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A Conceptual Model to Measure Football Player's Market Value. A Proposal by means of an Analytic Hierarchy Process

Un modelo conceptual para medir el valor de mercado de los futbolistas. Una propuesta a través de un proceso analítico jerárquico

Carlos Poza
Universidad Francisco de Vitoria. España

Abstract

The aim of this article is to propose a conceptual model to estimate football players' market value, particularly in the position of forward. The model has been constructed by means of an Analytic Hierarchy Process (AHP) and the participation of 26 football experts from the Spanish Leagues. The model is composed of three kinds of primary attributes: sports variables, personal skills variables and professional variables. Within each primary attribute, there are a range of 6-10 variables whose weights have been calculated thanks to the football experts' participation. The main results show that the sport variable is the most important factor to determine the market value, closely followed by personal skills. Furthermore, goals per match, competitiveness and contract duration are the most important directly observed variables to explain the forwards' market value. Notwithstanding, there are other tangible and non-tangible factors that we should consider in order to improve the valuation accuracy.

Key words: Football Player; Valuation; Market Value; Analytic Hierarchy Process (AHP).

Resumen

El objetivo de este artículo es proponer un modelo conceptual para estimar el valor de mercado de los jugadores de fútbol, en particular de los delanteros. El modelo se ha construido a través de un Proceso Analítico Jerárquico y la participación de 26 expertos en fútbol de las Ligas españolas. El modelo se compone de tres atributos: variables deportivas, variables de habilidades personales y variables profesionales. Dentro de cada atributo, hay un rango de 6-10 variables cuyas ponderaciones se han calculado gracias a la participación de los expertos en fútbol. Los principales resultados muestran que la variable deportiva es el factor más importante para determinar el valor de mercado, seguido de cerca por las habilidades personales. Además, los goles por partido, la competitividad y la duración del contrato son las variables directamente observables más importantes para explicar el valor de mercado de los delanteros. No obstante, hay otros factores tangibles e intangibles que debemos tener en cuenta para mejorar la precisión de la valoración.

Palabras clave: Jugador de fútbol; valoración; valor de mercado; Proceso Analítico Jerárquico.

Correspondence/correspondencia: Carlos Poza
Universidad Francisco de Vitoria. España
Email: carlos.poza@ufv.es

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Introduction

The importance and influence of football in today's society is becoming more and more evident according to the latest figures. In Spain, for example, in the first and second division, clubs handle a total budget of around 10 billion euros per year, while the Ministry of Interior remains at 9,000 million per year, the Ministry of Science and Education 6,500 million and the Ministry of Justice 1,800 million of euros (Aznar and Guijarro, 2012). This means that the weight of football teams exceeds 1% of the Spanish GDP.

Likewise, if we observe the rankings of the best paid sports in the world, we can identify not only golf, tennis or basketball players but also football players. In fact, we could highlight some examples such as Cristiano Ronaldo, Messi, Neymar or David Beckham among others.

Due to this current interest in football, along with the lack of regulation on the valuation practice in this sport[1], we consider it would be appropriate to offer an accurate and holistic method to value forwards, so that the results achieved could be based on the variables selected from expert consultation.

The aim of this article is to build a conceptual model to value footballers that play in the forward position, based on a multi-criteria decision tree. The construction of the model considers three kinds of variables: sport factors, personal skills factors and professional factors, and provides a new perspective for the interpretation and management of intangible assets in a sport company.

This paper is structured into four parts: in the first one, the literature review, the main authors on football players' valuation as well as most important variables to determine value market are highlighted. Different techniques are also described to consider a variety of options. In the second part, the method, the research process is covered in detail: mainly the Analytic Hierarchy Process (AHP) applied, the definition of the variables used in the proposed model and the survey. In the third part, the results, the variables' weight is presented in order to rank the importance to value football players, in comparison with other studies. Finally, the conclusion, the most relevant results achieved in the paper are summarized.

Literature Review

The issue of the identification of the most relevant determinants of the football players' market value is quite well described in the literature (Idson and Kahane, 2000; Kahn, 2000; and Wicker et al., 2013). Some of them are focused on variables to make a complete set and others are aimed at models and methods (Majewski, 2016).

Regarding the variables, many different ones have been found, such as the distance run by a player during a match, the nationality of a player, goals, matches played by season, assists, cards, age, nationality, etc. In some cases, the model has been developed using classical variables (sport variables) (Hamilton, 2012), but in other cases, models have added a new set of non-sport factors such as personal skills and professional determinants (Esic, 2016).

As far as methods of valuation are concerned, according to Aznar y Guijarro (2012), there are a lot of possibilities depending on the sort of asset to be valued. From a general point of view, for the specific case of market goods, simple and multiple correlation, valuation ratio, temporal comparison, distribution functions, least squares regression, spatial regression and the updating of rents are usually utilized. However, the cost of replacement and the residual value are more frequently used for the valuation of real estate.

[1] In football there is no regulation to value assets as in real estate sector, for example. Order EHA/564/2008 modifies the Order ECO/805/2003, on valuation standards of real estate and certain rights for financial purposes.

The valuation of goods normally does not respond to a single criterion, but rather to a set of potentially explanatory variables of the phenomenon to be measured. As Simon (1955) pointed out in the field of business theory, today's complex organizations do not act by trying to maximize a certain utility function, but rather, different objectives –many of which are incompatible with each other- are proposed. What is finally intended is to achieve a certain level of satisfaction in each of them. This multidimensional approach is extrapolated to other areas of work such as decision making, thus appearing the term "multi-criteria decision making".

In this regard, Aznar and Guijarro (2012) establish a classification within multi-criteria methods for decision making. The first one is called a continuous multi-criteria analysis, in which the decision maker is confronted with a set of feasible solutions formed by infinite points. The second one is called a discrete multi-criteria analysis, that includes cases in which the number of alternatives to be considered by the decision maker is finite and usually not very high.

In the multi-criteria decision theory, there are numerous asset valuation methods such as the CRITIC method, entropy, simple ordering, Analytic Network Process (ANP), AMUVAM and Analytic Hierarchy Process (AHP).

