IIMK/WPS/122/STR/2013/08

PATTERNS OF PED[1] TEST SANCTIONS IN PROFESSIONAL SPORTS – BASELINE AND IMPLICATIONS FOR RESEARCH

Deepak Dhayanithy[2]

[1] Performance-enhancing drugs

[2] Assistant Professor of Strategic Management, Indian Institute of Management Kozhikode, IIMK Campus PO, Kozhikode– 673570, email: deepak@iimk.ac.in

PATTERNS OF PED[2] TEST SANCTIONS IN PROFESSIONAL SPORTS – BASELINE AND IMPLICATIONS FOR RESEARCH

This paper establishes an empirical ground for the exploration of PEDs in professional sport, and the research implications. We use athlete level testing and sanctions data of 70 sports disciplines between 2001 and 2012, conducted by USADA (United States Anti-Doping Agency), and examine the sport specific effects, calendar year effects and career stage effects on the USADA sanctions rate – both in univariate studies as well as in multivariate Cox proportional hazards regressions. We find that certain sports such as cycling, weightlifting and track & field do have significant and positive effect on the USADA sanction rate. On the other hand, many seemingly lower and higher than average sanctions rate, like for soccer and basketball are not statistically significant, that is they don't move the baseline hazard rate up or down. There is a distinct inverted U relationship between career stage and sanctions rate, with a kink to a much higher sanctions rate in the veteran years of an athlete's career. Given these results, it becomes very important that we make careful study of the determinants and consequences of the use of PEDs in professional sport by athletes. This paper provides the empirical basis for the study of PEDs use by professional athletes, setting out important avenues for further empirical and theoretical research in the field.

INTRODUCTION

The history of doping in sports is old and did not start with the recent revelations of Lance Armstrong (Yesalis and Bahrke, 2002). The pressures of professional athletics are often pointed at in explanations of widespread doping. However, large scale national doping programs indicate to drivers existing at the national level as well (Yesalis and Bahrke, 2002; Whitten, 1997). Doping allegations, test failures and confessions have frequently sparked a call for even the legalization of the use of performance enhancing drugs (PEDs) in sport (Blue, 2006).

Despite the intervals of increased world and media attention on the issue of PEDs in sport, a widespread understanding of the exact extent of doping is only sparingly addressed. An exception to that being Dilger et al (2007) which provides insight grounded in extant literature on the economic incentives, extent and determinants of doping in professional sport. One challenge is, of course, the fact that we get to know only those cases where an athlete has failed a drug test, and has been issued a sanction (suspensions and bans). Methods ranging in their sophistication (see Pincock, 2005 for a feature on gene doping) exist to make the detection of PEDs very difficult (Crisp et al,

[2] Performance-enhancing drugs

2008). It is contended by many (Shermer, 2008 amongst others) that a large number of professional athletes who take PEDs believe that they can get away with it.

Even given these challenges, it is of obvious interest to the policy maker and researcher to have a sense of the baseline sanctions rate (failed drug tests by athletes leading to penalties being imposed), as well as the important factors, if any, determining this baseline sanctions rate. Of course, the real extent of the use of PEDs can be thought of as a multiple of this baseline sanctions rate. Pitsch, Emrich and Klein (2005) estimate doping in professional sport amongst elite German athletes competing at the international level to be as high as 58%, using randomized responses from a survey of 450 athletes. This is one notable exception to the otherwise distinct lack of empirical evidence in the doping subject matter, albeit using sample responses.

The objective of this paper is to establish this baseline sanctions rate, get an understanding of important factors driving this baseline rate, and join the work focused on establishing the ground for empirically (Pitsch et al, 2005) and theoretically grounded understanding (Haugen, 2004; Berensten, 2002; Shermer, 2008) of the extent and drivers of PEDs in sport. This paper seeks to establish the empirical ground for understanding the use of PEDs in sport and is organized as follows.

The next section sets the context and describes the data used in this paper, which is the testing and results data of USADA (United States Anti-Doping Agency) testing from 2001 to 2012. This data covers 70 sports disciplines and offers a good insight into the vast gamut of testing carried out by USADA. It is perhaps the most extensive form of athlete level dope testing data available that is freely available on the internet. In the third section we move onto examining patterns that emerge from the USADA data. The three key dimensions we investigate are (a) sport, (b) calendar year, and (c) athlete's career stage. In the fourth section of this paper, we carry out a thorough statistical analysis, in a Cox proportional hazards framework, of the effect of sport, calendar year and athlete career stage on the sanctions rate (our proxy for the use of PEDs in sport). We find evidence for significant sport specific effects in the case of cycling, weightlifting and track and field. But we also find evidence of no sport specific effects on other key sports including soccer and basketball. That is, for many other sports, the sanctions hazard curve is not shifted up or down significantly. Our discussion of the policy implications of this paper in the fifth section of the paper uses this key result of

the empirical analysis and discusses the results in light of some of key empirical and theoretical papers in the area of doping in sport. The sixth section concludes and highlights important avenues for extensions.

CONTEXT AND DATA

For most part, there is a lack of individual athlete and test level data for a range of sports and over a reasonable amount of years. USADA (United States Anti-Doping Agency) is an exception. The World Anti-Doping Agency, WADA, was instituted by the IOC (International Olympic Committee) in 1999 with an objective to unify the efforts of various sports agencies to eradicate doping from sport. USADA is one of the national anti-doping bodies, affiliated with WADA, which focuses on US athletes who are part of the Olympic, Paralympic and Pan American movements. In competition and out of competition drug tests on athletes is a key component of the USADA program. Between 2001 and 2012, USADA has conducted 74,353 drug tests on 14,783 athletes and 333 of them have been sanctioned for doping violations by USADA in these 12 years. The sanctions involve 75 different substances and range from 3 month suspensions from the sport to lifetime bans.

