Applying Driver's Aggressiveness to Employee's Behavior: a Tournament Theory Approach

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***Abstract*—This study explores if employee's behavior can be explained through comparison with stock car drivers, applying the tournament theory to drivers aggressiveness. As strategic human resources management demands precision tools to explain the staff effort input, it is expected to demonstrate the robustness of the theory to human resources area. Thereby it was used a multinomial logistic regression model to calculate the impact of qualitative and quantitative variables to contestants aggressiveness. As expected, the comparison is possible due to similar human behavior in different contexts, as a result validating the research hypothesis and proposing a valid logical approximation of stock car drivers to employees.**

***Index Terms*—Tournament theory, human resources, logistic regression, stock car, strategic management.**

I. INTRODUCTION

The human behavior may always surprise managers, based that the variables are mostly unclear; therefore, it is essential to managers to have tools that may assist on more precise decision-making. Tournament theory [1] has been widely used to explore man effort input in many areas, such as sports, management and other areas which is difficult to describe quantitative variables to human behavior [2]. Although, the theory may face problems too complex if applied directly to employee's behavior, thereby, an indirect analysis is an alternative to simplify the analysis.

Thereby the present research explores if variables applied to a completely different context may be imported and used by strategic human resources management. For this, the behavior of Brazilian stock car drivers was studied through the optics of tournament theory, later exploring the relationship of stock car variables to human resources case. As the engineering premise is to solve difficult problems with simpler tools, tournament theory is essential to maximize an organization efficiency by maximizing its staff input of effort.

This research explores both the comparison of NASCAR drivers to Brazilian stock car drivers, and applicability of stock car variables to strategic human resources management, aiming to validate the hypothesis that different contexts are comparable by using the tournament theory. As a result, it is expected to demonstrate a valid alternative to aid human resources decision-making by applying a different context variable to predict human behavior.

II. LITERATURE REVIEW

A. Tournament Theory

The tournament theory [1] describes how different prizes imply in different behavior, according to the difference between the potential win, therefore, in every situation characterized by a tournament it is possible to apply this theory. Gladiators fighting for survival, players competing a championship or employees aiming a promotion, are examples where theory can be applied to explain the behavior off the competitors [2]. A tournament can be described as a competition which the prize is given accordingly to the position off the competitor, disposed through a rank-order list [3], by this definition, road races are easily defined as a tournament where drivers acquire points judged by their performance, aiming to win the competition [4].

The performance of a driver (i) in a race is comprehended through the Equation 1, where 'q' represents the performance, the output of the sum between the level of effort, or investment, and a random component, such as luck or noise, respectively, 'μ' and 'ε' [1].

$$q_i = \mu_i + \varepsilon_i \tag{1}$$

Considering the prizes for two ranks are W_1 and W_2, where $W_1 > W_2$, and the cost of effort is given by $C(\mu)$, the probability P of an competitor 'i' win upon 'j', is the probability of the difference between the input of effort being bigger than their luck, or noise, therefore, the Equation 2 defines P.

$$P = \text{prob}[q_i > q_k] = \text{prob}[\mu_i - \mu_k < \varepsilon_i - \varepsilon_k] \tag{2}$$

As a result, the maximum effort of a driver (μ_{max}) implies in a maximum cost V, which is the product of the difference between the prizes and the partial derivate $\partial P / \partial \mu_j$.

$$\frac{\partial P}{\partial \mu_j}(W_1 - W_2) = V \tag{3}$$

The tournament theory is widely used to study the behavior of challengers in sports competitions[4], with great highlight to NASCAR [5][6], where it was used to test the efficiency of the pointing system, as well as the aggressive behavior of the drivers (ρ), given by the ratio between the cost of effort and the aggressiveness of the opponent. Consequently, a driver will try an overtake if, and only if, the difference between prizes is

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great enough to overcome his risk [6]. Although the great theory focus on the behavior upon winning, the divers carried more to finish racers than winning races during the "Chase I punctuation method (2004-2013)", being more important the guarantee of points than the bigger prize itself, so the difference between prizes wasn't big enough to encourage the drivers.