CRiteria Importance Through Inter-criteria Correlation (CRITIC) is a method of ranking alternatives based on multi criteria evaluation, especially when the variables are correlated, and the decision maker is not able to give relative preferences. In our case, we do not have evidence to state there is a high correlation among the variables. Entropy method needs to previously know the data to calculate the weights, however we do not have certain information to do it (there is no information concerning leadership, competitiveness and so on). Simple ordering criteria consists on decision maker selects the weights discretionally, what may be too biased from our point of view. Analytic Network Process is a generalization of the Analytic Hierarchy Process (AHP), by considering the dependence between the elements of the hierarchy. Many decision problems cannot be structured hierarchically because they involve the interaction and dependence of higher-level elements in a hierarchy on lower-level elements. Therefore, ANP is represented by a network, rather than a hierarchy. In our study, again, we do not have evidence of high correlation among variables to creates nodes. ANUVAM method is a mix of AHP and income update that is specific in environmental valuation.

Finally, we have decided to use AHP because it allows us to include quantitative and qualitative variables measured in different scales and making comparisons between assets based not only on the objective data but also on the experience of experts in this area of study. Moreover, this technique is especially interesting when the researcher starts from a minimum information, usually limited to the price for which some transactions of similar assets have recently been made. In the world of football, it is very common for these situations to occur, in which there is no far more information than just the player's selling.

In order to identify the most important factors that might explain the market value of a football player, we can observe all the information released by Transfermarkt (2019) and Opta (2019), that offer a wide series of statistics from which the value of the player may be determined (mainly sport factors). These variables may be age, number of matches played, goals, assists, own-goals, yellow cards, red cards, penalties scored, minutes per goal, minutes played and contract duration, among others.

In this sense, Majewski (2016) identifies the main factors that determine the market value of forwards through an econometric model of multiple linear regression. The dependent variable is the market value of the player and the independent variables used in the analysis are: age, number of matches played throughout the season, number of times the player plays as a starter, goals per season, assists per season, number of red and yellow cards per season, number of times a player is substituted throughout the season, minutes played, economic value of the team in which the player plays, team position in the league and FIFA ranking. Taking into consideration all these variables, the goals and assists are those that gain a greater weight in the model.

Esic (2016), for its part, proposes the MEVF model that is divided into three dimensions: 1) affinity with the brand, 2) personal dimension and 3) sport dimension. In particular, the model includes current commercial agreements (current remunerations and types of agreements), perceptual parameters such as notoriety, proximity, solidarity, friendliness, etc., official statistics of players (goals, fouls, passes...) and other objective parameters such as nationality, age, sort of club or position.

Yuang (2015) states that his project focuses on predicting the market value of top players using statistical modeling techniques. In order to do this, he divides the study into three steps: 1) data is collected and organized into dependent variables (i.e. market value) and independent variables (i.e. predictors); 2) various models are tested and evaluated; and 3) predictions are made via the accuracy of the models.

The data frame was organized into two parts: the first one is the value of the player at the end of that season, in millions of Euros, given by transfermarkt.de. The second part is served as predictors: position, rank of the player's national team, dominant foot of the player, height, age of the player at the point of recording value, international cups of the player at the end of the last season, market value of the player one year ago, division (club reputation), appearances of the player in current season, player's goals in the current season, goals per match of last season, a ratio of international cups to player's age (when the player becomes famous).

To combine all this information, four modeling techniques are used: OLS, KNN, Ridge Regression and Principle Component Regression. The main results show that value from last year is probably the predictor that contributes most as it appears in each of the first five components. Goals, appearances and international cups are also highly influential. These predictors are from the category of performance data and have strong correlation with each other, forming various combinations.

Moreover, Munkhaugen Gulbrandsen (2011) found that characteristics about the clubs and the player together with the market structure (number of interested clubs vs. number of sellers), are the main determinants for deciding the transfer fee and the player's wage. They created two frameworks to capture important club and player characteristics (bargaining factors): One in which there is one buyer and another in which there are competing bidders. By assuming complete information in the transfer market, the participants in the transfer can analyze which party has bargaining and/or market power and, consequently, what the transfer fee and wage should be.

Frick (2011) highlights a set of variables that may be considered as indicators to determine the individual player salaries in Germany. He develops a model in which player's age, the number of matches played in the Bundesliga, the number of appearances for one's home country in international matches and the number of career goals scored and the player's position on the pitch (goalkeeper, defender, midfielder and forward) explain the salaries in football, along with a pool of control variables such as the nationality and the year of the season.

Dobson and Gerrard (1999) state that unlike most major U.S. sport teams, it is common for professional football clubs around the world to trade players for cash. This article develops a model of the player-transfer market in football in which observed transfer fees are determined by player characteristics, selling-club characteristics, buying-club characteristics, and time effects. The model is based on data of 1,350 transfer fees in English professional football from June 1990 to August 1996. The estimated model is used to investigate the rate of inflation in transfer fees. In addition, the determination of transfer fees is considered within different segments of the transfer market. It is found that the determination of transfer fees differs markedly among segments.

From a non-sport point of view, some authors such as Herm, Callsen-Bracker and Kreis (2014) state that community's market-value estimates are excellent predictors of actual transfer fees. They use two blocks of determinants: variables that are directly related to players' talent (sport skills) and variables that result from online judgments by external sources (e.g., journalists, followers…) (non-sport variables). Both kinds of variables can impact on the footballer market value. Thus, the more followers and supporters have a footballer, the more possibility he will have to increase his market value, through merchandising, sponsors, endorsements, and so on.

Methodology

In this study, a mixed approach (qualitative and quantitative analysis) (Petrovic, Koprivica and Bokan, 2017) has been used to identify the most important factors that can explain football players' market value or his hypothetic transfer fees[2]. The qualitative part has consisted of interviewing football experts (professional coaches/managers, football players and sports journalists) to determine the key variables and the quantitative part of applying an Analytic Hierarchy Process to calculate the variables' weight in the conceptual model.

