WORKING PAPER

N° 2023-4

THE TRICKLE-DOWN THEORY: A REALITY IN FRENCH SPORTS?

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www.tepp.eu

TEPP – Theory and Evaluation of Public Policies - FR CNRS 2042

The trickle-down theory: a reality in French sports?

Florian Moussi-Beylie*

Abstract: The trickle-down effect of elite sports on mass participation is often used as an argument by policymakers to justify investments in elite sports and major sports events. According to this theory, sports success, the organization of major international sports events on national soil, and the renown of athletes are all factors that encourage individuals to participate in sports. The aim of this study is to provide evidence of the existence of this effect on French sports market. Previous studies on the subject have yielded contradictory results for each national market. To contribute to the understanding of this trickle-down effect, this study relies on data about membership in sports clubs from 28 Olympic federations covering the period from 2012 to 2019. Dynamic panel regression models, which take into account key variables determining sports participation in France, reveal a positive effect of hosting major sports events and the fame of athletes on the number of sports license holders. However, regarding sports success, a superposition of a crowding out effect and a training effect is observed. In addition, these impacts are relatively weak when compared to the total number of sports license holders across the 28 federations in the study.

Key words: trickle-down effect, sports club, dynamic panel data, sporting success, international sporting event, France.

JEL classification: L83, C23

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1 Introduction

According to recent research (Bull et al. 2020), physical activity has significant health benefits and can also generate economic benefits such as increased productivity and reduced healthcare costs (Hafner et al. 2020). However, physical inactivity in France, particularly among young people, is a major problem. According to the National Observatory of Physical Activity and Sedentary Behavior (Onaps), half of the population reports not engaging in any physical activity, while many individuals are overweight. Adolescents are particularly affected, with a prevalence of physical inactivity of 87% in France in 2016 (Guthold et al. 2020).

Sports policies in France are often justified by the need to succeed in major sports events, which could stimulate physical activity among the average citizen through a ripple contagion effect. Public authorities use this argument to justify investments in elite sports (Bosscher, Sotiriadou, and vanBottenburg 2013). This strategy, known as "trickle down", consists of supporting and promoting elite sports in order to stimulate physical activity among the population. France is one of the European countries that spends the most public funds on sports, with approximately 12 billion euros in 2016 (Eurostat). However, French government spending on mass sports represents only 4% of total expenditures, while high-level sports are up to for 9% (Mahtani et al. 2013). One of the objectives of these expenditures is to promote the emergence of international champions by granting the majority of funding and resources to this elite (Augustin and Arnaud 2008), and to attract major sports events to the French territory.

France is one of the countries that hosts the most international sports events in the world. The country is already a host for recurring events such as the Tour de France and Roland Garros. Other events organized include men's Euro football in 2016, handball world championships in 2017, Gay Games and Ryder Cup in 2019, women's football World Cup in 2019, Rugby World Cup in 2023, and Olympic and Paralympic Games in 2024. They are evidence of France's experience in organizing

major events (execution, media coverage, construction, security, *etc.*) as well as public policies aimed at sharing the event with the population and encouraging sports practice. However, sports participation rates in Europe have stagnated or decreased (Lera-López and Marco 2018).

Our study focuses on measuring the "trickle-down" effect in French sports context using dynamic panel data methods to identify the causal effect between elite sports success and mass participation.

2 Theory and literature review

My study focuses on the trickle-down effect, which assumes that high-level sports performance and major sports events inspire individuals to become more involved in sports or to be more physically active. In other words, sporting success, athletes themselves, and major sports events are factors that have various positive impacts on the recruitment and activity of amateur sports clubs (Wicker and Frick 2016). This hypothesis, which is based on these three factors, would theoretically give people the desire to join and invest in sports clubs. This theory is schematically represented in Figure 1. This would result in an increase in mass sports participation and an increase in the positive externalities of sports, particularly on health, employment, and well-being (Rasciute and Downward 2010). Demonstrating the trickle-down effect in the French sports market would aid in justifying public investments in elite sports by emphasizing the significance of widespread participation and membership in sports clubs.

Sports trickle-down theory has three dimensions. The first dimension we examine is the sporting success, which assumes that the victories and successes of high-level athletes at major international championships may inspire the population to engage more in sports. In other words, the success of high-level athletes will encourage individuals to participate in sports activities. Studies have examined this aspect of the trickle-down effect on sports participation, but they have produced contradictory

results, which can be attributed to variations in national sport market characteristics (Hindson, Gidlow, and Peebles 1994). Indeed, some studies find positive results between sporting success and the number of licensed athletes, especially in biathlon (Hanstad and Skille 2010) or in German football following a victory by the men's national team in the World Cup (Wicker and Frick 2016). However, other research suggests that this does not occur for all sports, but in fact, the increase is partly related to marketing and promotion activities of elite sports (Hindson, Gidlow, and Peebles 1994). Other studies even reveal divergent results, such as a decrease in the number of members during a period of sporting success (Feddersen and Maennig 2009), or even an increase in sedentary behavior (Hogan and Norton 2000). In addition, sporting success only inspires a population that already has an appetite for sports (Weed et al. 2015; Haut and Gaum 2018). Indeed, people who are exposed to international sporting successes and are already active will increase their training frequency (Mutter and Pawlowski 2014).

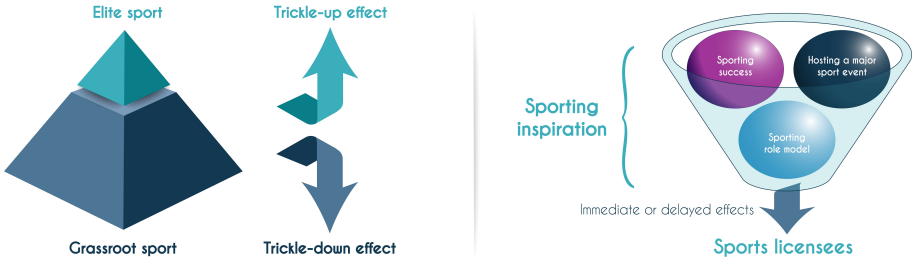

Figure 1: The trickle-down effect. Source : Castellanos-García and al (2021, page 107)

The second dimension of this theory suggests that there is a personality effect of athletes. Indeed, the media coverage of certain athletes and their personality can inspire individuals to engage in more sports by using them as inspirational models. Generally, an inspirational model is "an individual perceived as exemplary or worthy of imitation" (Yancey 1998) and can apply to the world of sports (Mutter and Pawlowski 2014). Some athletes stand out not only for their superior athletic abilities (Rosen 1981), but also for their popularity and personality (Adler 1985). This superstar status exposes them more to the population, allowing individuals to learn more about these athletes and their discipline. This creates a network effect, as individuals, in response to this increased media coverage, are encouraged

to consume more sports content and thus learn more about the sport in question (Stigler and Becker 1977). Studies have shown that athletes often play a role as a model for the population, and that their mediated actions can influence how they are perceived (Payne et al. 2003). Dawson and Downward (2011) and Dawson and Downward (2013) have demonstrated a positive correlation between participation in major sports events in person or through the media and the frequency of sports participation among the active population.