B. Strategic Human Resource Management (SHRM)

The effectiveness of an organization is dependent to how human resources professionals (HRP) link people, strategy, values and performance [7], based upon maximizing efficiency, predicting behavior is a key feature to managers. Therefore, it is necessary to know how employees react to different stimulations, such as difference between wages [1].

Although, it is difficult to establish variables that affect employees behavior [2]. Strategic human resource management (SHRM) has great dependence on how HRP's are able to analyze and manage people maximizing their effort and performance [8], as a result, tournament theory seems an possible approach [9]. The analysis of human behavior by the tournament theory had initially great focus on management [1], [9], although, a possible link between the theory and SHRM hasn't been fully explored. As found in the literature, SHRM has counted many fails due to bad allocation of human resources, demanding newer methods on how to better allocate resources, and so increasing its efficiency [8], [10].

C. Multinomial Logistic Regression

The logistic regression is similar to the linear regression, although, its calculus consider dependent qualitative variables, such as success or failure [11]. The quantity of variables to be discretized defines the type of logistic regression, if only two variables are to be used it is characterized as binary, in the case of more variables, it is multinomial [12], also, the logistic regression can be called as "logit model".

The logit model is given by the Equation 4 [12].

$$g(x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n \quad (4)$$

Where β_0, β_1, ..., β_n represents the calibration coefficients of each respective independent variable x.

III. EMPIRICAL MODEL

The tournament theory describes that a result depends on two conditions: the level of effort invested and a random variable (such as luck or noise) [1]. Thereby, it was supposed a relation between the aggressiveness of drivers and the probability of receiving a penalty based on Schwartz *et al.*[6] work, however, their variables cannot be fully applied in the Brazilian competition, due to intrinsic variations between the competitions, hence some variables where excluded and newer variables where created.

It was used an multinomial logistic regression, solved at the software EViews, to calculate the impact of different variables to the aggressiveness of the pilot, comparing the results obtained to the known coefficients found by Schwartz *et al.*[6], demonstrating that the human behavior depends on more factors than the position he is. In this way, this research aims to comprehend the impact of the pilot's condition in the competition (distance in points to the leader, starting position…), to the probability of suffering a penalty, represented by a dummy variable *Penalty*, therefore receiving 1 if positive to penalty, and 0 to negative. The Equation 5 presents logit model for *Penalty*.

$$Penalty = f(PTSAVAIL; PTSIN; ST; PTSBACK; CHANCE; TRACK) \quad (5)$$

The variables PTSAVAIL, PTSIN, ST and PTSBACK were imported from the model proposed by Schwartz *et al.* (2007), they represent, respectively, the maximum of points a driver still can win, the points a driver has won until the present race, the starting position, and the difference in points from the present leader. The variables *CHANCE* and *TRACK* were proposed to fulfill the model. The first represents the ratio between *PTSAVAIL* and *PTSBACK*. The second is a dummy variable, receiving 1 whenever the present track has any benefit that may encourage the aggressiveness of the drivers, and 0 if not.

It is expected that *PTSBACK, PTSAVAIL, ST* and *TRACK*, have a positive relation with the probability of suffering a penalty, meaning these factors subject the pilots to greater aggressiveness. While *CHANCE* and *PTSIN* have a negative relationship with the probability, based in the supposition that pilots with chance of winning will not assume great risks that may reduce their chance.

All the data analyzed includes every race from the 2015's "Campeonato Brasileiro de Stock Car" (Brazilian Stock Car Championship), obtained at www.livetime.com.br. The data was threated using Microsoft Office Excel 2013 and EViews. Six models were tested for the analysis, the three first with the dependent variable *PENALTY*, for the probability of suffering an official penalty. In addition, the three last use the dependent variable *PENALTY.UNIVERSAL*, where it is included the probability of not completing a race as a penalty, based towards the supposition that not completing a race is due to the risk taken by drivers and teams, therefore, by their aggressiveness.

