Estimation of football player performance rights using econometric models and product life cycle

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Published online: July 31, 2021

(Accepted for publication July 15, 2021)

DOI:10.7752/jpes.2021.s3271

Abstract:

Football is a sport in which business is growing increasingly. Sport clubs are not only associations but also enterprises that resemble traditional enterprises, which rely not only on good sports results but also on financial benefits. Profits obtained by football enterprises are mainly connected with sales of tickets, TV broadcasting rights or sales of club souvenirs. Transfers of players has become very important in the budgets of sports clubs in the last fifteen years. Intangible assets, such as football performance rights, have begun to play an extremely important role in the company's finance. The purchase of player cards gives the clubs a possibility of showing it in their balance sheet. That is why valuation of this type of asset is very important in every well-functioning enterprise. The aim of this study was to determine the possibility of using econometric modelling and modelling of the product life cycle in evaluation of players' performance rights. The study involved using classical econometric models estimated by the ordinary least squares method and a feasible generalized least squares method. The choice of the method of estimation depended on verification of the correctness of the OLS model. The estimation of models describing players' life cycle (PLC) was based on the logistic trend. The study used data from the ten most valuable players from the website transfermarkt.de. There was only one condition in choosing players for PLC modelling – the chosen players should pass a minimum of three phases to give the possibility to estimate the horizontal asymptote. The data was obtained from the transfermarkt.de web page and was related to the ten most popular and valuable football players in Europe. Results indicated the significance of econometric modelling in valuation of footballers' performance rights and provided very important information for negotiations for club managers and agents.

Key Words: sport, intangible assets, footballer's valuation, econometrics

Introduction

Football is a sport in which business is increasingly growing. P. Sloane [1] described football as an industry and has sports clubs that are similar to traditional enterprises, which expect not only good sports results but also financial benefits. One of the main sources of capital for running a sport activity becomes trading of footballers' performance rights. In truth, revenues from these transfers are still not a core way of obtaining money but it has become very important on the income statement.

One of the most important balance sheet items of a sport enterprise is intangible assets, which in football clubs are the player cards. The purchase of a player card allows the conclusion of a contract with the player to whom the card is assigned and to recognize this card as an intangible asset. Therefore, the valuation of this type of asset plays an important role in every well-functioning enterprise. The specificity of player cards makes them an element not only for managing the company's assets or human resources but also is a subject of active trade. According to FIFA data, the value of the transfer market in 2018 amounted to approximately 7 billion USD and increased by 10% in comparison to the previous year. The majority of deals in the football markets are of course made by the big five clubs, but the poorer leagues also see a relatively large number of transfers each year [2]. For many years, economists have tried to find a proper technique for valuation of athletes. Many of them use popular methods of companies or financial instrument valuations but there are also a group focused on dedicated techniques that are only for sports intangible assets. This study shows the necessity of using various techniques for the valuation of a football player's rights. The novelty of the study is the use of two kinds of econometric models: regression (using various independent sport variables) and trend (using the theory of product life cycle). The literature explains intangible assets or intellectual capital as immaterial resources commonly used by enterprises. There are some basic categories of intangible assets as follow [3]:

- human capital - employees, individual skills, proficiency, innovativeness;
- relationship capital - brands, customer relationships, relationships with marketing and distribution partners, supplier's relationship, investors relationship
- structural capital - business infrastructure and processes, working methods, information systems, databases, intellectual property.

