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USING MONTE CARLO METHODS FOR THE VALUATION OF INTANGIBLE ASSETS IN SPORTS ECONOMICS

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Abstract

This paper indicates the possibilities of using Monte Carlo simulations methods in players' performance rights value monitoring. The authors have formulated a hypothesis that connects Monte Carlo methods (MC) and econometric models of the player's life cycle that could give club managers another source of information for the decision process. The MC method in finance is usually used to value the option price on the basis of assumed distribution of price changes. In this approach, the method was used to determine future the hypothetical value of footballers' performance rights. Using econometric models of the player's life cycle we could observe and analyse the phase in the life cycle of a football player and determine volatility. In this paper we use historical data of the market values of chosen football players from the website http://transfermarkt.de. The analysis is based on popular valuable players after the growth phase of their life cycle. For the visualisation of the "Championships games bubble" problem we analyse the periods before and after the UEFA EURO 2016.
The opportunities and threats of a such an attempt are shown in this paper.

Keywords: valuation, players' performance rights, econometric models, Monte Carlo methods

JEL classification: G02, G12, L83

Introduction

Sports economics especially that of soccer, football, baseball and basketball, is not just only sport, but also a powerful branch of industry for investors and gamblers. Clubs, managers and players have become ordinary market participants. One of the most important assets on a sports transfer market are players' performance rights. One of the most popular games in the world is football, called soccer in the USA. Every two years, in June and July, during the either the European football Championships or of the football World Cup, the market begins to be more dynamic. Journalists make rankings of national teams based on the individual values of players. It creates the need of objective valuation without any noises caused by the "Championships games bubble". It also means that managers, club owners and footballers' agents have to monitor the value of a footballer in case of a sudden disadvantageous change.

Currently, the valuation of enterprises in the economy plays a very important role. Some researchers treat it as an autonomic discipline of science (Zarzecki, 2013). The process of valuation is very complicated in the case of ordinary companies and especially in case of specific branches. One of the most unusual branches is the sports industry (Sloane, 1971) and one of the most specific assets is a player's performance rights. This intangible asset gives a football manager the right to benefit from using the player and his brand.

The problem of the valuation of a footballer's performance rights is not well described in the literature. There still appears new ideas for making this process proper and more objective. A gamut of methods used for pricing the market value of footballers is very wide – from simple regression models to methods of option pricing. Yet the problem of the adequacy of the methods is not the only one. The second very important issue, according to some economists, is the valuation of a footballer's brand closely tied with his performance rights. If we would like to treat a football club as an enterprise, we should take the fair value of balance sheet elements to estimate a company's book value.

The main goal of the article is to indicate the possibility of using the Monte Carlo simulations to approximate the hypothetical market value of football players. The idea of using this method is the extension of the Turnau, Clark and Viney's proposition (Turnau, Clark, Viney, 2005). Simulation methods are very useful to approximate the value of financial derivatives in practice; thus, a natural consequence is to try to verify how it works in the field of players' performance rights. The presented research is a type of a case study for chosen footballers. We used the market values of Robert Lewandowski, Cristiano Ronaldo, Paul Pogba and Zlatan Ibrahimović taken from the website www.transfermakt.de. The values of risk free rate are

represented by 26-weeks treasury bills from the country where the players work (i.e., Germany, Spain and England respectively). The source of the data is the website investing.com. We try to estimate hypothetical market values for six months ahead.

1. The valuation of footballers' performance rights – literature review

The football player's performance right is a kind of a license for playing football in clubs in organized leagues. A player who plays football (or soccer) on every level is obligated to be registered in a national football association. The difference between an amateur and professional footballer can be seen on their earnings. An amateur may get only costs return and a professional player is a contract employee. The second document necessary to monitor the career of a player is a player's passport (monitoring is obligatory to control cash flows between the clubs footballers played for). This passport is not an identification document but a register of players' performance.

The footballer's performance rights confirm that a player is employed in a club and a club can make a profit using the image and the brand of a particular player. During the contract a footballer is obliged to play for the club and a potential buyer has to pay for these rights. Colloquially we call performance rights the market value of the player. From this point of view, performance rights are not only the element of human resource management, but most of all, a financial asset of the club. Trading these assets takes place on a private non-regulated market, whose capacity is rapidly growing. Table 1 shows the changes in the transfer market in the last three years.