The last dimension suggests that hosting major international sporting events on national soil will encourage the host country's population to participate in sports. Indeed, increased media coverage of a sporting event and facilitated access to sporting events, especially in stadiums, should encourage individuals to engage in more sports. These events have an impact on individuals' decisions to engage in new sports activities, to change the quantity and frequency of exercises practiced, and to modify their attitudes. This effect, also known as the sport economic and social legacy, is an argument in favor of bidding to host a sporting event (Veal, Toohey, and Frawley 2012). However, depending on geographical areas, timing, and events, conclusions can vary from a positive effect, no relation, or a decrease in the number of sports practitioners. A study on the effect of mega-sporting events demonstrates that they can stimulate the population's desire to engage in sports or participate more frequently (Ramchandani and Coleman 2012). During the 1964 Olympic Games in Japan, those who experienced it seemed to apply themselves to more sports than other generations (Aizawa et al. 2018). However, during the Rugby World Cup, this effect only concerns the sports practice of juniors (Frawley and Cush 2011). Moreover, research on the subject claims that the incentive effect of major sporting events only works for individuals who already have an appetite for sports (Weed 2009) and does not work for populations that do not engage in sports (Coalter 2004). Furthermore, there is no observed variation in Australians' sports behaviors following the 2000 Sydney Olympic Games (Hogan and Norton 2000; Vanden and Conolly 2001).

All these studies show conflicting results due to systemic differences between countries and contexts, which affect the measurement of trickle-down effects. In addition, differences in data have an impact on the results, as many studies focus on cross-sectional data (Veal, Toohey, and Frawley 2012). Finally, the method used can influence the results, and methodological differences can explain their variation (Storm, Nielsen, and Jakobsen 2018). These different conclusions justify a deeper understanding of the mechanisms of trickle-down effects and other factors determining mass participation. Furthermore, we observe no such study on French market. It is important to verify whether these results are generalizable to multiple sports and to the French context to inform public policies aimed at improving the quality of sport and strengthening mass participation with the approach of the Paris 2024 Olympics. This research thus follows the recommendation of Wicker and Frick (2016) that it is necessary to provide evidence of this trickle-down theory from other national markets in order to provide a more holistic view.

Although previous research has mostly focused on one aspect of trickle-down effects, other more recent studies that take into account all of these dimensions by using panel data and regression methods. These studies provide new evidence of a trickle-down effect. Weimar, Wicker, and Prinz (2015), who focus on the German sports market (12 Olympic sports over a period of 41 years), find a positive effect of hosting a mega-event in the same year and delayed effects for mediatized athletes and sporting success. Subsequently, in a more recent study, using the same procedure, Castellanos-García et al. (2021) on the English market (33 Olympic sports over 10 years) highlight a positive trickle-down effect that can last up to 4 years. However, in these two studies, the effect is weak and indicates that other factors not considered in these studies influence club sports participation, and the trickle-down effect is ultimately rather secondary.

3 Methodology

In accordance with Weimar, Wicker, and Prinz (2015), Wicker and Frick (2016), Storm, Nielsen, and Jakobsen (2018), and Castellanos-García et al. (2021), it is preferable to use longitudinal data with multivariate regressions rather than cross-sectional data with bivariate or descriptive correlation techniques. For all these reasons, panel data is preferred.

3.1 Data and Variables

Table 1 describes the variables used in the estimation models and their sources.

The variable of interest in our study is the number of license holders per sports federation categories. It is divided into two in order to measure the number of license holders for those under and over 20 years old. Indeed, this will allow us to control for the effect of age which results in a change in agents behavior (work, income, residence, education, independence) that appear at this time and may influence membership in a sports association (Ferndez-Villaverde and Krueger 2007; Masrul 2016). In our database, it is not possible to distinguish if a person is a member of more than one sports club simultaneously. In this case, an individual may be a member of a tennis club and an athletics club and will be represented twice in our sample.

The trickle-down effect is measured by the following three variables: GOLD, MEDIA, and EVENT. The first variable measures success by the number of gold medals won by national athletes in major international competitions such as the Olympic Games, World Cups, European Cups, or other similarly prestigious events like Roland Garros or major boxing tournaments. Only gold medals are counted due to the significant difference awarded to champions and gold medalists compared to lower positions. The second variable measures the media coverage of athletes or sports teams through the athlete or team of the year award, which is awarded following a vote by Radio France listeners before 2015 and subsequently the RMC

Table 1: Variables

Variable	**Description**	**Type**	**Source**
JUNIOR	Total number of licensed athletes aged 15 to 19 years old	Scale variable	INJEP
SENIOR	Total number of licensed athletes aged 20 years old and over	Scale variable	INJEP
GOLD	Number of golds won medals in major international competitions by sport	Scale variable	Various
EVENT	Number of major international competitions hosted nationally by sport	Scale variable	Various
MEDIA	Winner of the personality of the year award	Binary variable	Radio France, RMC
WorkTime	Average weekly working hours per worker	Scale variable	DARES
Income	Net national income per capita in US dollars	Scale variable	OECD
Population	Population	Scale variable	INED
Pop Junior	Population of 15-19 year olds	Scale variable	INED
Pop Senior	Population of 20-year-olds and over	Scale variable	INED
Exp State	State public expenditure in favor of sports	Scale variable	INJEP
Exp Local	Local public expenditure in favor of sports	Scale variable	INJEP
Internet J	Percentage of juniors who have connected to the internet every day	Scale variable	INSEE
Fitness	Numbers of fitness centers	Scale variable	EUROSTAT

Sources: Various sources were used, including data found on websites such as L'Equipe, sports federations, sports institutions such as FIFA and UEFA, etc.

Sport Award through a vote by RMC, Le Parisien, aujourd'hui en France, and BFMTV listeners. This variable allows measuring the effect of personality as a model of inspiration among the population. Finally, the last variable indicates whether France has hosted a major international sports event during the year for a given sport. However, major events that do not present spatial variation such as the Tour de France have not been counted.