Figure 1 shows the research process followed. In the first step, we have reviewed the empirical literature as well as interviewed a pool of football experts (5 in total) concerning sport valuation, which have allowed us to select a wide range of sport variables such as goals, assists, matches played and so on. In the second step, we have designed a draft survey to begin the process. In the third step, we have contacted 40 experienced football supporters (more than 20 years playing football as amateur and following Spanish League as a supporter) by means of a survey in order not only to have a first approach regarding the most relevant determinants to value football players, but also to implement a preliminar test to improve the quality of the survey that is carried out in the fifth step. In the fourth step, we have redesigned the survey, incorporating new items and modifying the wording of the text. Firstly, thanks to the supporters' information and most certainly because of the feedback from experts' interviews, in the fifth step, we have carried out the survey focused on 26 football experts (from Spanish Leagues) to extract the core information to value football players (through *surveymonkey*). The number of 26 has been based on data saturation, since there have been no big changes of variables' weights when we have incorporated new experts to the analysis (from 21 to 26 experts). In this regard, Bertaux (1981) pointed out that fifteen is the smallest acceptable sample, Charmaz (2006) for example suggested that 25 participants are adequate for smaller projects and Green and Thorogood (2009) stated that the experience of most qualitative researchers is that in interview studies it is necessary to interview around 20 people. And finally, in the last step, we apply the AHP to calculate the variables' weight to build the multi-criteria decision tree, which is relevant to compare players and determine their market value

[2] This collocation means the football player's market value comes from a specific model. For this reason, the hypothetic value may change depending on the model used. Thus, it is not real but an estimation. It is what a buyer would have to pay for the football player.

and transfer fees. This technique is especially useful, as we aforementioned, to achieve our goal because it allows us to analyze data from a holistic point of view. It combines numbers and objective data with opinions from experts who improve the quality of the prediction when comparing variables and football player performance.

Figure 1. The process of the research

Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) was developed by Saaty (1987) for decision-making in the United States Department of Defense. From that point on, the technique has been used on numerous occasions in business for complex decision-making.

Some examples could be observed in areas as diverse as society, science, education, economics, transport, allocation of productive resources, marketing, production, environmental applications, urban planning, public sector, health, resolution of international conflicts, sport, new technologies and even ethics (Aznar and Guijarro, 2012). Vaidya and Kumar (2006) reviewed 150 AHP applications in the decision area, 27 of which were studied in detail and classified per the topic addressed. This study undoubtedly reveals the importance of this method in any decision-making area.

According to Saaty (1987), the Analytic Hierarchy Process (AHP) is a general theory of measurement. It is used to derive ratio scales from both discrete and continuous paired comparisons. These comparisons may be taken from actual measurements or from a fundamental scale which reflects the relative strength of preferences and feelings. Moreover, he stated that AHP uses a hierarchic or network structure to represent problems and pairwise comparisons in order to establish relations within the structure.

Vargas (1990) distinguished AHP as a theory of measurement for dealing with quantifiable and/or intangible criteria that has found rich applications in decision theory, conflict resolution and models of the brain. It is based on the principle that, to make decisions, experience and knowledge of people is at least as valuable as the data they use.

Vaydia and Kumar (2006) defined Analytic Hierarchy Process as a multiple criteria decision-making tool. This is an Eigenvalue approach to the pair-wise comparisons. It also provides a methodology to calibrate the numeric scale for the measurement of quantitative as well as qualitative performances. The scale ranges from 1/9 for "least valued than", to 1 for "equal" and to 9 for "absolutely more important than" covering the entire spectrum of the comparison.

Thereby AHP is a method of selecting strategies based on a set of criteria or variables, which are sometimes in conflict. To do this, the criteria and the different alternatives are weighted using paired comparison matrices and a fundamental scale.

But why is an AHP applied? Decision-making can be considered as the choice, on some basis or criteria, of one alternative among a set of alternatives. A decision may need to be taken on the basis of multiple criteria rather than a single criterion. This requires the assessment of various criteria and the evaluation of alternatives on the basis of each criterion and then the aggregation of these evaluations to achieve the relative ranking of the alternatives with respect to the problem. The problem is further compounded when there are several or more experts whose opinions need to be incorporated in the decision-making. It is a lack of adequate quantitative information which leads to dependence on the intuition, experience and judgement of knowledgeable people called experts.

In general, the AHP allows us to face the following activities:

- Studying a situation.
- Organizing multiple criteria.
- Assessing multiple criteria.
- Evaluating alternatives on the basis of the assessed criteria.
- Ranking the alternatives.
- Incorporating the judgements of multiple experts.
- Allowing the researcher to analyze tangible and non-tangible variables, that is, using directly observed variables and indirectly observed (latent) variables such as competitiveness, leadership and so on, what improves the scope of the model.

It helps structure the decision-maker's thoughts and can help in organizing the problem (in our case: calculating football players' market value) in a manner that is simple to follow and analyze. Basically the AHP helps in structuring the complexity, measurement and synthesis of rankings. These features make it suitable for a wide variety of applications. The AHP has proved a theoretically sound and market-tested and accepted methodology. It is almost universal adoption as a new paradigm for decision-making. In addition its ease of implementation and understanding constitute its success. More than that, it has proved to be a methodology capable of producing results that agree with perceptions and expectations (Bhushan and Rai, 2004).

The AHP is developed as follows (main steps):

1. It starts from the interest that a decision maker can have in selecting the most interesting option, among a set of alternatives.
2. What criteria will be used to determine the selection are defined, that is, what characteristics can make an alternative more desirable on another. In Figure 2 we can observe an example with three alternatives and two criteria.

