increase the demand for sport participation in a country (Weed, 2009). Based on the sequences of demand decisions of the model of sport consumption (Downward, Dawson, & Dejonghe, 2009), it is further assumed that sport participation leads to the consumption of sport-related goods and services. Consequently, this study intends to utilise the sport-related expenditure to quantify one aspect of the effect of professional sports on the demand for sport participation, namely the increased expenditure.

A sample of German tennis players was analysed to test that hypothesis.[1] Active participants were surveyed because both the theoretical assumptions and the empirical evidence point out that the demonstration effect of professional sports mainly motivates already active participants to participate more (Mutter & Pawlowski, 2013). In addition, only the expenditure of active participants could be attributed directly to their tennis participation.

To estimate empirically the increase in tennis-related expenditure that can be attributed to professional tennis in Germany, the consecutive estimation of two causal links is required: and the causal effect of the frequency of sport participation on the demand for sport-related expenditure. Instead of an aggregated stimulus of professional sports, such as a major sporting event, this study employs the perceived relevance of professional sports, a concept that is based on the psychological construct of involvement (Zaichkowsky, 1985). In this way, differences in the individual responses to professional sports stimuli can be considered (Pawlowski et al., 2013). The econometric identification of this effect is aggravated by a potential selection bias: first, it is assumed that people with a high frequency of sport participation report a higher relevance of professional sports anyway, regardless of the causal effect of professional sports. Second, it is assumed that some expenses, e.g. purchasing new sport equipment, could initiate a desire to participate in sport more frequently. To avoid biased estimates, models with instrumental as well as lagged variables are employed.

This paper broadens the literature considerably. In general, systematic attempts to measure economically the societal effect of sport are largely lacking (Pawlowski & Breuer, 2012a). To date, no attempts have been made to put an economic value on the demonstration effect of professional sports. The first exploratory estimation of this effect provides a useful reference point and could act as an additional argument for the funding of professional sports. Moreover, there is still a need for a better understanding of whether professional sports causally increase the level of sport participation in a country.

This paper is structured as follows. Section 2 discusses the theoretical considerations related to the research questions. In section 3, the previous empirical evidence on the two causal links of interest is reconsidered. The sample selection, the variables and the identification strategies are presented in section 4. The descriptive and analytic results

follow in section 5. Finally, section 6 interprets the results and highlights their implications and limitations.

Theoretical considerations

Previous studies have employed different theoretical approaches, i.e. neoclassical or heterodox approaches, to analyse the demand for sport participation (Downward, 2007; Humphreys & Ruseski, 2011). This study's approach is based on the sequences of demand decisions of the model of sports consumption. Depending on personal tastes and preferences and subject to a budget constraint of time and money, individuals decide subsequently whether they participate in sport, how often they participate and how much money they spend on their sport participation (Downward et al., 2009).

According to the framework of sporting role models, professional sports can influence the preferences for sport participation (Mutter & Pawlowski, 2013). The framework is derived from a modern conceptualisation of role models introduced into a vocational setting by Gibson (2003, 2004) and Jung (1986). Due to their exceptional status and the extensive media coverage, professional athletes can be characterised as role models. However, there is often no personal relationship between the sporting role models and the observers. Consequently, the influence of sporting role models might appear distant and erratic, especially when compared with the influences of other potential role models, like family members or members of the peer group (Bandura, 1986; Lyle, 2009).

Role models are assumed to motivate people (Jung, 1986). According to Mutter and Pawlowski (2013), sporting role models can either inspire non-participants to start participating or motivate already active participants to participate more. However, it is assumed that role models most likely affect already existing behavioural tendencies, rather than changing them (Jung, 1986). As Lyle (2009) pointed out, an effect of role models on non-participants is rather unlikely because the motivations and barriers to sport participation are too complex. Similarly, Weed (2009, p. 7) discussed three potential outcomes of the demonstration effect of professional sports, which was conceptualised as a 'process, by which people are inspired by elite sport, sports people or sports events to participate themselves': (1) the number of participants could increase, (2) the frequency of participation of existing participants could increase, and (3) participants could switch between different sporting activities. In line with Mutter and Pawlowski (2013), he found that the demonstration effect is strongest if the initial barriers to sport participation have already been overcome. Consequently, the outcome of primary interest of this study is the effect of professional sports on the frequency of sport participation of already active participants.

The availability of professional sports is a necessary condition for any motivational effect (Mutter & Pawlowski, 2013). Extensive media coverage, the hosting of major sporting events, charismatic star athletes or the outstanding success of national athletes provide or increase the availability of professional sports. Moreover, the perceived similarity to a model is assumed to determine the model's motivational effect (Mutter & Pawlowski, 2013). The perceived similarity is related to external dimensions such as the nationality, the gender or the sport practised. Consequently, a female German professional tennis player is most likely to motivate a female German amateur tennis player. In addition, internal similarity dimensions, e.g. the perceived capability of individuals to replicate the observed behaviour, influence the motivational effect of role models (Lockwood & Kunda, 1997).

To model the demand for sport-related goods and services, the neoclassical theory was extended with Becker's (1965) theory of household production and Stigler and Becker's (1977) concept of consumption capital (Wicker, Breuer, & Pawlowski, 2010; Wicker, Prinz, & Weimar, 2012). Consumption capital can be accumulated by the repeated consumption of a good or service over time. This capital is now assumed to increase the utility of future consumption of the respective good or service (Stigler & Becker, 1977). The time spent on sport participation builds up a stock of sport-specific consumption capital, e.g. personal skill, sport-specific knowledge, knowledge of equipment, techniques or tactics. It is assumed that the utility derived from the consumption of sport-related goods and services, e.g. a new tennis racket or additional training hours, depends on that consumption capital.

Empirical evidence

The empirical evidence for both causal effects, (1) the effect of professional sports on the frequency of sport participation and (2) the effect of the frequency of sport participation on sport-related expenditure, will be reviewed consecutively.

Professional sports on the frequency of participation

Multiple studies have analysed whether professional sports stimuli influence the motivation for sport participation. With reference to role models, Mutter and Pawlowski (2013) found that the successes of the German national soccer teams (female and male) have a strong motivational effect on German amateur soccer players. Approximately one-third of the male amateurs and one-half of the female amateurs reported that these successes increase their intentions to participate more in amateur soccer. Similarly, Weed (2009) found that the demonstration effect of professional sports most likely increases the frequency of participation of regular participants. In addition, lapsed participants can sometimes be reactivated.