Other socioeconomic indicators at the national level were included in the analysis to control for additional factors that influence membership in sports clubs. An increase in income can have several contradictory effects on the opportunity cost. Indeed, an increase in income facilitates sports club membership by decreasing the entry cost (purchase of equipment, payment of the license) and increasing the probability of sports participation (Masrul 2016). But an increase in income can also be translated into an increase in employment responsibilities and an increase in work hours, which will decrease free time and potentially reduce participation and membership (Wicker, Hallmann, and Breuer 2013; Kokolakakis, Pappous, and Meadows 2015). After basic needs have been met, individuals could allocate some of their leisure time and income to leisure activities, especially sports participation. Therefore, we included variables related to the population of those over 20 years old and those between 15-19 years old. Indeed, the larger the potential population of consumers, the higher the probability of having many members in sports clubs. We included variables to capture the effect of public spending, including central government spending (mainly for sports in schools and high-level sports) and local government spending, which is more focused on mass sports.

Sports practice takes place during individuals' leisure time, which can be replaced by other activities such as fitness training (Borland and Macdonald 2003) and digital leisure activities. In recent years, the fitness training market has experienced significant growth, with an average increase of 7.42% in revenue between 2000 and 2020 in France (INSEE). In 2018, nearly 8.9% of French population was

registered in a gym (Rutgers et al. 2019). At the same time, digital leisure activities have also experienced strong growth, due to technological advancements, suggesting that individuals are dedicating more and more time to them. This variable has a negative effect on club sport membership in the English market (Castellanos-García et al. 2021). Therefore, data on Internet usage is included. The percentage of French people using the Internet daily has increased from 59.3% in 2009 to 71.4% in 2019.

4 Econometric Model: Dynamic Panel Data Regression.

To demonstrate the existence of a trickle-down effect in French sports, it is necessary to establish a positive and significant causal relationship between the variables of the number of licensed athletes (junior or senior) and one of the three sports variables (Gold, Event, Media).

We estimated several models that include our dependent variable, the number of licensees, and our three variables characterizing the trickle down effect. All our models include a lagged dependant variable on the number of membership, senior or junior licenses. Indeed, intrinsic motivations of individuals cannot be measured. We must consider the hypothesis that individuals are influenced by their personal networks on their membership in a sports club in previous years. These network effects come from social capital (Bourdieu 1986), which, through interaction with their social circle (friends, relatives, family, etc.), increases individuals' sports consumption and thus increases the general demand for sports. In Figure 2, we can observe the importance of integrating a lagged variable on licenses in our regressions. It shows the overall level of membership for the entire population from 2000 to 2019; for Seniors and Juniors from 2012 to 2019. The level of membership varies little from year to year, but there is a slight upward trend. Moreover, we note an average growth in the total number of licenses of 1.48%, which is slightly more pronounced among adults (1.11%) than among juniors (0.93%). Our data, therefore,

justify the inclusion of a lagged variable on licenses. This relative stability supports the argument that the memberships of one year are influenced by the memberships of the previous year. Due to this unobserved heterogeneity and dynamic nature, a dynamic panel data model must be applied (Bruno 2005).

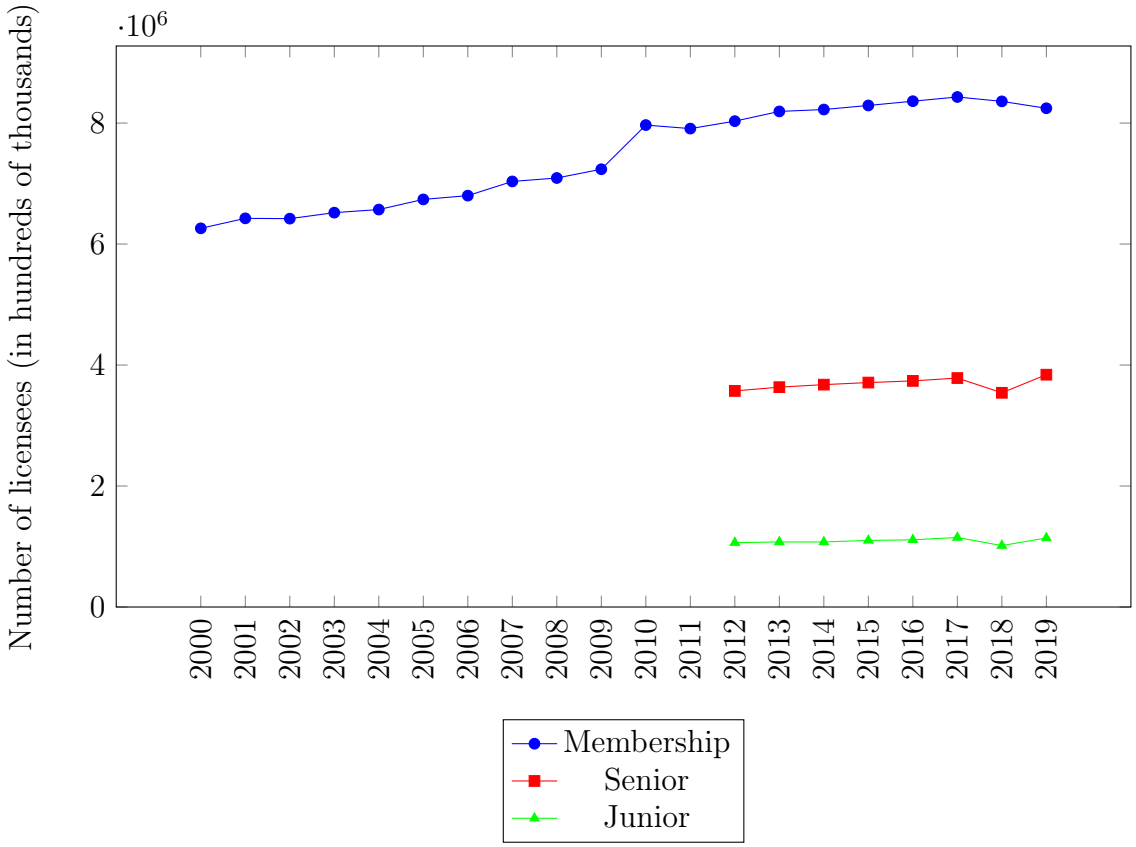

Figure 2: Number of members per year

We are then looking to estimate the following relationship:

$$\begin{aligned}\text{Membership}_{(i,t)} = \beta_0\text{Constant} + \beta_1\text{Membership}_{(i,t-1)} + \beta_2\text{Gold}_{(i,t)} + \beta_3\text{Event}_{(i,t)} \\ + \beta_4\text{Media}_{(i,t)} + \beta_5 X_t + u_i + v_t + e_{(i,t)}\end{aligned} \tag{1}$$

Where i represents sports federations, t represents the year, u is the individual-specific effect, v is the time-specific effect, e is the error term, β_1 to β_5 are the coefficients to be estimated, and X includes the control variables.