Exhibit 1: Tests and Sanctions, USADA 2001-'12, No: of athletes (1/2)

		Santion rate*		
Sport	# Athletes tested	Pre 2006	Post 2006	Total
Archery	101	0.0%	0.0%	0.0%
Badminton	50	0.0%	0.0%	0.0%
Baseball	283	0.9%	0.0%	0.7%
Basketball	440	0.0%	0.9%	0.2%
Basque Pelota	6		0.0%	0.0%
Biathlon	113	0.0%	0.0%	0.0%
Bobsled & Skeleton *	229	4.0%	0.0%	2.2%
Bowling	67	0.0%	0.0%	0.0%
Boxing +	332	2.0%	3.3%	2.7%
Canoe & Kayak	181	0.0%	0.0%	0.0%
Curling	124	0.0%	0.0%	0.0%
Cycling *	1,481	4.5%	3.3%	3.7%
Diving *	104	2.4%	1.6%	1.9%
Equestrian	131	0.0%	0.0%	0.0%
Fencing *	178	2.5%	0.0%	1.7%
Field Hockey	148	0.0%	1.2%	0.7%
Figure Skating *	221	0.9%	0.0%	0.5%
Gymnastics +	296	0.0%	1.2%	0.7%
Ice Hockey *	186	1.1%	0.0%	0.5%
Judo	305	1.3%	1.3%	1.3%
Karate	87	4.2%	0.0%	2.3%
Luge	71	0.0%	0.0%	0.0%
Modern Pentathlon	42	0.0%	0.0%	0.0%
Paralympic Alpine Skiing	69	0.0%	6.8%	4.3%
Paralympic Archery	25	0.0%	5.0%	4.0%
Paralympic Basketball	80	3.6%	0.0%	1.3%
Paralympic Boccia	10	0.0%	0.0%	0.0%
Paralympic Curling	19	0.0%	0.0%	0.0%
Paralympic Cycling	69	0.0%	1.9%	1.4%
Paralympic Equestrian	16	0.0%	0.0%	0.0%
Paralympic Fencing	14	0.0%	0.0%	0.0%
Paralympic Goalball	28	0.0%	0.0%	0.0%
Paralympic Judo	25	0.0%	0.0%	0.0%
Paralympic Nordic Skiing	15	0.0%	0.0%	0.0%
Paralympic Powerlifting	16	0.0%	0.0%	0.0%

Exhibit 1: Tests and Sanctions, USADA 2001-'12, No: of athletes (2/2)

		Santion rate*		
Sport	# Athletes tested	Pre 2006	Post 2006	Total
Paralympic Rowing	18		0.0%	0.0%
Paralympic Rugby	40	0.0%	3.3%	2.5%
Paralympic Sailing	26	0.0%	0.0%	0.0%
Paralympic Shooting	6	0.0%	0.0%	0.0%
Paralympic Sled Hockey	43	11.8%	3.8%	7.0%
Paralympic Soccer	42	0.0%	0.0%	0.0%
Paralympic Swimming	124	0.0%	0.0%	0.0%
Paralympic Table Tennis	15		0.0%	0.0%
Paralympic Tennis	30	0.0%	0.0%	0.0%
Paralympic Track & Field +	164	2.9%	5.4%	4.9%
Paralympic Volleyball	49	0.0%	0.0%	0.0%
Racquetball	29	0.0%	0.0%	0.0%
Roller Sports +	166	1.4%	2.1%	1.8%
Rowing +	502	0.0%	0.9%	0.6%
Rugby	34		0.0%	0.0%
Sailing	182	0.0%	0.0%	0.0%
Shooting	202	0.0%	1.8%	1.0%
Skiing & Snowboarding *	636	1.6%	0.3%	0.8%
Soccer	299	0.0%	0.8%	0.3%
Softball	158	1.0%	0.0%	0.6%
Speedskating	311	0.0%	0.5%	0.3%
Squash	29	0.0%	0.0%	0.0%
Swimming *	1,065	1.9%	0.7%	1.2%
Synchronized Swimming	76	3.2%	0.0%	1.3%
Table Tennis	40	0.0%	4.3%	2.5%
Taekwondo +	201	2.2%	3.7%	3.0%
Team Handball	190	1.0%	1.1%	1.1%
Tennis	53	0.0%	0.0%	0.0%
Track & Field *	2,837	3.1%	1.2%	2.0%
Triathlon +	368	0.0%	0.9%	0.5%
Volleyball	193	0.0%	0.0%	0.0%
Water Polo	115	0.0%	1.4%	0.9%
Water Skiing	79	0.0%	0.0%	0.0%
Weightlifting +	607	1.8%	3.2%	2.5%
Wrestling	292	2.8%	2.3%	2.4%
Grand Total	**14,783**	**1.7%**	**1.4%**	**1.5%**

Due to difficulties in matching athletes names in the sanctions list to names in the athletes test list, only 228 out of the 333 athletes sanctioned by USADA are reflected in the analysis. The inability to match all 333 cases of athlete sanctions is due to

(a) USADA reporting all sanctioned cases, even if they were sanctions on athletes who are not American, but tests were carried out on behalf of a different anti-doping agency. In this case, the sanction would appear in the USADA data in spite of the athlete not being in the USADA testing program data.

