Organizational Forms in Professional Cycling – Efficiency Issues of the UCI Pro Tour

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ABSTRACT: This paper gives a first economic approach to pro cycling and analyses the changes induced by the newly introduced UCI Pro Tour on the racing teams' behaviour. We develop an oligopolistic model starting from the well known Cournot framework to analyse if the actual setting of the UCI Pro Tour leads to a partially unmeant behaviour of the racing teams. In particular, we show that the blamed regional concentration of their race participation depends on a lack of incentives stemming from the licence assignation procedure. Our theoretical results are supported by empirical data concerning the performance of the racing teams in 2005 and 2006. As a recommendation for future improvements, we derive from the model the need for a relegation system for racing teams.

ZUSAMMENFASSUNG: Der Aufsatz stellt die erste ökonomische Analyse des professionellen Radsports dar. Er analysiert insbesondere die Anreizwirkungen der neuen UCI Pro Tour auf Teams und Fahrer. Ausgehend von dem bekannten Cournot-Ansatz entwickeln wir ein einfaches Oligopol-Modell, um zu untersuchen, ob die derzeitige Pro Tour-Organisation zu einem unerwünschten Verhalten der Teilnehmer führt. Wir zeigen, dass insbesondere das Problem der geographischen Konzentration der Rennteilnahmen der Teams von den mangelnden Anreizen abhängt, die vom jetzigen Lizenzvergabesystem ausgehen. Unsere theoretischen Ergebnisse werden durch empirische Daten aus der Pro Tour 2005 und 2006 gestützt. Als Empfehlung für zukünftige Entwicklungen leiten wir aus dem Modell die Notwendigkeit einer Öffnung der Pro Tour ab, mit Auf- und Abstiegsmöglichkeiten für Rennteams.

KEYWORDS: Sports economics, professional cycling, oligopolistic competition

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1. Introduction

Although cycling was one of the first sports to be practiced professionally, it has received until now almost no attention from sports economists.[1] This is somewhat surprising, especially if one takes into account the sharply increased popular success and the huge financial dimensions achieved by the main cycling events like the *Tour de France* or the *Giro d'Italia*.

Many institutional changes have occurred since in the late 19th century the first professional races have been organized across Europe. Essential has been, among others, the foundation of the international cycling association UCI in 1900, the establishment of a world ranking in 1984 and of the UCI World Cup in 1989. In 2005 the last two institutions have been replaced with the newly designed UCI Pro Tour, which aimed to create a sort of league of the best teams participating in the major one-day and stages races of the year, and to implement a unique top ranking system.

The target of this paper is to investigate the changes induced by this new organisational form using a theoretical model and empirical findings observed during the 2005 and the 2006 season. With a simple microeconomic approach, we study the behaviour of the racing teams before and after the introduction of the UCI Pro Tour. We develop an oligopolistic model starting from the well-known Cournot framework to analyse if the actual setting of the UCI Pro Tour leads to a partially unmeant behaviour of the racing teams. In particular, we show that the blamed regional concentration of their race participation depends on a lack of incentives stemming from the licence assignation procedure. Our theoretical results are supported by empirical data concerning the performance of the racing teams in 2005 and 2006. As a recommendation for future improvements, we derive from the model the need for a relegation system for racing teams. Like in team sports, the 'American' model of a close sport league seems inappropriate for the European socio-cultural environment.

This paper is one of the first academic approaches to professional cycling in economics. While sports economics in general has developed to a considerable branch of economic science (see Andreff 2006 for a recent overview), most of the effort is devoted to team sports. There is a large number of papers and books analyzing European professional football (e.g. Dobson and Goddard 2001 or the special issue of the *Journal of Sports Economics* in February 2006) as well as U.S. Major League sports (e.g. Fort 2003, Schmidt and Berri 2005). Often closely connected to professional team sports (except for the Olympic Games) is the

[1] This paper was presented at the 8th IASE Conference in Bochum (D), 2006. We are grateful to Wladimir Andreff, Joachim Prinz and Stephan Szymanski for first helpful remarks. Further comments are welcome.

analysis of the financing of sport infrastructure or sport mega events, which has also brought to a notable amount of works (see, among others, Siegfried and Zimbalist 2000, Baade 2003, Rebeggiani 2006). Among individual sports, professional golf is probably the best explored one (see Shmanske 2004 for a comprehensive survey), while a few papers study professional tennis (e.g. Magnus and Klaassen 1999), triathlon (Sowell and Mounts 2005) or road running (e.g. Lynch and Zax 2000). Very few attempts have been made to study cycling: Tondani (2005) provides a first assessment of the role of rankings in professional cycling, while Prinz (2005) and Torgler (2006) analyse the determinants of success at a specific race, the *Tour de France*.[2] Another recent paper by Cherchye and Vermeulen (2006) studies an alternative ranking methodology, applying it to *Tour de France* cyclists. Finally, Desbordes (2006) gives an overview of the commercial structure of pro cycling with a particular focus on France.

Due to this lack of research in economics, one has partly to rely on other disciplines like sociology (Jutel 2002, Brewer 2002), history (Rabenstein 1996) and other non-academic databases of media and race organizers (e.g. Schröder 2002, 2005; A.S.O. 2002-2006*)*.

2. An economic spotlight on professional cycling

2.1. Historical overview

Cycling has been one of the first sports being practiced professionally. A few years after the primary bicycle had been patented in 1817,[3] first races offering prize moneys were organized across Europe. One of the earliest official races with 1,000 Mark prize money was arranged by the *Münchener Bicycle-Club* in May 1886, with participants from Germany, England and France. During the first decades, road cycling was mainly run by full-time professionals employed by bicycle firms, which used the competitions as promotion events (Rabenstein 1996; Schröder 2002, 38-44). Beside prize moneys, riders received (not opulent) fixed salaries and technical equipment, while in exchange the sponsors' names were displayed on their jerseys. The first 'non-cyclistic' sponsors came up in 1953 (*Nivea*) and 1954 (*St-Raphael* – alcoholic beverages), causing many controversies (Brewer 2000, p. 282).

Beside road races, first indoor competitions were staged, and in 1896 even the Madison Square Garden in New York hosted a six days race. In the 1890s, technical innovations like the pneumatic tire allowed the establishment of first long distance competitions, like the

[2] In both, the importance of a low Body-Mass-Index (BMI) for succeeding in the Tour is pointed out. Prinz (2005) provides a detailed description of the physical peculiarities in road cycling. Similarly, a shorter paper by Dilger (2002) studies the dynamics of slipstreaming using physical equations. There are several other investigations about physical and medical topics in cycling. Some of them are cited and discussed in Prinz (2005).

[3] The first bicycle was constructed by Baron Karl Drais in Mannheim and therefore called later *Draisine*. Alleged earlier drafts have proved as fakes. For a detailed description of the early years see Lessing (2003).

Paris-Bordeaux (577 km) in 1891. Among these, some of the still existing Pro Tour races like the *Liege-Bastogne-Liege* (1892), *Paris-Roubaix* (1896) or *Milano-Sanremo* (1907) came into existence. A predominant role in cycling sport is played by stage races, in particular by the three major three-week stage events: The *Tour de France* was firstly organized in 1903. Sixty cyclists took part in the six stages, competing for 6,075 Francs prize money. The first *Giro d'Italia* took place in 1909, offering 5,325 Lire prize money. Finally, the *Vuelta a España* was established in 1935.

The history of cycling is also accompanied by the history of cycling organizations. The first national federations were founded in the late 19th century (e.g. the *Bund Deutscher Radfahrer* 1884 in Germany). In 1900 the federations of Belgium, France, Italy, Switzerland and the USA founded the *Union Cycliste Internationale* (UCI) in Paris, which was supposed to be the superordinate entity that should regulate, administrate and promote the sport. In 1965, the organization was split in an amateur branch (FIAC) and a professional one (FICP),[4] mainly due to pressures of the Olympic Committee, worried about the amateur status of Olympic cyclists. After the admission of professional athletes to Olympic Games in 1990, FIAC and FICP were reunificated within the UCI in 1992.

Greater changes occurred in the Eighties. In 1984, a ranking system was implemented and a few years later, in 1989, the ten major one-day races were grouped together to form the World Cup.[5] This introduction of rankings that had the aim to proxy ex-ante team and racers' performance represented a veritable revolution for cycling. Especially the fact that from then on the invitations to the single events were made according to the UCI ranking points induced major changes in racing behaviour and increased the overall competition level. Since collecting points was essential for participating in major events like the *Tour*, which were of high public interest and therefore important for the sponsors, teams began to abandon the traditional strategy with one captain surrounded by water-carriers, assuming a more aggressive race behaviour, with more team-members entitled to pursue own winning chances.[6]

[4] FIAC = *Fédération Internationale Amateur de Cyclisme*; FICP = *Fédération Internationale de Cyclisme Professionel*.

[5] A World Cup for racing teams existed since 1986. There had been several previous attempts to establish such a event series, like the *Challenge Desgrange Colombo* (1948-1958) or the *Super Prestige Pernod Trophy* (1958-1988). The composition of the UCI World Cup varied over time and included even newly established, Non-European races (e.g. the *Japan Cup* 1996) in order to promote cycling outside its original countries (Schröder 2005, p. 404-405).