Moreover, various studies and research reports have found additional evidence for a motivational effect of outstanding success of national athletes (Hallmann et al., 2012; IpsosMORI, 2009), sport-related media behaviour (Lines, 2007), star athletes (Schmidt & Högele, 2011) or hosting a major sporting event (UK SPORT, 2011; Weed, Coren, & Fiore, 2009; Weed et al., 2012). Nearly all the studies concluded that such a motivational effect is stronger for already active participants than for non-participants.

Previous research has analysed, to some extent, whether professional sports not only motivate individuals, but indeed influence the demand for the frequency of sport participation (Dawson & Downward, 2011, 2013; Downward, Lera-López, & Rasciute, 2011). Downward and Dawson (2011) analysed the DCMS Taking Part Survey and found that following professional sports is positively correlated with the frequency of weekly sport participation. Watching sports on television was correlated with 67 minutes more sport participation per week. In addition, attending a live sport event as a spectator in the four weeks before the interview was correlated with 44 minutes more sport participation per week. However, a selection bias could challenge the causality of these results. It can be assumed that people who watch sports on television or attend events as a spectator participate more in sports anyway, regardless of the causal effect of professional sport variables. The studies of both Lera-López, Ollo-López, and Rapún-Gárate (2012) and

Thrane (2001a) seem to confirm this view. They revealed that a higher frequency of participation in sports increased the probability of attending a live event as a spectator.

Summing up, the literature reveals several shortcomings regarding the causal effect of professional sports on the frequency of sport participation. (1) Most studies have only analysed a stated motivation for sport participation. However, such a motivation is not subject to a budget constraint, i.e. people could be motivated by professional sports, but this motivation does not lead to a behavioural outcome because of a lack of time or money. (2) Most studies have not accounted for the potential heterogeneity of individual responses to professional sports, i.e. they have analysed aggregated outcomes like membership figures or participation rates. (3) Studies that have estimated the effect of professional sport variables on the frequency of participation have not accounted for the potential endogeneity of the professional sport variables.

Determinants of sport-related expenditure

According to Taks, Renson, and Vanreusel (1999), the frequency of sport participation is the most relevant determinant of sport-related expenditure. Indeed, as summarised in Table 1, all the related studies that observed both variables revealed a positive effect of the frequency of participation on the amount of sport-related expenditure. Unfortunately, different measures of the frequency of sport participation and of the expenditure aggravate the comparability of the results. In addition, only a few studies have quantified the magnitude of the effect of interest. According to Thrane (2001b), a one unit increase in an ordinal measure of sport participation increased the sport-related expenditure by 105%, which equals $336 per year. Analysing aggregated data on 21 different sports, Wicker et al. (2010) found that one additional hour of sport participation per week increased the sport-related expenditure by €263 per year. Furthermore, Wicker, Prinz and Weimer (2012) revealed that a one-hour increase in the weekly participation of German triathletes increased their sport-related expenditure by €165 per year.

Regarding the other determinants of sport-related expenditure, most studies have agreed that the amount of expenditure is higher for males (Dardis, Soberon-Ferrer, & Patro, 1994; Lamb, Asturias, Roberts, & Brodie, 1992; Lera-López & Rapún-Gárate, 2005, 2007; Løyland & Ringstad, 2009; Preuß, Alfs, & Ahlert, 2012; Scheerder, Vos, & Taks, 2011; Thrane, 2001b; Wicker et al., 2010) and increases with income (Breuer & Schlesinger, 2006; Dardis et al., 1994; Lera-López & Rapún-Gárate, 2005, 2007; Preuß et al., 2012; Scheerder et al., 2011; Taks et al., 1999; Thrane, 2001b; Wicker et al., 2010; Wicker, Prinz & Weimer, 2012). Pawlowski and Breuer (2011, 2012b) found that households with a higher income had a higher probability of spending money on sport and recreational services. However, those households that spent money spent relatively less the more money they had available. Some studies found that increasing age decreases the amount of sport-related expenditure (Lamb et al., 1992; Lera-López & Rapún-Gárate, 2007; Thrane, 2001b). However, most studies have not identified a significant linear age effect. The evidence of the effect of education on sport-related expenditure is contradictory. While some studies have revealed a positive effect (Lera-López & Rapún-Gárate, 2005; Scheerder et al., 2011; Thrane, 2001b), others have not found a significant linear effect of higher education on sport-related expenditure (Dardis et al., 1994; Lera-López & Rapún-Gárate, 2007; Pawlowski & Breuer, 2011; Taks et al., 1999; Wicker, Prinz & Weimer, 2012).

Few studies have explicitly analysed the sport-related expenditure of tennis players (Preuß et al., 2012; Puhe, Ossyssek, & Leisner, 2005; Taks et al., 1999; Wicker et al.,

Table 1. Empirical evidence for the effect of the frequency of sport participation on sport-related expenditure.

Authors	Sample (*N*/sport)	Measure of sport participation	Measure of sport-related expenditure	Analysis	Effect of participation on expenditure (sign/magnitude)
Jones (1989)	9895/all sports	Ordinal (4 categories)	MF, EF, TC, AP, EQ, LIZ	Descriptive	+
Lamb et al. (1992)	10,013/15 sports	Metric (participation score)	MF, EF, TC, AP, EQ, LIT	Descriptive	+
Weber, Schneider, Kortlüke, and Horak (1995)	2866/all sports	Ordinal (3 categories)	MF, EF, TC, AP, EQ, LIT, TRA, NUT, INS	Descriptive	+
Taks et al. (1999)	900/15 sports	Metric (time investment)	MF, EF, TC, EQ, TRA, NUT, OTH	Regression	+/nn
Thrane (2001b)	1725/all sports	Ordinal (7 categories)	All expenses	Regression	+/105% per one unit increase
Breuer and Hovemann (2002)	1091/inline skating	n.n	MF, EF, TC, AP, EQ, TRA, NUT, INS, VAC, LIT	Regression	+/n.n
Davies (2002)	437/all sports	Ordinal (6 categories)	MF, EF, TC, AP, EQ	Descriptive	+
Lera-López and Rapún-Gárate (2005)	700/all sports	Ordinal (5 categories)	MF, EF, TC, AP, EQ, TRA	Regression	+/n.n
Lera-López and Rapún-Gárate (2007)	700/all sports	Ordinal (5 categories)	MF, EF, TC, AP, EQ, TRA	Regression	+/n.n.
Wicker et al. (2010)	10,013/15 sports	Metric (h/week)	MF, TC, AP, EQ, TRA, INS, LIT, LIZ, MED, NUT, OTH	Regression	+/€263 per one hour increase
Scheerder et al. (2011)	793/all sports	Ordinal (5 categories)	AP	Regression	+/n.n.
Wicker et al. (2012)	786/triathlon	Metric (h/week)	MF, AP, EQ, INS, VAC, LIZ, SER, NUT, MED, LIT, INC, OTH	Regression	+/€165 per one hour increase

Notes: AP: sport apparel, EQ: sport equipment, MF: membership fees, EF: entrance and admission fees, TC: travel costs, TRA: training and instruction, LIT: literature, LIC: licenses and starting fees, NUT: nutrition, INS: insurance, VAC: sport vacation, MED: medication, SER: other sport-related services, OTH: other sport-related expenses, n.n.: not noted in the paper.