(b) Name changes such as the taken on or dropping of a surname

In the case of later reason for mismatches, this translates to an adjustment factor of 1.5 that we need to apply to get a sense of the real PEDs sanctions ratio. Follow-ups to this research will focus on getting the remaining 105 athletes all mapped to the tested list, and reasons for mismatch clearly laid out so that we may account of them in our analysis (refer http://www.usada.org/athlete-test-history, accessed last on Feb 12th 2013). The overall sanction rate is 1.5% of athletes corresponding to a 'real' sanction rate of 1.5 times that which is about 2.3%. Our data summary as well as subsequent discussions will use the calculated sanction rate with the equivalent 'real' sanction rate in parenthesis (exhibit 1).

USADA PATTERNS

a. Sport

The (unfair) benefits of performance enhancing drugs (PEDs) are more pronounced in endurance (cycling, triathlon) and strength sports (discuss throws, 100m sprints). Use of hormones, anabolic steroids, and now blood doping essentially increase the athlete's body's ability to produce more power and stave off fatigue (Shermer, 2008). So, one of the first things we want to assess in our datasets is whether endurance and strength sports indeed have a higher sanctions ratio. Additionally, the dataset is split into pre-2006 (6 years) and post-2006 (6 years) to see which of these sports have reduced sanctions ratio, and which once have an increased ratio. The increase or decrease of sanctions ratio could be due to actual reduction in the athletes' use of PEDs (unobservable), or it could relate to increase or decrease of dope testing process efficacy.

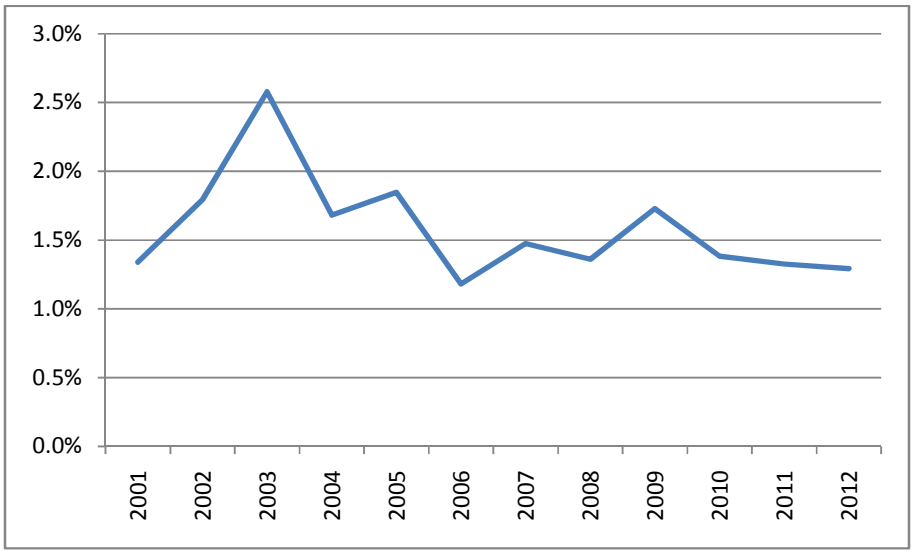


Fig 1: Ratio of Athletes sanctioned to athletes tested, by year

Having said that, as shown in *exhibit 1*, the overall sanctions ratio is 1.5% (2.3%) but the sanctions ratio is higher for say, boxing where is 2.7% (4.1%), for cycling where it is 3.7% (5.6%), for Fencing where it is 1.7% (2.6%), for Paralympic Alpine Skiing where it is 4.3% (6.5%), for Paralympic Track & Field where it is 4.9% (7.4%), for Taekwondo where it is 3% (4.5%), for Track & Field where it is 2% (3%), and for Weightlifting where it is 2.5% (3.8%). On the other hand, team sports such as soccer, softball and basketball have sanctions rates of only 0.3% (0.5%), 0.6% (0.9%) and 0.2% (0.3%) respectively. It is possible that the team nature of these sports allows fatigue to be managed efficiently by simply rotating players.

b. Year

Over the twelve years from 2001 to 2012, the highest sanction rate was 2.6% (3.9%) in 2003, and the lowest was 1.3% (2%) in 2011 and 2012 (see Figure 2). The sanctions ratio tends to go down (up) in immediate succession of when it goes up (down). This suggests that, perhaps, doping methods as well as doping testing (control) methods are innovated in quick response to advances in dope testing (control) and doping methods, respectively. Having said that, the trend in recent years is downward sloping and USADA and other dope control agencies could take heart from it.

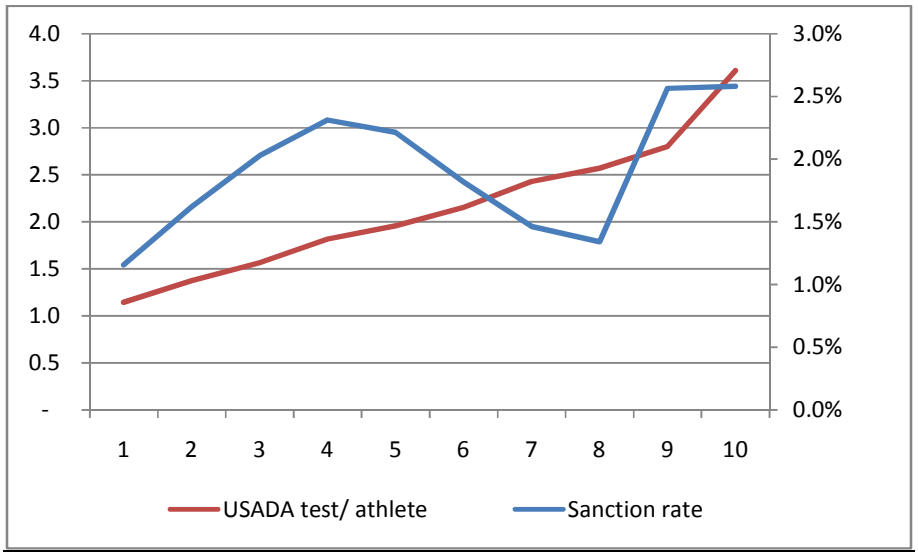


Fig 2: USADA test/ athlete per year and Sanction rate by no: of years in the program

While the is a reduction in the sanctions rate post-2006 compared to the earlier 6 years – overall 1.7% (2.6%) pre-2006 versus 1.4% (2.1%) post-2006, sports such as boxing and Paralympic Alpine skiing actually show an increase in the sanctions rate. This could be, however, on account of a more recent start of dope-testing in these sports rather than a real underlying spike in the extent of doping.