[6] This aspect is extensively discussed in Brewer (2002), p. 290-296.

2.2. The UCI Pro Tour

In 2005, the UCI ranking and the World Cup were replaced by the new UCI Pro Tour. The Pro Tour is a race series including the 27 most important races of all kinds (stage races, one-day races, a team time trial and the World Championship). It is a unique ranking system where the cyclists collect points throughout the year. These are added together at the end, determining the season's best racer.[7] While this establishing of an overall ranking is the major aim of the Pro Tour, other targets are:

- To force teams and cyclists to a more homogeneous race participation in a temporal and geographic sense. This serves to avoid the historical phenomenon of racers concentrating on competitions in their home countries (or in the sponsor's home country). In some cases, like for Lance Armstrong, there has even been a tendency to restrict one's season around one big event, reducing the competition time to two or three months. This trend has risen during the last years, probably due to increased competition.

- To reduce the planning/financial uncertainty of the teams by guaranteeing participation to each major event. Before the Pro Tour, the three major three-week stage races had a substantial freedom in inviting a team to their competition or not. Especially being excluded from the *Tour de France* could cause controversies with the sponsor. With the actual setting, every Pro Tour team has a right to participate in every race of the series.

The teams must apply for a Pro Tour Licence, which is limited to 20 Teams and runs 4 years, costing EUR 100.000 (UCI 2006). Additional fees are to be paid for each race. Each Pro Tour Team has to participate in all Pro Tour races and has to employ 25 riders. Also race organizers have to apply for a Pro Tour licence, with a maximum of 30 events being licensed per year. The UCI system comprehends either two lower categories, the *Continental Pro Teams*, which can be invited to Pro Tour races, and *Continental UCI-Teams*. No promotions and relegations are allowed for.

2.3. Economic structure of professional cycling

An empirical assessment about the economics of professional cycling is hampered by the fact that there is almost no data available about cyclists' salaries or even team budgets. This is somewhat sinilar to other fields of sports economics, but is particularly pronounced in professional cycling, where there aren't any corporations faced with disclosure requirements as in European professional football or in US major leagues. Prize moneys, which would be available from race organizers, do not play the same role as in tennis or golf as effort determinants

[7] A list of the races included together with the distribution of points is reported in the appendix.

(Ehrenberg and Bognanno 1990), because they are equally distributed among all team members. Nevertheless, we will briefly review revenues and expenditures of a professional cycling team to illustrate the economic dimension of modern pro cycling.

The revenues derive almost entirely from sponsoring. This takes mainly the form of team sponsoring with the teams adopting their sponsors' names. The enterprises involved are of various kinds. There have been international corporations (*Motorola*, *Panasonic*) as well as small enterprises (*Mapei*, *Fassa Bortolo*) engaged in professional cycling. In the last years, a growing interest from the financial sector is observable.[8] Individual sponsoring contracts are often limited to equipment support, with a few exceptions for superstars like Lance Armstrong, whose sponsor revenues in 2005 were estimated to reach USD 10-12m (Whittle 2005), or Jan Ullrich, whose endorsements were likely to bring him EUR 4-6m in the same year.

Prize moneys are considerably lower than in other professional sports. Only the major events provide noticeable sums, whereas one has to sum up the finals prizes and those for single stages and several special rankings (e.g. best climber ranking, team ranking). In 2006, the *Giro d'Italia* offered in total EUR 1.4m prize money, while the *Tour* reached slightly more than EUR 2m. Thereof, EUR 450,000 were destined to the overall winner. The amounts decrease sharply in competitions of medium importance like the *deutschlandtour*, where the overall winner 2006 only got EUR 14,000.[9] An old tradition claims prize moneys to be equally distributed among team members after each race. Doing so, the captain thanks his teammates for their assistance and teamwork.

Broadcasting revenues play a crucial role in financing modern sports. In professional European football, revenues from selling TV rights have become the most important source for the clubs (Deloitte 2006). Professional cycling has a long tradition as TV sport, although it suffers from its non-telegenic, long events and disadvantageous competition times in the afternoon. The broadcasting interest in traditional cycling countries like Italy, Spain, France and the Benelux is high and stable for the major events.[10] This interest decreases dramatically for minor events and in other countries. Outside Western Europe pro cycling is often at the mar-

[8] Several banks (*Banesto*, *Rabobank*, *Cofidis*, *Credit Agricole*, *Caisse d'Epargne*) as well as insurance companies (*Liberty Seguros*, *Ag2r*) have engaged as sponsors in professional cycling during the last decade.

[9] For a detailed description of the prize moneys see A.S.O. (2006) [*Tour*], RCS Sport 2006 [*Giro*] and ARD 2006 [*deutschlandtour*].

[10] For instance, the 2005 *Giro d'Italia* had an average share of 17.23% in Italian TV, with about 2m audience every day. The decisive mountain stage in Sestriere attracted up to 5m TV viewers (47.62% share). In Germany, a relatively new cycling country, there has been a growing interest since 1996, highly dependent on Jan Ullrich performance. The interest is mainly concentrated on the *Tour*: In 2005, the average TV-share was about 24% (2.8m audience). Other events like the *Giro* or the *deutschlandtour* attract on average 1-1.5m viewers. For comparison, the football European Championships 2004 averaged 12m in German TV (35% share). Top events like the semi-final between Germany and Italy during the World Championship 2006 attracted approximately 30m viewers (91% share) in Germany and 24m (98%) in Italy.

gin of public interest. In the USA, Lance Armstrong contributed with his particular biography and his outstanding success to gain some popularity, but it is a rather personal one, while cycling is still almost absent from major TV sport channels.[11]

Unfortunately, no reliable data about broadcasting revenues are available. These revenues are usually not distributed among the teams (unlike in football and most other team sports), but are retained by the organizers. This is a highly controversial point, with many team managers hoping to establish a new sharing system, possibly with the help of the new Pro Tour.

The teams' expenses consist in participating fees, operating costs, which are not negligible in pro cycling, and salaries. Racers are usually employed directly by the team manager (e.g. Olaf Ludwig for *Team T-Mobile* or Bjarne Riis for *Team CSC*), who sets up a company (e.g. the *Olaf Ludwig Cycling GmbH*) financed by the team sponsor and pays the racers' wages.[12] In Germany, drivers are usually self-employed, whereas in other countries (France, Italy, Spain), they have regular salaried positions with the teams.

Since salary data are not available from the teams, one has to base on estimations to provide some empirical evidence. Up to the Eighties, only the team leaders were relatively well paid, while the *gregari* had often to rely on prize moneys to cover their living expenses. The sign of the first million-contract by Greg LeMond[13] in 1985 induced a sharp rise in riders remuneration, which affected by and by even the water-carriers' wages. Today, a good sprinter like Oscar Freire, who is supposed to ensure his team some prestigious victories at one-day races during a season, earns around EUR 1m a year. Potential stage-race winners like Andreas Klöden, Ivan Basso or Roberto Heras range between EUR 1.2m (Klöden) and 2m (Heras). The wages can be even higher in the cases of top stars like Jan Ullrich or Lance Armstrong. Salaries for 'servants' (*gregari*) vary in Pro Tour teams between EUR 100,000 and 300,000, highly dependent on their previous experience and results, as well as on the team's budget. To protect lower categories riders and new professionals, the UCI has established a minimum wage to be paid (UCI 2006). This has to equal the minimum wage of the country of employment or be not less than EUR 30,000 a year (EUR 24,000 for a new pro).

All in all, a year team budget for a Pro Tour team varies from EUR 3.3m to EUR 18m. The team budgets for the 20 Pro Tour teams are reported in table 1. On the one hand we observe significant differences between rich (*T-Mobile*, *Rabobank*) and poor teams (*Liquigas*,

[11] Even the *Tour* has live coverage only by the cable station *Outdoor Life Network*.
[12] The team manager has also to employ the technical and medical staff. A Pro Tour racing squad requires 15-20 physiotherapists, mechanics, cooks and physicians. Altogether, a Pro Tour team is therefore made up of 40-45 members.
[13] The later *Tour de France*-winner Greg LeMond signed a three-year contract with the French team *La Vie Claire*, totalling $1m. A few years later, in 1989, he negotiated with the *Z*-Team the first contract endowed with more than $1m per season (Brewer 2002).

Saunier Duval), on the other hand we notice a significant rise of the absolute budgets amount and of the gap between rich and poor from 2004 to 2005, coinciding with the introduction of the Pro Tour. However, one should not draw too far-reaching conclusions. For a substantiated assessment whether this growing financial basis is due to the changed institutional setting, we need further details about the teams' budget structures.