The use of panel data and lagged variables in our regressions makes ordinary least squares (OLS) regressions unusable (Bond 2002; Hsiao 2022). Indeed, the addition

of a lagged explanatory variable violates the basic assumption of OLS, which is the absence of a correlation between the explanatory variables and the error term. In the same perspective, the Within estimator, which could be used here due to the presence of fixed effects, leads to underestimation of the results. This is especially true when the temporal dimension is small compared to the individual dimension. Therefore, a dynamic panel regression is estimated using a generalized method of moments (GMM) estimator (Arellano and Bond 1991; Blundell and Bond 2000). Moreover, our data confirms the interest of using this model because we have a small number of years (T<20) and many individuals (n>20) (Bruno 2005).

For our estimations, we use the System GMM of the Generalized Method of Moments in dynamic panel which combines the first-difference equation 2 and the level equation 1.

$$\begin{aligned}\Delta\text{Membership}_{it} = {} & \beta_0\Delta\text{Constant} + \beta_1\Delta\text{Membership}_{i,t-1} + \beta_2\Delta\text{Gold}_{i,t} \\ & + \beta_3\Delta\text{Event}_{i,t} + \beta_4\Delta\text{Media}_{i,t} \\ & + \beta_5\Delta X_t + \Delta v_t + \Delta e_t \end{aligned} \tag{2}$$

The first difference equation eliminates unobserved individual-specific effects through first-order differentiation. However, Blundell and Bond (2000) explain that if the series used are persistent, this leads to weak instruments for the first difference estimator. In the case of persistent series, it is preferable to use a System GMM, allowing the combination of the first difference estimator with additional conditions on the level equations (Arellano and Bover 1995; Blundell and Bond 1998; Blundell and Bond 2000).

$$\begin{cases} \Delta\text{Membership}_{it} = \beta_0\Delta\text{Constant} + \beta_1\Delta\text{Membership}_{i,t-1} + \beta_2\Delta\text{Gold}_{i,t} + \beta_3\Delta\text{Event}_{i,t} \\ \qquad\qquad + \beta_4\Delta\text{Media}_{i,t} + \beta_4\Delta X_t + \Delta v_t + \Delta e_t \\ \text{Membership}_{it} = \beta_0\text{Constant} + \beta_1\text{Membership}_{i,t-1} + \beta_2\text{Gold}_{i,t} + \beta_3\text{Event}_{i,t} \\ \qquad\qquad + \beta_4\text{Media}_{i,t} + \beta_5 X_t + u_i + v_t + e_{i,t} \end{cases}$$

This model has the advantage of controlling for individual effects specific to sports federations and potential endogeneity of explanatory variables (Wooldridge 2010). Indeed, there is a reverse causality observed in the literature. For example, variables explaining the trickle down effect can also be partly explained by our dependent variable. For instance, the number of gold medals may explain some of the number of licensees, and conversely, the quantity of members may explain success in sports competitions. We aim to show the impact of victories at major international sports events on the number of licensees. However, it is generally accepted that the number of licensees allows for a larger pool of potential champions and therefore increases the number of medals (Andreff, Andreff, and Poupaux 2008).

5 Tests

Table 2: Variable persistence and unit root test

Variable	Lagged Va.	P	Z	L*
Log MEMBERSHIP	0.990***	96.856***	-3.531***	-3.474***
Log SENIOR	0.991***	97.470***	-4.189***	-4.042***
Log JUNIOR	0.994***	100.992***	-4.300***	-4.117***
GOLD	0.617***	160.462***	-7.903***	-8.040***
EVENT	0.047	182.614***	-9.001***	-9.300***
Population	0.829***			
Pop Senior	0.947***			
Pop Junior	0.499***			
Income	1.09***			
Work Time	0.354***			
Exp state	0.071***			
Exp local	0.003			

Note: * Significant at the 10% level. ** Significant at the 5% level. and *** Significant at the 1% level. Lagged Va. in OLS regression: $Z_{(i,t)} = \beta_0 Z_{(i,t-1)} + u_i + v_t + e_{(i,t)}$ with Z = Membership, Senior, Junior, Gold, Event, and Media. P, Z and L* are the inverse chi-squared, the inverse normal and the inverse logit of a ADF Fisher-type test.

We examined the persistence properties of the series used (membership, senior and junior licensees, number of gold medals, hosting of major international sports events, and control variables) and tested the hypothesis of unit root using a Fisher ADF test. Although the OLS estimator is biased upward when the autoregressive coefficient is less than one, the series appear to be highly persistent without exhibiting a unit root (table 2), justifying the use of the system generalized method of

moments model. Indeed, Blundell and Bond Blundell and Bond (2000) have shown that in the case of highly persistent series, it is better to prefer system estimations over first-difference estimations.

For our System GMM regressions, we use two-step estimators with robust standard errors, as they are more efficient (Windmeijer 2005). Several types of tests are then associated with the dynamic panel GMM model. Firstly, the two tests defined by (Arellano and Bond 1991), AR1 and AR2, are used to validate the non-rejection of the null hypothesis of first-order autocorrelation of residuals (AR1) and absence of second-order autocorrelation of first-difference errors (AR2). However, for the first model, we also performed a Wooldridge test in a static form (without lagged variables) to check for autocorrelation of errors, which justifies the use of a dynamic model. Our interpretations are subsequently reinforced by Hansen's overidentification diagnostics, which control for unobserved effects such as the reverse causality between membership and independent variables, thereby allowing the validity of lagged variables as instruments to be tested.

6 Results and discussion

6.1 Descriptive statistics

Table 3 presents the descriptive statistics. On average, our 28 sports federations (see Annex A) recorded 132,277.2 registrations for individuals over 20 years old and 39,157.05 registrations for adolescents (15-19 years old). However, there is a wide disparity between federations. On average over the period, the football federation has the highest number of members with 978,862.25 adult members and 299,022.375 adolescent members. Among all the sports federations studied, 23 have won at least one gold medal at a Major International Sporting Event (MISE), with an average of 1.47 gold medals per year and a maximum of 10 medals for one federation in one year. There is also a great disparity between federations that have little or no sporting success, such as table tennis or field hockey, which did not win any gold medals at a

MISE between 2012 and 2019. In contrast, the judo and swimming federations won 42 and 45 gold medals, respectively, over this period. The hosting of MISE is also very variable between federations, with an average of 0.12 MISE hosted in France, with a maximum of 2 events per year, but 5 for the rugby federation over the entire period. Finally, only 3.1% of sports federations had one of their athletes elected athletes of the year.The high standard deviations of our sports variables confirm the heterogeneity among the 28 sports federations, justifying the switch to logarithm for the estimations. Allowing us to present our results in semi-elasticity.

