A decision model to value football player investments under uncertainty

Florian Follert

*Faculty of Management, Seeburg Castle University,
Seekirchen am Wallersee, Austria, and*

Werner Gleißner

*Faculty of Business and Economics, TUD Dresden University of Technology,
Dresden, Germany*

Abstract

Purpose – From the buying club's perspective, the transfer of a player can be interpreted as an investment from which the club expects uncertain future benefits. This paper aims to develop a decision-oriented approach for the valuation of football players that could theoretically help clubs determine the subjective value of investing in a player to assess its potential economic advantage.

Design/methodology/approach – We build on a semi-investment-theoretical risk-value model and elaborate an approach that can be applied in imperfect markets under uncertainty. Furthermore, we illustrate the valuation process with a numerical example based on fictitious data. Due to this explicitly intended decision support, our approach differs fundamentally from a large part of the literature, which is empirically based and attempts to explain observable figures through various influencing factors.

Findings – We propose a semi-investment-theoretical valuation approach that is based on a two-step model, namely, a first valuation at the club level and a final calculation to determine the decision value for an individual player. In contrast to the previous literature, we do not rely on an econometric framework that attempts to explain observable past variables but rather present a general, forward-looking decision model that can support managers in their investment decisions.

Originality/value – This approach is the first to show managers how to make an economically rational investment decision by determining the maximum payable price. Nevertheless, there is no normative requirement for the decision-maker. The club will obviously have to supplement the calculus with nonfinancial objectives. Overall, our paper can constitute a first step toward decision-oriented player valuation and for theoretical comparison with practical investment decisions in football clubs, which obviously take into account other specific sports team decisions.

Keywords Football, Valuation, Investment, Decisions, Uncertainty, Decision model, Risk, Simulation

Paper type Research paper

1. Introduction

A football [1] company, such as Juventus FC, FC Bayern Munich, or Real Madrid CF, produces a peculiar type of entertainment service that is sold on the relevant market. If we assume that

a league structure already exists, the service production of the individual club consists of assembling a team (e.g. Neale, 1964; Franck, 1995). Individual players represent the main assets from an economic point of view (e.g. Yang and Sonmez, 2005; Martín Lozano and Carrasco Gallego, 2011; Campa, 2021) [2]. We speak here simplistically of "players as assets". However, the human capital that serves the club in achieving its production goal is reflected in the balance sheet as the player's registration (e.g. Sloane, 1969; Speight and Thomas, 1997; Martín Lozano and Carrasco Gallego, 2011), which represents intangible assets that are recognized in accounting standards (e.g. Martín Lozano and Carrasco Gallego, 2011; Campa, 2021). One example of the significance of this item is Juventus (2023, p. 54), where a player's registration rights account for almost 40% of total assets. From an economic perspective, it does not play a significant role that *players* are not bought and sold literally, as Weintraub (1958, pp. 183–184) points out that even if they are not traded in the literal sense, the value of their services or the tradable contractual right results from the expected future revenue streams.

For a football club, the financial perspective is more important than often assumed, as numerous studies have discussed the relationship between financial resources and sporting success (Szymanski and Kuypers, 1999; Hall *et al.*, 2002; Frick, 2005; Di Simone and Zanardi, 2020). The importance of financial management for professional sports clubs is emphasized by Di Simone and Zanardi (2020, p. 823): "at the microeconomic level, companies are encouraged to follow the profit maximization to improve the sport performance."

It is undeniable that the purchase of a player represents an investment from the club's point of view, from which the club expects benefits in the following periods (e.g. Carmichael and Thomas, 1993; Dobson and Gerrard, 1999; Dobson *et al.*, 2000; Leaflet and Follert, 2023). Bayern Munich, for example, would certainly not have paid the highest transfer fee ever paid by a German club for Harry Kane if they did not expect to reap the benefits over the duration of the contract. Investing in assets can be seen as the core of entrepreneurial activity (e.g. Klein, 2008). This applies regardless of whether the assets are in physical or intangible form. From an economic perspective, the valuation of an investment is the economic appraisal of future uncertain benefits (e.g. Matschke and Brösel, 2021).

The literature on sports economics has dealt with labor markets and thus also with the transfer of players at an early stage (Rottenberg, 1956). Early works on the transfer market in European football in the 1990s also dealt with the field partly on a theoretical level (e.g. Carmichael and Thomas, 1993; Dobson and Gerrard, 1999). Due to good data availability and emerging metrics such as the "market values" of the "transfermarkt" platform, a large number of studies can now be found that attempt to estimate "objective" player values from past data (for an overview, see Rodríguez *et al.*, 2022; Franceschi *et al.*, 2023). However, there is a gap in the current literature concerning the question of how a player's investment should be appraised from a business economics perspective for the purpose of decision-making. In this respect, our approach differs fundamentally from a large part of the literature (e.g. McHale and Holmes, 2023; Thrane, 2024). It is not the aim of this study to explain observable variables but to support managers in their decision-making process with a valuation model. From a methodological point of view, we are dealing here with a practical-normative approach that provides managers with an economically adequate means for a given objective. In this paper, we argue that analyzing past transfer price data is interesting from an econometric perspective but has almost little relevance for managerial decision-making, which is future-oriented and has to address imperfections. Thus, in contrast to early sports economic models, we do not assume neoclassical equilibria but rather integrate market realities.