Table 1. The dynamics of the 'BIG 5' spending on transfers in the last 3 years (million USD)

Transfer market	2016	2015	2014	Growth rate (%)
Germany	573	364	323	33.19
England	1,348	1,169	1,160	7.80
Italy	470	453	282	29.10
Spain	503	570	684	–14.25
France	207	298	222	–3.44
BIG 5	3,102	2,862	2,671	7.77

Source: FIFATMS.com, *Knowledge in Transfer.*

The BIG 5 is a group of the richest football leagues in the world. Its spending on the transfer market amounts to 74% of the total spending but it is slowly reducing. The reason for

such a change are new investors joining the game, e.g., the Chinese. We could observe that the value of the transferred performance rights went up by about 7.77% year by year. In truth, we can observe a decline in two leagues; however the growth in two others is more serious. All these facts confirm the importance of the problem of the valuation of footballers' performance rights.

Many authors have discussed the problem of the valuation of footballers' performance rights. The first scientific paper was published by Carmichael, Forrest and Simmons in 1999. It was a proposition of using a regression model with quantitative and qualitative variables describing players' characteristics and their productivity. It was presented as follows:

$$F_i = X_i\beta_i + Y_i\gamma_i + Z_i\delta_i + e_i,$$

where:

F_i – the value of the transfer,

X_i – the vector of measurable characteristics and a player's productivity indicator,

Y_i – the vector of non-measurable characteristics of a player.

After that many models were constructed and the most important are:

– The proposition of Gerrard and Dobson (2000):

$$F_i = \alpha_0 + \alpha_1 X_i + \alpha_2 Y_i + \alpha_3 B_i + u_i,$$

where B_i is the vector of characteristics of the selling player club.

– The model of player's performance rights valuation (Lucifora, Simmons, 2003):

$$\ln\left(F_i\right) = \alpha_0 + \alpha_1 X_{1i} + \alpha_2 X_{2i} + \alpha_3 X_{3i} + \alpha_4 Z_i + e_i.$$

Another set of variables was used in this model:

$\ln(F_i)$ – natural logarithm of revenues connected to the player's football performance,

X_{1i} – the vector of characteristics describing the game experience of the player,

X_{2i} – the vector of characteristics describing the game performance of the player,

X_{3i} – the vector of characteristics describing the game reputation of the player,

Z_i – the vector of characteristics describing the quality of the club selling the player.

– The trinomial tree and option pricing models as players' valuation tools (Turnau et al., 2005).

– DCF model (assuming that the value of a player is a function of the whole team (Trequattrini, Lombardi, Nappo, 2012)).

– Econometric models with dummy variables representing untypical effects (Buriamo, others, 2015).

– The model of valuation estimated with feasible generalized least square (FGLS) for forwards players (Majewski, 2016):

$$F_i = \alpha_0 + \alpha_1 X_{1i} + \beta_1 W_{1i} + \beta_2 D_{2i} + e_i,$$

F_i – the market value of the player,
X_i – vector of measurable characteristics of the player and his productivity,
W_i – vector of factors connected to the club and players,
D_i – dummy variable representing the goodwill of the player.

There is also a group of methods supporting the valuation process, such as econometric models describing phases of the player (product) life cycle (Majewski, 2015). In this approach, the author assumed that every phase had an individual rate of changes. Thus, it results in the fact that every phase has a different equation of trend, i.e., in the phase of the introduction of the shape of the curve of the market values allows to approximate a linear trend, in the phase of growth the best, as a general rule, is an exponential trend, in stabilization – logarithmic, and in the decline phase – power. Nevertheless, everything depends on the individual characteristics of the player. Such an approach allows a researcher to use e.g., simulation methods more precisely.