Table 3: Descriptive statistics

Variable	Obs	Mean	sd	Minimum	Maximum
MEMBERSHIP	223	294,103.70	421,619.20	877	2,135,193
SENIOR	223	132,277.20	198,070.10	277	994,987
JUNIOR	223	39,157.05	61,215.90	142	323,211
Log MEMBERSHIP	224	5.09	0.66	2.94	6.33
Log SENIOR	223	4.74	0.67	2.44	6.00
Log JUNIOR	223	4.18	0.66	2.15	5.51
GOLD	223	1.475336	2.203206	0	10
EVENT	223	0.1210762	0.3404484	0	2
MEDIA	223	0.0313901	0.174762	0	1
Work Time	223	35.76233	0.1322635	35.6	36
Income	223	35,796.93	2,888.69	31,715.32	40,766.84
Population (in million)	223	66.4	0.632	65.2	67.1
Pop Junior (in million)	223	16.2	0.111	16	16.4
Pop Senior (in million)	223	50.1	0.567	49.2	51
Exp State (in billion)	195	6,285	0.278	5.89	6.707415
Exp Local (in billion)	195	6,767	0.358	6.31	7.435903
Internet J	223	87.90%	3.30%	84.20%	93.60%
Fitness	223	58,427.74	14,803.33	38,072	84,043

Interpretation: For the Junior category, out of 223 observations that include 28 Olympic federations over 8 years, we observe an average of 39,157.20 members in sports clubs, with a standard deviation of 61,215.90, a minimum of 142 members, and a maximum of 323,211.

6.2 Direct trickle down effect

In three regressions, I sought to demonstrate the direct effect of the elite sport trickle-down effect on mass participation among the entire population, adults aged 20 and over, and adolescents aged 15 to 19 years old. The data are weighted for all 28 sports in the current year. This is a direct relationship between our variable

Table 4: Results of the dynamic panel data regression for the years 2012-2019

Variable	Model 1	Model 2	Model 3
Log MEMBERSHIP L1	0.949***		
Log SENIOR L1		0.988***	
Log JUNIOR L1			0.994***
Gold Medals	-0.004**	-0.003**	-0.007**
Home Events	0.006	0.080*	0.004
Star	0.024**	0.03**	0.034**
Work Time W	-0.011	-0.120	
Income	3.10E-06	0.000	
Population	-9.14E-09*	3.65e-09	-1.39E-08
Exp Local	0.022*	0.019	-0.011
Exp State	-0.024**	-0.103	-0.115***
Internet			-0.391***
Fitness			3.06E-06***
Constant	3.029	-0.14	1.133
Year dummies	Yes	Yes	Yes
No, of Obs	196	194	194
AR (1) (p-value)	0.005	0.015	0.015
AR (2) (p-value)	0.357	0.539	0.481
Hansen Statistic (p-value)	0.541	0.844	0.780
Wooldridge test (p-value)	0.000	0.006	0.076

Note: * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

of the number of members of sports federations and independent variables. The latter consists of a lagged variable of the number of sports license holders, as well as our three variables of interest: hosting a major sporting event on national soil, the number of gold medals obtained, and the media coverage of national athletes. In the tree model, the socio-economic variables included are: the general population for model 1, the adult population for model 2, the adolescent population for model 3, working time, and income. The results are presented in Table 4.

Young people are likely to behave differently. Their sentiments and tastes towards to elite sports are different. Indeed, adolescents can be more affected by the inspiration effect of high-level athletes (vanBottenburg 2002). In fact, in the sociological literature, young people frequently identify with high-level athletes (Payne et al. 2003). As for the literature in economics, the results are conflicting. Weimar, Wicker, and Prinz (2015) as well as Castellanos-García et al. (2021) find a trickle-down effect only from the hosting of major international sports events on the national

soil. However, Storm, Nielsen, and Jakobsen (2018) find only an effect of sporting success on children's membership following a sporting success in the Danish market. However, Craig and Bauman (2014) find no effect following the hosting of the Winter Olympics and medal gains on the membership of adolescents and children in sports clubs.

In all models the results for the eight years of our sample show that the estimated coefficient of the variable lagged by one year on the number of sports club members is significant at the 1% level while the estimated coefficient of the variables of interest related to gold medals and media coverage are significant at the 5% level. However, unless in the model 2 with the Senior the indicator of the international major sports events hosted on national soil, the estimate is significant at the 10% level. Regarding the estimations of the socio-economic variables, in the first model, the estimates for the population and local public expenditures are significant at the 10% level, and central government expenditures are significant at the 5% level. In the model 3 concerning adolescents, central government expenditures, internet usage, and private fitness facility population are significant at the 1% level.

The level of membership in sports clubs in the previous year is a very good indicator of future membership levels. The number of mediatized athletes are another very important and positive factor for current adult members. The best athlete of the year is elected following a public vote, which must have already assimilated the sporting successes through media coverage of the current year. These results can serve as a proxy for public awareness of sporting success. The coefficient values suggest that the inclusion of an athlete from the 28 Olympic federations in our database leads to an increase of 2.4% in sports club members for the entire population, and 3% for adults, and 3.4% for adolescents. By comparison, in Castellanos-García et al. (2021)'s study, the effect shows a positive impact of approximately 1,500 members, whereas in Weimar, Wicker, and Prinz (2015)'s study, the effect is not statistically significant.

In contrast to my initial intuition of a positive trickle-down effect of successful athletes, my estimates show a contrary effect. In fact, for each gold medal won in a major international competition, there is a decrease in the number of members in the same year in all models. Thus, I observe an eviction effect that can occur either autonomously or simultaneously with a trickle down effect but with a greater magnitude. Ruseski and Maresova Ruseski and Maresova (2014) explain this negative effect as a result of the allocation of resources to elite athletes, which entails opportunity costs that can influence decisions related to sports and physical activity participation in the entire population. It's also possible that the negative effect observed is due to potential athletes' perception of the inaccessibility of exceptional sports performances by elite athletes. Another possible explanation is that the increase in the number of sports broadcasts combined with increased promotion in recent years may have led to a certain degree of fatigue, thereby reducing interest in sports. To address this question, it is necessary to study this variable with delays in another model. This result can be explained by the choice of public policies to allocate a larger proportion of funding to elite sports rather than mass participation, resulting in gains in medals but a loss of participants.