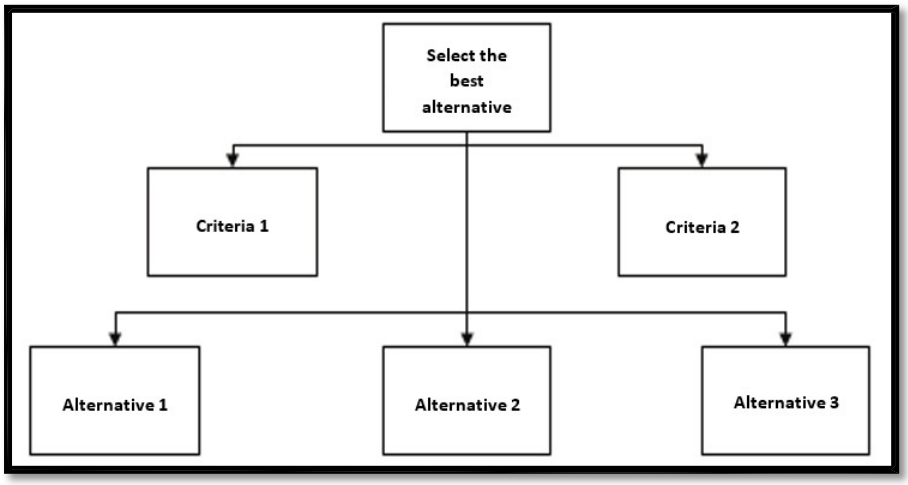

Figure 2. An example of an Analytic Hierarchy Process

3. In this regard, Arrow and Raynaud (1986) stated that "*we have to admit that a normal brain is not created to make complex decisions by multiple criteria: the amount of information is too large to allow simultaneous treatment... Due to personal experience, we estimate that four criteria and four alternatives is the maximum complexity treatable by the human being"*. In order to overcome this limitation, Saaty (1987) proposes to make the paired comparisons between the different elements, since the human brain is perfectly adapted to the comparison of two elements with each other and therefore it raises the fundamental scale previously seen.

4. Once the alternatives have been identified and the criteria have been defined, the researcher should order and weigh the different criteria to accurately select the best option. The procedure followed is the pairwise comparisons using a fundamental scale (Table 1) proposed by Saaty. From this information, the eigenvector is calculated to weight each variable.

Table 1. Pairwise comparisons by means of Saaty Scale

VALUE	DEFINITION	COMMENTS
1	Same importance	The criteria A is as important as the criteria B
3	Moderate importance	The experience and the opinion slightly favor A on B
5	Big importance	The experience and the opinion notably favor A on B
7	Huge importance	The criteria A is far more important than B
9	Extreme importance	There is no doubt that A is far more important than B
2,4,6,8	Intermediate values between the previous ones, when necessary to qualify	
Inverse	If the criteria A is "big importance" against the criteria B: Criteria A against Criteria B: 5/1 Criteria B against Criteria A: 1/5	

Source: Saaty (1987)

5. In the next step, the different alternatives are weighted using each criterion. To do this, we compare all the alternatives and we obtain *n* matrix, being *n* the number of criteria. From each matrix, the eigenvector is calculated and will indicate the weight of the different alternatives in function of each criterion.
6. From the previous processes, two matrices are obtained. One of them represents a matrix *nxl,* with the weights of criteria and another matrix *mxn,* with the weights of the alternatives for each criterion.
7. The product of the second matrix from the first one will generate a matrix *mxl* that indicates the weights of the alternatives in function of all the criteria. It therefore indicates the most interesting alternative.

A brief example applying AHP

Imagine we want to find out the Cristiano Ronaldo's market value. To do this, we applied an AHP:

- We are going to calculate the value comparing with Messi (alternative 1), Bale (alternative 2), Neymar (alternative 3), Suarez (alternative 4) and James (alternative 5) (Neymar could be considered as an outlier case). Messi has a market value of €183 million, Bale was signed by €90 million, Neymar €220 million, Suarez €81 million and James €80 million.
- We are going to select the variables (criteria) to value the footballer: goals per match (criteria 1), cards per match (criteria 2), assist per match (criteria 3), age (criteria 4), leadership (criteria 5) and merchandising (criteria 6).
- We calculate the variables' weight according to Saaty scale and expert opinions (see Table 2). And then, we obtain the eigenvectors that indicate the weight of the different alternatives in function of each criteria (see Table 2).

Table 2. Cristiano Ronaldo example: Pairwise comparisons by means of Saaty Scale

	Goals	Cards	Assists	Age	Leadership	Merchadising	EIGENVECTOR
Goals	1	6	2	2	2	5	0,3366
Cards	1/6	1	1/4	1/4	1/4	1/2	0,0449
Assists	1/2	4	1	1	1	4	0,1917
Age	1/2	4	1	1	1	3	0,1811
Leadership	1/2	4	1	1	1	3	0,1811
Merchadising	1/5	2	1/4	1/3	1/3	1	0,0645
Consistency ratio	0,80%	< 10%					1,0000

Source: prepared by the author.

- We extract all the quantitative variables from Opta (2019) and the qualitative ones according to pair comparisons from experts. Regarding the first ones, we obtain the data as well as normalize the variables (see Tables 3 and 4).

Table 3. Cristiano Ronaldo example: Quantitative variables (last three seasons)

	GOALS	MATCHES	CARDS	ASSISTS	AGE
Cristiano Ronaldo	114	100,625	11	36,125	33
Messi	105,5	110,375	16	45,125	29
Bale	32,25	70,5	3	23,375	26
Neymar	74	103,875	15	32	24
Suarez	86,625	102,375	12	44,375	29
James	22,75	72,75	9	31,75	24

Table 4. Cristiano Ronaldo example: Normalized quantitative variables

	GOALS PER MATCH	CARDS PER MATCH	ASSISTS PER MATCH	DIF. 33 - AGE
Cristiano	0,2565	0,1450	0,1576	0,0000
Messi	0,2164	0,1094	0,1795	0,0870
Bale	0,1036	0,3725	0,1456	0,2174
Neymar	0,1613	0,1098	0,1353	0,3043
Suarez	0,1915	0,1352	0,1903	0,0870
James	0,0708	0,1281	0,1916	0,3043
	1,0000	1,0000	1,0000	1,0000

-Concerning the second ones, we extract the data from pair comparisons according to experts' opinion (see Table 5).

Table 5. Cristiano Ronaldo example: Qualitative variables vs Pair Comparisons

LEADERSHIP	Cristiano	Messi	Bale	Neymar	Suarez	James	EIGENVECTOR
Cristiano	1	1/5	2	1/2	1/2	1/2	0,0814
Messi	5	1	6	4	4	4	0,4635
Bale	1/2	1/6	1	1/2	1/2	1/2	0,0620
Neymar	2	1/4	2	1	1	1	0,1310
Suarez	2	1/4	2	1	1	1	0,1310
James	2	1/4	2	1	1	1	0,1310
Consistency ratio	1,19%	< 10%					1,0000
MERCHANDISING	Cristiano	Messi	Bale	Neymar	Suarez	James	EIGENVECTOR
Cristiano	1	1	5	5	5	5	0,3516
Messi	1	1	5	5	5	5	0,3516
Bale	1/5	1/5	1	1/4	1/2	1/2	0,0455
Neymar	1/5	1/5	4	1	2	2	0,1143
Suarez	1/5	1/5	2	1/2	1	1	0,0685
James	1/5	1/5	2	1/2	1	1	0,0685
Consistency ratio	3,59%	< 10%					1,0000

-The final footballers weight is obtained as an average of each criteria/variable (see Table 6).

