Chapter X: The Tour de France: a success story in spite of competitive imbalance and doping

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Introduction

The Tour de France is one the world's largest sports events. The three-week race attracts 10 to 15 million (non-paying) spectators along the roads each year and individual stages are watched by 15 to 20 million TV viewers worldwide (see chapter 5). Although generally cycling races are not lucrative, the Tour de France organiser's balance sheet reveals that the Tour has always been profitable in the past two decades.

How can this attractiveness and the economic success story be explained? Most sports economists are used to turn to a contest's outcome uncertainty as a first explanatory variable for success. However, fans of the Tour de France are not often surprised by the name of the final winner of the race, usually not even by the three riders sharing the podium. Nobody needs more than a few riders' names to predict with great certainty who the winner will be. Thus, explaining Tour de France success by outcome uncertainty and its usual metrics in terms of competitive balance must be checked carefully. Tour de France attendance and TV audience do not seem to be seriously threatened and surely not definitely affected by recurring doping scandals either. This was neither the case after big doping issues many decades ago (for example when Tom Simpson died during the climb of the Mont Ventoux in 1967), nor in the past twenty years (from the Festina affair in 1998 up to Lance Armstrong being stripped from all his Tour de France wins in 2012). Although doping seems not to be an immediate threat to the popularity of the Tour de France, it is clear that doping detection and doping sanctions have not been efficient and effective enough so far to clean this sport contest from the use of forbidden doping substances and practices. This raises the issue of what could be a better way to combat the use of doping in the Tour de France or in cycling in general.

The chapter goes as follows. In the first section it is demonstrated how the Tour de France is a high quality product. This is a result from its accurate design, its management, its economic model and its finance structure, both in comparison to other mega-sporting events and with reference to tournament theory. It is not easy to assess the competitive balance in the Tour de France since, as was demonstrated in chapter 10, it is at the same time an individual and a team sport contest. After reviewing some results published in literature so far, a new metrics for evaluating competitive balanced in the Tour de France is presented in section 2. Finally, the Tour de France cannot ignore doping as a potential threat to fan attendance and TV viewing. We therefore discuss the issue of doping and a new procedure to deal with doping in section 3.

1. A successful managerial and economic model

A top sports event offered for free will automatically attract a significant demand. Beyond this basic and quite obvious cause of Tour de France attractiveness, its design and management are also explanations of its success. As we will show below, the latter may be due, to some extent, to the Tour fitting with the recommendations derived from tournament theory and to basically sticking to a modern model of professional sport finance.

1.1. A well-designed and well-managed sport event

The Tour de France is managed by Amaury Sport Organisation (ASO). ASO also organises other professional cycling races (such as Paris-Roubaix or the Critérium du Dauphiné Libéré) as well as golf tournaments, track and field events, car races and horse-riding contests. Professional road cycling accounts for close to 70% of ASO revenue, mainly because of the success of the Tour de France (Desbordes, 2006). Since ASO is a privately-owned company, it aims at profit maximising and designs its strategy accordingly. A first strategic tool consists in multiplying the number of trophies within a race. This process started up in 1919 with introducing the yellow jersey and lasted until 1989 when the number of trophies has nearly stabilised, respectively rewarding the best rider overall (yellow jersey), the best climber (polka-dot jersey), the best sprinter (green jersey), the best young rider (any rider aged below 25, white jersey), and the best-ranked team. From time to time other trophies appeared and vanished again after some years. By creating “different races within the race”, ASO attempted and succeeded in making the Tour de France a more vivid contest with multiple opportunities for duels between riders or teams competing for a given trophy and changes in the tactics adopted by riders or teams during the course of the race.

Two other factors that attract people to see riders on the Tour de France roads are linked together. The first one is the riders’ performance, the second one lies in the hardness of the race. Based on the number of racing days and the number of rest days per racing day, the Tour de France became much harder after the 1920s with the number of racing days stabilising up to about 20 while one rest day per ten racing days became the usual ratio. Before the 1920s the number of stages was usually 15 at most and the riders enjoyed at least one day of rest after each stage. The overall riding distance was 2,428 kilometers in 1903 and rose to a maximum of 5,745 kilometers in 1926. Since then the distance shortened to about 3,500 kilometers on average. Thus, compared with the initial era of so-called ‘road’s convicts’ (*les forçats de la route* in French), riders now spend more days on the roads and have less often time to rest. However, this has been made feasible by reducing the average stage length from over 300 kilometers until 1926 to less than 200 kilometers since the 1960s. Consequently, the average duration of a stage, i.e. the time actually spent by riders on their bikes, fell from 10 to 16 hours before the 1930s to slightly over 4 hours in the 2000s. The race also became harder due to the introduction of mountain stages. The first mountain ever climbed in the Tour de France was the Ballon d'Alsace in the Vosges region in 1905. A handful of years later, high-mountain stages in the Pyrenees (1910) and the Alps (1911) were introduced. However, the number of passes over 1,000 meters in a given Tour de France has not increased significantly on average since the 1920s.

Apart from the physical hardness of the Tour de France, it is also the increase in riders' performances that has made the Tour attractive to spectators. The overall average speed of the yellow jersey winner was between 25 and 30 kilometers per hour (km/h) until the late 1930s. Since World War II it has steadily increased. From 25.7 km/h in 1903 to 41.7 km/h in 2005 (the fastest Tour ever) is an improvement of 62%. Part of this acceleration is due to technical progress affecting riders' bikes such as the introduction of derailleur gears, the increase in the number of gears, lighter bikes, profiled wheels, etc. (Calvet, 1981; Andreff, 1985). Improvement of the road surface, shorter stages, multiple stakes and high effort intensity in the crucial parts of the race have also triggered both higher rider performance and increased attractiveness to spectators. Improved physical and medical preparation, better nutrition, and sometimes doping may have played a role as well. Another index of riders' performance is the withdrawal ratio, the percentage of riders who do not finish all stages of the Tour de France. This ratio decreased from over 70% in the 1920s to 40% in the 1930s and about 20% during the 2000s. The highest withdrawal ratio was reached in 1926 (as explained above the longest Tour de France ever held) with 126 withdrawals out of 162 riders (77.8%), meaning only 36 riders finished the Tour de France that year. In 2009, the lowest withdrawal ratio was recorded with 156 out of 180 riders finishing the Tour de France. Only 24 riders (13.3%) abandoned the race.