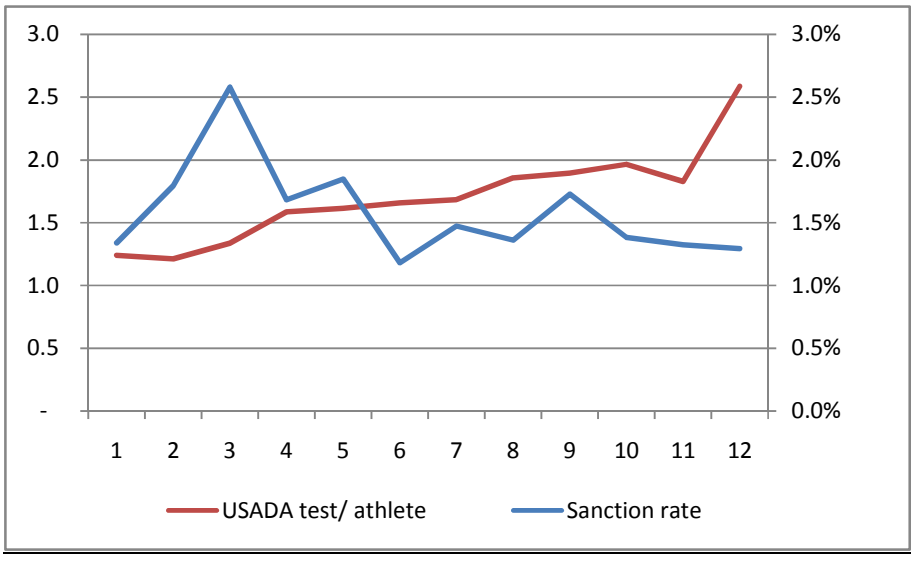


Fig 3: USADA test/ athlete per year and Sanction rate by year, 2001 (1) to 2012 (12)