Hosting major sports events on national soil has a positive effect of 8% on the number of members, but only for adults. This result is in line with previous research, notably Weimar, Wicker, and Prinz (2015) and Castellanos-García et al. (2021). This can be explained by an increased attention from the national public towards these events, which are considered geographically closer.

In our first model, any increase in the population will lead to a nearly negligible decrease in the number of sports license holders. Any increase in local sports expenditures will increase the number of sports license holders by 2.2%, while an increase in public spending by the central government will lead to a decrease of 2.4% in the number of sports license holders.

For the third model concerning the adolescent population, we investigate club membership for adolescents aged 15 to 19 years in the current year. Our results are presented in Table 5. Given the different behaviors for adolescents, we have included additional control variables compared to the population aged 20 and over. We still include the three elite sport variables and the variables of government spending, but we have replaced working time and the level of income with internet consumption and the number of fitness centers in the area. According to a study by (Muller 2018), 52% of young people (16-25 years old) in the French sports market include strength training-fitness in their sports activities, ranking ahead of running (32%) and team sports (29%).

In this model, a $1 billion increase in public spending by the state in sports, mainly directed towards sports at school, will lead to a 11.5% decrease in the proportion of adolescent members in the 28 sports federations of the sample. The number of fitness centers in France has significantly increased in recent years, as has the use of new technologies in sports. Young people are particularly receptive to new information and communication technologies (ICTs) for their sports practice. In fact, the incidence of use of the internet by young people has increased over the period considered, from 85% in 2012 to 92.3% in 2019. We observe a decrease in the number of young members in sports clubs due to the increase in internet use. For any increase in the percentage of adolescents who connect to the internet daily, the number of members decreases by 39.1%. One possible explanation for this result could be a transfer of their leisure time to digital activities. This shows that these leisure activities are in competition with each other. However, a survey by Muller (2018) shows that young people use the internet in part for sports-related applications in a logic of informal practice without membership in a sports club. These connected sports practice then competes with formal sports practice in a sports club, it not only highlights a decline in young people's incidence of sports practice, but it also supplants it. These applications that allow for practice with fewer constraints,

particularly in terms of costs (transportation, schedules, registrations, equipment, etc.), are increasingly attracting young people and could explain this result. We are dealing with a situation of a mix between young people who do not practice sports and prefer another use of their leisure time in the digital realm and another part who also has an informal sports practice and who would also compete with formal practice in a club. New technologies can then be a hindrance to physical activity (which can be exercised without membership in a club) or a hindrance to formal sports practice through membership in a sports club. The internet then becomes an important substitute for young people's membership in a sports federation, suggesting greater difficulty in attracting young people to sports clubs. Unlike studies by Castellanos-García et al. (2021) and Weimar, Wicker, and Prinz (2015), which focused on other sports markets, the increase in the number of fitness centers has a positive impact on sports club memberships in France. This can translate into complementary practice, as going to a gym will encourage individuals to want to join a sports club.

6.3 Mixed effects with lagged variables

In three other models, we introduced lagged variables up to four years to measure the trickle down effect over time, unlike the previous model which only considered the current year. We also tested the influence of other control variables that could affect the level of membership. As with the first model, the data were aggregated for the 28 sports studied. In this section, our aim is to estimate the causal relationship between the three variables of interest potentially capturing trickle-down, which may take more than one year to be affect by individuals, and the number of members in sports clubs. The results are presented in Table 5.

Just as in our three first model, the one-year lagged variable of the number of members is significant at the 1% threshold, confirming that past levels of membership are a very good indicator for current levels for all, adult and adolescent population.

These results confirm one of my hypotheses in Table 5. Indeed, I observe a significant negative effect of an increase in the number of gold medals won at major competitions on the number of members. This negative effect persists for four year in the model 2 and three years for the model 3. Nevertheless, I observe a reversal of the trend starting from the third year, where the effect becomes positive. Which leads to an increase in the number of sports club members three years after a gold medal victory by 0.8% for seniors and by 1.3% for adolescents. This effect occurs in the fourth year after winning a gold medal in the adult population, with an increase of 1.2%. These results confirm the theory that two effects overlap here: a displacement effect, which is more important at the beginning, and a trickle-down effect which gains importance later. In other words, investments for elite athletes displace spending to encourage sports at the local level. Training for elite athletes and the facilities to accommodate them are not easily accessible for everyday practice. However, the trickle-down effect related to the model operates in parallel, initially with less significance, but eventually dominated by our positive coefficient in the third year. This also demonstrates a strong power of retention of sports victories among the population.

In regards to hosting a major international sporting event on national soil, a similar argument to that of gold medals could be made. Indeed, organizing major sporting events also requires investments in infrastructure that can then be diverted from those intended for mass participation. However, the positive relationship once again between hosting a major event and the number of members suggests another effect.This effect is short-lived and only lasts during the year of the event, indicating a "festive" effect surrounding the competition in the very short term in model 4 for the entire population. For each major international sporting event hosted in France, the number of sports club memberships increases by 1.8% in the entire population. Additionally, this effect is observed in model 6 for adolescents, where the number of licensed adolescents increases by 4.6% in the same year. Furthermore, this positive

effect can persist for up to two years after the sports event, leading to a 6.2% increase in sports participation. The hosting of these championships reinforces the motivation to participate in a sport during the same year and two years. The underlying catalytic mechanism comes from a publicity and proximity effect of the Games that sensitizes individuals to sports participation within a federation through the desire to emulate and identify with the athletes participating in these competitions. The effect of hosting a major sports event has a stronger impact on the adolescent population. These results are consistent with the findings of Castellanos-García et al. (2021), who observed a lasting effect one year after hosting a major international sports event on the English youth population aged 16 and 17.

However, the lack of persistence of this estimation in the subsequent years for the entire population raises questions. This result is common with the study by Weimar, Wicker, and Prinz (2015). They explain, through Buchanan (1965) theory of clubs, that the positive effect does not last due to a limited club absorption capacity. Indeed, club capital is rather inelastic in the short term, as it is difficult to quickly recruit a coach, facilities and the number of members in a team is fixed. In Figure 3 in Appendix, we can observe the evolution of the total number of sports facilities in France from 2014 to 2020, showing a slight increase from 302,256 in 2014 to 318,037 in 2020, encompassing all types of sports facilities. Club managers must then think about the optimal price of subscriptions, but also about an optimal number of members. For example, if too many individuals show up at an archery club, the shooting ranges will always be full, and people will not be able to practice as much as they would like. This will lead to unsatisfactory conditions for the sports practice for some individuals, thus increasing the probability of departure of dissatisfied members from the club. Thus, in many sports, the size and number of teams are fixed, so that welcoming X new members to a team means that X old members must leave. For example, in 2019, France hosted the European Volleyball Championships, and the French Volleyball Federation claims that the competition attracted 81,600 spectators during the 21 matches held in France, with increased

media coverage of 460 million viewers across Europe. It is worth noting that in the same year, the number of licensed players was 63,439, compared to 53,834 in 2018.