Table 6. Cristiano Ronaldo example: final weights

	GOALS PER MATCH	CARDS PER MATCH	ASISST PER MATCH	DIF. 33 - AGE	LIDERAZGO	MERCHADISING	FINAL WEIGHT
Cristiano	0,2565	0,1450	0,1576	0,0000	0,0814	0,3516	0,1605
Messi	0,2164	0,1094	0,1795	0,0870	0,4635	0,3516	0,2345
Bale	0,1036	0,3725	0,1456	0,2174	0,0620	0,0455	0,1330
Neymar	0,1613	0,1098	0,1353	0,3043	0,1310	0,1143	0,1714
Suarez	0,1915	0,1352	0,1903	0,0870	0,1310	0,0685	0,1509
James	0,0708	0,1281	0,1916	0,3043	0,1310	0,0685	0,1496
							1,0000

- Finally, we calculate the Cristiano Ronaldo's market value according to his performance and the rest of footballer's market value (see Table 7). The value is €125 million, perhaps a little overinflated because of Neymar's transfer fee and the current situation (behavior of PSG and Manchester City).

Table 7. Cristiano Ronaldo example: market value calculation

	FINAL WEIGHT (FW)	VALUE MARKET (VM)	RATIO FW/VM	VALUE "RONALDO"
Cristiano	0,1605	¿?	780,23	125
Messi	0,2345	183		
Bale	0,1330	91		
Neymar	0,1714	220		
Suarez	0,1509	81		
James	0,1496	80		
TOTAL	0,6049	472		

Variables

After knowing an example of AHP, reviewing the literature and the expert feedback, these are the variables used in this specific study (see Figure 3):

Dependent variable

Y≡ Football player's market value/transfer fee [VALUE]. It represents the price of a football player. We can extract this information from Transfermarket (2019). For example, Dani Ceballos has a market value of €30 million, although he has finally moved from Real Madrid to Arsenal on-loan.

Independent variables (criteria)

Latent variable 1 (primary attribute 1): Sport variables.

X1≡ Goals scored per match (number) [goals]. Cristiano Ronaldo and Messi hugely highlight in this case.

X2≡ Assists per match (number) [assists]. Messi and Riquelme are ones of the best assistants in history.

X3≡ Dribbles per match (number) [dribbles]. In this section, Messi, Hazard or Neymar top the list.

X4≡ Pass success (%) [pass_S]. In comparison with total passes and per match. Xavi Hernández is probably one of the most accurate passers in history.

X5≡ Speed (Km/h) [speed]. Maximun speed that a football player can reach. Roberto Carlos or Mbappé are two good examples of extreme velocity.

X6≡ Shots on target per match (number) [shots]. Cristiano Ronaldo usually leads this ranking.

X7≡ Fouls received per match (number) [fouls_R]. Neymar, as a dribbler, is by far one of the football players that more fouls receive per match.

X8≡ Interceptions per match (number) [interceptions]. This ability of defense is characteristic from Kanté or Makélélé.

X9≡ Field vision [vision]. It implies we need an expert opinion to assess this ability, therefore it may be considered as an intangible characteristic. Zidane or Laudrup highlighted in this section.

X10≡ Tactical discipline [tactic]. As in the variable before, we need to extract this information from an expert. Busquets is a perfect example of tactical intelligence.

All these variables, except X9 and X10, can be found in Opta, Football-Data or Stats, among others, and are metric ones. In addition, X9 and X10 variables must be measured comparatively between players by an expert, according to Saaty's scale (1987).

Latent variable 2 (primary attribute 2): Personal skills variables.

X11≡ Withstanding pressure [pressure]. Sergio Ramos and Cristiano Ronaldo are two representative examples to withstand pressure. They really have a strong personality.

X12≡ Leadership [leader]. Guardiola and Simeone, when they were football players, showed a special capacity to lead a team.

X13≡ Team integration [integration]. This variable reflects the ability to work in a team and create a good atmosphere within it. Marcelo or Roberto Carlos might represent this skill. However, the opposite example could be Anelka.

X14≡ Family/personal stability [stability]. Emotional stability is a key issue to improve performance, thus a good environment around a player will help to boost his results. Iker Casillas, Cesc Fábregas and Raúl Gonzalez Blanco could be some examples.

X15≡ Discipline and effort capacity [discipline]. Some players such as Puyol or Cristiano Ronaldo have a special capacity of personal growth.

X16≡ Competitiveness [competitive]. Cristiano Ronaldo, Mascherano, Raúl González, Sergio Ramos and Simeone are some good examples of competitive players.

X17≡ Age gap (33 years minus player's age) [age_G]. The threshold of 33 years old helps to calculate the gap of growth for a player. The younger the player is, the more days the player can help the team. Mbappé is 20 years old against Modric who is 34, thus the market value from this point of view is totally different.

From X11 to X16, an expert opinion should be used to extract this intangible information. Someone who can discriminate these attributes among professional football players. Again, these kinds of variables must be measured comparatively between players by an expert, following the Saaty's scale.

X17 variable may be extracted from Opta and other websites related to football data and statistics. It is a metric variable.

Latent variable 3 (primary attribute 3): Professional variables.

X18≡ Relevance / Popularity [popularity]. It is measured through the number of followers in social networks, such as Facebook, Instagram or Twitter. More supporters mean more market value, because of the advertising impact. Cristiano Ronaldo leads the ranking (320 millions of followers, adding these three social networks), Neymar is the second one (203 millions) and Messi the third one (187 millions).

X19≡ Merchandising [merchandising]. This variable is calculated considering sales and sponsors revenues. Forbes is the main source to extract this information. The last report shows that Messi, Cristiano Ronaldo and Neymar are on the top list.