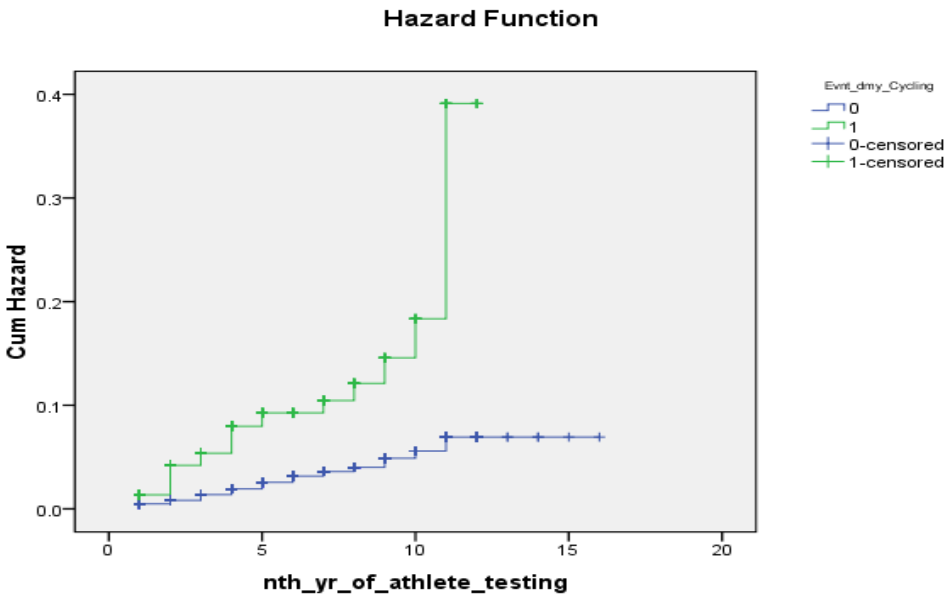


Fig 4 (a): Kaplan Meier Curves – Event Dummy: Cycling

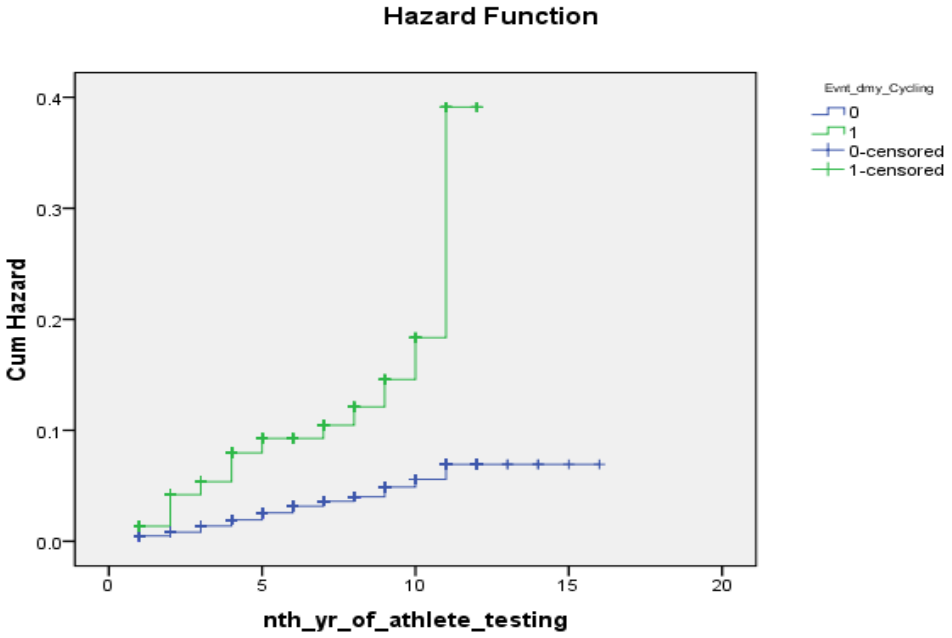


Fig 4 (b): Kaplan Meier Curves – Event Dummy: Weightlifting

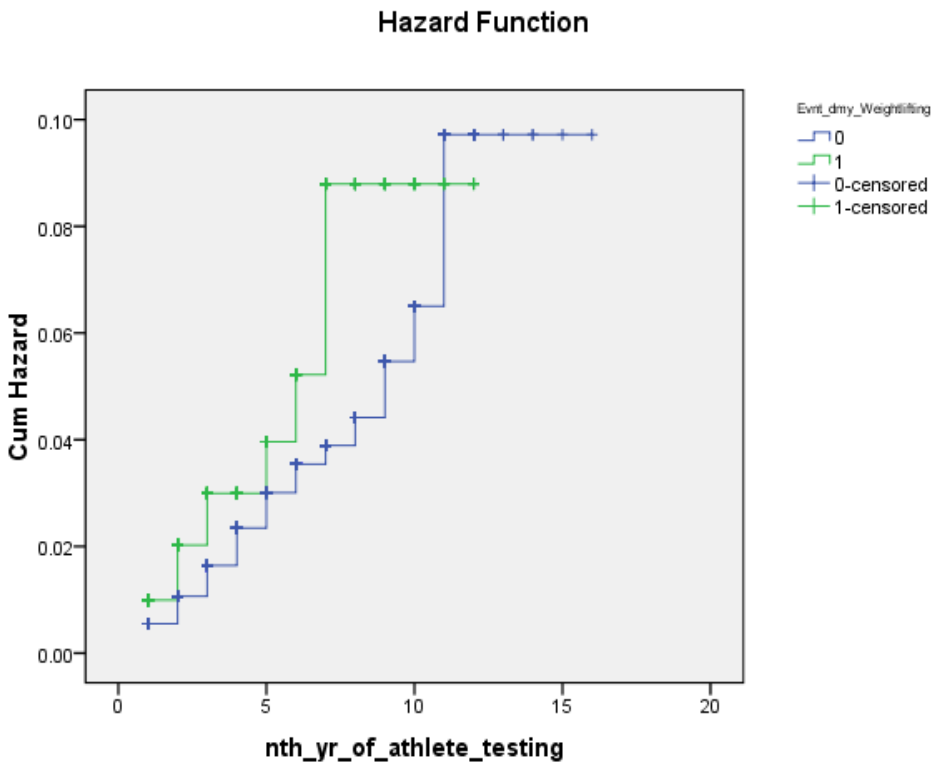


Fig 4 (c): Kaplan Meier Curves – Event Dummy: Track and Field

c. Career stage

The number of years that an athlete is been in the USADA program is a good indicator of the number of years she has been a professional athlete. Between 2001 and 2012, USADA tests per athlete per year have been increasing with the number of years she has been a professional athlete. It has grown from little over 1 test per athlete per year in the 1st year as a professional athlete to over 3.5 tests per athlete per year beyond 10 years as a professional athlete (Figure 5). This corresponds to tests per athlete per year growing from 1.2 in 2001 to 2.6 in 2012 (Figure 5).

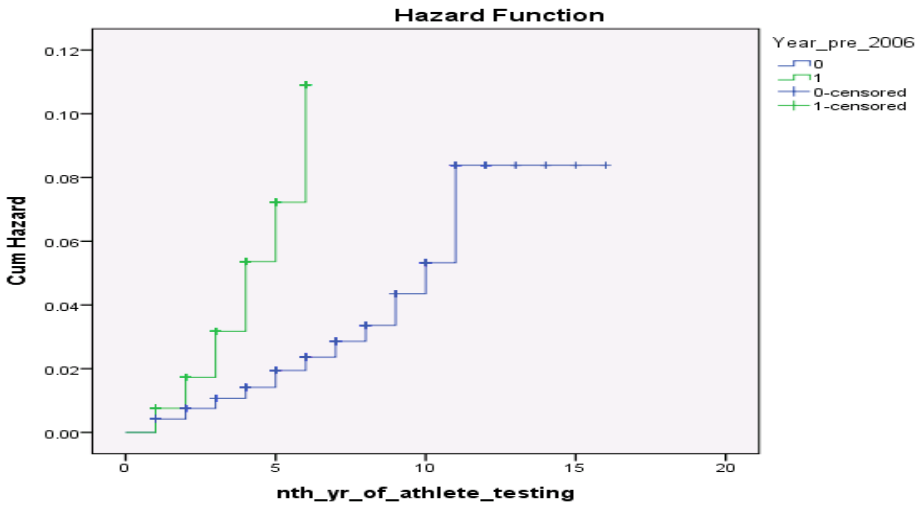


Fig 5: Kaplan Meier Curves – Year dummy: Calendar year is pre-2006 or not

The longer an athlete remains professional and in the USADA program the more she would be tested for doping violations. However, this does not have a straightforward relationship with the sanctions rate over the athlete's career. Indeed, the sanctions rate grows from 1.2% (1.7%) in the first year of an athlete in the USADA program to a maxima of 2.3% (3.5%) in the 4th year. Thereafter, the sanctions rate falls to 1.3% (2.0%) in the 8th year of the program, only to climb back up to 2.6% (3.9%) beyond the 10th year as a professional athlete (Figure 5).