Last but not least, the Tour de France is a sports event that is supplied for free to millions of spectators along the roads. However, the demand for it is not infinite. The demand is rationed by various constraints such as the date and location of a stage or the hosting capacity of a geographical site (like the slopes of the Mont Ventoux or Alpe d'Huez), limiting the number of spectators. Nevertheless, from an economic point of view, a free sport event is likely to draw a huge attendance. Indeed, 10 to 15 million spectators per year attend the race over the course of three weeks. This is significantly more than the biggest mega-sporting event in the world, the FIFA World Cup with an attendance of 3,115,800 people in Germany 2006 and 3,224,342 in South Africa 2010. Moreover, since all spectators cannot attend the Tour 21 days long, they also demand a story telling which was first supplied by newspapers, then through radio broadcasts and eventually through TV broadcasts.

1.2. The financing model of the Tour de France

The Tour de France has not always been a profitable business. Until the 1950s, financial deficits were common (Reed, 2010). The deficits vanished with rising TV rights revenues. The first Tour de France TV broadcast was the finish of the last stage at the Parc des Princes stadium in Paris in 1948 whereas the first TV broadcast of a mountain pass was at the Aubisque in 1958. Nowadays, the Tour is the major sports event in the French broadcasting market with well over 80 hours of broadcast, ahead of the Roland Garros tennis tournament (77 hours), Champions League matches, Formula 1 races and the rugby Six nations tournament. In 2013, 24 million French people watched the Tour de France for at least one hour on French television, a TV market share of slightly over 30%. In chapter 5 it was explained how from the 1970s on the Tour de France was also broadcast in more and more countries. Today it is a global mega-sporting event. Over 100 TV channels in 190 countries now broadcast the Tour de France, with live broadcast in 60 countries (www.aso.fr). Consequently, the Tour de France TV rights revenues have increased significantly over the years. In 1960, the French public TV channel started paying TV rights for broadcasting the Tour de France. The French broadcasting rights equalled € 23 million in 2009 (CSA, 2011) and have grown to € 24.9 million in 2013. Although this is significant, it is less than the football Champions League broadcasting rights in France (€ 50 million) or the French professional football league broadcasting rights over one season (€ 668 million). No detailed information on the international TV deals is available, but in chapter 3 it was shown that the global broadcasting rights for the Tour de France probably amount to about € 50 million a year. As a result, the budget of the Tour de France has literally skyrocketed since the 1980s. From 1980 to the late 1990s, the Tour operational budget grew from € 5 million to € 50 million (Mignot, 2013) primarily due to the growth of TV rights revenues that multiplied by 65 over the same period of time (from € 250,000 to € 16 million). In the past decade, the budget further increased from € 77 million in 2003 up to € 130 million in 2013.

Table 1 illustrates the financing sources of the Tour de France. Basically, three types of income can be distinguished: TV broadcasting rights, merchandising and sponsorship revenue, and income from municipalities. The media success story is the basis for the solid economic foundations of the Tour de France because it provided 44% of its overall budget in 2010. Just like in other professional sports, TV rights are now an important source of revenue, resulting from an organiser's strategy of using its monopoly power over the Tour de France to increase these rights. From the 1950s to the 1980s two-thirds of Tour de France revenues originated from merchandising and sponsorship. This kind of revenues emerged in 1925-1929 when the Tour had transformed from a race opposing individual riders into a race between opponent teams sponsored by trademarks and commercial companies. Since 1930, additional sponsorship income was generated with the introduction of a publicity caravan, i.e. dozens of vehicles preceding the riders by a few minutes and distributing product samples to spectators (see chapter 1). The share of advertising and sponsorship revenue has declined in the past two decades to 51% of the budget in 2010. Finally, each year over 200 cities are a candidate for hosting a Tour de France stage arrival and/or departure and those who are successful pay between € 50,000 and € 100,000 for this privilege. However, because of the rising overall budget the share of the contributions from these cities in the total budget of the Tour de France has decreased from 40% in 1952 to 5% in 2010.

Table x.1 Financing sources of the Tour de France and professional football in 2010

Revenue source (in % of overall finance)	Tour de France	English Premier League football	French football Ligue 1
TV broadcasting rights	44	51	57
Merchandising & Sponsorship	51	22	28
Municipalities	5	0	2*
Spectators (gate revenue)	0	27	13

* Municipal subsidies

The Tour de France has thus also evolved towards a contemporary model of professional sports finance and developed from a so-called SSSL (= Spectators, Subsidies, Sponsors, Local) model to a MCMMG (= Media, Corporations, Merchandising, Markets, Global) model with regard to its major sources of finance (Andreff & Staudohar, 2000). In the MCMMG model, media, in particular through TV broadcasting rights, have become a significant source of income for many sports. Furthermore, alongside with sponsors and gate receipts (spectators) whose share in overall finance of sports events has shrunk, new sources of finance have emerged including corporations (investment funds, big companies, Russian oligarchs, Middle Eastern sheiks enriched by oil sales, …), merchandising of non sporting goods (e.g. T-shirts) under a club's or a player's label, and markets. With respect to the latter, we see that money is channeled into contemporary professional sports from two markets: a labour market for talent in which a club makes money in selling home-educated and trained talented players and a capital market that enables to trade a club's shares at the stock exchange and collecting money from the fans as shareholders. Most of these new sources of finance are global.

From table 1 we also see that although the current Tour de France financing model is in line with big professional sports leagues such as the football English Premier League and the French Ligue 1, it remains specific in a way too. For example, its TV-dependence is slightly lower in percentage of overall revenues compared to football and merchandising and sponsorship (51%) is still a more important source of income to the Tour de France organisers than TV rights revenues. This may be interpreted as either the Tour de France being in a transition phase between the SSSL and MCMMG models, or as a consequence of the absence of gate revenue which must be compensated for by sponsorship money. In fact, the lack of gate revenue potentially deprives the Tour de France of up to a quarter (like in English football) of overall revenues. The share of public money received from municipalities is more important in the Tour de France than in European football though it is now reduced to 5% only. At the end of the day, the profitability of the Tour de France is likely to be guaranteed as long as it will attract media, advertisers and sponsors even without any spectatorship income.