Such elements often determine the success or collapse of a company on the market. Football players are the most important component of the football enterprise without any doubt. Herm & others [4] defined the market value of a player as an estimated amount of money that could be paid by a club for a player to sign a contract independently from the real amount of the transaction. If football players are treated as intangible assets, problems of this recognition in the balance sheet appears. Partially, it has been solved by validation by the UEFA Financial Fair Play rules in 2010 using International Accounting Standard (IAS) number 38 “intangible assets” as a reference point, which indicates that the value of a player’s performance rights is derived from the value of a transfer or incurred fees for a player. IAS 38 defines a component of intangible assets as the possibility to identify non-monetary elements without a physical form [5]. Of note, when discussing intangible assets, it is necessary to remember that these resources are controlled by units that have to generate economic profits in the future. This part of the enterprise’s assets are the players. Despite the fact that a footballer’s performance rights fit exactly into the definition of intangible assets, recognition in the balance sheet at the moment of purchase and signing of the contract with an athlete or valuation at the end of the financial year are still problems for contemporary sport clubs [6]. Another problem is connected to the classification of costs related to purchasing of a player or the amortisation of a player’s performance right [7]. This problem is the result of the lack of professional literature concerning these type of market transactions. Therefore, there could be risks related to manipulation of the value of football players, what is additionally supported by the significant dynamics of the transfer market [8]. The success of each product on the market is described by the product life cycle (PLC). Every stage of the PLC explains the total sale of a product from the moment the product enters the market to moment of withdrawal of the product from sale. The curve describing the history of a sale of a product for every stage of development in most cases looks like the letter “S”. It could also be used for describing a sportsman’s performance rights over their lifetime. It is very easy to transform PLC stages, such as introduction, growth, maturity and decrease, from theory to the professional player’s life cycle. In the very beginning phase of introduction, the price of the player is very low – the portal Transfermarkt shows only prices above 50 thousand EUR. Sometimes, transfers in this phase are barter, but they also represent some value. As a footballer’s skills evolve, his value also quickly begins to be evaluated, and he transfers to better and richer leagues. These changes are noted in the growth phase. The growth of the value of a player at this stage could be very significant only if his skills are high enough, and this creates the possibility of a new brand. The fact that a brand has been built up is confirmed by the increased interest of sponsors, which results in increased earnings that are not strictly related to the sports contract (sponsorship contracts). This results in a further increase in the value of the player performance rights, when of course the player’s form remains stable and his skills continue to develop. The duration of this stage is strictly dependent on individual opportunities of the player. The phase ends with a slowdown in the growth of the player’s performance rights value. This begins the most important period in the player’s life cycle - maturity. This stage characterises the stabilization of the market value of the player at a high level. The sustainable policy of a club or other owner of players’ performance rights could result in long-term profits for both the player and club. The last stage is the decreasing stage. It usually could have two forms: a slowdown and acceleration. Because of this fact, players attempt to allow their sports career to slow down simultaneously at a high level of revenue. The accelerated phase concerns random cases connected mostly with injuries or other events that influence the loss of form of a player [9]. This study was based on the market values of the ten most valuable football players in Europe. The list of players was prepared based on information from the popular website transfermarkt.de from the 1st February 2020.

The aim of the study was to indicate the possibilities of using econometric modelling and the theory of product life cycle for football player card valuation. We used available econometric methods appropriate for this type of analysis, i.e., classical trend analysis using the least squares method. If necessary, after model verification, other available models, such as the generalized least squares method with heteroscedasticity correction and nonlinear models, were used.

Materials & methods

The database was created based on information from transfermarkt.de. The ten most valuable players were tested according to the transfermarkt.de information as of 01/02/2020. The most valuable players at the moment are listed in Table 1.

Table 1. Most valuable players as of 01/02/2020 Source: transfermarkt.de

Name	Age	Club	Position	Market value
Kylian Mbappe	21	PSG	Centre-Forward	200,00 mio €
Raheem Sterling	25	Manchester City	Left Winger	160,00 mio €
Neymar	28	PSG	Left Winger	160,00 mio €
Sadio Mane	27	Liverpool	Left Winger	150,00 mio €
Mohamed Salah	27	Liverpool	Right Winger	150,00 mio €
Harry Kane	26	Tottenham	Centre-Forward	150,00 mio €
Kevin De Bruyne	28	Manchester City	Attacking Midfielder	150,00 mio €
Lionel Messi	32	Barcelona	Right Winger	140,00 mio €
Jadon Sancho	19	Borussia Dortmund	Right Winger	130,00 mio €
Antoine Griezmann	28	Barcelona	Second Striker	120,00 mio €

The monthly periods data were used in this study by taking into account the fact that new information about the market values of players appears discreetly. We selected the ten most valuable players because the players were in the stage of football maturity and because of the availability of their data.

The variables used in the study for each player were:

- market value (MV) – monthly market value of the player in million euro,
- number of scored goals (G) – the number of goals scored by the player in a month,
- number of assists (A) – the number of a player's assists in a month,
- number of yellow cards (Y) – the number of yellow cards received by the player in a month,
- number of red cards (R) – the number of red cards received by the player in a month.