Teams*	**Budget 2003 (Mill. EUR)**	**Budget 2004 (Mill. EUR)**	**Budget 2005 (Mill. EUR)**	**Change 04-05 in %**	**Budget 2006 (Mill. EUR)**
Ag2r Prevoyance					7,3
Astana					7,5
Bouygues Telecom		n.a	7		7
Cofidis	6	8	8	0	8
Crédit Agricole	5	5.5	6	+9.1	6
Team CSC	4.5	6	6	0	7
Davitamon-Lotto	6	6	6	0	6
Discovery Channel	6.5	7	8.4	+20	8,4
Domina Vacanze	2.5	7	6	-14.3	
Euskaltel-Euskadi	5	6	6	0	5
Fassa Bortolo	5.5	6	9	+50	
Francaise des Jeux	6	5.5	6.5	+18.2	6,5
Gerolsteiner	6	8	12	+50	7
(Caisse d'Epargne –)	6	5.5	6.5	+18.2	6,5
Illes Baleares					
Lampre-		5	n.a.		6
Caffita/Fondital					
Liberty Seguros	6	6	8	+ 33.3	
Liquigas-Bianchi			5		5
Milram					6
Phonak	n.a.	7.7	10.5	+36.4	8
Quick Step	7.5	8	9.3	+16.3	9,3
Rabobank	6	9	15	+66.7	10
Saunier Duval-Prodir		3.5	3.3	-5.7	3,8
T-Mobile Team	9	12	18	+50	15

* In some cases, the main team sponsor changed over time (e.g. from *US Postal* to *Discovery Channel*).

Table 1: Team Budgets 2004-2005
Data: A.S.O. 2002-2006, various media releases.

2.4. Peculiarities of professional cycling

Before starting a theoretical analysis of professional cycling, one has to bear in mind some peculiarities which distinguish this sport from others:

- The most distinctive feature, from a theoretical point of view, is the fact that cycling is an individual sport practiced in teams. It is neither a pure single sport, like golf, tennis or athletics, which can be analysed using tournament models, nor a classical team sport like football or basketball. The professional cyclist acts as a single racer, but is highly dependent on his team. This is obvious in special team contests like team time trials, but concerns every race situation, especially during a stage race. There are in a squad

one or a few captains and a number of 'servants', called *domestiques* or *gregari*. The single members of the squad have well specified duties: tactical ones like avoiding breakaways or starting sprints, but even very simple ones like delivering food and water to the captains. Without a strong team even superstars can hardly win a major event.[14] This particular social organisation has characterised cycling from the beginning, creating the rather unique figure of the *gregari*: professional sportsmen, who spend their whole career not pursuing their own personal success, but helping their team leaders to win.[15]

- Cycling events are non-homogeneous, with significant differences between single races and types of races (stage and one-day races, time trials, mountain stages). These differences are much more pronounced that in other sports. A 100m runner does more or less the same act his whole career long. In the case of golf and tennis, the surface respectively the shape of the course may change. In cycling, however, winning a stage race is something completely different than succeeding in a 'classic' one-day event like the *Milano-Sanremo*, and time trials require different skills than a mountain stage.[16] A great *finisseur* like 2005 world-champion Tom Boonen does not have the ghost of a chance during mountain stages and ends such races often beyond the 100th position. Although they can specialize themselves on particular contests, during their careers cyclists have to compete in every kind of race. The search for the "overall best racer" is an old dispute among cycling fans and is one of the targets of the new UCI Pro Tour.

- Professional cycling is considered the physically hardest sport. Especially the three-week stage races require almost inhuman efforts from the riders. During a mountain stage a rider burns 8,000-10,000 calories (Prinz 2005) and repeats a similar effort the next day, for a total of 21 stages with only two days of rest. Athletes face also a high number of competition days, up to 100 in one season, unlike in other endurance sports as triathlon or marathon. During a year, a professional cyclist covers a distance of 35.000-40,000 km in training and competitions. These exertions have a positive exter-

[14] A first econometric support for this (quite undoubted) thesis is provided by Torgler (2006, 21-23), who includes variables measuring the team effect in multiple regressions explaining riders performance in the 2004 *Tour de France*.

[15] This need for teamwork is mainly determined by physical peculiarities of cycling: The major obstacle in cycling is wind resistance. By riding behind another rider, one can save up to 30% energy. Shading the captains from wind is therefore an essential tactical need, whereto much of the effort of the *gregari* is devoted, especially during flat stages (Brewer 2002, Prinz 2005).

[16] Top climbers are normally lightweights, like the legendary 56kg-rider Marco Pantani, while time trial specialists are muscular athletes (e.g. Michael Rich or Serhiy Honchar), being able to generate more than 500 watts. This aspect is indirectly confirmed by Torgler's analysis of the 2004 *Tour*, in which the BMI doesn't matter for time trial, but is highly significant as effort determinant in mountain stages (Torgler 2006, 19-21).

nality in generating high incentives for technical and medical research. There is nevertheless also a negative externality in form of high incentives for doping.[17]

- While in most team sports the major aim of the participants is to win the whole series (e.g. a *Bundesliga* season or the *FIFA World Championship* in football), the newly established Pro Tour does not have a similar importance. Prevailing in the overall Pro Tour does still not constitute the main goal of the teams and cyclists, but winning the single races, especially the big three-week stage races.

- An empirical/financial peculiarity is the fact that road cycling is an outdoor sport practiced on public ground. This implies that no gate revenues can be taken into account for organizers to finance themselves and distribute them among the racing teams. Although mega-events like the *Tour de France* attract millions of spectators along the streets every year, this does not lead to any revenues for the organizers.[18] They take in revenues from selling broadcasting rights, merchandising activities and direct sponsoring.[19] The major stage races demand furthermore a fee from cities willing to host a stage. London, for example, paid £ 3.6m to host the 2007 prologue of the *Tour*.

Starting from these preliminary observations, our leading question will be: Is the newly introduced UCI Pro Tour the best organisational setting, ensuring optimal incentives for cyclists and teams or does it need to be reformed?

3. The new UCI Pro Tour – A Theoretical analysis

Establishing the new Pro Tour in 2005, the UCI opted for the constitution of a closed league. Two controversial topics arise from this choice, which need a theoretical justification: a) the optimal number of teams in the Pro Tour league, and b) the preference for a closed league rather than for a system of promotions and relegations. We treat these two topics in the next two sections.

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[17] The doping problem has been studied extensively in the last years in sports economics. See among others, Berentsen (2002), Dilger and Tonsdorf (2004), Haugen (2004) and Maennig (2002). Some studies even postulate a liberalisation of doping in professional sports (Savulescu et al. 2004). Actually, cycling is experiencing again a doping scandal of huge proportions after the revelations of the so called *Operacion Puerto* in Spain, which led to the exclusion of some of the favourites from the 2006 *Tour the France*, like Jan Ullrich and Ivan Basso. At the end of the *Tour*, the overall winner Floyd Landis was also tested positive. The 2007 edition of the Tour was completely overshadowed by doping scandals.

[18] A first attempt to modify this peculiarity has been undertaken during the 2006 World Championships in Salzburg, when the organisers set up two video screen-equipped "visitor centres" along the track as well as 1800 VIP and 500 "Guest"-seats in the start and finish-area. The "visitor centres" were planned to offer 20,000 seats. The aim of the organizers was to generate 10% of the expected total revenues (Hohenauer 2006).

[19] The French bank *Credit Lyonnais* pays 4.5m a year for its logo to be displayed on the famous yellow dress, worn by the *Tour de France*-leader (Whittle 2006).

3.1. The optimal number of teams

The choice of the optimal number of teams should mainly take into account the congestion problem: this number can't be infinite in a single race, as should the number of firms in a theoretically perfect competitive market. The UCI rules limit the total number of cyclists in a race to the reasonable number of 200, including racers from teams out of the Pro Tour invited by local organizers. Of course, the number of teams could be increased, lowering the number of teammates. But, as stated above, since the production function incorporates a strong labour division inside the teams, it is quite difficult to follow this option.[20]

Moreover, in choosing the optimal size of the league, it is necessary to preserve the homogeneity of the product offered on the market. As in other sports, the competitors produce an indivisible joint product (Neale 1964). Introducing more teams that are not able to supply a good of a level adequate to the expected standards leads to a lower competitive equilibrium. In professional cycling, those considerations matter much more than theories like those of, among others, Vrooman (1997). He predicts – following James Buchanan's theory of clubs (Buchanan 1965) – that members have a joint interest in total revenues generated by the club. Hence, the individual optimum is to set the league at the number of teams such that where average revenue per member is maximized.[21]

Determining exactly the optimal size of the Pro Tour league would require a different theoretical approach and is not the main aim of this paper. We can nevertheless observe that, differently from other team sports, in professional cycling teams seek to win single competitions, rather than the whole Pro Tour (or, in the past, the World Cup) ranking. Hence, joining the Pro Tour league is not an objective but a way to participate to the main races and to try to win those the sponsors regard as "strategic" for their brand.

This implies a differentiation of teams' effort in the single races so that only a small number of Pro Tour teams are really interested in winning a specific race. The main consequence of this behaviour is an undesirable decrease of competitive equilibrium, which leads many experts to the opinion that a twenty-team league is over dimensioned.

many specialized sport magazines noticed in the past that in competitions like the *Giro d'Italia* or the *Vuelta a Espaňa* the effort spent by several teams had been significantly lower than possible, so that enrolling minor league teams, more motivated and interested to perform

[20] In 2005, the UCI rules set at 9 the number of cyclists per team in stage-races and 8 in one-day races.
[21] Adopting this theory means in general a smaller number of teams than the social welfare optimum.

well, would have raised the competitive equilibrium.[22] The trade-off between Pro Tour teams interested in spending effort only in selected races and the smaller teams, which would like to compete in some of the top-races but with few possibilities to do it, leads us to the other issue, the closed league.