X20≡ Seller Team [seller]. It reflects the team resistance to sale a football player. It is based on expert opinions (Saaty's scale). For example, we can highlight the Neymar failed transfer from PSG to Barcelona FC or the Pogba unsuccessful transfer from Manchester United to Real Madrid, because of the resistance seller team.

X21≡ Buyer Team [buyer]. It reflects the club capacity to sign a football player. More budget or market value of a club tends to explain more expenditure to sign new players. Following Forbes or Transfermarket, we can find this information. Manchester City (€1,27 billions), Real Madrid (€1,18 billions) and Barcelona (€1,16 billions) are the most valuable clubs in the world.

X22≡ Years to end the contract [contract]. The number of years to end a contract usually explain the football player's market value. The less years to expire a contract, the less market value will have the player. This strategy was used by Real Madrid to sign Hazard from Chelsea. All this information may be extracted from Transfermarket.

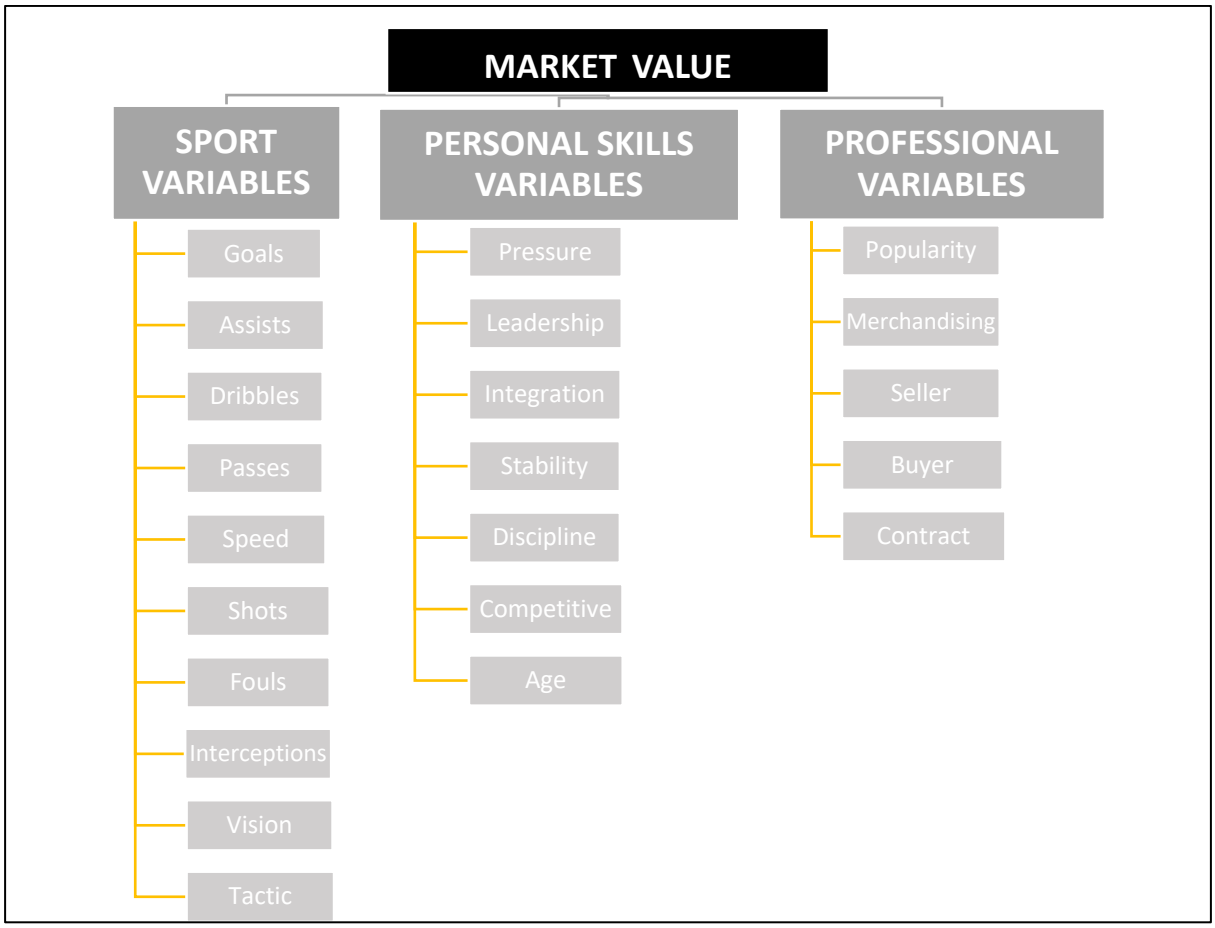

Figure 3. Structure of the theoretical model

Results

After applying the Analytic Hierarchy Process, the primary variables' weights were estimated by means of the eigenvectors that were calculated from the pairwise comparisons, carried out in the conducted survey. These comparisons were introduced into the AHP matrix to obtain the eigenvectors mentioned. The consistency ratios were under 5% for 3x3 and 5x5 matrices as well as under 10% for 7x7 and 10x10 matrices. In this regard, we can trust in the results described in this paper (Aznar and Guijarro, 2012).

However, Guyon (2018) states that *"the core of the discussion on formative measurement models has been the empirical meaning of such measures. With a few exceptions* (Bollen and Diamantopoulos, 2017) *most authors consider now that formative measurement is irrelevant because the empirical meaning is a fallacy"*. But according to Bollen (2007), this would be

unfortunate, not least because it could encourage researchers to use only latent variables that are measured with effect (reflective) indicators even though these might not be the latent variables best suited to a theory. Bollen and Diamantopoulos (2017) describe the understanding of models with causal/formative indicators as a viable measurement option and to reinforce their relevance in empirical research endeavors. Fried (2017) also explain the utility of formative models to the extent indicators determine the latent variable. That means in our study that an increase, for example, in goals per match will rise the sport latent variable as well as the football player's market value.

As expected, the sport variables were the most valued (0.420), followed by personal skills (0.339) and professional variables (0.241) (see Figure 4). However, it is worthy to highlight the importance of the personal attributes as they are close to the technical skills, and some experts identified them as the most relevant variables to estimate the football's market value. To some extent, these experts gave far more weight to intangible variables than tangible attributes such as goals, assists and others.