To the extent that the sanctions rate is a good indicator of the extent of the doping problem in professional sport, the rise of the sanctions rate in the first 4 years may be attributed to the process by which an increasing number of athletes feel it necessary to dope to enhance their performance (reference). The alternatives to keeping abreast with the peer-group sporting performance are unattractive, and in team sports such as Tour de France cycling could include dismissal from the team (job loss, Shermer 2008).

The fall in the doping sanctions rate post the 5th year of an athlete's career has two drivers – first, those athletes who survive longer into their careers could be the better athletes with presumably larger to lose from a positive dope test, as well as better 'natural' athletic prowess; and second, athletes who have survived longer into their careers with the unfair advantage of PEDs have developed competence to not test positive. Beyond the 9th and 10th year in professional sport, however, a combination of wear and tear on a veteran athlete's body and the now reduced penalty of a doping ban

(a lifetime ban now means fewer earning years lost) could be causing the sanctions rate to climb up to higher levels.

STATISTICAL TESTS, INTERACTIONS AND RESULTS

The multivariate effect of sport, time and athlete's career on PEDs sanction rate (as understood from PEDs sanction rate) are vital for the policy maker's intervention to be well calibrated and effective. Dhayanithy (2013) compares the analysis of regulation drivers from (a) time-to-event analysis (using proportional hazards) with the analysis using (b) logistic regression. This study points to the difficulty of an apriori fixing of the time window of reckoning which is vital to logistic regression analyses. The current study follows Dhayanithy (2013) to examine the relative importance of sport and calendar year in explaining 'time to a failed drug test', which in turn is measured by the career stage variable. In this framework, an explanatory variable is significant if it causes a parallel shift of the baseline hazard of a sanction, up or down.

Exhibit 2: Cox Proportional Hazards regression results

Variables in the Equation

	B	SE	Wald	df	Sig.	Exp(B)
Year_pre_2006	1.192	.150	63.356	1	.000	3.295
Evnt_dmy_Cycling	1.637	.170	92.543	1	.000	5.140
Evnt_dmy_Weightlifting	.798	.278	8.267	1	.004	2.221
Evnt_dmy_Track	.675	.166	16.558	1	.000	1.965
Evnt_dmy_Soccer	-1.062	1.005	1.117	1	.291	.346
Evnt_dmy_Basketball	-1.065	1.007	1.119	1	.290	.345

Omnibus Tests of Model Coefficients[a]

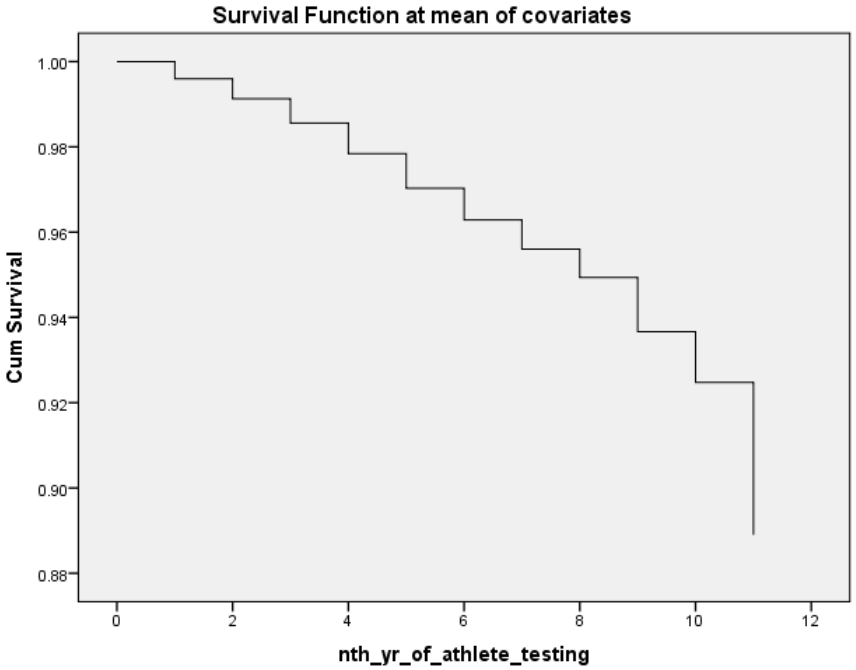
-2 Log Likelihood	Overall (score)			Change From Previous Step			Change From Previous Block		
	Chi-square	df	Sig.	Chi-square	df	Sig.	Chi-square	df	Sig.
3791.565	167.790	6	.000	142.172	6	.000	142.172	6	.000