All the above data concerned the players' performances in all competitions, such as league matches, the Champions League, Europa League or the cup of the country they played in. The main source of the data was portal transfermarkt.de. This is a most popular website concerning the football transfer market and hypothetical values of players from almost all world football leagues. The website is available in thirteen language versions, and it is possible to find information about match results, detailed footballers' performance data (goals, assists, cards, time on the football pitch, etc.), transfer rumours and news or other news connected with the football world. The very important component of the platform is information about hypothetical market value of players. This part of the website is built based on a special algorithm. The starting point in the valuation process is the real market value of the player, and its final version is a result of estimations of all interested groups of professionals, journalists and football fans [10]. Each registered member of the portal users could publish his own estimation, and if this estimation is supported by solid motivation, it could have an impact on the hypothetical expert market value of the player listed on the website. The fact is that the website does not pretend to provide a scientific method of the valuation but is only a reliable source of information about the market price, which is often used to determine the relationship between the market value and its determinants.

Prior literature studies allowed us to formulate a typology of valuation models, as presented in Table 2.

Table 2. Typology of sportsman performance rights valuation

Property	Expert	Econometric	Numeric	Option pricing models	Mixed Approach
Data	Unknown, based on expert experience	Sport results, economic data, biological data [11], psychophysical data, hypothetical market values	Hypothetical market values (i.e., from transfermarkt.de)	Hypothetical market values (i.e., from transfermarkt.de), values of OPTA index	All available data
Costs	Unknown (probably very high)	Main data sources are free of charge	Free of charge	Data from OPTA index are payable	Main data sources are free of charge
Verification	Difficult	Comparison with real market values			
Complexity	Unknown	Easy to use	Low difficulty level		Easy to use

Source: own research

Many models are based on the commonly available data in the literature. These models typically use variables characterizing football players, such as market values of players, number of goals scored, assists, yellow and red cards, and substitutions. These data are published on many different websites free of charge. However, some models require more sensitive data. They could be collected during original research – dedicated (such as anthropometrics data or data describing physical abilities) and secondary data (i.e., values of the OPTA index). Unfortunately, most are payable.

The literature indicates some general models that are useful for the valuation of footballers' performance rights. Other models include those from:

- Carmichael, Forrest and Simmons [12];
- Dobson, Gerrard and Howe [13];
- Lucifora and Simmons [14];
- Tunaru, Clark and Viney [15];
- Trequattrini, Lombardi and Nappo [16];
- Wicker, Prinz, Weimar, Deutcher and Upmann [17];
- Buriamo, Frick, Hickfang and Simmons [18];
- Muller, Simons and Wienman [19];
- Coluccia, Fontana, Solimene [20]; and
- Konopielko, Soltysiak [21].

The last decade has been full of attempts regarding using econometric models for valuation of performance rights. Most have used the listed models above [22, 23, 24, 25, 26, 27, 28, 29].

The current research has involved two types of econometric models: models of trends representing PLC (logistic trend) and feasible generalized least squares (FGLS), when OLS models are negatively verified [26, 27].

Many other authors have presented in the literature models for other disciplines, especially Australian football or baseball [28, 29]. It is possible to use their experience to estimate the values of footballers in soccer.

Results

In this study, we carried out two types of econometric modelling to describe the formation of a player's market card value. The first involved modelling the logistic trend function and the second involved modelling of values based on sports achievements (without lagging variables and with lagging variables for both the explanatory and the dependent variable). The results show two models for each player. It is proposed that the final value of the player's card should be the result of the two models. In this way, value simulations can be made, which can be helpful both for players' agents and sports clubs. The results of the modelling are presented in Table 3.