1.3. The Tour de France and tournament theory

A more theoretical reason may explain why the Tour de France is such a successful sport contest. The tournament theory (Tullock, 1980) was first conceived for analysing the efforts dedicated by competing job seekers to get a job and was then adapted to sporting contests, namely tennis tournaments (Rosen, 1986). Each participant is assumed to independently choose the quantity of resources (physical efforts) he is going to invest in view of winning the tournament and receiving the winner's prize. His winning probability increases with this quantity. Let V stand for the value of the winner's prize and n the number of competing participants. Each participant i dedicates an effort e_i and his probability of winning p_i depends on his share in the overall effort devoted by all participants that is:

$$p_i = \frac{e_i^m}{e_i^m + e_j^m}$$

The financial gain of participant i is: $\pi_i = p_i V - c_i e_i^m$

where c_i stands for marginal cost of each participant i's effort or investment in the tournament and m is a parameter that measures the power of the tournament to discriminate across competing participants, *i.e.* m indicates how much one unit of competitor i's effort increases his winning probability.

The assumption that the organiser of a sport tournament acts profit maximising implies that the goal is to attract as many spectators as possible by gathering high quality athletes and by securing that these athletes dedicate maximal efforts to win. Therefore the organiser must conceive incentives in such a way that athletes maximise their efforts and, consequently, produce a spectacular sporting event. From tournament theory it is mathematically derived (Szymanski, 2003; Andreff, 2012) that:

a/ When one competitor has a very high capacity to win, the tournament practically is without interest for other participants who will dedicate only a minimal effort. The organiser must avoid such a competitive imbalance.

b/ Individual effort and aggregated effort of all the participants increase with the value of the winner's prize V.

c/ Individual effort decreases with the number of participants.

d/ Aggregated effort increases with the number of competitors.
e/ Participants' efforts are more intense in a tournament with multiple prizes, where there are several prizes or trophies at stake, as soon as the competitors' abilities to win are different.
f/ The effort will be more intense the wider the gap between the winner's prize and the prize rewarding the runner-up, and the wider the gap between the prize for the runner-up and the prize rewarding the third ranked rider, and so on. This is particularly true when the differences between the competitors' winning abilities are small.

As ASO indeed aims at making a profit from organising the Tour de France, the choice of an appropriate incentive mechanism is crucial. Most of the prerequisites for a successful and attractive sport contest are fulfilled by the Tour de France. By inviting a peloton of about 200 riders, ASO fulfils the precondition (d). If ASO intended to further increase the number of riders, it could deteriorate the condition (c) of tournament theory. Anyway, the maximum number of riders engaged in a professional cycling race is regulated by the international cycling federation. The only trade off open to ASO is between more teams with fewer riders each and fewer teams with more riders each. At the end of the day, the organiser chooses the number of teams and which teams are selected to participate in Tour de France each year. As described in chapter 2, this is not without conflicting interests between the organisers of the '*grand tours*' (ASO, RCS and Unipublic) and the UCI claiming that all the Pro Tour teams must be invited in each '*grand tour*' (Rebeggiani & Tondani, 2008). Total prize money in the Tour de France is now over € 2 million (for a detailed analysis, see chapter 3) which, compared with other cycling races, is rather fulfilling the prerequisite (b). Since the prize money is distributed over multiple trophies, condition (e) is satisfied as well. Only condition (a) is debatable when one witnesses a rider winning the Tour de France five times like Jacques Anquetil, Eddy Merckx, Bernard Hinault and Miguel Indurain, or, in the case of the later disqualified Lance Armstrong, seven times in a row. Condition (a) is not valid either when the yellow jersey winner is too much ahead of the second-ranked rider, like in 1952 when Fausto Coppi won the Tour de France with a lead of over 28 minutes. In fact, condition (a) raises the issue of competitive balance in the Tour de France which is discussed in section 2 below. Finally, prerequisite (f) refers to the distribution of Tour de France prize money across different trophies and best-ranked riders. In the 2014 Tour de France, for every lower position in the general classification the prize money was more or less halved between the first seven ranked riders: from € 450,000 for the winner over € 200,000 for the runner-up to € 100,000 for the third ranked rider, and so on to € 11,500 for the rider ranked in seventh place. A similar gap is assessed as a strong effort incentive in most individual sports tournaments such as, for example, tennis. With this incentive prize structure a rider who jumps from the seventh to the fifth rank multiplies his financial gains by four and the same occurs when a rider jumps from the third to the first place. The prize structure for winning a stage is similar with also approximately a doubling of the monetary reward for one rank improvement between the four best ranked riders. The prize structure for the other trophies is less in tune with tournament theory. In the race for the green, the white and the polka-dot jerseys, financial gains are not doubled when a rider improves his rank by one. These trophies thus clearly have a less incentive prize structure. If one ASO objective is to “multiply the races within the race” this must not go as far as disturbing the contention for the yellow jersey. That is the reason why incentives are significantly lower (€ 25,000 for the green and polka-dot jersey winners, € 20,000 for the white jersey winner) and less structured according to the tournament theory for trophies that only appeal to specialised riders like sprinters or climbers.

It should be remarked though that this focus on prize money is not always relevant in the context of cycling races. There are significant indirect financial and non-financial gains too from winning, such as a salary increase and fame. Since, as was shown in chapter 3, to an individual cyclist salaries are much more important than prize money, this incentive could be higher than the pure prize money.

2. Is competitive balance an explanation for the Tour’s attractiveness?

When economists attempt to explain a successful attendance and/or TV audience for a sports event, they are used to refer to competitive balance. Applying this concept to professional road cycling is not evident but in chapter 12 this issue is discussed in detail. An introduction to competitive balance in the Tour de France and a new tentative metrics is presented here.

2.1. Competitive balance and professional road cycling

Outcome uncertainty is at the heart of sports economics (Rottenberg, 1956; Neale, 1964). When a big gap between the aggregated players’ talent of two teams is witnessed, there is a quite low probability to win for one team while the other is nearly certain of winning. In such a case, outcome uncertainty is negligible and the game exhibits a competitive imbalance or a weak competitive balance. If, by chance and as it happens sometimes, the underdog defeats the favourite team, the outcome will be assessed as a ‘surprise’. However, the notion of a surprising sporting outcome is still in the cradle (M. & W. Andreff, 2014). A similar approach is used to assess the outcome uncertainty of a sport contest or a sports league. Sports economists often assume and then attempt demonstrating that a balanced sport contest or game does attract big audiences while a low attendance signals a weak competitive balance. This view has been mitigated in recent years. A distinction between two types of sport show consumers has been successfully tested. On the one hand, fans and season ticket holders basically expect the greatest possible number of wins from their favourite team and thus care less about competitive balance. On the other hand, TV viewers and casual spectators often care less about the winning team and are attracted by more balanced games. For example, for NBA basketball it has been shown that fans wish at least two-thirds of wins for their favourite team (Rascher & Solmes, 2007). This differentiation in the product market for sport shows has recently been integrated in a disequilibrium model of a team sports league (Andreff, 2014a).