The crucial question of this paper is how know-how from the corporate world could be used for investments in football clubs. Therefore, we present an ex ante valuation model that, on the one hand, has the necessary valuation theoretical rigor and, on the other hand, can be seen as the starting point for practical application to investment decisions in football clubs

and other related areas. In this respect, we would like to provide managers with a calculus on the basis of which they can prepare a more rational (e.g. Simon, 1997) investment decision. However, this is not understood as a normative requirement. Rather, the model shows how a club should proceed when pursuing the goal of profit maximization and determining its maximum willingness to pay for an investment in a player. Of course, the club is, for example, completely free to pursue other objectives – e.g. win-maximization – and to supplement the determined value with nonfinancial components ("psychic income", Sloane, 1969, p. 195). Our approach is based on the semi-investment-theoretical valuation increasingly proposed in the literature on business valuation in recent years (e.g. Dorfleitner and Gleißner, 2018; Gleißner and Follert, 2022), which on the one hand accepts the imperfections of real conditions under which managers have to decide and on the other hand is mathematically practicable. To this end, we use a simple present value model and derive the risk-adequate discount rates from a stochastic planning model.

We thus contribute to a closer relation between valuation theory and sports management's decision making (see also Franceschi *et al.*, 2024). On the one hand, this approach is important for scientific discussion, as once again, despite the enormous availability of data, it is not sufficient to conduct research based only on past data; further research is needed that considers the real-world determinants of decision-making, especially the uncertainty associated with future relatedness (see Ackermann and Follert, 2018; Leifheit and Follert, 2023). On the other hand, we try to provide sports business practice with a simple model that can be used to establish a theoretical reference point that might represent a benchmark for a player investment, which serves to reference the rationality of decisions in clubs and can contribute to further professionalization.

Our contribution is innovative because it uses methods developed in recent years for the valuation of companies in imperfect markets to be able to weigh risk and return in decisions with uncertain effects. We show for the first time how such methods could be applied to a sports economics question to better prepare for a management decision – knowing well that practical application is not yet readily possible – namely, the assessment of the maximum acceptable transfer price of a soccer player. Based on financial planning, quantitative risk analysis and risk aggregation, we calculate a decision value that can form the basis of the management decision.

The remainder of the paper is structured as follows. In section 2, we review and critically review the literature on player transfers, especially the widespread econometric analyses published in the last decade. In section 3, we present our decision model for player valuation and illustrate the valuation process with a fictitious numerical example. In section 4, we discuss the approach and point out the limitations, particularly concerning sport specificity. Finally, section 5 draws conclusions.

2. Literature review and research gap
2.1 Previous literature
The economics of sports player transfers have a long tradition within the sports economics literature (see Dobson and Gerrard, 1999). The seminal paper by Rottenberg (1956) addresses the baseball player labor market and develops seminal insights. For a long time, the discussion focused on salaries, the distribution of talent, or market control rather than the macro level of labor respective transfer markets (e.g. El Hodiri and Quirk, 1971; Kahn, 1993; Fort and Quirk, 1995). Since the 1990s, football-specific research has focused more on the individual level of the transfer market. Here, we also see the connecting point for our model, as it is a business economic decision model designed to be as concrete as a possible reference point for practical decision-making purposes. The economic problem of player valuation in professional football has now been addressed in the literature for approximately 30 years

(see, e.g. the seminal paper by Carmichael and Thomas, 1993). Reilly and Witt (1995) also consider the influence of race on the transfer fee. Other studies examine different independent variables to explain the transfer price, usually analyzing the characteristics of the player, the selling club, or the buying club (e.g. Carmichael *et al.*, 1999; Speight and Thomas, 1997). Dobson and Gerrard (1999) and Gerrard and Dobson (2000) note the lack of a theoretical basis for these methods, and they present a formal model that can be subject to empirical testing. In the following years, further refined empirical analyses on the estimation of transfer fees are presented (e.g. Dobson *et al.*, 2000).

The sports economics literature, which has focused on football transfers, is largely empirically driven by this phenomenon. Specifically, it aims to explain a dependent variable, e.g. the transfer fee or "market value", on the basis of certain independent variables as influencing variables. A gap exists, however, for approaches that support the decision-making of sports managers. Interestingly, Sloane (1969) already presents a very simple valuation approach in which he discounted future revenues from the player. However, he assumes the relevant discount rate is given and is not derived conclusively, nor is uncertainty taken into account.