2010). The yearly average expenditure ranged between €258 and €1070. Only Wicker et al. (2010) applied regression analysis and revealed that the frequency of participation, the level of income and the subjective skill level significantly increased the amount of tennis-related expenditure. To sum up, the review reveals the considerable inadequacy of the literature in quantifying the effect of the frequency of sport participation on the amount of sport-related expenditure, especially in tennis.

Method

Data and variables

To put an economic value on the demonstration effect of professional sports via the sport-related expenditure, active sport participants had to be surveyed. Unfortunately, a random sampling approach was not feasible. No systematic register of all German amateur tennis players was available. Instead, between January 2012 and March 2012, a convenience sample of $N = 488$ German amateur tennis players was drawn online. The regional tennis associations were contacted and asked to forward the questionnaires to their members. In this way, systematic a-priori selection of respondents could be prevented.

The frequency of sport participation, i.e. the dependent variable of the first causal link, was surveyed by the average hours of tennis participation per week in the current season $[ACTIVITY_t]$. In addition, the hours of participation in the previous season $[ACTIVITY_{t-1}]$ were surveyed.

The total tennis-related expenditure, i.e. the dependent variable of the second causal link, was split into eight variables. In line with the related literature, the respondents were asked to report their average yearly expenditure on tennis equipment *[EQU]* and tennis apparel *[APP]*, club membership fees *[FEE]*, entrance fees for commercial tennis suppliers *[COM]*, training and instruction *[TRA]*, starting fees and licenses *[LIC]*, nutrition during participation *[NUT]* and tennis-related travel costs *[TC]*. The questionnaire explicitly asked only for the expenditures that could be attributed selectively to the active tennis participation. Therefore, categories such as tennis-related literature or sport vacations were excluded (Lera-López & Rapún-Gárate, 2007). Based on all the expenditure variables, the total yearly tennis-related expenditure *[EXPENDITURE]* was calculated.

Analysing the behavioural outcomes of professional sports is aggravated by the problem of attribution. It is difficult to determine from quantitative data whether a behavioural change could distinctly be attributed to one professional sports stimulus, like a major sporting event (Lyle, 2009). Moreover, the perception and interpretation of professional sports stimuli are highly subjective and heterogeneous (Pawlowski et al., 2013). While one person interprets an Olympic silver medal as a success, another might interpret the same event as a failure. To circumvent these issues, the present study employs a measure of perceived relevance of professional sports *[PRO_RELEVANCE]*, which is based on the psychological concept of involvement. Zaichkowsky (1985, p. 342) defined involvement as 'a person's perceived relevance of the object based on inherent needs, value, and interests'. Studies have found that professional sports involvement is an antecedent for specific behavioural patterns, like attending professional sports events or following professional sports through the media (Lascu, Giese, Toolan, Guehring, & Mercer, 1995; Shank & Beasley, 1998).

To measure *[PRO_RELEVANCE]*, the Sports Involvement Inventory (SII) of Shank and Beasley (1998) was employed. The SII is an eight-item semantic differential that was

constructed to assess the perceived relevance of a sports subject on two dimensions, i.e. an affective and a cognitive dimension. It has been empirically tested and applied in several other sport studies (Ko, Kim, & Claussen, 2008; Tokuyama & Greenwell, 2011). In this study, the respondents had to assess professional tennis on the eight item pairs that are shown in Table 2.

After recoding, the mean of the eight items provides a comprehensive measure of the perceived relevance of professional tennis. Further, the respondents were required to rate on a scale from 1 (*low approval*) to 10 (*high approval*) whether the successful era of German professional tennis players, i.e. from 1985 until 2000, had initially influenced their decision to start participating in tennis *[START]*. Finally, a set of sport-specific, demographic and socio-economic characteristics was surveyed. All the variables are presented in Table 3.

Identification

It is assumed that the individual relevance of professional sports is not randomly assigned. Rather, it depends on a choice of the amateurs and, therefore, is not exogenous (Cameron & Trivedi, 2009). According to the framework of sporting role models, the perceived similarity between models and observers influences the motivational effect of the models. A higher frequency of tennis participation could increase this similarity dimension, e.g. because of a higher skill level. Due to this reverse causal effect, *[PRO_RELEVANCE]* may not be independent of the potential outcomes of the frequency of participation. Consequently, an OLS estimation would lead to inconsistent coefficients of the causal effect of interest (Angrist & Pischke, 2009). The identification of the causal effect of the relevance of professional tennis on the frequency of amateur participation requires the estimation of an additional model with instrumental variables.

An instrument is a very special variable that satisfies two assumptions (Angrist & Krueger, 2001). (1) The instrument has to be relevant, i.e. it has to be partially correlated with the endogenous regressor, namely *[PRO_RELEVANCE]*. (2) The instrument has to be exogenous, i.e. it has to be uncorrelated with the dependent variable, namely *[ACTIVITY]*, besides its influence on the endogenous regressor.

The instrument was deduced from the peculiar history of professional tennis in Germany. The Wimbledon title of Boris Becker in 1985 initiated an era of success for contemporary German tennis. Until 1999, an outstanding number of 29 Grand Slam titles was won, mainly by the athletes Stefanie Graf (22 titles), Boris Becker (6) and Michael

Table 2. The Sports Involvement Inventory, adapted to tennis (Shank & Beasley, 1998). Respondents answered the question: 'For me, professional tennis is…'

	1	2	3	4	5	6	7	
Boring								Exciting
Interesting								Uninteresting
Valuable								Worthless
Appealing								Unappealing
Useless								Useful
Not needed								Needed
Irrelevant								Relevant
Important								Unimportant

Table 3. Relevant variables.