Taking the audience interest as a benchmark, the Tour de France would definitely be considered to be a well-balanced competition given its 10 to 15 million people attendance. But since this sport show is offered for free, such a conclusion might be misleading. If one wants to really test the concept of competitive balance, a next issue is to develop an accurate metrics. With team sports, the theoretically best competitive balance for a game is when both teams have a 50% probability of winning. The most used proxy for this probability consists of comparing the win percentages of the two teams and, for the league as a whole, of designing some sort of win dispersion or concentration indices (Andreff, 2012; Groot, 2008), the most famous being the Noll-Scully index. These indices are static as they pertain to just one game or one season. A dynamic competitive balance index refers to several seasons in a row or, in the case of Tour de France, to several consecutive years. Usually dynamic competitive balance is measured by looking at a rank correlation coefficient across seasons.

The only (albeit serious) problem with aforementioned indices is that just like any other cycling race, the Tour de France is not a bilateral confrontation between two teams or two riders and the competitive balance indexes for team sports league thus cannot be applied as such. One cannot derive and calculate a win percentage between, for example, *Team Sky* and *Movistar* from their performances in previous cycling races since their sporting outcomes are not the result of a bilateral confrontation but of an overall series of contests with many other cycling teams. Since it is not possible to define bilateral win percentages, another metrics has to be developed. This is all the more the case because road cycling is at the same time an individual sport and a team sport. There is just one yellow jersey winner but all riders are grouped into teams and no one can win the yellow jersey without the work and effort from his teammates. Moreover, given the multiple trophies that are at stake, two or more teams often divide labour and co-operate (sometimes collude) in view of winning a specific trophy. Such division of labour usually alleviates competition, influences the competitive balance, and if it happens too frequently, may offset the organizer's incentives to solicit more effort from the riders.

2.2. How imbalanced is the Tour de France?

Mignot (2013) uses two indexes of Tour de France outcome uncertainty. The first one measures how many times the yellow jersey has switched from one rider to another, divided by the number of racing days. This index was rather stable until 1939 then peaked up during the 1950s and remained high since then. A second index is the final time difference between the yellow jersey winner and the second-ranked rider. This difference was often over one hour during the 1920s but it has been reduced in the past decades to some minutes or even only a few seconds. Based on this criterion, we find extremely balanced Tours in 1989 (when Greg Lemond won 8 seconds ahead of Laurent Fignon), in 2007 (23 seconds between Alberto Contador and Cadel Evans), in 1968 (38 seconds between Jan Janssen and Herman Van Springel) and in 1987 (40 seconds between Stephen Roche and Pedro Delgado). The same benchmark exhibits very imbalanced Tours in 1952 (28 minutes and 17 seconds between Fausto Coppi and Stan Ockers), in 1948 (26 minutes 16 seconds between Gino Bartali and Briek Schotte), in 1951 (22 minutes between Hugo Koblet and Raphaël Geminiani) and in 1969 (17 minutes and 54 seconds between Eddy Merckx and Roger Pingeon). Although this index thus seems to indicate that the Tour de France was less balanced until the late 1960s and became much more balanced since the 1980s, this conclusion might be a bit misleading. First of all, it relies on comparing two riders only and therefore is not robust. Second, within stage time differences were much more pronounced in the 1940s and 1950s than in recent decades, making it very awkward to use time differences to compare competitive balance over time.

The dynamic equivalent of the above criterion would be to check the same rider winning several Tours de France in a row like Louison Bobet (1953-55), Jacques Anquetil (1961-64), Eddy Merckx (1969-72), Bernard Hinault (1978-79 and 1981-82), Miguel Indurain (1991-95) and Lance Armstrong (1999-2005). Although this leads to the impression that the Tour is very imbalanced, the conclusion relies on the performance of only one rider, making it even less robust than above. Nevertheless, it means that one feature often associated with outcome uncertainty, namely an unforeseeable sporting result (Neale, 1964) is missing or really weak in Tour de France.

A common limitation to all previous indexes is that they assess competitive balance only on the basis of one or two riders or, at maximum, of a small number of riders in contention for the yellow jersey as with Mignot’s jersey switching index. They give neither any idea of a team’s strength nor of the overall dispersion or concentration of strengths in the peloton. One step further therefore is to find a ranking during the pre-Tour de France cycling season that may represent the respective strengths of different teams. Rogge et al. (2013), when testing the efficiency of Tour de France cycling teams, used the number of cycling quotient (CQ) points obtained by the riders selected for the Tour de France as earned on the eve of the Tour. Individual CQ rider values collected from the CQ website (www.cqranking.com) are subsequently aggregated into a team score. In the same vein, a calculation of cumulative points obtained for the UCI ranking on the eve of the Tour by a team’s selected riders has been used for approximating the collective strength of this team (Andreff, 2014b). Since this index correlates well with team performances, UCI points are a rather satisfying index for predicting Tour de France outcomes. For example, the best UCI-ranked team has won the yellow jersey in 2012 and 2013 and the green jersey in 2011 while the weakest teams have practically no chance to win any trophy. The latter participate in the Tour with a single hope and objective: win at least one stage. Though interesting as one of the variables that explain team efficiency and performance in Tour de France, UCI and CQ rankings do not actually compare with usual indices of competitive balance in team sports.

Since the Tour de France can be considered to be a team sport contest basically, below we build indexes that resemble the indexes used in sports economics to assess competitive balance of team sports leagues. These indexes should neither be based on the performance of one or two riders, nor on recurring wins of a single rider or even on the past potential strength of teams like the aforementioned indexes and rankings. They must instead account for the actual strength of the complete team in the Tour de France and be based on dispersion or concentration indicators, as is common in competitive balance literature. The actual strength chosen here is the cumulative time spent by all team members to ride the complete Tour de France divided by the number of riders of the team that actually finished the race and thus did not abandon. Let us call this index the *team's actual average time* performance. Table x.A1 in the appendix to this chapter shows for the 2007-2013 period the teams' average times, expressed in time lags behind the fastest team of that year. This allows to rank teams on the basis of their actual strengths over 21 racing days. Note that the fastest team is not necessarily the yellow jersey's one. This happens only twice (2008 and 2009) in seven years. The fastest team is sometimes, but certainly not always, the first ranked team in the Tour's team classification calculated on the times achieved by the best three team members in each stage. This happens three times (2008, 2012 and 2013) out of seven years.