3.2 The choice of the closed league

The structure of a closed league seems at first glance not consistent with the peculiarities and the tradition of professional cycling, a sport born and practiced mainly in Europe, which was never largely developed in the United States. However, the league setting of the Pro Tour seems to reflect American closed leagues like the NBA or NFL.[23] Why this choice? Several political reasons have been mentioned in section 2.2. A theoretical support could be that a system with promotions and relegations may not be profitable since a sport team operates in a local market (gate revenues) and in a larger market (broadcasting rights). As argued by Noll (2002), in both cases the demand for a team's products depends on its quality, the quality of its opponents and the team's tradition. Moreover, demographic characteristics and the economic framework of the hometown matter especially for local products. This means that teams in better markets will have a higher marginal revenue product of increments to the team quality. Hence, teams operating in the best locations generally have higher optimal quality than teams in worse locations and the optimal distribution of teams can be ensured by closed leagues.

However, we regard this theory as not adoptable to professional cycling for several reasons. First of all, pro cycling is not properly a team sport but an individual sport practised in team. The centre of interest is the single racer, not the team, as shown by the fact that teams do not have the same characteristics of these involved in football or basketball leagues, like a long history linked to a name, an headquarter (or a stadium) which identifies the team with a town, etc.. Hence, the importance of the local market is marginal, at least at professional level, while the national market can lose the great part of its importance when the main sponsor is a

[22] ASO, RCS and Unipublic, the organizers of, respectively, the *Tour de France*, *Giro d'Italia* and *Vuelta a España* and other one-day races, had a serious contention with the UCI during the winter 2006-07, not only because of the TV royalties division, but also for their refuse to adopt the Pro Tour invitation policy, which stipulates that all Pro Tour teams have to be invited to each race.

[23] There are only a few examples of closed leagues in the European sports tradition. The only prominent and still existing one is the Six Nations event in rugby, which indeed could also be seen as a tournament. Other recent attempts to establish such leagues, like the *Deutsche Eishockey Liga* (DEL) in Germany, faced serious problems and were mostly modified or abandoned.

multinational firm.[24] Supporters are linked to the nationality of the single rider, not to the team. Sometimes fanship can even cross the borderlines, leading some cyclists to be markedly appreciated abroad.

The absence of a local market rules out the question whether the relegation of a team from a big town (or country) and the promotion of a team from a small market represents a net decrease of social welfare, as supposed by Szymanski (2003). Rather, the guarantee that in every season the best teams compete in the best races and that every team should avoid relegation increases competition and disincentives opportunistic behaviour and position-rents.

The individualistic dimension of cycling contributes also to dismantle the theory according to which promotions/relegations reduce outcome uncertainty (competitive balance), lowering thereby demand for the other teams of the league. This applies because the relegated team has a relative quality level higher than the average quality of the lower league while the promoted team has a relative quality level lower than average quality of the upper league. Since the teams' quality is almost exclusively due to the individual quality, the free cyclists market allows maintaining an optimal allocation of talents in the leagues, even if the teams are relegated or promoted.

Moreover, the idea that a relegation system reduces the demand for the other teams of the league is not consistent with the peculiarity of cycling because part of the demand is induced by the quality of the races they participate in. Competing in a major three-week stage race or in one of the traditional one-day 'classics' increases the demand for sponsorship more than competing in races with less reputation, independently of the decrease of the competitive balance of the league due to the introduction of the promotions and relegations.

Hence, most of the reasons supporting the choice of a closed league are not adequate to professional cycling. In this framework, the Pro Tour assumes the form (and the undesirable characteristics) of an oligopoly.

3.2. Rents and competitive balance in an oligopolistic setting

In order to describe the oligopolistic structure of the UCI Pro Tour, we focus on a static model, in which:

1. There is only one period of competitive interaction.
2. Teams perform their actions simultaneously.
3. Competition is limited to the case of only two teams.

[24] There are cases where multinational companies finance teams belonging to small federations. It is the case of Biarne Riis' *Team CSC*, enrolled in the Danish federation, financed by the multinational CSC, and having its headquarter in a small village in Tuscany.

4. Exogenous factors, like weather conditions or other circumstances not under the control of the teams, do not affect the final outcome.

In particular, we are interested to explore the outcome produced by an oligopolistic setting as the one introduced by the UCI and to propose eventual corrections. The standard oligopoly theory[25] provides different results. We take into exam firstly the approach *à la* Cournot.

Following Cournot (1838), in a model readapted for professional cycling, there are two teams, A and B. Each of them decides *ex-ante* (before the start of the season) its output level, that is, which amount of points q they aim to get, on the basis of their abilities and objectives.

The aggregate output will be $Q = q_1 + q_2$, so that for getting points it is necessary an effort $\varepsilon(Q) \equiv \varepsilon(q_1 + q_2)$. The teams have the same revenue. $r>0$ per unit of q. r represents the rent obtained by the team in terms of reputation of the cyclists, visibility of the sponsors, etc.. The difference between r and ε also represents a rent for the team, consisting in all the indirect gains earned by the team and the sponsorship by competing in Pro-Tour races. Such a rent can be seen as the visibility on the media, popularity of its cyclists, improvement of the reputation of the team management, etc.

Under this assumption, team A's maximization problem given team B's points q_B^* will be:

$$\underset{q_A \geq 0}{Max} \quad rq_A - \varepsilon(q_A + q_B^*)q_A \tag{1}$$

Assuming $q_A > 0$, the first order condition will be

$$r = \varepsilon'(q_A + q_B^*)q_A + \varepsilon(q_A + q_B^*) \tag{2}$$

In equilibrium, the best-response correspondence of the two teams will be

$$\begin{aligned} r &= \varepsilon'(q_A^* + q_B^*) \cdot q_A^* + \varepsilon(q_A^* + q_B^*) \\ r &= \varepsilon'(q_A^* + q_B^*) \cdot q_B^* + \varepsilon(q_A^* + q_B^*) \end{aligned} \tag{3}$$

And then, in the general hypothesis of n teams, we obtain:

$$r = \varepsilon'(Q_n^*) \cdot \left(\frac{Q_n^*}{n} \right) + \varepsilon(Q_n^*) \tag{4}$$

In the case of $n=1$, we get a monopolistic outcome:

$$r = \varepsilon'(q) \cdot (q) + \varepsilon(q) \tag{5}$$

On the other side, r tends to ε when the number of competing teams tends to infinity. Hence, in this framework that follows the Cournot duopoly, the presence of two firms is not able to ensure a competitive outcome. In the case of a reduced number of teams, the revenue r

[25] For a survey see e.g. Mas-Colell et al. (1995), pp. 383-398.

is greater than the effort ε. A gradual reduction of the team's rent is observable when the number of teams increases, but the size problems discussed in section 3.1 do not allow for a league that enrols an infinite number of teams.

3.3. Disutility and differentiation

Up to now we assumed that once decided q, the effort level ε adjusts to the level necessary to get the planned number of points, independently on the amount of points targeted by the other team. But which outcome do we get, if the teams' strategic variable adopted is the effort level ε instead of the points? In professional cycling these two strategies are not necessarily alternatives. In fact, we can make the hypothesis that *ex-ante* the teams decide the number of points, choosing implicitly an average effort. But, as we already said, the main objective for the teams is to win in the single races, while the participation to the Pro Tour is only a way of access to them. Hence, points are collected in very different races for what concernes the skills and the abilities they require to compete for the victory. Implicitly this means that points are allocated according to the function $q(\varepsilon)$: The higher the effort spent, the higher will be the number of points earned. The function $q(\varepsilon)$ is continuous and has a positive slope such that $q'(\varepsilon) > 0$ and there exists an $\varepsilon^* < \infty$ such that $q(\varepsilon) = \max$ for each $\varepsilon \geq \varepsilon^*$.

Races are also different in respect of the interests of the sponsorship and for the perceived prestige level. In particular, we include additionally to the assumptions 1.-4. of section 3.2 a fifth assumption:

5. The teams have different effort evaluations across single races.

We can assume that for reasons like the sponsor's nationality or the main market on which it operates or the race prestige perceived by the management, teams are built accordingly to the sponsorship target races. They hire cyclists with personal characteristics, ability levels and skills consistent with this target.[26] This realistic assumption implies that every team faces in every race a certain disutility, which affects its specific effort in a single race.

In formalizing these assumptions, we assume that the net effort of each team is affected by the distance from the team's home country and the race country, a good proxy of the disutility depicted above. We formalize this by defining the net effort as $\varepsilon_A - td$, where $t>0$ is a parameter that measures the disutility per unit of distance d from the race location to the centre of business of the team.

[26] Take as an example the Belgian squad *Quick Step*, which is traditionally set up to be competitive in one-day races, according to the Belgian preferences. On the contrary, Spanish teams are mainly constituted by mountain and time trial specialists in order to prevail in stage races. The most extreme example was the American team *Discovery Channel*: Since the *Tour de France* is the only cycling event which has some popularity in the U.S., the squad was hired exclusively for supporting Lance Armstrong in winning the *Tour*.