Variable	Description	Scale
Tennis		
$ACTIVITY_t$	Hours of tennis participation per week	Metric
$ACTIVITY_{t-1}$	Hours of tennis participation per week of the last season	Metric
PRO_RELEV.	Professional tennis involvement (from 1 to 7)	Ordinal
EXPER	Years of active tennis participation	Metric
1986to2000	Started tennis between 1986 and 2000	Binary
START	Influence of the successes of German professional tennis on the starting decision (from 1 to 10)	Ordinal
SUCCESS	Started between 1986 and 2000 and START = 10	Binary
Sport-related expenditure		
EXPEND.	Yearly average: total tennis-related expenditure	Metric
EQU	Yearly average: tennis equipment	Metric
APP	Yearly average: tennis apparel	Metric
FEE	Yearly average: tennis club membership fees	Metric
COM	Yearly average: entrance fees for commercial tennis supplier	Metric
TRA	Yearly average: training and instruction	Metric
LIC	Yearly average: starting fees and licenses	Metric
NUT	Yearly average: nutrition during tennis participation	Metric
TC	Yearly average: tennis-related travel costs	Metric
Personal characteristics		
AGE	Years of age	Metric
FEMI	Feminine (1 = yes)	Binary
FAMILY	Household size in numbers	Metric
MARRIED	Married (1 = yes)	Binary
SINGLE	Single (1 = yes)	Binary
RELA	Lives in a relationship (1 = yes)	Binary
Educational status		
NONE	No graduation (1 = yes)	Binary
SECOND	Secondary school graduation (1 = yes)	Binary
DEGREE	University entrance degree (1 = yes)	Binary
UNIV	University or PhD degree (1 = yes)	Binary
Occupational status		
SCHOOL	School pupil (1 = yes)	Binary
APPREN	Apprenticeship or undergraduate (1 = yes)	Binary
PARTTIME	Part-time employment (1 = yes)	Binary
FULLTIME	Full-time employment (1 = yes)	Binary
RETIRED	Retired (1 = yes)	Binary
OTHER	Other employment (1 = yes)	Binary
Family income		
INC1000	Monthly net income: under €1000 (1 = yes)	Binary
INC2000	Monthly net income: between €1000 and €2000 (1 = yes)	Binary
INC3000	Monthly net income: between €2000 and €3000 (1 = yes)	Binary
INC3000+	Monthly net income: over €3000 (1 = yes)	Binary

Stich (1). In addition, Becker and Stich won the doubles tournament of the Olympic Games in 1992. Moreover, the male team won three Davis Cup titles (1988, 1989 and 1993) and the female team won two Fed Cup titles (1987 and 1992). Surprisingly, after the French Open title of Graf in 1999, not a single major title could be won by German athletes. To summarise, a very successful 15-year period of German professional tennis is surrounded by periods of no major successes at all.

According to the framework of sporting role models, the availability of role models is a necessary condition for their motivational effect. Fifteen years of outstanding achievements in combination with the surrounding media coverage ensured the availability of professional tennis in Germany. Before and after this period of time, the availability of German professional tennis is assumed to have been significantly lower. The question of whether an amateur player has been attracted to tennis by the successful era of the German athletes was used as an instrument for contemporaneous relevance of professional tennis.[2]

According to Kenyon and McPherson (1973), the relevance of professional sports is a persistent attitude. In addition, there is some theoretical and empirical evidence that related concepts, like fandom to a professional sports team, are also persistent over time (Funk & James, 2001, 2006; Ross, James, & Vargas, 2006). Consequently, it is assumed that *[SUCCESS]* has a partial effect on *[PRO_RELEVANCE]*, which satisfies the instrument relevance. The instrument *[SUCCESS]* is assumed to be exogenous. Because of the temporal order of determination, the instrument is independent of the potential outcomes of the frequency of sport participation, i.e. it cannot have been influenced by the participation itself. Finally, after controlling for non-linear age and experience effects, the instrument did not influence the dependent variable, other than through the first-stage channel.

The information on two variables was used to determine this effect. Firstly, the starting year of the amateurs was derived from their reported experience. All the amateurs who started in 1986, i.e. the first year after Becker's first success, until 2000, i.e. the year after the last success of Graf, were assumed to have been potentially influenced by the era of successful professional tennis *[1986to2000]*.[3] However, during this period of time, the German sport federations heavily promoted sport participation with various campaigns (Keiner, 2006). Consequently, a positive trend in sport participation in general could be observed before and during this period (DOSB, 2012; van Bottenburg, Rijnen, & van Sterkenburg, 2005). It follows from this that not all of the newly gained tennis participants could be attributed explicitly to the professional tennis successes. Therefore, a second variable, i.e. *[START]*, directly asked whether the successes of the German professional tennis players had influenced the decision to start participating in tennis.

Based on both variables, a new binary variable *[SUCCESS]* was constructed. Each individual who reported a value of 10 for the variable *[START]*, i.e. the highest approval, and a value of one for the variable *[1986to2000]*, i.e. started his or her participation during the era of successful professional tennis, was assigned a value of one. Only the category of highest approval *[START= 10]* was chosen because it casts no doubt on the respective decision. Nevertheless, to check the sensitivity of the results, additional instruments with *[1986to2000]* = 1 and *[START]* = 9–10 and *[START]* = 8–10, respectively, were employed. The results are reported in the appendices.

Model specification

Research has suggested that the decisions about sport participation and sport-related expenditure are distinct (Downward et al., 2009; Lera-López & Rapún-Gárate, 2005, 2007). Therefore, it was assumed that the errors of the two equations are uncorrelated and the two causal effects of interest were estimated consecutively.[4]

For the effect of the relevance of professional tennis on the frequency of tennis participation, a standard linear model is considered:

$$\ln y = \alpha + \beta q + \gamma x + \varepsilon, \tag{1}$$

with the logarithm of weekly hours of tennis participation as the dependent variable y, the standardised relevance of professional tennis as the regressor of primary interest q, a K × 1 vector x of control variables and an error term ε. The dependent variable was included in logarithmic form because it can be assumed that the regressors affect the frequency of sport participation in a non-linear way, e.g. not every additional year of experience has the same constant effect on the sporting behaviour. In line with previous studies that modelled the demand for the frequency of sport participation, the x contained proxy variables for available time, personal characteristics and sport-specific characteristics. Variables describing the income and the educational status were excluded from the model because of potential endogeneity (Cabane & Clark, 2011). Even under the assumption that these variables influence the regression coefficients, they should be excluded from the models (Angrist & Pischke, 2009). Equation (1) was estimated by OLS. In addition, to control for the potential endogeneity of *[PRO_RELEVANCE]*, it was estimated by IV, using the dummy *[SUCCESS]* as an instrument for *[PRO_RELEVANCE]*.