Harwood and Anderson (2015) state that one of the main aims of their book is to help coaches to identify some football players' behaviors and recognize their potential impact upon performance. They highlight five psychological skills to boost performance, called 5C: commitment, communication skills, concentration, control and confidence. In particular:

Commitment. This motivational quality drives the player within their training and matches. It is characterized by players who show consistent effort, high quality preparation and a desire for learning (improvements from their mistakes).

Communication. It represents a player's ability to relate to others through how they send and receive information to and from each other. It is an interpersonal quality that is characterized by players who share information, ask helpful questions, listen respectfully and accept feedback.

Concentration. This is essentially a player's ability to focus on the right thing, at the right time. It is characterized by players who focus on a task through to a conclusion and stay focused on key components of a task during many potential distractions that compete for the player's attention.

Control. It is characterized by a player's ability to regulate their thoughts, feelings and emotions in order to manage their behavior and performance. Players with expert control know how to apply and ration their energy in response to a specific situation on and off the pitch.

Confidence. It is the outcome of well-developed commitment, communication, concentration and control. It is characterized by players who try new skills, take calculated risks, show strong body language and stay involved in the game. Such players consistently "play brave" regardless of the time left in the match.

In FIFA (2019), it is stated that the trends in modern football have shown that mental strength is now a key capacity for players at the highest level and an essential part of their training. They point out that mental strength is composed of various factors such as: concentration, care, discipline, self-control, self-confidence, resistance to stress, aggressiveness, risk-taking, psychological stamina, competitiveness and playing for the team, motivation and drive for improvement. These factors are determinant to enhance performance, not only in-self, but also because there is a high correlation with the technical attributes. In this regard, it is not strange that personal skills variables present a high weight in the model, quite near sport variables. To some extent, it is a way to confirm the success of sport variables. A football player with high personal skills will facilitate the performance of his technical skills.

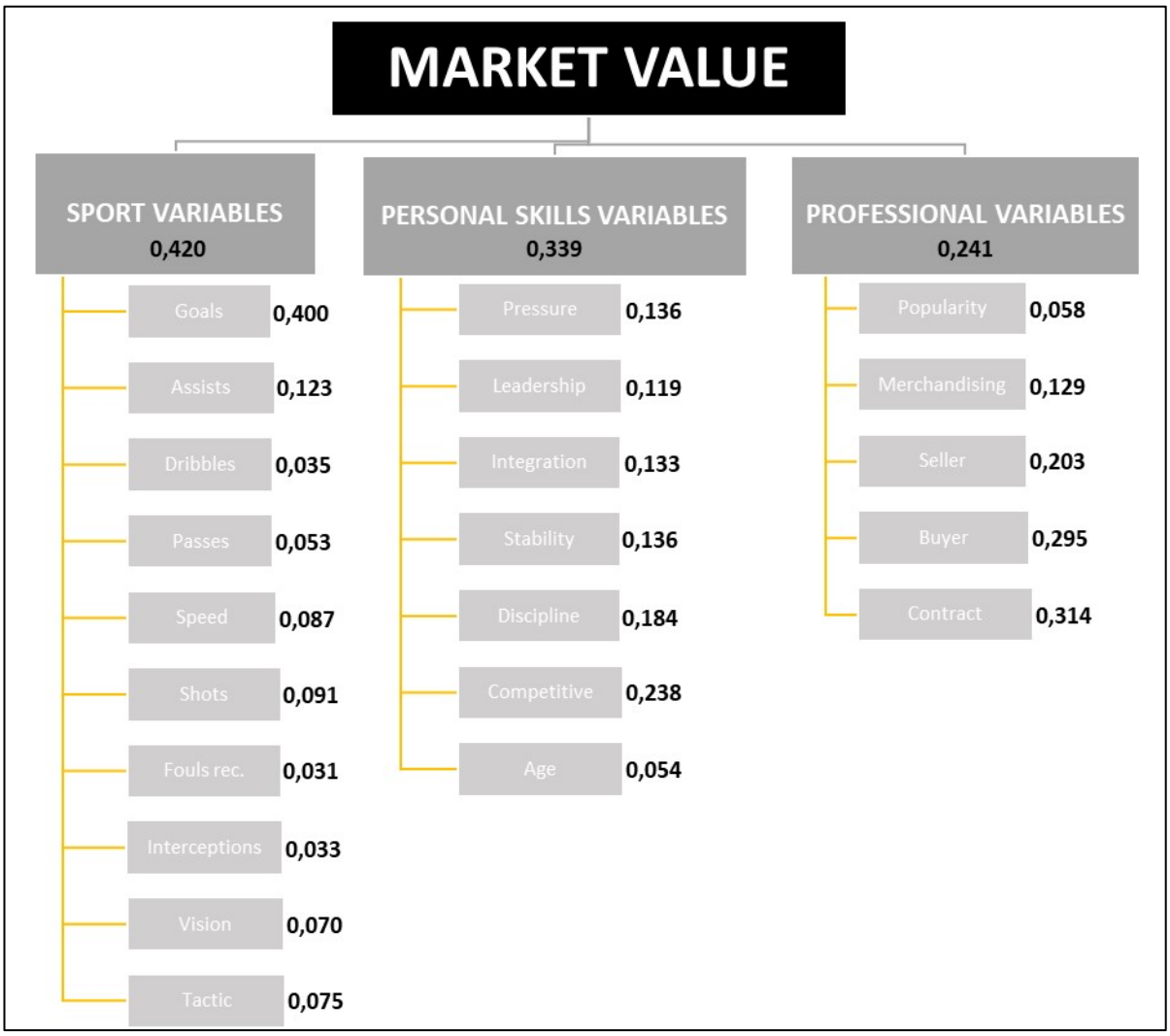

Figure 4. Conceptual model to value football players (forwards)

In the second level of variables (see Figure 4), we found that within the sport variables, goals per match (0.400) is by far the most important variable to measure the market value. This is a result that makes sense because teams win matches when they score goals. In fact, it is the core variable of the model. The same results were obtained by Majewski (2016), who identified the following as the most important variables: goals and assists, and by Yuang (2015), that showed how relevant goals are to value a football player. The rest of the ranking was: assists per match (0.123), shots per match (0.091), speed (0.087), tactic (0.075), vision (0.070), passes per match (0.053), dribbles per match (0.035), interceptions per match (0.033) and fouls received (0.031).