2. Monte Carlo simulations in options pricing

Monte Carlo methods are well known in mathematics and physics, but since 1977 they have become more useful in other disciplines, e.g. in finance (Boyle, 1977). These methods consist in the generation of a discretionary number of observations fulfilling specified assumptions i.e., randomness, a type of distribution, parameters of distribution, etc. Thanks to the knowledge of the process deciding the changes in observations and thousands of simulations, the researchers get the distribution of marginal values of the financial asset. A deterministic character of the method is the reason why the values reached are called pseudorandom (Majewska, 2004).

In practice, using the Monte Carlo methods consists of two parts: a generation of a number of pseudorandom observations, normalization to known distribution, i.e., N(0; 1), calculating the path using the Brown motion, as in the equation below (Jorion, 2003), and finally the estimation of the distribution of the marginal values of financial assets.

$$\ln S = \ln S_0 + \left(\mu - \frac{\sigma^2}{2}\right) \times t + \sigma \times \varepsilon \sqrt{t},$$

where:

S – the future price of the financial asset,

S_0 – the present price of the financial asset,

μ – the mean of the financial asset on the base of real data,

σ – the standard deviation of the financial asset on the base of real data,

t – time,

ε – stochastic process with known distribution.

Using the Monte Carlo simulation (MC) nowadays is very popular in finance, especially in assets pricing – currency options and real options. Simulations give analysts a hypothetical distribution of the financial asset, particularly when we have not enough information about the assets and the process. It can be concluded that, in the case of MC methods, the researcher gets hypothetical information about probable profits and losses. The role of such a kind of results in sports finance may be crucially important. Benefits obtained thanks to MC can be grouped in some general points:

1. For accounting: better approximation of the valuation of intangible assets.
2. For the managers of football clubs: information about the expenses and costs of the player's employment.
3. For the football agents: information about the margins of the potential transaction.
4. For the footballer: help in specifying requirements from a potential employer and in calculating missing costs in the case of arbitrage.

3. The research and empirical results

The research is based on four cases: Robert Lewandowski, Christiano Ronaldo, Paul Pogba and Zlatan Ibrahimović. Each of the chosen players is one of the world's-top players, however considering their age, football performance and their market value they are on different levels and phases of their professional careers.

The research was conducted in the following steps:

1. The econometric analysis of the phases of a football player's life cycle.
2. Calculation limits of the last phase – specification of the number of observations for the estimation of a standard deviation.

3. Using the Monte Carlo simulation for an approximation of the distribution of footballers' performance rights.
4. Comparison results obtained for two periods of time – before and after EURO 2016.

The first step is very simple – we estimated numerous econometric trend models on the basis of the knowledge of the product life cycle theory (PLC) for various periods of time. Then we chose the best approximation comparing the obtained results. This way we obtained different models for the PLC phases. Points of intersection of curves indicate limits of phases. The results of this step are presented in Table 2.

Table 2. The results of estimation of PLC phases for the chosen players

The name of the player	Econometric models of PLC			
	introduction	growth	stabilization	decline
Robert Lewandowski	$y = 0.1784t - 0.4592$ $R^2 = 0.9603$	$y = 5.5087e^{0.0626t}$ $R^2 = 0.947$	$y = 14.523t^{0.3861}$ $R^2 = 0.8945$	None
Cristiano Ronaldo	$y = 0.3785t + 18.652$ $R^2 = 0.7765$	$y = 1.2639t + 31.171$ $R^2 = 0.9433$	$y = 0.4515t + 83.668$ $R^2 = 0.7559$	None
Zlatan Ibrahimovic	$y = 0.511t + 20.724$ $R^2 = 0.7751$	$y = 0.6868t + 21.317$ $R^2 = 0.9213$	$y = 31.465t^{0.11}$ $R^2 = 0.8392$	$y = –0.3566t + 41.576$ $R^2 = 0.8063$
Paul Pogba	$y = 2.2603e^{0.121t}$ $R^2 = 0.968$	$y = 41.027e^{0.0157t}$ $R^2 = 0.8867$	None	None

Source: own calculations.

Twelve econometric models are presented in Table 2. As we can see, in the case of one player (Ibrahimovic) it was possible to estimate trend models for all of the PLC phases. For two of them (Lewandowski and Ronaldo), we estimated the trend models for three phases, and in the case of Pogba we estimated two models. Each model fits well to the empirical data, thus we could suppose that the obtained limits for a particular period were correct.