Now, if $m_1, m_2, \ldots, m_n$ stand for all teams' actual average times (with n the number of teams), then we can determine the actual average team time for the whole peloton (μ) as follows:

$$\mu = (m_1 + m_2 + \ldots + m_n) / n$$

We define σ as the standard deviation of the distribution of all actual teams' average times around the mean μ.. The standard deviation is a potential index of competitive balance. For example, one can compare σ_1 for Tour de France 1 to σ_2 for Tour 2 and conclude from $\sigma_1 < \sigma_2$ that Tour 1 is more balanced than Tour 2 since the teams' strengths are more closely matched in the former than in the latter.

Remind that the famous Noll-Scully index compares the actual standard deviation of win percentages to a theoretical optimal one, the best possible competitive balance when all teams have à 50% probability to win. What would be the best Tour de France competitive balance? It is obvious that when $\sigma = 0$ all teams have shown exactly the same strength. However such perfect competitive balance is as much theoretical as the Noll-Scully benchmark of all teams having an equal 50% probability to win. Its practical interest is limited in the real world. Another index is required to qualify how much one specific Tour de France is balanced or imbalanced. Here two options exist. One is to refer to the coefficient of variation $\sigma / \mu = \varpi$. A statistical distribution is considered as extremely scattered (i.e. the Tour is extremely imbalanced) when $\varpi \geq 1$, and the closer to zero the less it is scattered. As a benchmark $\varpi < 0.2$ may be accepted for concluding that a Tour is balanced. A second option is to compare the observed distribution of team's actual average times with a Gaussian (or normal) distribution. In the latter, 68.3% of the population is contained between $\mu - \sigma$ and $\mu + \sigma$. If for a given Tour de France the number of teams comprised within this interval is smaller than 68.3%, not only the Tour is imbalanced but it must be assessed as abnormally imbalanced since teams' strengths are less concentrated in the central part of the distribution than in a Gaussian population. Such an imbalanced situation could result from having too many weak teams participating in the Tour de France. Conversely, if the number of teams in the above interval is bigger than 68.3%, then the Tour is less imbalanced than it would have been under the conditions of a Gaussian distribution.

Table x.2 presents the values of the static competitive balance indexes for the Tour de France editions from 2007 to 2013. With regard to σ, the 2011 Tour is the most balanced one (when runner-up Andy Schleck was 1'34" behind Cadel Evans) while the least balanced one is the 2013 Tour (when Nairo Quintana finished 4'20" behind Christopher Froome). The 2007 edition is one of the least balanced Tours despite a tiny 23" time lag between Alberto Contador and Cadel Evans. According to the coefficient of variation ϖ all Tours de France were clearly imbalanced with a value between 0.45 and 0.63, quite over the 0.2 benchmark. The most imbalanced were 2011 and 2012 with values of at least 0.61. Overall, competitive balance seems to deteriorate over time when comparing the values of ϖ in 2007-2008 and in 2011-2013.

Table x.2 Static competitive balance in the Tour de France, 2007-2013

	2007	2008	2009	2010	2011	2012	2013
n : number of teams	19	19	20	22	21	22	22
μ : mean	4238.5	3049.5	3340.8	3063.6	1899.9	2715.7	3704.3
σ : standard deviation	2071.8	1386.2	1847.8	1695.8	1139.5	1706.2	2113.5
ϖ : coefficient of variation	0.49	0.45	0.55	0.50	0.60	0.63	0.57
$\mu - \sigma$	2166.7	1663.3	1493.0	1707.8	760.5	1009.5	1590.7
$\mu + \sigma$	6405.1	4712.9	4833.8	5111.5	2660.4	3725.2	5295.0
number of teams < $\mu - \sigma$	4	3	4	4	2	3	3
number of teams > $\mu + \sigma$	3	1	2	3	5	5	6
teams within ($\mu - \sigma ; \mu + \sigma$)	12	15	14	15	14	14	13
% teams within ($\mu - \sigma ; \mu + \sigma$)	63.2	78.9	70.0	68.2	66.7	63.6	59.1

The 2010 Tour de France with a 68.2% of teams within the ($\mu - \sigma$; $\mu + \sigma$) interval has a nearly Gaussian distribution of teams' strengths and can be taken as a benchmark. Several Tours (2007, 2011, 2012 and 2013) concentrate a smaller percentage than 68.3% in the same interval and are abnormally imbalanced compared with a Gaussian population. The 2008 and 2009 Tours are less than Gauss-imbalanced with a percentage of teams within the interval higher than 68.3%. Overall, the 2008 and 2009 Tours were the least imbalanced while the 2007 and 2013 Tours were the most imbalanced.

The above indexes are static indicators of competitive balance. A concept of dynamic competitive balance is developed using Spearman rank correlation coefficients (r_s). The correlation coefficients are calculated between each couple of different Tours de France between 2007 and 2013 and the ranking of the teams is based on their average times (see table x.A1). If according to their strengths (average times) all the teams are exactly ranked in the same order for two different Tours then r_s = 1. The outcome of the second Tour in terms of team ranking can be predicted with 100% accuracy when one knows the Tour team ranking of the first Tour. There is no outcome uncertainty over time and the sport contest is perfectly imbalanced over time. On the other hand, if r_s = 0 or has a very low value, the correlation between two Tours' team rankings is not significant. One cannot accurately predict the team ranking of the second Tour based on the team ranking of the first Tour. There is outcome uncertainty and there is a significant amount of dynamic competitive balance.

Table x.3 summarizes the results. Most rank correlation coefficients are low and statistically insignificant. This is partly due to the turnover in invited teams which sometimes leaves only a small number of teams comparable between each couple of Tours de France. For example, only 9 teams participated in both the 2007 and 2013 Tour de France. It should be noted though that in consecutive years, this number is often much higher. In fact, in the 2012 and 2013 Tour de France precisely the same 22 teams took part. There are few exceptions to the above conclusion of statistically insignificant correlations. We find correlations significant at the 5 or 10% level between the Tours of 2007 and 2009, between the Tours of 2007 and 2010, between the Tours of 2008 and 2009, and between the Tours of 2009 and 2010. But the highest correlation, with a 1% statistical significance, is between the 2007 and 2008 Tour de France. In these years of post-Armstrong domination, some teams like *CSC / Saxo Bank*, *Caisse d'Epargne* and *Euskaltel* fielded strong squads two years in a row and were twice ranked among the best 5 teams (measured in average team time). Other teams like *Gerolsteiner*, *Barloworld* and *Française des Jeux* performed much worse in 2008 and 2009 and belonged twice to the worst performing teams.