The models 1 and 4 assume only the variables imported [6], 2 and 5 adds the variable *CHANCE*, and to measure 3 and 6 it is added *TRACK*. It is expected to validate the universality of the imported variables, the impact of *CHANCE* and *TRACK* to the system, and the behavior of the variable when considered every variable.

IV. MODEL RESULTS

The first three models, analyzing *PENALTY*, are found at Table 1, which presents significant impact of every variable presented.

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Table I: Impact And Significance Of The Variables To Models 1 To 3

	1		2		3	
Variable	***Coefficient***	***P-value***	***Coefficient***	***P-value***	***Coefficient***	***P-value***
C	34.86538*	0.0000*	35.38353*	0.0000*	13.96797*	0.0016*
PTSVAIL	-0.082037*	0.0000*	-0.083753*	0.0000*	-0.034066*	0.0006*
PTSIN	-0.050154*	0.0000*	-0.050290*	0.0000*	-0.021567*	0.0002*
ST	0.048187*	0.0027*	0.047140*	0.0034*	0.026538*	0.0018*
PTSBACK	-0.128971*	0.0000*	-0.130610*	0.0000*	-0.053521*	0.0006*
CHANCE	-	-	0.007456*	0.0287**	0.005358*	0.0087*
TRACK	-	-	-	-	0.680629*	0.0001*
McFadden R-squared	0.273725		0.285522		0.329655	

Note: *α<1%; **α<5%.

Font: Authors estimation.

The initial supposition of positive impact was confirmed to the driver's starting position, the same as encountered by Schwartz [6].Analogously *PTSIN* had the same known result, meaning that the driver's accumulated points discourage the aggressiveness of the driver. In other words, the bigger amount off points a driver has, the less aggressive he shall be in order to prevent the possibility of losing probability of winning the championship.

However, *PTSAVAIL* and *PTSBACK* act contrary to the supposition, being negative to the probability of suffering penalties. Therefore, the maximum punctuation available, the less aggressive the competitor shall be, and the greater the distance from the leader, lesser shall be the risks taken by the challenger.

The variable *CHANCE* shows great significance variation when applied with and without *TRACK*, also both have positive relation with *PENTALTY*. This way, *CHANCE* has confirmed the supposition, proving that a challenger with bigger chances of winning the championship are less aggressive, in order to maintain their chance of winning. *TRACK* confirmed that tracks with bonus prizes, or different winnings, stimulate the pilots to take more aggressive behaviors, and therefore, greater risks.

Models 4 to 6 are shown at Table 2, which demonstrate changes at every variable significance when compared to the first three models, an expected outcome due to the increase of amplitude to the dependent variable.

Table II: Impact And Significance Of The Variables To Models 4 To 6

	4		5		6	
Variable	***Coefficient***	***P-value***	***Coefficient***	***P-value***	***Coefficient***	***P-value***
C	15.19333	0.0006*	15.19314	0.0006*	10.18471	0.0001*
PTSVAIL	-0.036439	0.0002*	-0.036473	0.0002*	-0.024283	0.0001*
PTSIN	-0.022949	0.0001*	-0.022906	0.0001*	-0.014907	0.0000*
ST	0.013131	0.0906**	0.013169	0.0994**	0.008286	0.0910**
PTSBACK	-0.058471	0.0002*	-0.058452	0.0002*	-0.038637	0.0000*
CHANCE	-	-	0.000562	0.8491***	8.00E-06	0.9964***
TRACK	-	-	-	-	0.223151	0.0999**
McFadden R-squared	0.22834		0.228390		0.231927	

Note: *α<1%; **α<10%; ***not significant.

Font: Authors estimation.