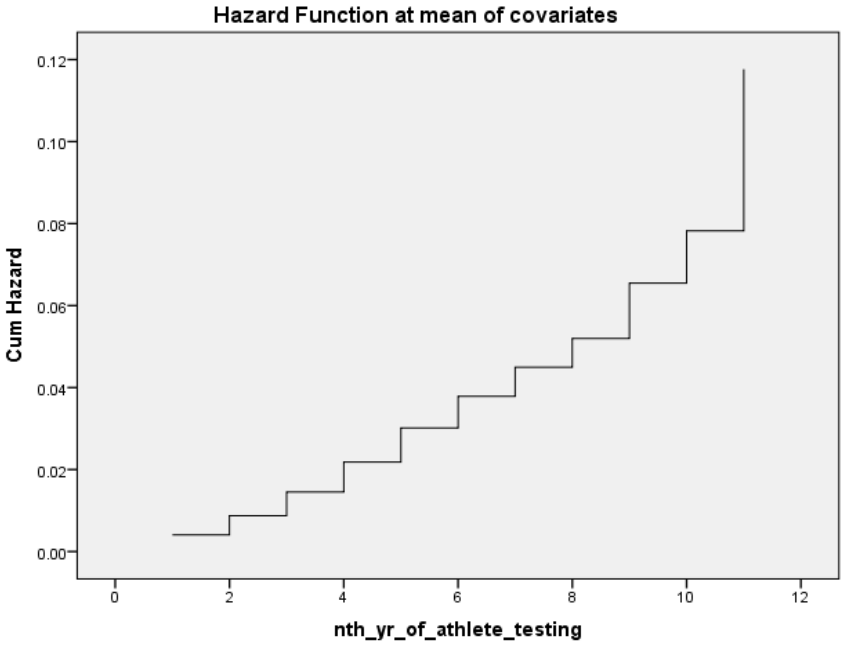
a. Beginning Block Number 1. Method = Enter

Covariate Means

	Mean
Year_pre_2006	.439
Evnt_dmy_Cycling	.100
Evnt_dmy_Weightlifting	.041
Evnt_dmy_Track	.192
Evnt_dmy_Soccer	.020
Evnt_dmy_Basketball	.030

Exhibit 2: Cox Proportional Hazards regression results – contd.





The Kaplan Meier curves (Klein and Moeschberger, 1997) show that events such as cycling (fig. 4a), weightlifting (fig. 4b), and track and field (fig. 4c) do have proportionally higher hazard of PEDs sanction rates. This is corroborated by the Cox proportional hazards regression results as well (exhibit 1). While sports such as soccer and basketball events have lower PEDs sanctions ratios (exhibit 1), their impacts on hazards are neither proportional nor significant (exhibit 2).

POLICY IMPLICATIONS

The results in the previous two sections indicate that higher or lower PEDs sanction rates in some cases have more to do with career stage (time) effects rather than sport specific effects. Yes, cycling (fig. 4a), weightlifting (fig. 4b) and track and field (fig. 4c) deserve special attention given that the higher PEDs sanctions rate is unequivocally sport-specific. At the same time, the lower PEDs sanctions rates in sports such as soccer and basketball may have more to do with career stage and economic incentives, rather than any sport specific or career stage specific factors alone. Or, career stage and economic incentives interact with sport specific factors such as team or individual play, in the determination of the outcome, the PEDs sanction rate.

Haugen (2004) and Berentsen (2002) develop early game theoretic models of doping in sport. Shermer (2008) throws light on the doping problem in the sport of cycling, indicating that competitors may be faced with the Prisoner's Dilemma. Although, both players not doping would deliver the best payoff to each of them (clean competition and no prospect of a life ban), the promised performance benefits of 4% of so (Shermer, 2008) ensures that the NE of this game is indeed both players doping, and therefore actually negating the performance edge but incurring the sanctions risk. Curry and Mongrain (2005) deals with policy interventions which could, potentially, lead to a decrease of doping in professional sport.

Dilger et al (2007) summarizes the various policy dimensions when it comes to the control of doping in sport. They include the simple performance payoffs and game-theory model assumptions of the Prisoner's Dilemma game (Shermer, 2008; Haugen, 2004; Berentsen, 2002). Some of them are homogeneity of contestants (ability as well as risk appetite), decision process of PEDs use including the interaction with information availability, uniformity of the actual enhancement in performance across athletes, uniformity of healthy risks to different athletes, modulation of winner take all

competition (like final table players in poker tournaments are allowed to reach a decision on the distribution of the prize money while keeping aside a smaller sum to actually play for). Also suggested is a role for fellow participants in the dope testing of athletes because of peer insight into what is PEDs driven athletic performance versus what isn't, akin to tennis players being allowed to make a limited number of unsuccessful challenges of the line calls. At the extreme, there are even calls for the legalization of PEDs in sport (Kayser et al, 2005).

Two insights emerge from our work. First, sanction rates (and hence the incidence of PEDs use) increases from the athlete's debut to about the 3rd or 4th year of her professional career, and then falls to a lower level, and spikes significantly in past the 8th year pointing to a "veteran doping effect". Second, there is a sport specific upward or downward effect on the baseline sanctions rate of some, but not all sports. Cycling, weightlifting and track and field have significant sport specific effects. At the same time, the absence of sport specific effects in other sports like soccer and basketball points to the importance of baseline hazard to a positive dope test, which is simply a function of time spent as a professional athlete. This together with the earlier discussion of the policy literature on doping indicates that there is need for more grounded understanding of the PEDs use phenomenon.

One interesting observation on the USADA data is that although the sanctions rate shows an inverted U relationship with the career stage with a kink post the 8th professional year, the number of test per athlete per year increases uniformly with the career stage. There is no association of the dope testing effort with the sanctions rates that are observed, over an athlete's career stage. This provides an area to focus on for optimization of anti-doping testing procedures and protocols, especially should they be driven by the career stage of the athlete. Or, it could be posed if the increased testing of older athletes is a case of age discrimination, given that there appear to be no career stage effects of increased participation in competition by athletes. Indeed, it is commonly observed that athletes compete the most in order to break into the upper echelons of the sport's rankings, subsequent to which they participation is more carefully worked out.

Another area, albeit one to do with data cleaning mainly, is to carefully investigate is the full mapping of USADA test sanctions with the tested athletes. This will enable us

to get a clearer picture devoid of the 1.5x factor we have applied in this paper to work around the issues of not finding matches to the athletes sanctioned in the master list of athlete's tested.