Regarding the causal effect of the frequency of tennis participation on the amount of tennis-related expenditure, the following linear model was considered:

$$\ln d = \delta + \ln\theta y + \varphi z + \omega, \tag{2}$$

with both the tennis-related expenditure as the dependent variable d and the frequency of tennis participation as a regressor y in logarithmic form to obtain the elasticity of primary interest. In accordance with the theoretical considerations and the related literature, the K × 1 vector z contained sport-specific and personal characteristics. The income and the educational status were included in the models because they were considered to be exogenous. In line with previous research, the occupational status was excluded from the model to prevent potential multicollinearity.

It can be assumed that $[ACTIVITY_t]$ is not totally independent of the potential outcomes of *[EXPENDITURE]*. Purchasing a new tennis racket or a new set of tennis apparel could produce the desire to play more tennis. In addition, the purchase of a ticket for multiple entrances from a commercial tennis supplier is likely to increase the frequency of tennis participation. Consequently, a reverse causality bias is apparent and an OLS estimation would overestimate the causal effect of interest. To overcome this bias, the frequency of sport participation during the last season $[ACTIVITY_{t-1}]$ was determined as a regressor. Due to the temporal order of determination, the lagged frequency of participation was assumed to be exogenous (Angrist & Pischke, 2009). According to Lechner (2009), there could be 'persistent components' in decisions about sport activities. Such components could jointly determine the past frequency of participation and the current expenditure decision. However, as stated earlier, the two decisions were assumed to be independent (Lera-López & Rapún-Gárate, 2007). Therefore, such a bias can be ignored.[5] Two models were estimated by OLS, one with $[ACTIVITY_{t-1}]$ and one with $[ACTIVITY_t]$ as the regressors of primary interest. Again,

sensitivity checks were employed. Additional models with the expenditure on tennis apparel and tennis equipment as dependent variables were estimated.

Results

Table 3 summarises the descriptive statistics of the total sample and conditional on the 50th percentile of the relevance of professional tennis. To test the specific representativeness of the sample, the crucial characteristics will be compared with a study by Wicker (2009), who also surveyed German amateur tennis players, and the official data on all organised tennis players (DOSB, 2012). Of the surveyed amateurs, 35% were female (Wicker: 20%; DOSB: 39.5%) and the average age was slightly over 44 years (Wicker: 43.5; DOSB: 42.5). On average, tennis had been practised for 21.58 years (Wicker: 17.48). This season, the amateurs spent 4.16 hours per week (Wicker: 4.14) on active tennis participation. Last season, with 4.97 hours per week, the average amount was slightly higher. The aggregated expenditure for tennis-related goods and services was €1117.86 per year (Wicker: €1070; Table 4).

The conditional statistics give the first indication for the relationships of interest. Amateurs with high relevance of professional tennis played more tennis per week in both the current season and the previous season. Furthermore, amateurs with high relevance of professional tennis spent more money on tennis-related goods and services. The conditional statistics of the instrument *[SUCCESS]* give an initial impression of the first-stage relationship. Approximately 40% of the sample started their tennis activity between 1986 and 2000. However, as discussed earlier, a positive trend in sport participation in general could mask the effect of interest. A χ^2 test indicated that the difference between the low and the high involvement groups for *[1986to2000]* is not statistically significant. Nevertheless, combined with the direct inquiry of the influence of the successes, i.e. *[START]*, the group differences become significant. Notably, 10.6% of the high-relevance amateurs and only 1.2% of the low-relevance amateurs were attracted to tennis by the successful era of the German professional athletes. Regarding the other control variables, the groups of high- and low-relevance participants significantly differed only by gender. Males tended to report higher relevance of professional tennis.

The results of the OLS and IV regression of the demonstration effect of professional sports are shown in Table 5. The variance inflation factors of all the variables were below 5, indicating no signs of serious multicollinearity.[6] According to the centred R^2, both models explained approximately 20% of the variance of the dependent variable. The coefficients of the two models were quite similar. Participants with a higher relevance of professional tennis spent between 21.5% and 24.4% more time playing tennis. The coefficient of *[SUCCESS]* in the first-stage regression and the Kleibergen–Paap statistics of the IV regression confirmed the assumption that the instrument had a significant effect on *[PRO_RELEVANCE]*.[7]

In line with the existing evidence, females spent considerably less time playing tennis than males. Due to the joint significance of *[AGE]* and *[AGE2]*, increasing age had a reverse u-shaped effect on participation, a result also found by Ruseski, Humphreys, Hallmann, and Breuer (2011). In line with economic theory, working full-time and having a domestic partner seemed to act as time constraints for the frequency of tennis participation (Dawson & Downward, 2011, 2013; Humphreys & Ruseski, 2006). Working part-time increased the frequency of participation by 28% and being retired

Table 4. Descriptive statistics for the total sample and conditional on the 50th percentile of professional tennis involvement.