Concerning the personal skill variables, competitiveness (0.238) and discipline/effort capacity (0.184) were the two most relevant attributes, followed by withstanding pressure (0.136), family/personal stability (0.136), team integration (0.133), leadership (0.119) and age (0.054). Within this latent variable the gap between the most important attribute (competitiveness) and least important one (age) is narrower than in the first latent variable (sport factors), which scoring goals becomes irreplaceable. Lazear and Shaw (2007) report that higher effort leads to higher performance and subsequent higher payment, what may be related to higher market value. Our results show the same idea, however others authors such as Wicker et al. (2013) and Treble (2001) who found the opposite conclusion. The insignificant effects of effort on player values seem surprising but, according to these authors, effort is not an adequate compensation

for missing talent because some players may be able to read the game better, resulting in better positioning and hence less meters to run.

As far as the professional attributes are concerned, there are three main variables that have a special influence on the market value: number of years to end the contract (0.314), buyer team (related to budget to sign) (0.295) and seller team (resistance to sale) (0.203). In these cases, more years to end the contract, more budget to sign and more resistance to sale mean more football player's market value. These results coincide with Dobson and Gerrard (1999), who stated that selling-club characteristics and buying-club features are noteworthy to explain the football player's market value; as well as Munkhaugen Gulbrandsen (2011) who pointed out that the number of interested clubs to buy versus the number of sellers have a significant impact on transfer fees. Finally, merchandising (sales and sponsors measured in dollars) (0.129) and relevance/popularity (number of followers in social networks) (0.058) are the least important variables in the professional factor, but they can increase the accuracy of the forecasting (Esic, 2016). In fact, Frick (2006) suggests that all the players are paid (they are valued) according to their marginal product: players attracting spectators and inducing these additional spectators to buy merchandising products have a higher remuneration –even after their contribution to the performance on the pitch has been controlled for. In this case, again, there is a wide gap between the most important variable and the least important one, which means that experts clearly think that the date of expiration of contracts and the type of team are determinants to modify the transfer fees.

After generating the variables' weight (level 1: primary attributes and level 2: variables), the importance of each variable can be ranked in comparison with the others in the model (multiplying level 1 by level 2) (Figure 5). It may be observed that goals per match is the most powerful variable to explain the forwards' market value, by far. Moreover, there is a pool of variables in a second position such as competitiveness, contract duration and buyer team that play an important role to determine the market value. And finally, apart from a set of variables that improve the accuracy of the model, there are four variables whose importance is not very high: dribbles per match, popularity/relevance (number of followers in social networks), interceptions per match and fouls received.

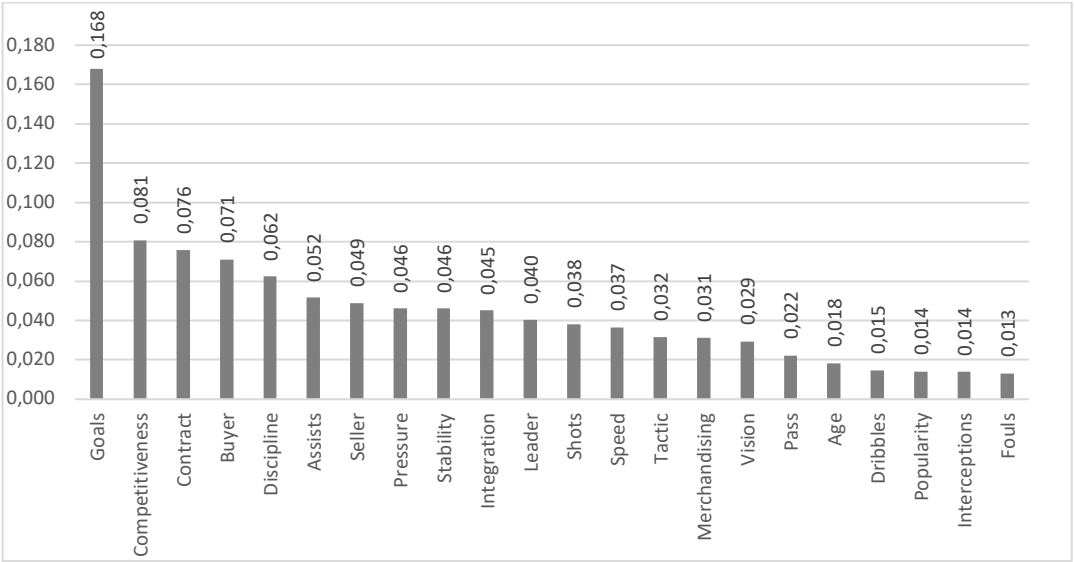

Figure 5. Ranking of the variables by importance

Conclusions

The aim of this study has been to build a conceptual model to estimate forwards' market value by means of an Analytic Hierarchy Process (AHP). This technique, along with the experts' participation, has allowed us to construct a holistic model which is composed of three primary attributes: 1) sports variables, 2) personal skills variables and 3) professional variables, together with 22 directly observed variables (tangible and non-tangible).

Sports variables are the most important attribute to estimate a forward's market value, but the weight of personal skills is close to the technical factors because of the importance of the non-tangible attributes in football (Lazear and Shaw, 2007). In the end, although professional attributes are not as important as the first two ones, it helps the model to improve the accuracy to value football players.

Within the directly observed variables, goals per match is clearly the most relevant variable to value forwards. However, competitiveness, contract duration and buyer team are also in the forefront to estimate the football players' market value.

This model could be one of the most comprehensive ones to value football players in Spain. However, it has some limitations that also represent chances for future research. First, it must be considered that this study is limited to a specific time period (2018-19). Thus, it would be interesting to replicate the study in a few years to compare the results and reinforce the weights of the variables. Second, within the position of forward, differentiation must be made between strikes/center-forwards, second strikers and wingers/outside-forwards. Therefore, it could be made more specific by selecting a certain forward to enhance the model's accuracy. And finally, this study is restricted to Spain. In this regard, future research should check the robustness of the present findings by using a foreign sample of experts.

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