The presence of the disutility introduces a differentiation between the behaviour of two teams because they may now strictly prefer getting more point in a race than in another, even if the contest effort requested is the same.

Assume the races and teams on a market structured as a linear segment, with the teams lying at the two extremes and the race located at the point *x*. The points available will be won by team A if at its location $\varepsilon_A - tx > \varepsilon_B - t(1-x)$.

The location of the race for which the two teams present the same level of net effort is the point x^*, where $\varepsilon_A - tx^* = \varepsilon_B - t(1-x^*)$ or:

$$x^* = \frac{t - \varepsilon_B + \varepsilon_A}{2t} \tag{6}$$

Team A's points at the end of the race will be:

$$q_A(\varepsilon_A, \varepsilon_B) = \begin{cases} q(\varepsilon_A) & \text{if } \varepsilon_A > \varepsilon_B - t \\ (t - \varepsilon_B + \varepsilon_A)q/2t & \text{if } \varepsilon_A \in [\varepsilon_B - t\ ,\ \varepsilon_B + t] \\ 0 & \text{if } \varepsilon_A < \varepsilon_B - t \end{cases} \tag{7}$$

Since each team searches for its best response to any effort choice of the other team, team A restricts its effort to the range $[\varepsilon_B - t\ ;\ \varepsilon_B + t]$ because any effort $\varepsilon_A > \varepsilon_B + t$ yields the same number of points as setting $\varepsilon_A = \varepsilon_B + t$ and any effort $\varepsilon_A < \varepsilon_B - t$ yields zero. Thus, if the second equation of (7) is the stable solution, team A's best response solves

$$\underset{\varepsilon_A}{Max} \quad (r - \varepsilon_A)(t - \varepsilon_A + \bar{\varepsilon}_B) \cdot \frac{q}{2t} \quad s.t. \quad \varepsilon_A \in [\bar{\varepsilon}_B - t\ ;\ \bar{\varepsilon}_B + t] \tag{8}$$

Omitting the proofs, the equilibrium that arises is then $\varepsilon_A + t = \varepsilon_B + t = r$.

In this equilibrium, if disutility tends to zero, we would obtain an outcome like in a Bertrand-style model (Bertrand 1883), where teams set their effort level equal to revenues and the duopoly works as perfectly competitive market.[27] In the other direction, when disutility increases, it is observable a departure from the competitive outcome. The final result of the introduction of a disutility from distance is that teams, having different abilities, spend more (net) effort in some races than in others.

4. Empirical verification

In section 3 we proved that even in the case of the UCI Pro Tour, an oligopoly does not provide a competitive market outcome. The equality between non monetary revenues and effort, predicted by a "classic" oligopolistic Bertrand-style model does not hold introducing

[27] This case has been extensively discussed in a previous version of the paper (Rebeggiani/Tondani 2006), but has no particular explaining power for the UCI Pro Tour case.

disutility in getting points in the farthest race. Assuming that teams do not compete on effort, as in the Cournot-style model, we found that a competitive outcome can be achieved only with a very high number of teams. In this section we present an empirical investigation aimed at validating this theoretical findings. A confirmation of the oligopolistic behaviour of the Pro Tour teams can be found by analyzing the ranking of the first editions of the UCI Pro Tour in 2005 and in 2006. The point scales are reported in the Appendix.

We examine the points collected by each rider in every race. Then, in every race we aggregate the individual points by team. The races are aggregated by the host nation (with the exclusion of the *Tour de France* from French races) and, in some cases, also by kind of events (for instance, we aggregated all the "Northern Classics"[28] independently on the nation). Points have been normalized such that the figures in every box represent the percentage of the total point got by the team achieved in that specific country.

First of all, this procedure allows for an analysis of the competitive equilibrium in the two first editions of the Pro Tour. We measure competitive equilibrium with a simple measure of entropy, which is

$$H = -\sum_{j=1}^{N} \frac{q_j}{Q} \log\left(\frac{q_j}{Q}\right) \tag{9}$$

where N is the number of teams, q_j are the points got by team j, and Q are the total points assigned. Such an index can vary in a range between 0 (no heterogeneity at all, hence perfect equilibrium among the teams) and $\log(N)$, which stands for maximum heterogeneity. In order to normalize the index in a range between 0 and 1, we can compute an index of relative entropy:

$$RH = \frac{H}{\log(N)} \tag{10}$$

In 2005, *RH* was equal to .9585, while in 2006 reached the value of .9592. Hence, the competitive equilibrium in Pro Tour has been very low in the two first editions of this challenge. The first 10 teams of the ranking in 2005 got 68.89 per cent of the points available; this percentage increased to 70.28 in 2006. The ratio between the top ten teams and the last ten increased from 2.32 to 2.36. This means that from 2005 to 2006 inequality between the subgroups of the weakest teams and of the best teams slightly increased.

An analysis of the teams' behaviour over time (table 2) shows that the percentage of the points obtained by every team varies in the range ±3 per cent. This is a first confirmation of

[28] As Northern Classics cycling fans indicate the traditional Belgian, Dutch and Northern-French races, which take place in spring.

the oligopolistic structure of the Pro Tour. Slightly larger is the mobility in the ranking, which varies in the range ±6 ranking positions.

The main results are summed up in tables 3 and 4. The third column shows the percentage of the total points got by every team, while the fourth shows the Gini-Index of the concentration of the points got by the teams grouped by nations. The normalized points are represented from the fifth column onwards.

We can observe from table 3 that in 2005 9 teams out of 18 achieved the relative majority of their points in the race hosted in the country where the team is affiliated (arrow).[29] Other 4 teams achieved in the home country the second highest number of points (dot). Moreover, it is observable a concentration of effort on some particular events or groups of homogeneous events (square). Furthermore, even in 2006, 9 teams spent the main part of their effort in the races organized in their home countries (table 4).

This first analysis confirms the supposition that the oligopolistic framework of the Pro Tour encourages behaviours far from pure competition. In particular, teams put a larger effort on the race organized in the home country. It is possible to argue that the different effort can be explained by the different kind of races. For instance, one-day races organized in Belgium and the Netherlands require different skills than those need to be competitive in the *Vuelta a España*. But if one considers that already the formation of the racing squads follows the particular national preferences for special kinds of competitions (one-day races in Benelux, stage-races in Spain), the problem remains the same.

Moreover, the non-competitive behaviour is stronger for the worst teams. The scatter plots in figure 1 and 2 show how these teams concentrate their effort in remarkably few races. The *x*-axis represents the percentage of the points achievable in the Pro Tour got by every team. The *y*-axis represents a Gini index which measures how much concentrated in few or more races the points got by every team are. It emerges clearly that those which achieved more points relatively to the total show a smaller concentration index concerning their race participation. The correlation index (equal to .73 in 2005 and to .54 in 2006) confirms the close connection between the two variables.

By aggregating the twenty teams by nationality (table 5 and 6), we can observe that in 2005, in 5 nations out of the 7 which host at least one Pro Tour race, the local teams, in aggregate, achieved the relative majority of their points in local races (arrow). Again, it is observable a concentration of effort on some particular events (square). The number of nations in which the local teams collect the relative majority of their points in local races decreases to

[29] We take into account 18 teams out of 20 because two of them (the Danish *CSC* and the US-American *Discovery Channel*) represent countries in which no Pro Tour races are organized.

two (Italy and Spain) in 2006, but this reduction is attributable to a larger mobility of the single cyclists outside the national borderlines.

This analysis is nevertheless a first empirical attempt and significant shortcomings. First of all, basing the analysis exclusively on points, even if they are the best (and only available) effort proxy, does not consider the whole uncertainty of a sport competition, and in particular of cycling, like mechanical accidents, cyclists performance variability, and so on. Moreover, the possibility of collusions, a typical element of oligopoly and a fundamental variable in cycling (Caruso 2005), both in the weak form of the "tacit alliance" and in the strong form of money compensation, is not considered here. Neither the effect of doping, a factor that can strongly affect sport contest outcomes, is taken into account. Finally, riders and their effort are supposed here to be ex ante homogeneous. But the cycling tradition of one country itself shapes, through the training methods and the selection in junior teams, particular kind of riders. Cyclists from some countries have a better performance in one-day races rather than in stage-races, others in stage races.[30] When they, as in the current setting, are grouped in teams homogeneous in nationality, this factor plays an important role, inducing some teams more likely to be successful in certain races than in others. Moreover, more sophisticated models could consider and tolerate an at least slightly major propensity to spend more effort in home races, which would better capture the long lasting tradition of cycling events.

Nevertheless, we think that the empirical investigation provides some evidence that show the needs of correction of the current settings of UCI Pro Tour, in order to achieve larger degree of efficiency without offsetting the peculiarities of professional cycling.

[30] It is e.g. the case of the Belgian cyclists, not able to win a three-week race since the 1970s with Eddy Merckx. On the other side, the first Spanish winner of a Northern Classic has been Igor Astarloa in the 2003 edition of *Fleche Wallonne*.