Variable	*N*	Mean (SD) for continuous and% yes for binary var	Lower 50% of *[PRO_RELEV.]*	Upper 50% of *[PRO_RELEV.]*[a]
Tennis participation				
$ACTIVIVITY_t$	488	4.16 (3.15)	3.39 (2.42)	5.04 (3.55)*
$ACTIVIVITY_{t-1}$	488	4.97 (3.59)	4.14 (3.07)	5.82 (3.87)*
PRO_RELEVANCE	488	5.44 (1.12)		
EXPER	488	21.58 (12.76)	20.99 (13.45)	22.18 (12.02)
START	488	3.77 (3.15)	2.93 (2.54)	4.63 (3.47)*
SUCCESS	488	5.88%	1.21%	10.61%*
1986to2000	488	40.57%	38.31%	42.86%
START = 10	488	6.49%	1.21%	11.84%*
Sport-related expenditure in €				
EXPENDITURE	488	1117.86 (760.63)	907.93 (622.28)	1330.33 (827.34)*
EQU	482	141.20 (114.90)	120.69 (104.53)	160.76 (121.02)*
APP	481	140.31 (95.64)	121.71 (83.67)	158.08 (102.90)*
FEE	439	245.25 (118.16)	241.27 (114.26)	248.83 (121.77)
COM	274	488.70 (783.70)	499.79 (956.85)	478.55 (585.14)
TRA	216	711.22 (1357.85)	504.33 (626.08)	876.73 (1719.33)
LIC	199	99.73 (106.05)	81.85 (90.58)	111.50 (113.95)
NUT	283	302.08 (394.25)	237.11 (294.11)	349.22 (448.30)*
TC	289	257.44 (346.99)	205.76 (344.71)	296.83 (344.58)
Personal characteristics				
AGE	488	44.37 (17.09)	44.98 (17.48)	43.74 (16.71)
FAMILY	488	2.73 (1.16)	2.80 (1.14)	2.65 (1.17)
FEMI	488	34.69%	40.32%	28.98%*
MARRIED	488	58.62%	60.08%	57.14%
SINGLE	488	27.59%	27.02%	28.16%
RELA	488	13.59%	12.50%	14.69%
Educational status				
NONE	488	13.59%	12.50%	14.69%
SECOND	488	21.10%	20.16%	22.04%
DEGREE	488	24.95%	24.19%	25.71%
UNIV	488	40.37%	43.15%	37.55%
Occupational status				
SCHOOL	488	9.94%	8.87%	11.02%
APPREN	488	10.34%	9.27%	11.43%
PARTTIME	488	10.95%	12.50%	9.39%
FULLTIME	488	47.46%	45.16%	49.80%
RETIRED	488	17.24%	20.16%	14.29%
OTHER	488	4.06%	4.03%	4.08%
Family income				
INC1000	488	13.60%	11.81%	15.35%
INC2000	488	15.27%	16.03%	14.52%
INC3000	488	24.48%	24.05%	24.90%
INC3000+	488	46.86%	48.10%	45.64%

[a]U test for continuous variables; χ^2 test for binary variables. *1% significance.

by 19%. Being married or living in a relationship decreased the frequency of participation by 29% and 19%, respectively.

Table 6 shows the results of the OLS regression of the second causal link. The implemented regressors explained approximately 19% of the variance of the total yearly tennis-related expenditure. Again, no serious multicollinearity could be detected. As

Table 5. OLS and IV estimation results with the logarithmic frequency of tennis participation as the dependent variable and robust standard errors in parenthesis.

Variables	OLS	First stage	IV
PRO_RELEVANCE	0.215 (.029)***		0.244 (.122)**
FEMI	−0.229 (.066)***	−0.326 (.107)***	−0.219 (.078)***
AGE	0.009 (.003)***	−0.004 (.006)	0.009 (.003)***
AGE2	−0.000 (.000)	0.000 (.000)	−0.000 (.000)
EXPER	0.012 (.008)	0.021 (.011)*	0.011 (.009)
EXPER2	−0.000 (.000)	−0.000 (.000)	−0.000 (.000)
SCHOOL	0.110 (.105)	0.422 (.163)***	0.098 (.115)
APPREN	−0.001 (.122)	0.107 (.201)	−0.004 (.123)
PARTTIME	0.286 (.105)***	0.119 (.176)	0.283 (.105)***
RETIRED	0.181 (.096)*	−0.348 (.159)**	0.191 (.107)*
FULLTIME	Reference	Reference	Reference
OTHER	0.112 (.139)	0.270 (.173)	0.104 (.145)
FAMILY	−0.041 (.028)	−0.063 (.044)	−0.038 (.031)
MARRIED	−0.286 (.088)***	0.136 (.156)	−0.292 (.093)***
RELA	−0.181 (.096)*	0.187 (.159)	−0.187 (.102)*
SINGLE	Reference	Reference	Reference
SUCCESS		0.832 (.124)***	
Constant	1.064 (.164)***	−0.083 (.257)	1.063 (.164)***
Observations	488	488	488
Centred R^2	0.2004	0.0970	0.1987
Kleibergen–Paap rk LM			19.341
Kleibergen–Paap rk Wald F			45.045

*10% significance, **5% significance, ***1% significance.

expected, the frequency of participation was the most influential determinant of the sport-related expenditure (Taks et al., 1999). An increase in participation of 1% per week (of the last season) increased the expenditure by 0.45%. The 95% confidence interval ranged from a 0.35% to a 0.55% increase in the total yearly expenditure. In line with the expected reverse causality bias, using the current season as a regressor yielded higher estimates. In line with the neoclassical theory of demand, rising income increased the sport-related expenditure. After controlling for participation, the other regressors explained rather little variance of the total expenditure. Thrane (2001b) assumed that the socio-demographic determinants affect the sport-related expenditure only indirectly, via the frequency of sport participation.[8]

Discussion

The results of this study provide first evidence for the monetary value of the demonstration effect of professional sports. According to the framework of sporting role models, tennis amateurs with a higher relevance of professional tennis spent 24.4% more time playing tennis. In line with the theory of consumption capital, 1% more sport participation led to 0.35%–0.55% more sport-related expenditure. According to Preuß et al. (2012), the aggregated yearly expenditure of all tennis players in Germany is approximately €1759 m. Given the earlier results, between €150.22 million (0.244 × 0.35 × 1759) and €236.06 million of the total tennis-related expenditure of German participants could be attributed to the demonstration effect of professional tennis in Germany.

Table 6. OLS estimation results with the logarithmic total expenditure as the dependent variable and robust standard errors in parenthesis.

Variables	EXPENDITURE	EXPENDITURE
$ACTIVIVITY_{t-1}$	0.450 (.051)***	
$ACTIVIVITY_t$		0.472 (.056)***
FEMI	−0.131 (.083)	−0.050 (.084)
AGE	0.000 (.000)	0.001 (.004)
AGE2	−0.000 (.000)	−0.000 (.000)
EXPER	0.010 (.010)	0.007 (.010)
EXPER2	−0.000 (.000)	−0.000 (.000)
NONE	−0.318 (.159)**	−0.265 (.159)*
SECOND	Reference	Reference
DEGREE	−0.148 (.101)	−0.091 (.082)
UNIV	−0.037 (.080)	−0.010 (.082)
INC1000	Reference	Reference
INC2000	0.154 (.151)	0.158 (.151)
INC3000	0.339 (.146)**	0.330 (.153)**
INC3000+	0.199 (.149)	0.189 (.157)
Constant	5.977 (.199)***	6.027 (.191)***
Observations	488	488
Centred R^2	0.1917	0.2028

*10% significance, **5% significance, ***1% significance.