Table 3. Empirical results of model estimations

Player	Product life cycle model	Regression model – sports activity	Key findings
K. Mbappe	$MV = \frac{220}{(1 + e^{-3.67782 + 0.113485 \cdot t})}$ $skor. R^2 = 0.923752$ $p(t) < 0.0001$	$MV = -66.8667 + 6.42659 \cdot t - 3.09518 \cdot G_{t-5}$ $skor. R^2 = 0.932035$ $p(t) < 0.0001; p(G_{t-5}) = 0.0511$	Strong negative influence of 5-time-lagged goals scored
R. Sterling	$MV = \frac{176}{(1 + e^{-1.59246 + 0.0552637 \cdot t})}$ $skor. R^2 = 0.904579$ $p(t) < 0.0001$	$MV = 1.24345 \cdot G_{t-1} + 0.676371 \cdot G_{t-4} + 0.594754 \cdot G_{t-7} + 0.980064 \cdot MV_{t-1}$ $skor. R^2 = 0.932035$ $p(G_{t-1}) = 0.0486; p(G_{t-4}) = 0.0226;$ $p(G_{t-7}) = 0.0601; p(MV_{t-1}) < 0.0001$	Strong positive influence of 1, 4 and 7-times lagged goals scored and 1-time-lagged market value.
Neymar	$MV = \frac{198}{(1 + e^{-2.67108 + 0.0476025 \cdot t})}$ $skor. R^2 = 0.909181$ $p(t) < 0.0001$	$MV = 2.92196 + 0.982345 \cdot MV_{t-1}$ $skor. R^2 = 0.987229$ $p(MV_{t-1}) < 0.0001$	Strong positive influence of 1-time-lagged market value.
S. Mane	$MV = \frac{165}{(1 + e^{-3.20618 + 0.0671412 \cdot t})}$ $skor. R^2 = 0.940014$ $p(t) < 0.0001$	$MV = 0.309554 + 0.889808 \cdot t - 0.152378 \cdot MV_{t-4}$ $skor. R^2 = 0.932035$ $p(MV_{t-4}) < 0.0001; p(MV_{t-1}) = 0.0046$	Strong negative influence of 4-times-lagged market value.
M. Salah	$MV = \frac{165}{(1 + e^{-4.08074 + 0.07993711 \cdot t})}$ $skor. R^2 = 0.841104$ $p(t) < 0.0001$	$MV = 0.590486 \cdot G_{t-5} + 0.999951 \cdot MV_{t-1}$ $skor. R^2 = 0.998202$ $p(G_{t-5}) = 0.0964; p(MV_{t-1}) < 0.0001$	Strong positive influence of 5-times lagged goals scored and 1-time-lagged market value.
H. Kane	$MV = \frac{165}{(1 + e^{-2.70859 + 0.102768 \cdot t})}$ $skor. R^2 = 0.929171$ $p(t) < 0.0001$	$MV = -17.8395 + 2.67840 \cdot t + 1.53732 \cdot G_{t-5}$ $skor. R^2 = 0.948621$ $p(t) < 0.0001; p(G_{t-5}) = 0.0496$	Strong positive influence of 5-times lagged goals scored.
K. deBruyne	$MV = \frac{165}{(1 + e^{-3.17251 + 0.0582885 \cdot t})}$ $skor. R^2 = 0.935376$ $p(t) < 0.0001$	$MV = -25.0597 + 1.15833 \cdot t - 7.13286 \cdot Y_t$ $skor. R^2 = 0.805115$ $p(t) < 0.0001; p(Y_t) = 0.0026$	Strong negative influence of yellow cards.
L. Messi	$MV = \frac{198}{(1 + e^{-2.891616 + 0.0168422 \cdot t})}$ $skor. R^2 = 0.761495$ $p(t) < 0.0001$	$MV = 49.1217 + 0.765020 \cdot t + 0.904424 \cdot G$ $skor. R^2 = 0.884154$ $p(t) < 0.0001; p(G) = 0.0001$	Strong positive influence of goals scored.
J. Sancho	$MV = \frac{132}{(1 + e^{-4.30927 + 0.208049 \cdot t})}$ $skor. R^2 = 0.949699$ $p(t) < 0.0001$	$MV = -40.8236 + 5.05155 \cdot t + 2.40534 \cdot G_{t-2} + 2.44053 \cdot G_{t-4}$ $skor. R^2 = 0.966663$ $p(t) < 0.0001; p(G_{t-2}) = 0.0721;$ $p(G_{t-4}) = 0.0479; p(MV_{t-1}) < 0.0001$	Strong positive influence of 2-times lagged and 4-times-lagged goals scored.
A. Griezmann	$MV = \frac{165}{(1 + e^{-2.35703 + 0.0510237 \cdot t})}$ $skor. R^2 = 0.910508$ $p(t) < 0.0001$	$MV = 5.69118 + 1.34655 \cdot G_{t-2} + 0.925287 \cdot MV_{t-1}$ $skor. R^2 = 0.949177$ $p(G_{t-2}) = 0.0170; p(MV_{t-1}) < 0.0001$	Strong positive influence of 3-times lagged goals scored and 1-time-lagged market value.