Table x.3 Spearman rank correlation between Tour de France average team time rankings, 2007-2013

	2007	2008	2009	2010	2011	2012
2008	0.62*** (16)					
2009	0.53* (13)	0.55** (16)				
2010	0.50* (12)	0.35 (15)	0.43* (18)			
2011	-0.02 (9)	0.24 (11)	-0.08 (13)	0.20 (16)		
2012	-0.55 (9)	-0.04 (11)	0.26 (14)	-0.09 (16)	0.19 (19)	
2013	0.27 (9)	0.21 (11)	0.19 (14)	-0.14 (16)	0.14 (19)	0.10 (22)

Between brackets: the number of teams common between two Tours de France
*** significant at 1%; ** significant at 5%; * significant at 10%

This leads to a major conclusion. When multiple years are considered, the Tour de France generally shows a dynamic competitive balance, with uncertainty and unpredictability. However, when just one Tour is considered, the Tour de France rather exhibits a static imbalance. This implies that in the course of the race it is rather predictable what teams will perform the best, but from one Tour to the other the outcome is much more unpredictable due to team changes, team recruitment, the selection of riders for the next Tour, and the resulting team performance. One could therefore conclude that although each Tour is a new story, for each story the scenario is rather well known to the spectators. Nevertheless, the Tour still attracts tens of millions of people along the roads and in front of television sets. This confirms earlier observations in sports economics research that questioned the importance of competitive balance as the main determinant of viewership interest for a sports event.

3. Doping did not hinder Tour de France success, but could it be fought better?

The Tour de France success story has not been disturbed too much so far by its long-lasting association with doping, not even by the doping troubles of the past decade. Does this mean that doping has no impact on the Tour outcome? Or that fans and spectators are unaware of doping? Or that the anti-doping combat has become so effective that doping use is actually on its way down within the peloton? Doping in cycling is discussed in detail in chapter 13. An introduction to doping in the Tour de France and an innovative procedure to better deal with the use of doping is presented below.

3.1. Doping: an unobservable determinant of the Tour de France outcome

It is very difficult to empirically test the impact of doping on the outcome of a sports contest since there is no available database about who is doped or not in a team, in a sport, or in the Tour de France. As a consequence, the above used competitive balance indexes as well as the analyses of sporting success determinants (Torgler, 2007) or team efficiency (Rogge et al., 2013) in the Tour de France, are for certain distorted to an unknown extent. In fact, they do not include an explanatory or dummy variable supposed to capture the doping effect on rider and team performances. For example, the estimated probability to be ranked among the first 25 riders for the yellow jersey trophy calculated by Torgler (2007) is substantially disturbed by the ex post disqualifications of Lance Armstrong and other doping-connected events. It is all the more strange that most empirical studies about the Tour de France do not even mention doping or do not give a reason why this unobservable, or hardly observable, variable is not taken into account. One can find more about the data and methodological limitations that hinder using a doping variable in a model explaining the distribution of Olympic medals across nations in Andreff et al. (2008).

The Tour de France and doping have a long-lasting intertwined history. Doping has heavily influenced and distorted the outcome of the Tour de France for many decades. In 1960, Roger Rivière fell from his bike when riding down the Perjuret pass. His dizziness was assumed to be the result of the consumption of *palfium* pills. Disaster struck in the 1967 Tour de France when Tom Simpson died during the ascent of the Mont Ventoux. His death was attributed to a combination of exhaustion and doping abuse (amphetamines). The situation certainly did not improve during the 1970s. Bernard Thévenet, the 1975 and 1977 Tour winner, later admitted he used cortisone. Michel Pollentier was the first yellow jersey wearer disqualified for doping. He was excluded from the 1978 Tour de France when he tried to cheat in a doping test. Joop Zoetemelk, the 1980 Tour de France winner, is the only rider to have tested positive no less than three times during the Tour de France: in 1977, in 1979 and in 1983. He mostly escaped punishment and was only sanctioned with time penalties and small fines. In 1988 yellow jersey wearer Pedro Delgado controlled positive for the use of *probenicid*, but was not excluded. Although the substance was on the IOC list of prohibited products, it was not on the UCI list of prohibited products. Mass industrialised doping penetrated cycling and the Tour in the 1990s. The use of epo became widespread. This became known to the general public as a result of the Festina doping scandal in the 1998 Tour de France. But the Festina scandal did not end doping in the Tour de France. In fact, the worst was yet to come. The 1998-2010 period can easily be qualified as the darkest period ever for the Tour de France. With the ex post disqualifications of Armstrong, Landis and Contador, the Tour lost nine out of its twelve final yellow jersey winners between 1999 and 2010.

Despite the overwhelming evidence on doping, the Tour de France audience has not dropped over the years. A recent inquiry in Flanders (Van Reeth & Lagae, 2014) however, did show that most spectators do prefer "clean" performances in the Tour over doping-prone exceptional results. The study shows they are well aware of doping that plagues the Tour de France. But although they think that it is a problem that will never disappear completely from cycling and thus will continue to affect its credibility, cycling fans do not refrain from attending or watching it on TV, as another study (Van Reeth, 2013) has demonstrated. A new doping case *during* the Tour de France appears to have no significant immediate impact on average TV audiences of the Tour de France and triggers a small 7.6% decrease in peak TV audiences. However, the impact of doping seems to have a stronger impact in the year following the unveiling of a major doping case, like the Festina case in 1998 or the Contador case in 2012. A significant 17.5% decline in average TV audience and a 7.7% fall in peak TV audience is recorded for the following Tour de France. This impact seems to temporary though since the effect only lasts for one year. Although apparently it has not strongly affected Tour attendance and TV audiences so far, doping may still be damaging the Tour success story in the long run. This requires new ideas on how to combat doping in cycling more efficiently.

3.2. How to combat doping more efficiently?

Anti-doping policy is still very much inspired by a traditional view on doping. In this vision, doping is considered to be fraudulent behaviour and therefore must be analysed based on the theory of the "economics of crime" (Becker, 1968), as it has been applied to sports (Bourg, 2000; Maennig, 2002). Detection and sanctioning is then validated by an argument that runs as follows: a/ since it is forbidden by law, doping is fraudulent, and must be controlled; b/ since doping is profitable for an athlete in terms of wins and revenues, even it is forbidden athletes are prone to use it; c/ in order to stop doping, its costs to the athlete must be raised through stronger sanctions (fine, suspension, …) up to a level where it is no longer profitable to dope. In the end, an athlete makes the decision to dope if the expected net gain is positive, i.e. if the extra benefits (revenue, fame, …) that can be expected from the use of doping exceed the costs of using doping (actual costs and expected costs of sanctions if caught).