With an R^2 of 20%, the constructed model of the demonstration effect of professional sports had high explanatory power. The first-stage regression revealed that the employed instrument had a significant effect on the potentially endogenous regressor. In addition, the results reacted robustly to different configurations of the instrument. The IV estimation revealed that tennis participants with high relevance of professional tennis spent 24.4% more time playing tennis. With the average weekly time investment of 4.16 hours, this equals 61 minutes per week. The results are in line with the studies of Dawson and Downward (2011, 2013), in which professional sport behaviour, i.e. event attendance and TV viewership, was correlated with 44–67 minutes more sport participation per week.

Due to the identified reverse causality bias, it was assumed that the OLS model overestimates the causal effect of interest. However, the IV coefficient of *[PRO_RELEVANCE]* was slightly higher and the standard error of the IV coefficient was over four times larger than the corresponding OLS coefficient. There are two reasons for this. (1) The standard errors of IV estimations are always larger than the corresponding OLS standard errors (Cameron & Trivedi, 2009). (2) Weak instruments, i.e. instruments that are only weakly correlated with the endogenous regressor, could aggravate the problem of large standard errors (Bound, Jaeger, & Baker, 1995). While the first-stage regression indicated a significant effect of the instrument on the endogenous regressor, the magnitude of that effect was only moderately large and the surveyed sample size was rather small. Consequently, the resulting 95% confidence interval of the IV estimation ranged from 0.4% to 48%. The 95% confidence interval of the OLS estimation was much tighter, ranging from 15.8% to 27.2%. Therefore, the results represent a rough approximation of the exact magnitude of the 'real' causal effect of the relevance of professional sports.

The expenditure estimations confirmed the assumptions of the theory of consumption capital and the results of previous studies. The causal effect of the frequency of sport participation on sport-related expenditure is substantial (Taks et al., 1999). One more hour of tennis per week increased the average total expenditure by approximately €101 per year. This result is lower than the results of both Wicker et al. (2010) and Wicker, Prinz and Weimer (2012), who found corresponding effects of €263 and €165 per year, respectively. However, these studies analysed different sports, which aggravates the comparability. Again, this result is robust to different configurations. One more hour of tennis per week increased the average expenditure on tennis equipment by approximately €12 and the expenditure on tennis apparel by approximately €10 per year. Moreover, the results confirmed the assumption of a potential reverse causality bias in the relationship between sport participation and sport-related expenditure. According to the obtained results, the bias is positive and overestimates the effect of participation on the expenditure by approximately 15.7% to 25.3%. This result should improve both the interpretation of related studies and the planning of further studies on sport-related expenditure.

Implications and limitations

A considerable part of the sport-related revenues of governments comes from the taxation of sport-related expenditure (Gratton & Taylor, 2000; Pawlowski & Breuer, 2012a). Considering a value-added tax of 19%, the demonstration effect of professional tennis increases the sport-related revenues of the government by approximately €28.5–€44.9 million each year. The nature of the applied instrument indicates that the success of national athletes leads to a long-term increase in the individual relevance of the corresponding professional sport. Consequently, investments in the quality of national athletes, i.e. the 'production of success' (Houlihan & Green, 2008), could directly lead to an increase in the sport-related tax income of governments. These results could act as an additional rationale for the use of public funds for professional sport purposes.

Indirectly, the economic value of the demonstration effect of professional sports is much higher. Sport participation itself can lead to benefits in physical (Humphreys, MacLeod, & Ruseski, 2011) and mental health (Downward & Rasciute, 2011; Pawlowski, Downward, & Rasciute, 2011; Rasciute & Downward, 2010). According to Preuß et al. (2012), over 20% of the German population only participates in sports between three times a month and once a year. Similarly, Ruseski et al. (2011) found that Germans participate in physical activity for only 82 minutes per week, on average. However, the WHO recommends that individuals aged between 18 and 64 years should spend at least 150 minutes per week on physical activity to obtain health benefits [World Health Organisation (WHO), 2010]. Consequently, increasing the frequency of participation of already active participants can yield additional health benefits and subsequently increase productivity, e.g. educational achievements and long-term labour market outcomes (Lechner, 2009; Pfeifer & Cornelißen, 2010).

This study has some limitations. From a theoretical point of view, the motivational effect of sporting role models has to be further differentiated. According to self-determination theory (SDT), the motivation for sport participation could be arranged on a continuum from amotivation over extrinsic forms of motivation (external, introjected, identified, integrated) to intrinsic motivation (Ryan & Deci, 2007; Vallerand, 2007). Previous research has suggested that only the more autonomous types of motivation, e.g. identified, integrated and intrinsic motivation, lead to a long-term commitment to sport

participation (Pelletier, Fortier, Vallerand, & Briére, 2001). Consequently, future studies should examine the type of motivation that is triggered by sporting role models. This would contribute to the discussion about the sustainability of the effects of sporting role models.

From a methodological point of view, this study analysed a non-random convenience sample, which restricts the representativeness of the results. Consequently, conclusions about the population of interest have to be drawn cautiously. Nevertheless, compared with the data of the DOSB (2012), the sample is assumed to accomplish specific representativeness of all German tennis players in terms of age and gender. In addition, compared with the sample of Wicker (2009), the crucial statistics of the average frequency of participation and of the yearly sport-related expenditure seem to be appropriate. Another limitation is related to the cross-sectional nature of the data. According to Lyle (2009), the effects of professional sports stimuli on sport participation should be analysed with longitudinal or panel data. Future studies should strongly consider longitudinal research designs to shed further light on the effects of professional sports. Finally, it can be assumed that the average sport-related expenditure is difficult to assess with a standardised questionnaire (Davies, 2002; Scheerder et al., 2011). Pawlowski and Breuer (2011, 2012b) argued that secondary data based on written records of household accounts yield more accurate results. Consequently, a measurement error would cause the estimates to be biased. However, primary consumer surveys offer an advantage over secondary data sets because sport-specific variables, e.g. the frequency of participation, could be included.

Conclusion

This is an exploratory study that provides a first monetary estimation of one aspect of the demonstration effect of professional sports on sport participation. The results show that professional sports causally increase the time spent on sport participation, which subsequently causally increases the amount of sport-related expenditure. In line with the existing CVM literature, the results could be used to legitimise partly public investments in professional sports. Despite their limitations, the results provide a useful first reference point for sport managers, governments and future research.

However, the economic value of the demonstration effect of professional sports was only examined through one channel, namely the increased expenditure. With additional evidence for the efficacy of the demonstration effect on non-participants or lapsed participants, additional health and productivity benefits could be claimed. Consequently, it is recommended that future studies focus on the influence of professional sports stimuli on the subgroup of non-participants.