Source: Own research using GRETL program.

Abbreviations: MV – market value; G – goals; Y – yellow cards; t – time variable.

Discussion

Table 3 presents two types of econometric models describing the market value of football players: the product life cycle model and regression model as determined by a sport activity or lagged market value. We used data from players with the highest current market values. This decision was made based on willingness of using a function that describes the whole player's life cycle (almost full cycle) as represented by a logistic function. This function has a horizontal asymptote that represents the limit value that the market value is aiming for. In addition to the analytical forms of individual functions, the table also presents the corrected linear determination coefficient and the p-value statistics for the model parameters to show the significance of individual variables used in the models.

The best-fitted models of the players' life cycle were found for S. Mane and J. Sancho. The degree of matching exceeded 94%, whereas the worst fitted model was the life cycle model of L. Messi's card (76%). In most econometric models, the number of scored goals played an important role (for Neymar, the best estimates were obtained for models without sporting performance), but often, it was a variable that was delayed in time. This means that the number of goals scored in previous months (the variable lagged by even 7 months) had an impact on the market value. In the case of K. DeBruyne, yellow cards played an important role in reducing his value. However, it should be emphasized that the best models were obtained in his case for the time-delayed market values (dependent variable) for the explanatory variables. A very well fitted model was obtained for J. Sancho, but for the sake of scientific reliability, it should be stated that it contains too few numbers of observations, which means that the interpretation of the results should be done more cautiously.

In the cases of L. Messi and Neymar, the results were significantly different from the others. Neymar's performance rights market value was primarily influenced by its value in previous months (this may indicate that Neymar has a value for Paris Saint Germain even in the situation when he does not score goals and does not assist - it is the "brand" value of the player). In L. Messi's case, his market value was affected by the number of goals he scored. Worse results were obtained for models with time delays. This may mean an anticipation of Messi's market value estimates - they expect the Barcelona forward to score a certain number of goals. This is also due to the recognition of his value by experts and confirms his "brand".

Horizontal asymptotes were obtained for all football players. Therefore, the maximal expected values for the chosen players were estimated (the value placed in a counter). The highest estimated market value in the future was established for K. Mbappe at 220 million Euro, and the lowest among those analysed was established for J. Sancho at 132 million Euro.

Conclusions

Our results showed the usefulness of econometric models in estimating the market value of players' performance rights. Both the trend function describing the life cycle of the card ("player") and the classic econometric model with many regressors can be effective tools that support the human resources management process in a sports club. Both the trend and regression functions were characterized by a high fitting to the real data and the high significance of the models' parameters. One disturbance to this process could be the presence of the "player's brand", which introduced a disturbing element into the model (could be eliminated by non-linear regression or the FGLS method).

The use of a trend model in valuing the market value of footballers has a major advantage. First, it provides the possibility of obtaining additional information, which results from the construction of the logistic function. One of the basic information is obtaining the limiting value for the price of player's rights, i.e. the horizontal asymptote. This is an additional piece of information that gives the personnel managers in a sports club useful information for assessing the value of a future contract or a player's salary. The second may be, for example, to use information about the change in the dynamics of the value curve (transition to maturity). This type of information can also be used by managers.

In the case of regression models, different variants are possible. We propose an estimation using time-varying variables. In this case, the closest information on the player's performance is important and can seriously affect both his value and the value of his contract.

These two approaches proposed for valuation, the trend model and regression models, could be used jointly for forecasting. Similarly, valuation of real estates both predicted values that could be averaged to obtain the final value of the player's performance rights. Thanks to this, the final value characterises scientific cautiousness, which could result in insignificant errors in the estimated values. This is very important, especially in accounting, when CFOs must comply with financial standards, government regulations and regulations of national leagues organizations. Added value in such a mixed estimation involves the use of sport results, sport performances and player life cycles.

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