A new analytical approach to doping in sports economics relies on game theory. The starting point is to basically assume that riders dope themselves because it corresponds to their deeply rooted economic and financial interests, and not because they are bad by nature, professional cheaters or criminals. Two papers written in the wake of the Festina scandal (Eber & Thépot, 1999 and Berentsen, 2002) analyse doping as a result of a prisoner's dilemma, one of the most famous problems in game theory. In a nutshell, the doping game is a prisoner's dilemma adapted here to cycling where: a/ there is a (financial and health) cost borne by riders when they use doping; b/ the use of doping substances and techniques enables a rider to enhance his performances; c/ if, in an assumed two-rider race, both riders dope the final ranking remains unchanged compared to a situation without doping; and d/ if one of the two riders is caught, he will never denounce the other rider for being doped as well. Cycling the latter behaviour is known as *omerta* or the 'law of silence': it is forbidden to openly talk about doping. In such a prisoner's dilemma, it can be shown that doping is a dominant strategy which means that it is always much more profitable for both riders to dope. The game theoretic literature about doping has also proposed several new anti-doping policy recommendations, all focused on providing riders reduced incentives to use doping. Eber and Thépot (1999) advocate lower spreads between the prizes (which is in conflict with tournament theory), fewer races, improved testing and better prevention. Berentsen (2002) suggests a new rank-based sanctioning mechanism.

However, as long as the wrong incentives are given to riders also these solutions will be of little help in the fight against doping. We therefore suggest a revolutionary anti-doping regulation in cycling where the riders themselves lose interest in the use of doping, or even have an interest not to dope even when other competitors do. This can be realized by the use of appropriate incentives. The suggested scheme below is to some extent in line with Breivik's (1992) views, and elaborates on the 'drug diary system' put forward in Bird and Wagner (1997), and on Andreff (2012). The device would work as follows:

(1) At the start of the cycling season, all riders (in accordance with their doctors) must register compulsory the list of all doping substances and techniques they plan or, when necessary, want to use over the whole season. Such a doping diary is secret to the other riders. It could, for example, be deposited in the hands of each rider's lawyer or with the UCI. Riders fully commit themselves to stick to the self-declared list of doping products.

(2) If,during the season, a rider is tested positive for having taken products listed in his diary, no sanction applies.

(3) However, if a rider is tested positive for having taken products not on this list, the sanction is extremely severe, for example a lifetime ban from professional cycling. A severe sanction is needed because not only did the rider use doping, he also cheated and blurred the transparency required for this scheme to be efficient. Because the rider does not want to comply with the rules of the game, he is excluded from professional cycling forever.

(4) If a rider is performing extremely well, other riders who are suspicious (anyone of them, under the precondition that they are at least two) are allowed to ask the rider (or his lawyer or the UCI) to unveil his doping diary in order to check whether the rider complies with it.

(5) If it appears from (4) that the suspected rider does not comply with his doping diary, just like under (3) he is banned for life from professional cycling.

(6) If it appears from (4) that the suspected rider does comply with his doping diary, the two or more claiming riders have to admit that the suspected rider either is definitely stronger than they are during this season or that his doping diary is more efficient or better programmed than their own.

(7) As a result of this scheme, in particular at the beginning of such a regulation when there may be many claims against successful riders, other riders would have an incentive to copy the unveiled

doping diary of the winners. This would trigger three beneficial incentives. First, step by step a doping norm (diary) will prevail in the whole peloton, a typical story of social norm formation. All riders will start to use the same most efficient or best conceived doping programme. Second, because of this social norm formation, riders will soon realize that the differential and artificial competitive advantage of hidden doping is limited and short-lived. Third, the *omerta* system will vanish because the best doping programme will be publicly known to and consequently openly used by all riders once the most performing doping diaries of suspected winners are unveiled.

(8) Once riders are convinced that doping becomes useless as soon as doping substances and techniques are no longer differential between riders, it will not be very difficult to convince them that a same optimal doping recipe does not imply 'the more the better'. Step by step, the optimal doping programme could be downgraded and freed from its most health threatening substances. In the long run, with the riders' consent only the safest stimulating products, necessary in a hard and demanding sport such as cycling, would be maintained in the programme.

Moreover, such anti-doping regulation features an incentive scheme where each rider is not interested in more and more doping for himself, but instead is interested in benefiting from a competitor's decision to over-dope beyond his declared programme. To illustrate this point, imagine a four-rider racing circuit that operates under the above regulation. It will produce the following incentive scheme:

(a) At the beginning of the season, rider A is more or better doped than riders B, C and D. He wins all the races (100%).

(b) In such situation, B, C and D will ask A to unveil his doping diary. Assume that A is complying with his diary. Other riders will then also adopt it and the four riders will share the wins (25% each).

(c) If rider A, in order to keep his initial advantage, decides after a while to cheat and over-dope beyond his self-declared diary, then he would again temporarily win 100% of the races, instead of 25%. As a result, B, C and D would again ask to unveil the doping diary of A. The anti-doping test would show that A did not comply with his doping diary and the rider would be banned for life from cycling. At the end of the day, the three remaining riders would share the wins (33% each).

(d) Having learned from rider A's poor experience, B, C and D probably would not cheat on their own diaries and would be satisfied with 33% of all wins (instead of the initial 0 and the subsequent 25%). If however, by chance, one of them does cheat according to his doping diary, the two other will again intervene and will now share 50% each.

With the suggested regulation, an over-doped rider can increase his overall share of wins only temporarily, i.e. until the others ask have his doping diary unveiled. With regulation-embedded incentives, a rider cannot expect to increase his share in wins in a durable way when he over-dopes. He can expect a share increase though when competitors over-dope beyond their diary. The outcome is that each rider's interest is to let the others over-dope and yield a higher share in wins from their exclusion. The incentive scheme is efficient and works in the right direction. Each rider becomes unwilling to over-dope or cheat whatever the others do and benefits in terms of wins from the wrong over-doping strategy possibly adopted by competitors. Doping thus shows a self-defeating strategy and will ultimately be rejected by most riders.