CONCLUSION

This works establishes the empirical ground for a detailed study of the phenomenon of PEDs in sport. PEDs use at an aggregate level has a strong career stage pattern in addition to certain sports having a strong influence on the baseline sanctions rate curve. Some of the variables that should be studied within the current empirical time-to-event framework are (a) age of debut of the professional athlete, (b) relationship between the sanctions rate and the real doping rate, and (c) the drivers of the career stage pattern, that is, an inverted U with a significant upward kink in the veteran stage of an athlete's career. The inclusion of more realistic facets of sport and athlete incentives in the game-theoretic framework following Haugen (2004), Berentsen (2002) and Shermer (2008) is an equally critical part of furthering our understanding of the use of PEDs in sport, so that doping policy can be more measured and effective.

Further, given the significant sport effects on the baseline sanctions rate, there needs to be careful focus on the detailed sport specific factors driving the use of PEDs by professional athletes. A sampling of such studies includes contextual influence and athlete attitudes (Smith ACT et al. 2010), socio-economic and age-related determinants (Humphreys and Ruseski, 2011), and sport specific studies (Stoudohar 2005). This paper is a first step in the development of a research agenda along these two broad lines, with the objective to inform PEDs related policy in sport.

REFERENCES

1. Berentsen A. 2002. The economics of doping. European Journal of Political Economy, 18: 109 - 127.

2. Blue A. 2006. It's the real dope. New Statesman, 14th Aug: 41.

3. Crisp S, Sheehan T and Hughes J. 2008. The science of doping control. Laboratory Equipment, Sep: 7 – 9.

4. Curry PA, Mongrain S. 2005. Deterrence in rank-order tournaments. Mimeo, Department of Economics, Simon Fraser University.

5. Dhayanithy D. 2013. What drives performance – diversity, selectivity, experience or methodology? IIMK Working Paper Series, 117/ STR/ 2013/ 03.

6. Dilger A, Frick B, Tolsdorf F. 2007. Are athletes doped? Some theoretical arguments and empirical evidence. Contemporary Economic Policy, 25 (4): 604 – 615.

7. Dixit A, Skeath S and Reiley DH Jr. 2010. Games of strategy. Viva-Norton student ed. NY.

8. Haugen KK. 2004. The performance-enhancing drugs game. Journal of Sports Economics, 5: 67 – 86.

9. Humphreys BR, Ruseski JE. 2011. Socio-economic determinants of adolescent use of performance enhancing drugs: evidence from the YRBSS. The Journal of Socio-Economics, 40: 208 – 216.

10. Kayser B, Mauron A, Miah A. 2005. Viewpoint: Legalization of performance-enhancing drugs. Lancet, 366: S21.

11. Klein JP and Moeschberger ML. 1997. Survival analysis: techniques for censored and truncated data. Springer-Verlag, NY.

12. Pincock S. 2005. Feature: Gene doping. Lancet, 366: S18 – S19.

13. Pitsch W, Emrich E, Klein M. 2005. Zur haufigheist des dopings im leistungssport: ergebnisse eines www.surveys. Leipziger Sportwissenschaftliche Beitruge, 46: 63 – 77.

14. Shermer M. 2008. The doping dilemma. Scientific American, 298 (4).

15. Smith ACT, Stewart B, Oliver-Bennetts S, et al. 2010. Contextual influences and athlete attitudes to drugs in sport. Sport Management Review, 13: 181 – 197.

16. Stoudohar PD. 2005. Performance-enhancing drugs in baseball. Labor Law Journal, 139 – 149.

17. Whitten P. 1997. Strong-arm tactic. The New Republic, 17th Nov: 10 – 11.

18. Yesalis CE and Bahrke MS. 2002. History of doping in sport. International Sports Studies, 24 (1): 42 – 76.

Indian Institute of Management Kozhikode

*Type of Document: (***Working Paper/Case/ Teaching Note, etc.)**	*Ref. No.:*
WORKING PAPER	***IIMK/WPS/122/STR/2013/08***

Title:

PATTERNS OF PEDTEST SANCTIONS IN PROFESSIONAL SPORTS – BASELINE AND IMPLICATIONS FOR RESEARCH

Author(s):	*Institution(s)*
Deepak Dhayanithy	Assistant Professor of Strategic Management Indian Institute of Management Kozhikode IIMK Campus PO Kozhikode, Kerala 673 570. Phone: 91-495- 2809433 email: deepak@iimk.ac.in
Subject Areas: **Strategic Management**	*Subject Classification Codes, if any:*
Supporting Agencies, if any:	*Research Grant/Project No.(s):*
Supplementary Information, if any:	*Date of Issue:* **March 2013** *Number of Pages:* ***17***

Abstract:

This paper establishes an empirical ground for the exploration of PEDs in professional sport, and the research implications. We use athlete level testing and sanctions data of 70 sports disciplines between 2001 and 2012, conducted by USADA (United States Anti-Doping Agency), and examine the sport specific effects, calendar year effects and career stage effects on the USADA sanctions rate – both in univariate studies as well as in multivariate Cox proportional hazards regressions. We find that certain sports such as cycling, weightlifting and track & field do have significant and positive effect on the USADA sanction rate. On the other hand, many seemingly lower and higher than average sanctions rate, like for soccer and basketball are not statistically significant, that is they don't move the baseline hazard rate up or down. There is a distinct inverted U relationship between career stage and sanctions rate, with a kink to a much higher sanctions rate in the veteran years of an athlete's career. Given these results, it becomes very important that we make careful study of the determinants and consequences of the use of PEDs in professional sport by athletes. This paper provides the empirical basis for the study of PEDs use by professional athletes, setting out important avenues for further empirical and theoretical research in the field.

Key Words/Phrases: Performance-enhancing Drugs, Baseline of Sanction rates