Notes

1. Over five million Germans actively participate in tennis (Preuß et al., 2012) and, according to the official data of the German Tennis Association, 1.5 million Germans are members of a tennis club [Deutscher Olympischer Sportbund (DOSB), 2012]. On average, Germans spend over €1000 per year on tennis-related goods and services, like tennis equipment, apparel or lessons (Wicker et al., 2010). Moreover, professional tennis in Germany has a very successful and unique history, which has already been discussed in the literature (Feddersen, Jacobsen, & Maennig, 2009; van Bottenburg, 2002; Weimar, Wicker, & Prinz, 2012).
2. Previous studies that have analysed the influence of outstanding national success in professional sports on membership figures and sport participation rates have found contradictory results. See,

for example, Feddersen et al. (2009), Humphreys, Maresova, and Ruseski (2012) or Rebel and O'Dwyer (2008).
3. The evidence suggests that the demonstration effect of professional sports occurs with a time delay of at least one year (Weimer et al., 2012).
4. Even if a correlation between the errors of the two equations is assumed, such a single equation estimation would yield consistent results. However, a joint estimation, for example, with a GMM estimator, could yield efficacy gains (Cameron & Trivedi, 2009).
5. Of course, the two decisions are related because the frequency of participation influences the expenditure by construction of Equation (2). However, this is a systematic correlation that is controlled for by the inclusion of $[ACTIVITY_{t-1}]$ in the model.
6. The exceptions were the variance inflation factors of *[EXPER]* and *[EXPER2]*. However, these variables are related to each other by the construction of the model. Furthermore, they act only as control variables. The coefficient of interest is not affected by the multicollinearity between them (Cameron & Trivedi, 2009).
7. The results of the sensitivity checks can be found in Appendix 1. Of the sample, 6.49% started in the successful period and reported a value of 9 or 10 for *[START]*; 11.36% started in the successful period and reported a value of 8, 9 or 10 for *[START]*. Using these values in addition to the starting point, i.e. *[1986to2000]* = 1, as instruments for contemporary relevance of professional tennis did not change the tendency of the results. However, the alternative configurations lost efficiency because the instrument relevance decreased.
8. The results of the sensitivity checks are shown in Appendix 2. Again, the results were robust to alternative configurations, i.e. using only the expenditures on tennis equipment and tennis apparel as dependent variables.

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Appendix 1. Sensitivity checks for the first causal link: IV and 2SLS estimation results with alternative IV configurations.

Variables	[1986to2000] = 1 and START = 9 and 10 as IV	[1986to2000] = 1 and START = 8, 9, 10 as IV	All three configurations together as IVs
PRO_RELEVANCE	0.326 (.198)*	0.287 (.186)	0.248 (.117)**
FEMI	−0.192 (.093)**	−0.205 (.093)**	−0.218 (.078)***
AGE	0.009 (.003)***	0.009 (.003)***	0.009 (.003)***
AGE2	−0.000 (.000)	−0.000 (.000)	−0.000 (.000)
EXPER	0.009 (.010)	0.010 (.010)	0.011 (.009)
EXPER2	−0.000 (.000)	−0.000 (.000)	−0.000 (.000)
SCHOOL	0.066 (.136)	0.081 (.133)	0.097 (.115)
APPREN	−0.012 (.125)	−0.008 (.126)	−0.005 (.123)
PARTTIME	0.276 (.106)***	0.279 (.106)***	0.283 (.105)***
RETIRED	0.220 (.123)*	0.206 (.119)*	0.193 (.106)*
FULLTIME	Reference	Reference	Reference
OTHER	0.081 (.157)	0.092 (.153)	0.103 (.145)
FAMILY	−0.031 (.034)	−0.034 (.032)	−0.038 (.030)
MARRIED	−0.309 (.100)***	−0.301 (.098)***	−0.292 (.092)***
RELA	−0.207 (.108)*	−0.198 (.105)*	−0.188 (.101)*
SINGLE	Reference	Reference	Reference
Constant	1.061 (.167)***	1.062 (.165)***	1.063 (.164)***
Observations	488	488	488
Centred R^2	0.1752	0.1897	0.1982
Kleibergen–Paap rk LM	11.159	11.798	22.793
Kleibergen–Paap rk Wald F	15.582	13.640	15.753
Hansen J statistic			0.272

*10% significance; **5% significance; ***1% significance.

Appendix 2. Sensitivity checks for the second causal link: OLS estimation results with the logarithmic expenditure for tennis apparel and tennis equipment as dependent variables.

Variables	lnEQU	lnEQU	lnAPP	lnAPP
$ACTIVITY_{t-1}$	0.417 (.057)***		0.343 (.050)***	
$ACTIVITY_t$		0.428 (.059)***		0.332 (.052)***
FEMI	−0.251 (.078)***	−0.196 (.080)**	0.020 (.067)	0.071 (.069)
AGE	−0.009 (.004)**	−0.009 (.005)*	−0.007 (.004)*	−0.009 (.005)*
AGE2	−0.000 (.000)	−0.000 (.000)	0.000 (.000)	0.000 (.000)
EXPER	0.003 (.010)	0.001 (.010)	0.013 (.009)	0.013 (.009)
EXPER2	0.000 (.000)	0.000 (.000)	0.000 (.000)	0.000 (.000)
NONE	−0.347 (.148)**	−0.284 (.148)*	−0.159 (.137)	−0.091 (.139)
SECOND	Reference	Reference	Reference	Reference
DEGREE	−0.206 (.100)**	−0.174 (.100)*	−0.100 (.083)**	−0.047 (.084)
UNIV	−0.182 (.092)**	−0.147 (.092)	−0.123 (.074)*	−0.095 (.076)
INC1000	Reference	Reference	Reference	Reference
INC2000	0.364 (.154)**	0.375 (.151)**	0.246 (.131)*	0.259 (.133)*
INC3000	0.368 (.154)**	0.389 (.153)**	0.284 (.129)**	0.296 (.133)**
INC3000+	0.339 (.150)**	0.347 (.149)**	0.358 (.128)***	0.367 (.132)***
Constant	4.288 (.194)***	4.337 (.189)***	4.137 (.156)***	4.184 (.156)***
Observations	466	466	465	465
Centred R^2	0.1786	0.1847	0.1406	0.1352

*10% significance; **5% significance; ***1% significance.