Teams	Points (in % of total points)			Ranking		
	2005	*2006*	*diff*	*2005*	*2006*	*Diff*
Fassa Bortolo	6,14	-	-	8	-	-
Domina Vacanze	1,62	-	-	18	-	-
Team Csc	8,06	11,02	2,95	2	1	1
Discovery Channel Pro Cycling Team	7,89	7,72	-0,17	3	2	1
Liberty Seguros - Würth Team	6,92	7,63	0,70	7	3	4
Lampre - Caffita	5,09	7,12	2,03	10	4	6
Illes Balears - Caisse D'epargne	4,65	7,11	2,46	13	5	8
Rabobank	7,68	6,96	-0,72	4	6	-2
Quick Step	8,06	6,60	-1,46	1	7	-6
Gerolsteiner	7,12	6,00	-1,12	5	8	-3
T-Mobile Team	7,11	5,20	-1,91	6	9	-3
Saunier Duval - Prodir	4,05	4,90	0,86	14	10	4
Davitamon-Lotto	4,91	4,33	-0,58	12	11	1
Liquigas-Bianchi	4,99	4,18	-0,81	11	12	-1
Euskaltel - Euskadi	2,45	3,79	1,34	16	13	3
Ag2r Prevoyance	-	3,65	-	-	14	-
Phonak Hearing Systems	5,80	3,47	-2,33	9	15	-6
Credit Agricole	2,94	2,79	-0,15	15	16	-1
Française Des Jeux	1,35	2,34	0,99	19	17	2
Milram	-	2,21	-	-	18	-
Cofidis, Le Credit Par Telephone	2,11	2,08	-0,02	17	19	-2
Bouygues Telecom	1,06	0,90	-0,16	20	20	0

Table 2: Teams' points and rankings in the 2005 and 2006 UCI Pro Tour

	TEAMS		% OF TOTAL POINTS	GINI INDEX	ITALY	FRANCE (without TOUR)	SWITZERLAND	POLAND	SPAIN	GERMANY	BE.NE.LUX	WORLD CHAM-PIONSHIP	TOUR DE FRAN-CE	GIRO D'ITALIA	VUELTA A ESPANA	NORTHERN CLASSICS
b	Quick Step	←	**8.06**	.410	12.79	12.21	7.63	0.00	17.37	13.55	25.38	9.54	1.53	1.15	4.01	22.52
dk	Team Csc		**8.06**	.562	9.54	23.66	5.73	0.00	15.46	0.95	28.44	0.00	16.22	2.67	10.69	4.96
us	Discovery Channel Pro Cycling Team		**7.89**	.550	21.44	21.83	1.95	5.07	10.53	0.00	12.09	0.00	27.10	17.54	0.78	10.72
n	Rabobank	←	**7.68**	.559	15.63	0.20	7.01	19.44	18.04	0.00	30.26	0.00	9.42	0.00	14.83	9.22
d	Gerolsteiner	●	**7.12**	.494	23.11	19.87	1.51	0.22	9.50	21.81	13.17	0.00	10.80	3.24	0.86	9.94
d	T-Mobile Team		**7.11**	.661	1.08	14.29	2.38	0.00	8.44	8.87	36.58	0.00	28.35	0.87	8.44	16.88
e	Liberty Seguros - Würth Team	←	**6.92**	.576	11.56	11.33	6.89	0.00	36.00	12.22	20.22	0.00	1.78	1.33	28.00	8.00
i	Fassa Bortolo	●□	**6.14**	.588	19.05	17.79	6.27	12.78	0.25	8.52	34.59	0.00	0.75	6.52	0.25	41.60
s	Phonak Hearing Systems	←	**5.80**	.402	14.85	14.85	23.34	0.00	12.73	8.49	9.28	0.00	16.45	2.65	2.12	3.98
i	Lampre - Caffita	←	**5.09**	.439	35.65	12.69	12.39	9.06	9.06	8.16	8.16	0.00	4.83	22.96	0.00	6.04
i	Liquigas-Bianchi	□	**4.99**	.549	22.22	15.43	6.48	7.72	22.53	0.00	25.00	0.00	0.62	20.68	0.31	33.95
b	Davitamon-Lotto	←□	**4.91**	.618	20.38	15.36	0.00	0.00	19.44	0.00	32.92	0.00	11.91	20.38	11.60	39.18
e	Illes Balears - Caisse D'epargne	←	**4.65**	.622	13.25	14.24	0.00	0.00	37.09	0.00	1.99	13.25	20.20	13.25	18.21	1.66
e	Saunier Duval - Prodir	←	**4.05**	.735	16.35	20.91	0.00	0.00	47.15	5.70	9.89	0.00	0.00	15.97	0.76	0.00
f	Credit Agricole	←	**2.94**	.759	45.03	32.46	0.00	0.52	2.62	2.62	3.66	0.00	13.09	18.85	0.00	0.00
e	Euskaltel - Euskadi	●	**2.45**	.674	2.52	31.45	9.43	0.00	20.13	0.00	32.08	0.00	4.40	2.52	15.72	0.00
f	Cofidis, Le Credit Par Telephone		**2.11**	.721	31.39	0.73	11.68	0.00	10.95	0.00	40.15	0.00	5.11	8.76	8.76	26.28
i	Domina Vacanze	●□	**1.62**	.774	34.29	0.00	26.67	0.00	0.00	0.95	38.10	0.00	0.00	34.29	0.00	28.57
f	Française Des Jeux		**1.35**	.670	22.73	0.00	5.68	35.23	3.41	0.00	26.14	0.00	6.82	0.00	3.41	12.50
f	Bouygues Telecom		**1.06**	.833	36.23	0.00	0.00	0.00	8.70	0.00	4.35	50.72	0.00	0.00	0.00	4.35

Table 3: Points per team in the 2005 UCI Pro Tour

	TEAMS		% OF TOTAL POINTS	GINI INDEX	ITALY	FRANCE (without TOUR)	SWITZER-LAND	POLAND	SPAIN	GERMANY	BE.NE.LUX	TOUR DE FRANCE	GIRO D'ITALIA	VUELTA A ESPANA	NORTHERN CLASSICS
dk	Team Csc		11.02	.264	20.15	19.16	9.02	0.00	8.16	9.15	20.27	14.09	15.45	7.54	26.45
us	Discovery Channel Pro Cycling Team		7.72	.350	19.58	14.11	6.53	0.71	24.16	7.58	24.16	3.17	0.88	4.59	11.82
e	Astana - Würth Team	←	7.63	.567	10.36	2.14	33.21	0.18	44.82	7.50	1.79	0.00	17.86	0.36	3.21
i	Lampre - Caffita	←	7.12	.331	34.23	16.44	1.91	9.18	5.35	10.90	13.38	8.60	0.57	0.57	16.63
e	Illes Balears Caisse d'epargne	←	7.11	.471	3.45	10.54	9.00	0.00	42.53	0.38	17.24	16.86	8.05	3.45	3.45
n	Rabobank		6.96	.299	21.53	19.57	4.70	4.89	1.96	9.00	17.81	20.55	0.00	0.98	0.00
b	Quick Step Innergetic		6.60	.502	40.41	12.58	1.44	0.62	2.06	9.28	28.87	4.74	0.00	0.00	12.37
d	Gerolsteiner		6.00	.257	19.95	15.42	5.67	13.15	4.08	11.56	23.13	7.03	0.00	0.45	6.35
d	T-Mobile Team		5.20	.440	4.19	15.71	4.45	0.00	14.14	2.09	26.70	32.72	0.00	5.24	4.19
i	Saunier Duval - Prodir	←	4.90	.572	26.67	10.00	11.94	0.56	48.61	0.28	1.94	0.00	0.00	13.89	26.11
b	Davitamon-Lotto		4.33	.379	9.43	4.72	25.47	13.21	4.72	0.00	12.58	29.87	23.90	0.00	8.81
i	Liquigas-Bianchi	←	4.18	.410	28.99	13.03	7.49	3.91	17.26	0.00	26.71	2.61	6.51	1.30	11.07
e	Euskaltel - Euskadi	←	3.79	.353	14.39	12.95	15.83	0.36	32.73	0.00	10.79	12.95	0.00	0.00	0.00
f	Ag2r Prevoyance	←□	3.65	.531	3.73	33.96	0.00	0.00	23.13	2.61	1.87	34.70	0.00	19.40	3.73
ch	Phonak Hearing Systems	←□	3.47	.525	39.22	1.18	6.27	2.75	35.69	4.31	10.59	0.00	5.10	28.24	37.25
f	Credit Agricole		2.79	.376	6.34	18.54	0.00	9.76	28.29	0.98	20.49	15.61	0.00	2.93	4.39
f	Française Des Jeux	←	2.34	.620	22.67	52.91	0.58	0.00	0.00	0.00	23.84	0.00	0.58	0.00	22.67
d	Milram		2.21	.432	31.48	0.00	5.56	0.00	18.52	22.22	18.52	3.70	4.32	0.62	0.00
f	Cofidis, Le Credit Par Telephone		2.08	.499	43.14	2.61	7.19	13.07	22.22	0.00	0.00	11.76	0.00	0.00	8.50
f	Bouygues Telecom	●	0.90	.667	0.00	15.15	0.00	1.52	68.18	0.00	0.00	15.15	0.00	0.00	0.00