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Initially, start position has a loss of significance from 1% to 10%, unveiling that it is more important to the probability of receiving penalties than not finishing the race. *CHANCE* assumes no significance to the system, and the effect of *PISTA* is oppose to the impact observed before, reducing even more the significance of *CHANCE*. Therefore, there is no relation between the chance of assuming the leadership and not completing the race.

The variable *TRACK* shows a loss of significance, however it still is relevant, for that reason, the probability of not finishing a race is dependent to the present track. *PTSAVAIL, PTSIN* and *PTSBACK*, keep their properties analyzed before at models 1 to 3, demonstrating the robustness of Schwartz [6] variables. It is emphasized that even with loss or gain of significance, every variable keeps their positive or negative relationship with the output; therefore, the probability of not finishing a race follows the concept of penalty, as supposed initially by this research.

V. MODEL APPLICABILITY TO SHRM

The aggressiveness of stock car pilots is clearly a tournament behavior; however the competition inside an organization is not always clear. The comparison between both behaviors, driver and employee, though, can be done, since it is possible to make analogies from the track to the company. Through this logic, each variable hereby can be associated with a social phenomenon, or a group of social events, as follows:

D. PTSIN

The number of points a driver has accumulated can be compared to the position one held at a company, such as a CEO won't act aggressively since he is already at the top-rank positions, and doesn't intend to lose his position[9];

E. ST

The starting position of an employee has close analogy to *PTSIN*, however it loses significance when applied to the possibility of not finishing a race, or being fired. Therefore, *ST* assumes the behavior such as the preference rank-order list to receive a promotion, in other words, an employee who is closer to receive a promotion will be more conservative to his effort, being less innovative in his actions.

F. PTSBACK

As the objective of every employee is wage, the bigger the gap between wages, more an employee will invest effort, however, bigger gaps may result in an opposite effect [1]. The further the salary of one employee to his superior, less motivated he will be, for this, every work executed by a group demands two conditions: either the difference between wages of every worker is small, either the group leader is capable of motivating the performance of the group.

G. TRACK

Every project developed by the company may work as a different track, since an employee has an opportunity to arouse the attention of his superiors, the bigger the project one is involved, more aggressive he shall be, therefore, being more innovative, working longer periods or presenting greater efficiency.

H. PTSAVAIL

The possibility of growing inside a company may initially suggest that a worker will input greater effort on his job, nevertheless, the data found confirms Lazear and Rosen [1] theory of which a challenger will not be motivated to input effort. Thereby, an employee shall not exceed in aggressiveness to intangible promotions, however, the closer an opportunity is, the more effort he will input.

I. CHANCE

The more susceptible an employee is to receive a promotion, greater effort he will apply. However, this analysis may be compromised due to the loss of significance of the variable in more large conditions, thus the effect of the factor will be less important to the not completion of a task, or being fired. Although, if the analysis only includes the infraction of the companies values or task limitation, the variable shows significance.

Every condition analyzed above can be found in the literature [1], [2], [9], [10], [13]–[15]. Even if not literally as described, the problematic presented is clear to SHRM, and any quantitative method to measure or analyze human behavior is essential do HRP, and therefore, the comparison here depicted is valid to guide the decision-making of SHRM.

VI. CONCLUSIONS

Although the theory has been applied in an indirect context, it has been shown that the comparison of two different systems is possible. As a result, difficult problem situations may be solved by applying the theory in similar contexts, such as sports, and then applying the variables proposed to the original problem itself. The robustness of Schwartz's variables [6] has been proved, as a result they may be applied in similar analysis as base variables. As well, the tournament theory is proved to measure the behavior of contestants in both individual and collective situations. In this optic, it is shown that NASCAR and Brazilian Stock Car drivers have similar aggressiveness behaviors, of which is valid to compare to employees effort in an organization.

Therefore, the theory may be used to assist decision-making of SHRM as an alternative to predict human behavior, thus maximizing the efficiency of HRP, and consequently, the organization efficiency. In addition, an indirect analysis is possible due to similar human behavior in different contexts, explaining generic situations through specific case studies.

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