Thus, we have information about how many observations we should make to estimate a standard deviation. The information about standard deviation in the year, length of the estimation period and risk-free-rate (26-weeks T-bills for the country of club-employer) is presented in Table 3.

There are some important parameters presented in Table 3. These parameters are used in MC simulations. The most important is σ – parameter and, as it is shown in the table, we can conclude that the four-month gap in observations led to significant changes in the standard deviation**.** The second parameter presented – risk-free-rate depends on the country of the employer (club) and in a few cases could significantly influence the valuation. The last parameter

is the market value of the player (starting point for simulations) and it is a hypothetical value estimated by experts form the transfermakt.de web site. The next step was to simulate probable changes in the value of footballers' performance rights. The results were presented in a graphical form – distribution of obtained value.

Table 3. Estimated and collected parameters for MC simulations

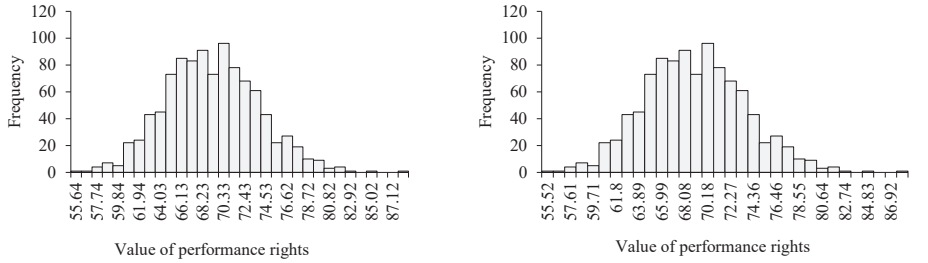
The name of the player		σ (in year scale)	n – period	RFR (%)	C	MV (mil. euro)
Robert Lewandowski	1	0.0865	44	–0.568	Germany	70
	2	0.0956	48	–0.626		75
Cristiano Ronaldo	1	0.0961	60	–0.274	Spain	110
	2	0.0901	64	–0.280		110
Zlatan Ibrahimovic	1	0.1013	70	–0.465	France	15
	2	0.0929	74	0.307	England	12
Paul Pogba	1	0.1309	27	–0.271	Italy	65
	2	0.1119	31	0.307	England	70

Legend: 1 – a period of time before Euro 2016; 2 – a period of time after Euro 2016; C – country; MV – a market value. RFR – the risk-free-rate.

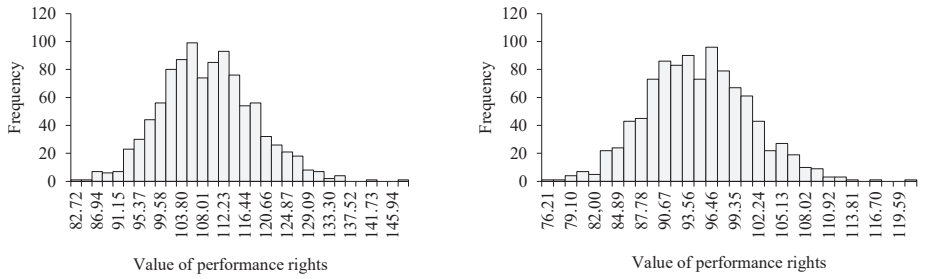
Source: own calculation.

Figure 1 presents eight charts containing possible changes in the market values of chosen footballers – there are simulations for November 2016 on the left and for March 2015 on the right (1,000 simulations for each case).