Table 4: Points per team in the 2006 UCI Pro Tour

		% OF TOTAL POINTS	GINI INDEX	ITALY	FRANCE (NO TOUR)	SWITZERLAND	POLAND	SPAIN	GERMANY	BE.NE.LUX	WORLD CHAM-PIONSHIP	TOUR DE FRANCE	GIRO D'ITALIA	VUELTA A ESPANA	NORTHERN CLASSICS
Belgium	←□	**12.97**	**.453**	15.66	13.40	4.74	0.00	18.15	8.42	28.23	5.93	5.46	8.42	6.88	28.83
Danmark		**8.06**	**.562**	9.54	23.66	5.73	0.00	15.46	0.95	28.44	0.00	16.22	2.67	10.69	12.79
France		**7.46**	**.490**	35.88	12.99	4.33	6.60	5.98	1.03	18.14	7.22	7.84	9.90	3.09	14.43
Germany		**14.23**	**.486**	12.11	17.08	1.95	0.11	8.97	15.35	24.86	0.00	19.57	2.05	4.65	18.81
Italy	←□	**17.83**	**.478**	26.06	14.06	9.92	9.15	8.97	5.35	24.68	0.00	1.81	17.69	0.17	29.42
The Netherlands	←	**7.68**	**.559**	15.63	0.20	7.01	19.44	18.04	0.00	30.26	0.00	9.42	0.00	14.83	16.23
Spain	←	**18.06**	**.537**	11.84	16.95	3.92	0.00	36.63	5.96	14.82	3.41	6.47	7.84	17.72	5.20
Switzerland	←	**5.80**	**.402**	14.85	14.85	23.34	0.00	12.73	8.49	9.28	0.00	16.45	2.65	2.12	7.96
United States		**7.89**	**.550**	21.44	21.83	1.95	5.07	10.53	0.00	12.09	0.00	27.10	17.54	0.78	10.72

Table 5: Points per nation in the 2005 UCI Pro Tour

		% OF TOTAL POINTS	GINI INDEX	ITALY	FRANCE (NO TOUR)	SWITZERLAND	POLAND	SPAIN	GERMANY	BE.NE.LUX	TOUR DE FRANCE	GIRO D'ITALIA	VUELTA A ESPANA	NORTHERN CLASSICS
Belgium	•	**10.93**	**.297**	24.92	8.65	13.46	6.91	3.39	4.64	20.72	17.31	11.95	0.00	10.59
Danmark		**11.02**	**.264**	20.15	19.16	9.02	0.00	8.16	9.15	20.27	14.09	15.45	7.54	26.45
France	•	**11.76**	**.385**	15.18	24.63	1.55	4.87	28.37	0.72	9.24	15.45	0.12	4.47	7.86
Germany		**13.41**	**.231**	18.54	10.38	5.22	4.38	12.25	11.96	22.78	14.49	1.44	2.10	3.51
Italy	←	**11.30**	**.326**	31.61	14.74	4.70	6.54	11.31	5.45	20.05	5.61	3.54	0.94	13.85
The Netherlands		**6.96**	**.299**	21.53	19.57	4.70	4.89	1.96	9.00	17.81	20.55	0.00	0.98	0.00
Spain	←	**23.42**	**.434**	13.72	8.91	17.50	0.27	42.17	2.04	7.94	7.45	6.48	4.42	8.19
Switzerland	□	**3.47**	**.525**	39.22	1.18	6.27	2.75	35.69	4.31	10.59	0.00	5.10	28.24	37.25
United States		**7.72**	**.350**	19.58	14.11	6.53	0.71	24.16	7.58	24.16	3.17	0.88	4.59	11.82

Table 6: Points per nation in the 2006 UCI Pro Tour

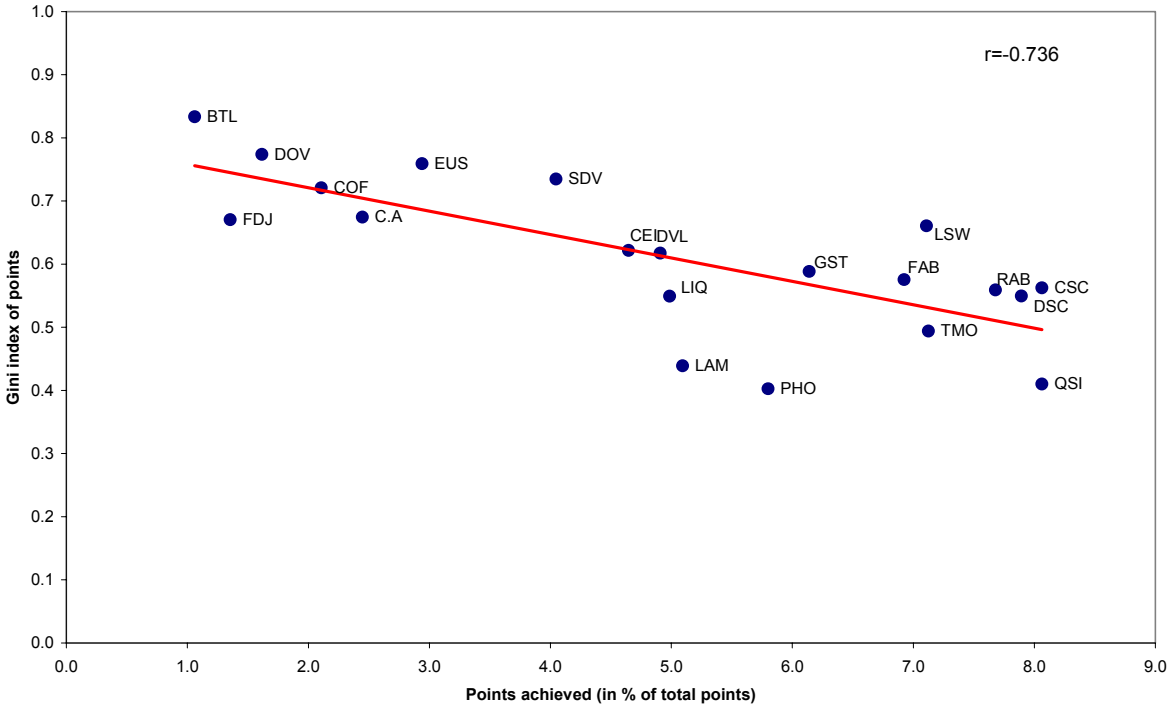

Figure 1: Concentration of the teams' participation 2005

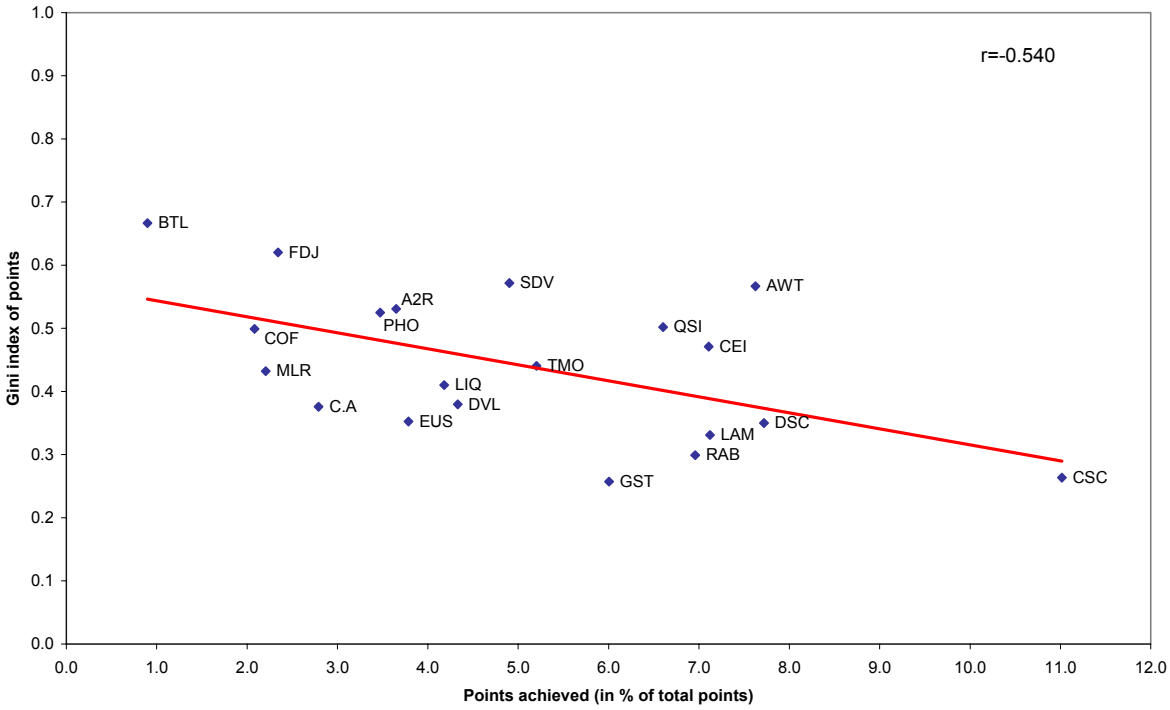

Figure 2: Concentration of the teams' participation 2006

5. Efficiency improvements

5.1. The introduction of a promotion/relegation system

The findings of the previous section can be summed up in the conclusion hat the current structure of UCI Pro Tour suffers from typical competitiveness problems of oligopolistic markets. Hence, a way to improve the general setting has to be found. We already know that the most immediate solution would be to increase the number of teams in the league, but this cannot be implemented for the already mentioned problems of congestion and qualitative level of the collective good produced.