Should one be optimistic about the above-suggested anti-doping regulation? For certain, it must not be considered to be a miracle solution. But the proposal at least focuses on a crucial point that could possibly be elaborated a bit further in forthcoming studies: the incentive scheme must convince riders that as soon as doping diaries are not differential between riders, doping is no longer a strategy that enables them to win more than their natural ability warrants. It may happen that there will be significant transition costs between the current anti-doping system and the one proposed here. In the first periods of the new regulation enforcement, some riders may feel or assume that the best performing doping programme is the most overloaded one. These riders might use substances dangerous to their health or life. If this assumption reveals to be true, they will soon be copied by other riders and lose their temporary comparative advantage. If on the contrary the assumption were to be wrong, or after a temporary increase in the number of sicknesses and deaths in the peloton (a sort of transition crisis between the two anti-doping systems, the hard price to pay for adopting the second one), all riders would be convinced that the best or optimal doping programme is in no way the most comprehensive or dangerous one in terms. It might be difficult though to convince stakeholders in cycling to enforce such a new regulation. Although riders would probably soon understand the mechanics of the embedded incentive scheme, they might be more concerned about the short-term effects of such a scheme on their health, i.e. when dangerous substances are put on the doping diary list (and subsequently used) by a large number of riders. But significant obstacles might also come from cycling governing bodies such as the UCI, Tour de France organisers ASO, and so on. They might especially fear the transparency about doping practices in the peloton that would result under such a regulation and its impact on the image (and thus the economic value) of cycling. Why not try to convince them as well that the good incentives that the proposed scheme creates are always preferable to the current bad incentives?

Conclusion

The Tour de France is one of the most popular and attractive sport events in the world. It attracts millions of people along the roads and reaches a global TV audience. This results from its nice design and appropriate management, the fact it is a product that is supplied for free, an acceptable fitness with the prerequisites of tournament theory, and a modern model of finance linking its sporting success with TV rights revenues. However, the Tour success story is not decisively associated with an excellent competitive balance. A new metrics of the latter, adapted to the team sport dimension of cycling, exhibits that each Tour de France is basically imbalanced while its dynamic competitive balance over the years is much better. Already for a long time but especially since 1998 does the Tour de France has to deal with doping scandals and rider disqualifications, although so far this did not harm spectator and TV viewership interest for the Tour. However, the long term credibility of the Tour is still at stake. From this point of view, an innovative, more efficient and perhaps controversial anti-doping regulation including incentives not to dope is developed here.

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Table x.A1 Team average time per rider in the Tour de France expressed as the time lag behind the fastest team

Teams	2007	2008	2009	2010	2011	2012	2013
AG2R Prévoyance	54'17" (7)	5'18" (8)	19'27" (7)	43'19" (8)	23'04" (8)	35'36" (8)	39'24" (7)
Agritubel	1h47'08" (6)	1h01'27" (5)	16'02" (6)				
Skil / Argos Shimano			2h05'39" (6)			1h 53'17" (6)	1h57'09" (8)
Astana	no one (0)		18'54" (7)	1h08'15" (8)	1h00'15" (7)	34'34" (7)	1h28'48" (5)
Barloworld	1h38'23" (8)	1h08'04" (4)					
BMC				1h09'52" (7)	38'38" (9)	13'05" (9)	41'04" (8)
Bouygues Telecom / Europcar	1h27'55" (7)	53'08" (8)	1h01'34" (9)	51'37" (9)	46'47" (8)	32'21' (7)	1h04'39" (8)
Caisse d'Epargne / Movistar	**BEST (8)**	38'57" (8)	36'03" (7)	**BEST (9)**	1h02'24" (7)	10'43" (6)	17'04" (8)
Cervélo			1h11'35" (8)	1h37'48" (8)			
Cofidis	no one (0)	46'22" (8)	1h09'05" (9)	51'06" (7)	48'58" (9)	1h37'50" (7)	37'25" (5)
Crédit Agricole	1h38'41" (8)	58'18" (7)					
Discovery Channel	13'47" (8)						
Euskaltel-Euskadi	25'16" (8)	30'36" (9)	26'54" (4)	33'42" (7)	12'53" (6)	38'33" (5)	56'27" (7)
Française des Jeux	1h55'24" (7)	1h16'09" (7)	1h05'17" (7)	1h18'02" (8)	29'09" (7)	33'14" (8)	54'37" (6)
Garmin		1h04'23" (8)	58'33" (9)	1h09'42" (6)	22'23" (8)	1h 22'40" (6)	36'54" (5)
Gerolsteiner	1h39'02" (9)	1h27'48" (6)					
Katusha			1h03'55" (7)	1h08'30" (7)	**BEST (5)**	35'21" (7)	43'50" (9)
Lampre	1h12'39" (8)	1h04'38" (7)	1h50'33" (6)	1h53'38" (8)	42'28" (8)	38'28" (4)	58'42" (6)
Liquigas / Cannondale	1h18'52" (8)	53'42" (7)	59'23" (8)	1h05'16" (9)	33'26" (9)	38'27" (9)	1h43'38" (6)
Leopard Trek					37" (9)		
Lotto	58'23" (7)	58'28" (9)	42'12" (9)	9'24" (7)	44'06" (6)	1h 01'43" (9)	1h57'51" (6)
Milram	1h53'30" (7)	50'44" (9)	1h07'31" (8)	1h28'17" (7)			
Orica GreenEdge						30'31" (8)	2h02'20" (8)
Quick Step	1h26'59" (9)	1h16'54" (7)	1h13'47" (6)	41'19" (8)	32'57" (7)	48'56" (7)	45'47" (9)
Rabobank / Belkin	1h12'57" (6)	23'03" (8)	55'17" (8)	27'31" (8)	18'54" (6)	34'39" (4)	1h37'46" (9)
RadioShack				12'03" (8)	17'32" (5)	**BEST (6)**	3'55" (9)
Saunier Duval / Footon Servetto	1h03'08" (6)	no one (0)		1h09'39" (4)			

Saxo Bank / CSC	20'34" (7)	**BEST (8)**	**BEST (8)**	1h08'07" (8)	35'14" (9)	1h19'05" (9)	**BEST (8)**
Sojasun					1h05'59" (9)	1h12'56" (8)	1h17'11" (7)
Sky				54'11" (8)	18'54" (8)	20'06" (8)	58'41" (7)
T. Mobile / HTC Columbia	1h15'16" (6)	47'42" (8)	1h11'55" (9)	1h06'42" (6)	13'37" (9)		
Vacansoleil					19'07" (6)	43'41" (4)	1h15'02" (6)

Between brackets: the number of riders of the team finishing the Tour de France.