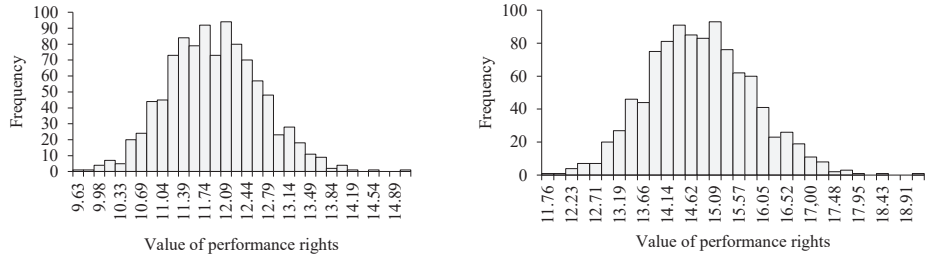
The graphs presented above show the hypothetical distribution of footballers' performance rights. The shapes of the distribution are very similar before and after EURO 2016, but only in the case of Robert Lewandowski when even the limits are constant (a change of the average equals 7.08%). It means that the European Championships did not have any impact on the value of this player. The change in the simulations of Cristiano Ronaldo may have been caused by winning EURO 2016 by Portugal. In this case, even the limits went up significantly (a change of the average equals 14.50%). In the case of the value of Zlatan Ibrahimović, MC simulations indicate a fall in his market value, even if the change of the club is taken into account (a change of the average equals –19.71%). The last analysed player is Paul Pogba – his situation is opposite to that of Zlatan Ibrahimović. He changed his club and the quota of the transfer had a great impact on his market value. Additionally, it is worth noting that he is a very young player – his PLC has only two phases (a change of the average does not confirm that and equals 7.93%). Specific values are presented in Table 4.



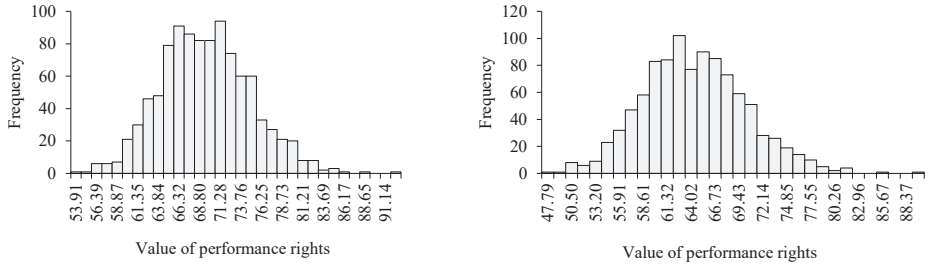
The market values of Robert Lewandowski



The market value of Cristiano Ronaldo



The market value of Zlatan Ibrahimovic



The market value of Paul Pogba

Figure 1. The simulation of the players' performance rights for November 2016 and March 2015 for the chosen football players

Source: own elaboration.

Table 4. Statistic parameters of a player's simulated market values by using the MC method before and after EURO 2016

Player	Period	Max	Min	Median	Average
Robert Lewandowski	after Euro 2016	91.98	60.67	73.19	73.33
	before Euro 2016	87.97	55.52	68.32	68.49
Christiano Ronaldo	after Euro 2016	136.44	88.43	107.53	107.75
	before Euro 2016	121.04	76.21	93.89	94.11
Zlatan Ibrahimović	after Euro 2016	15.04	9.62	11.76	11.79
	before Euro 2016	19.15	11.76	14.65	14.69
Paul Pogba	after Euro 2016	92.21	53.81	68.60	68.82
	before Euro 2016	89.72	47.79	63.49	63.77

Source: own elaboration.

There are some statistic measures of values generated using the Monte Carlo simulations. As it is possible to conclude in three of four cases (excluding Zlatan Ibrahimović) values after EURO 2016 are higher than before. It could indicate, in small part, that the European Football Championships could have an impact on the values of players participating in it.

Conclusions

In this article we have analysed the usefulness of the Monte Carlo simulations in the valuation of football players' performance rights. We assume, similarly to the valuation of real options, that such a method can indicate probable paths of development of a player's market value. We used the market values of four well known football players to verify the hypothesis that simulations supported by econometric models could be an effective tool for the participants of the football market.

Additionally, we assumed that there is the EURO 2016 effect, and in two of the cases we could suppose that it could work – in the case of Cristiano Ronaldo (again he proved to be the best footballer in the world) and in the case of Paul Pogba (this summer he was the player who broke the world transfer record.in world football).

The main advantage of the Monte Carlo simulation is the possibility of observing not only the final value but the distribution of probable values. It gives a user the possibility of setting up the strategy including more probable scenarios. The proposed approach of joining methods in one process makes the results more objective and implements sources of new information to the decision process.

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