A second-best strategy to avoid behaviours as those depicted above, reducing the rents and increasing competitiveness of the Pro Tour, could be the introduction of some penalties. In particular, we propose that at the end of the season *n* teams should be dropped off the competition and substituted by an equal number of promoted ones that will compete in the new season.

In every season, the teams will then maximise an objective function that includes an evaluation of the outcome of the second period. This means, a team will maximise the points got in the season 1 taking into account the two possible outcomes of season 2, that is to be relegated in the continental circuit with the probability β or to stay in the Pro Tour with the probability *1-* β, with $\beta'<0$. The maximization problem for a team will be:

$$\underset{q_A>0}{Max}\ rq_A - \varepsilon(q_A+q_b)q_A + (1-i)\left\{\beta\cdot(L_r) + (1-\beta)\left[rq_A^2 - \varepsilon(q_A^2+q_B^2)q_A^2\right]\right\} \qquad (9)$$

where q_A^2 represents the expected optimal points got if the team in season 2 remains in the Pro Tour, while *i* represents a rate of team preference. L_r stands for the loss that occurs to the team in the case it is relegated. L_r is not equal for all teams, it is rather a subjective parameter depending on the overall ability level *a*. In a promotion/relegation system the loss occurred in case of relegation will be higher for those with a low ability because in the closed league they could get a positive rent even if their overall ability was low, while now they have to put more (costly) effort in competitions to avoid relegation. On the other side, teams with a high ability have a smaller *L* because changing over from a closed league to the relegation system does not lead to a need of augmenting the effort to remain in the Pro Tour.

Hence, rearranging the first order condition for team A, the optimal level of points will be

$$q_A = \frac{r-\varepsilon(q_A+q_B)}{\varepsilon'(q_A+q_B)} + (1-i)\frac{\beta'\cdot\left[L_r - rq_A^2 - \varepsilon(\cdot)q_A^2\right] + \beta\left[\varepsilon(\cdot) + \varepsilon'(\cdot)q_A^2 - r\right] + r - \varepsilon'(\cdot)q_A^2 - \varepsilon(\cdot)}{\varepsilon'(q_A+q_B)} \qquad (10)$$

Note that from (5) the optimal level of points without the promotion/relegation system would be

$$q_A = \frac{r - \varepsilon(q_A + q_B)}{\varepsilon'(q_A + q_B)} \tag{11}$$

Hence, q_A will be higher with the promotion/relegation system if the second term of the right-hand side of (10) is positive. Such a term is positive if the numerator is larger than zero. This constraint holds for a level of the loss such that

$$L_r > r \cdot q_A^2 - \varepsilon(\cdot)q_A^2 + \frac{1}{\beta'} \cdot (r - \varepsilon'(\cdot)q_A^2 - \varepsilon(\cdot)) - \frac{\beta}{\beta'} \cdot (r - \varepsilon'(\cdot)q_A^2 - \varepsilon(\cdot)) \tag{12}$$

Inequation (12) provides a result of the introduction of relegation. The right-hand side of (12) represents the total revenues plus the expected best-response correspondence in season 2. If L_r is larger than that amount, the team will increase its pursued optimal number of points after the introduction of the relegation system. If not, the team will decrease its q. Hence, if the teams take into account the loss caused by possible relegation, the competitive equilibrium of the Pro Tour will increase.

5.2. The implementation of an open league in UCI Pro Tour

Following the message arisen from the theoretical analysis and confirmed by the empirical investigation, in this section we formulate some proposals in order to improve the efficiency of the UCI Pro Tour.

Having already argued about the impossibility of increasing the number of teams because of the problem of attractiveness and congestion, our theoretical results lead us to the following alternative proposal: The UCI Pro Tour should introduce a relegation mechanism excluding the worst teams and promoting new teams at the end of every season. From an operative point of view, we propose the relegation of 3 or 4 teams out of the 20 actually enrolled in Pro Tour.[31] Since the UCI did not implement a "second division" under the top league, but a series of continental challenges, the promoted teams could be selected between the winners of those competitions.

Some secondary advantages could also arise from this reform. In particular, a broader recruitment of the promoted teams from various continental circuits could support the internationalization of professional cycling – a scope actually pursued by UCI – through the upgrade of non-European teams in the Pro Tour. Moreover, sponsors interested to finance a Pro Tour

[31] While we can't provide a theoretically supported „optimal" number, we rely on the experience of European team sports leagues, where normally 10-15% of the league is replaced every year by relegation/promotion.

team could even "get in" earlier, investing money and time by supporting squads in continental challenges trying to push them into the top league. This solution would be an indirect help for rising competition and interest toward smaller races, which since the introduction of Pro Tour in 2005 have suffered from a lower presence of the main teams and of media and sponsors.

Nevertheless, several problems should be taken into account before introducing such an open league. First of all, the increased uncertainty would also be an obstacle for sponsors to engage, a problem well known from European football, where relegations are often accompanied by the loss of financial supporters. Furthermore, the severe financial requirements of the UCI for obtaining a Pro Tour license could constitute an obstacle for teams to accept a promotion. This issue is also well known from minor sports in Europe, like table tennis, volleyball or in some cases even basketball, where successful teams refuse a promotion due to the impossibility of matching the increased costs in the top league. The UCI should therefore develop a more flexible license assignation procedure, taking also into account possible financial trouble of relegated teams. Shaping an optimal open league would be thus a challenging, but worthwhile exercise, which however goes beyond the scope of the present paper.

6. Conclusion

This paper has given a first economic analysis of professional cycling and has then examined the effects of the newly introduced UCI Pro Tour on teams' and racers' behaviour. We derived the need for some changes, especially the opening of the Pro Tour "closed league" by introducing a relegation system.

Since it is one of the first academic approaches to the topic, much work remains to do. On the theoretical side, more complex models should be developed, starting from the peculiarities of professional cycling listed in chapter 2.4. One could study alternative organisational forms, or even the behaviour of cyclists in contests, using perhaps game-theoretic models. A good framework could be the model recently set up by Gershkov et al. (2007). Another interesting field is the application of the existing studies on doping to the particular case of pro cycling.

For what concerns empirical research, cycling offers good possibilities for effort/success studies (like Prinz 2005 and Torgler 2006), as the competitions' results are well documented since decades, while there is almost no basis for financial and organisational analysis. Such an investigation of pro cycling requires at least some financial statistics to start from. While salary data will probably remain difficult to access to, at least the publication of detailed budget data of racing teams and race organizers should be possible, as it is the case in other profes-

sional sports like football. Here the transparency induced by the academic attention has contributed, in our opinion, to a greater financial discipline of the football clubs during the last years. Similar positive externalities could result from cycling studies, so the UCI should enhance the publication of financial data as well as other economic and organizational information.

Current developments indicate that the actual setting of the Pro Tour is in fact perceived as not satisfying by teams and race organizers (e.g. RSN 2006). Those of the three major stage races have threatened many times to abandon the Pro Tour, mainly because they fear losing control on their own event, and in particular on the related TV rights. The closed-league shape was moreover blamed as fatal for excluded teams and race events.

Several changes are therefore expected to take place in the next years. This represents a great research fields for sports economists, which should not be neglected: In a recent interview, T-Mobile team manager Bob Stapleton pointed out how underdeveloped pro cycling is in a economic sense. Despite the organisational difficulties and the doping scandals, there seems still to be plenty of room for improvements to make the physically hardest sport an even commercially successful one.

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Appendix

Pro Tour 2005: Points scale for individual rankings

	Tour de France	*Vuelta a España, Giro d'Italia*	*Paris-Nice, Tirreno-Adriatico, Milano-Sanremo, Ronde van Vlaanderen, Vuelta Ciclista al Pais Vasco, Paris-Roubaix, Liège-Bastogne-Liège, Tour de Romandie, Volta Ciclista a Catalunya, Critérium du Dauphiné Libéré, Tour de Suisse, deutschlandtour, Eneco Tour, Tour de Pologne, Giro di Lombardia*	*Gent-Wevelgem, Amstel Gold Race, La Flèche Wallonne, Vattenfall Cyclassics, Clasica Ciclista San Sebastian-San Sebastian, GP Ouest France-Plouay, Züri Metzgete, Paris-Tours*
Final classification of the races				
1	100	85	50	40
2	75	65	40	30
3	60	55	35	25
4	55	45	30	20
5	50	40	25	15
6	45	35	20	11
7	40	30	15	7
8	35	26	10	5
9	30	22	5	3
10	25	19	2	1
11	20	16		
12	15	13		
13	12	11		
14	10	9		
15	8	7		
16	6	5		
17	5	4		
18	4	3		
19	3	2		
20	2	1		
Stages and Prologues (in parentheses the points scale for the season 2006)				
1	5 (10)	3 (8)	1	
2	3 (5)	2 (4)		
3	1 (3)	1 (2)		

Riders belonging to an UCI Professional Continental Team do not score any points. The points corresponding to the place obtained are not awarded. The team time-trial does not award points to single riders.