Regarding the effect of media coverage of elite athletes on sports licenses, a positive and lasting effect is observed on the entire population for up to one year. If a federation among the 28 in our sample has an athlete or sports team elected as the best athlete or team of the year, it leads to an 11.1% increase in the number of licenses in the same year and a 12.2% increase the following year, significantly at the 5% level. This effect is only significant at the 10% level for adolescents, with a gain of 11.8%, and it is not enduring over time. This result is in line with the findings of Weimar, Wicker, and Prinz (2015), who found no effect for adults but a lasting effect after one year for adolescents. These findings are consistent with research showing that younger individuals are more likely to spend time gathering information about superstars and being influenced and inspired by athletes with personalities and role models.

7 Conclusion

The study aims to measure the trickle down effect of elite sports on formal sports membership between 2012 and 2019 on a sample of 28 sports federations and two distinct populations, adults (20 years and older) and young people aged 15-19. It should be noted that the trickle down effect in sports consists of supporting and promoting elite sports through the hosting of major international sports events, sports successes, and the media coverage of professional athletes to stimulate sports practice in the population. Previous club membership is the most important factor in influencing the number of members. The trickle down effect is examined through three dimensions that have different effects. Firstly, high-level sports successes have a negative effect at first, but a positive delayed effect, ultimately contributing to an increase in the number of adult and adolescent sports members. This is therefore a mixed effect, with a significant initial displacement followed by a higher trickle

Table 5: Results of the dynamic panel data regression with lagged variables, 2012-2019

Variable	Model 4	Model 5	Model 6
Log Membership L1	0.965***	-	-
Log Senior L1	-	0.983***	-
Log Junior L1	-	-	0.945***
Gold Medals			
–.	-0.010**	-0.010*	-0.022***
L1.	-0.004	-0.014*	-0.022***
L2.	-0.009	0.008*	0.013*
L3.	0.004	0.012**	0.013
L4.	0.002	0.003	0.004
Home Events			
–.	0.018*	0.029	0.046*
L1.	-0.002	0.005	0.045
L2.	0.004	0.054	0.062**
L3.	-0.001	0.049	0.050
L4.	-0.040	0.028	0.019
Star			
–.	0.111**	0.076	0.118*
L1.	0.122**	0.099	0.151
L2.	0.054	0.053	0.081
L3.	0.015	-0.023	-0.016
L4.	-0.003	0.039	-0.131
Work Time W	-0.101	-0.007	-
Income	-0.789	4.12E-06*	-
Population	-1.10E-8	2.71E-08*	-1.48E-08
Exp Local	-0.011	0.037	0.027
Exp State	0.001	-0.039	-0.080
Internet	-	-	0.039
Fitness	-	-	-3.19E-06
Constant	-0.790	-1.435*	0.288
Year dummies	Yes	Yes	Yes
No. of Obs	112	110	110
AR (1) (p-value)	0.044	0.072	0.027
AR (2) (p-value)	0.124	0.346	0.98
Hansen Statistic (p-value)	0.991	0.643	0.927
Diff in Hansen	0.937	0.612	0.677

Note: * Significant at the 10% level. ** Significant at the 5% level. and *** Significant at the 1% level. This model examines the impact of our three trickle down variables (OR, Event, Media) on club membership for all the population, senior and junior for the current year (–.) and for lagged effects of the four previous years (L1. for one year, L2. for two years, L3. for three years, and L4. for four years).

down effect allowing a gain for sports clubs in terms of members. Secondly, hosting a major international sports event on French soil is associated with a gain in sports membership through a "festive" effect for all the population, but this effect is not sustained over time. However this effect is durable for junior population, Showing that major international sports events capture more attention from young people and transform this attention into sports participation. Finally, the inspiring personality of athletes also has a positive and durable effect for the young population. These results differ for adolescents who exhibit distinct behaviors towards sports.

However, it is interesting to note a negative effect of internet use on the number of adolescent club memberships. It is not possible to completely conclude on a decrease in their sports participation as part of this population uses the internet through applications for informal sports practice, mostly at home. This shows that technological development represents a challenge for future generations' club membership in France. Furthermore, the multiplication of private fitness centers in the territory has a weak but positive effect on membership in a sports federation. This is an interesting result because one might expect a null or negative effect by thinking that these centers compete with club practice by absorbing some of consumers' free time and expenses. Finally, the results show that these centers are complementary to club practice.

However, the obtained results should be interpreted with caution. Although our three variables of interest capturing the trickle-down effect have a statistically significant positive impact on the level of membership in sports federations, this impact is relatively weak when compared to the total number of sports license holders across the 28 federations in the study. In addition, they are not correlated in the long term with memberships. Castellanos-García et al. (2021) found a weak correlation (up to 14%) in the long term between trickle-down variables and sports club membership in England. This result implies that trickle-down variables are not the only factors that influence sports club membership. Indeed, despite positive results, some years

the number of licensed sports players decreases, which means that the trickle-down effect is counterbalanced by larger negative effects of other variables.

To further our research on French national market, we could consider several avenues. Firstly, it would be interesting to replicate the analysis after the 2024 Paris Olympic Games to evaluate the impact of this major event on French market. We could also analyze the data by gender to characterize gendered differences in sports practices, especially as the volume of available data is expected to increase in the coming years. Indeed, behaviors towards sports differ between men and women and awareness of elite sports may be different for women (Vescio, Wilde, and Crosswhite 2005). Next, we could add a spatial dimension to study regional or even local differences. Specifically, we could focus on certain types of neighborhoods, such as politically marginalized areas that suffer from unequal access to sports facilities (on average, three times fewer sports facilities are observed, Gatel and Cormier-Bouligeon (2017)). Finally, it would be interesting to examine the impact of the ripple effect on sports participation in general.

In this study, we have demonstrated evidence of the causal effect of trickle down on French national market. However, it is important to note that the explanatory power of our model remains moderate, and interpretations must be nuanced. Additionally, the average effect we observed applies to all the federations studied, which include popular sports such as football, basketball, and horse riding, as well as more niche sports such as biathlon and weightlifting.

This study is of particular importance for public policies oriented towards sports, especially with the approaching 2024 Paris Olympic and Paralympic Games. The trickle-down effect is a potential lever to encourage membership in sports clubs in France and sports participation in general. This phenomenon links elite sports to grassroots sports and can be used to promote the three key indicators of elite sports, especially at the 2024 Games, to increase the number of sports club members, al-

though the impact attributed to them is moderate. This opens up new perspectives for evaluating the social impact of mega-sports events, by measuring their influence on the number of license holders and overall levels of sports participation. From an economic standpoint, this increase in sports demand is beneficial to the local economy, stimulating the consumption of sports articles and increasing revenue for institutions through membership fees. In 2019, French sports articles market represented a value of €19.9 billion, with an average spending growth of 3.5% since 2010. However, to meet this increased demand, clubs must be able to quickly adapt and offer equal or superior quality service to attract and retain new members. To fully leverage this trickle-down effect, the public authorities must provide financial assistance to strengthen the club's intake capacity. We are also seeing an increase in funding for clubs since the announcement of the 2024 Olympic Games, notably through the "5000 local facilities" program, which provides €200 million to build or renovate local sports facilities. The "marketing" lever is also important in encouraging the population to participate in sports, using channels such as newspapers and television, as well as local initiatives such as Olympic Day and the Generation2024 label . These initiatives contribute to strengthening the positive impact of the trickle-down effect on sports participation.

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A Appendix

Table 6: List of Olympic federations and number of members in 2012

Number	Federation	Seniors	Juniors	Total Membership
1	Athletics FF	113,788	30,177	236,417
2	Rowing FF	25,832	7,302	38,269
3	Badminton FF	103,967	25,839	163,956
4	Basketball FF	157,882	84,393	468,136
5	Boxing FF	22,955	9,561	41,600
6	FF of canoeing and kayaking	18,724	7,099	37,029
7	Cycling FF	65,264	14,251	115,329
8	FF of Horse riding	205,593	116,181	706,449
9	Fencing FF	17,549	8,829	58,107
10	FF Football	960,237	282,423	1,973,260
11	FF Gymnastics	59,526	24,788	286,279
12	Weightlifting and bodybuilding	45,100	5,403	51,176
13	Handball FF	133,517	76,020	470,590
14	FFF of Field Hockey	6,859	2,481	16,877
15	FF of judo-jujitsu and associated disciplines	130,698	44,751	573,457
16	FF of wrestling and associated disciplines	7,812	2,347	20,050
17	FF of swimming	91,257	35,978	289,558
18	FF of modern pentathlon	282	168	958
19	FF of taekwondo and associated disciplines	17,993	6,776	52,397
20	FF of tennis	516,707	137,346	1,111,316
21	FF of table tennis	91,698	21,703	190,539
22	FF Shooting	137,109	5,963	154,289
23	FF archery	36,782	9,594	65,279
24	Triathlon FF	28,801	3,059	37,567
25	Volleyball FF	48,976	18,423	90,938
26	Ice Hockey FF	9,324	2,343	19,901
27	Golf FF	376,193	13,706	422,761
28	Rugby FF	141,937	66,894	339,150

Source: Iniep (2019)

B Appendix

Table 7: Specification tests

Test name	test type	P-Value
Lagrange Multiplier Test - (King and Wu)	Individual effects	0,000***
Lagrange Multiplier Test - time effects (King and Wu)	Time effects	0,979
Lagrange Multiplier Test - two-ways effects (Gourieroux, Holly and Monfort)	two-ways effects	0,000***
F test	two ways effects	0,000***

C Appendix

Table 8: Variable persistence and unit root test in level and rate

Variable	Lagged Va.	P	Z	L*
Membership	1,001***	80,123**	-2,439***	-2,198**
Senior	1,000***	132,0741***	-5,7914***	-5,831***
Junior	1,012***	102,215***	-4,561***	-4,334***
Child	1,007***	113,273***	-5,093***	-4,959***
Rate Membership	0,325***	108,993***	-5,172***	-4,958***
Rate Senior	0,123***	118,668***	-6,146***	-5,878***
Rate Junior	-0,37	113,802***	-5,319***	-5,109***
Rate Child	-0,455	125,208***	-6,094***	-5,936***

D Appendix

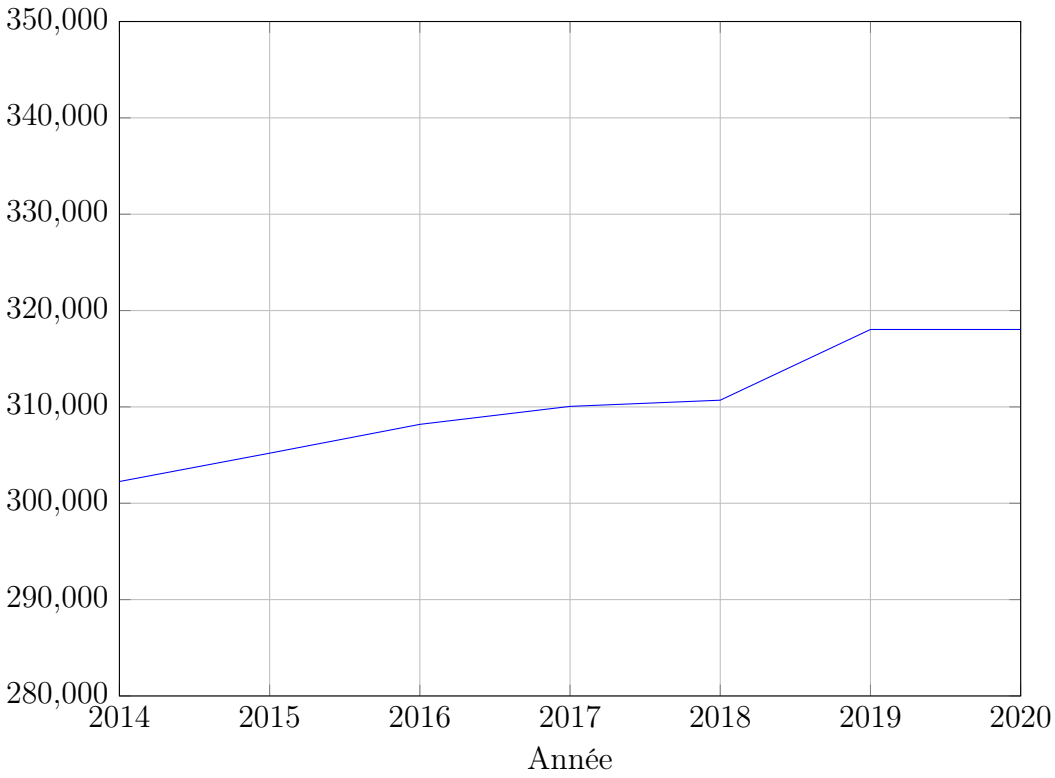

Figure 3: Changes in the number of sports facilities in France over the years.

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