Another exception is the paper by Tunaru *et al.* (2005), who propose an option pricing framework. The authors highlight the importance of uncertainty regarding player performance, income and injuries, making a valuable contribution to managerial decision-making in football clubs. However, in addition to the well-known general critique of real option models (see, e.g. Brösel *et al.*, 2012), it should be emphasized that Tunaru *et al.* (2005) specify stochastic processes and do not build on a planning model or a risk analysis – e.g. the analysis of uncertain planning assumptions [3]. The model approach of Tunaru *et al.* (2005) is built on the traditional framework of the valuation of perfect markets, which is not an adequate setting for real decision-making (e.g. Brösel *et al.*, 2012). In contrast, the model presented in this study does not assume the perfection of the capital market and uses a simulation-based valuation to address uncertainty.

With the increasing development of the transfer market and, in particular, the "Bosman ruling", a certain dynamic was set in motion that is accompanied by an increasing number of transfers and ever higher transfer fees (e.g. Brocard and Lepetit, 2019). This is also reflected in the literature. Notably, the number of studies dealing with the valuation of players has increased significantly in the last ten years (see the review by Franceschi *et al.*, 2023), which is probably due to the good availability of data, especially concerning individual player performance.

According to a comprehensive analysis of the literature, Franceschi *et al.* (2023) find 29 empirical studies that deal with the value determinants at the individual player level and can be separated into 111 model specifications. These studies try to explain or estimate the main value drivers by analyzing the influence of different independent variables on the player's value. As a proxy for this dependent variable, several studies use the figure "market value" [4] provided by the platform [5] "transfermarkt.de" (e.g. Rubio Martín *et al.*, 2022; Thrane, 2024). Some studies analyze these crowd-based valuation figures as proxies for transfer fees (e.g. Herm *et al.*, 2014; Müller *et al.*, 2017; McHale and Holmes, 2023) or salaries (e.g. Prockl and Frick, 2018; Thrane, 2019).

As potential value drivers, several independent variables are tested in the econometric literature. Following Franceschi *et al.* (2023), we note player age [6] (e.g. Coates and Parshakov, 2022), minutes played (e.g. Majewski, 2016; Müller *et al.*, 2017), assists (e.g. Franck and Nüesch, 2012; Rubio Martín *et al.*, 2022), goals (e.g. Müller *et al.*, 2017; Rodríguez *et al.*, 2019), yellow and red cards (e.g. Franck and Nüesch, 2012; Müller *et al.*, 2017), overall appearance (e.g. Franck and Nüesch, 2012; Majewski, 2016), senior national team status (e.g. Wicker *et al.*, 2013; Coates and Parshakov, 2022), and the ability to use both feet (e.g. Müller *et al.*, 2017; Prockl and Frick, 2018) as the most tested explanatory variables. Obviously, there

are different categories of independent variables that are interpreted as value drivers. Müller *et al.* (2017) interpret the value of a player as a function of various variables that can be assigned to the categories "characteristics", "performance" and "popularity".

2.2 Critical reflection from an economic and legal perspective
From a valuation theoretical point of view, there are numerous issues with the current state of the art in the (sports) economics literature. These studies try to explain which variables influence the value of a player based on past data. They implicitly assume that there is an (objective) value for each player, which is determined by the player's characteristics. However, such an objective "market value" can exist only in a perfect market (e.g. Matschke and Brösel, 2021). Obviously, however, the market for football players in particular is highly imperfect. On the one hand, the preferences of the clubs differ, which are manifested in the respective entrepreneurial ends. On the other hand, the clubs have different restrictions, e.g. on financing or in the sporting area. For that purpose, we can imagine two clubs, let it be Chelsea FC and FC Bayern Munich. Chelsea already has three strikers who harmonize very well with each other. Bayern Munich currently has an injured striker and is looking for a new striker. It is easy to see that the willingness to pay, i.e. their value, for one and the same striker will be different for both clubs. The fact that neither tangible nor intangible assets have an objective value that is attached to them like a property has actually been known in the economic literature since Austrian economist Menger (2007 [1871]) was the most recent. Value is subjective and results from the respective marginal utility (Gossen, 1854; Jevons, 1871; Menger, 1871; Walras, 1874) that a subject expects from a good. Incidentally, this insight has also been adopted in business valuation (e.g. Olbrich *et al.*, 2015) and player's valuation (see Franceschi *et al.*, 2024). If sports economics and management studies now assume that players have objective values that are determined by external observers – who have no "skin in the game" – based on players' characteristics (see the review by Franceschi *et al.*, 2023), then these fundamental principles are obviously not considered. The lack of differentiation between values and prices is also problematic (Franceschi *et al.*, 2024). In imperfect markets such as the market for football players, they regularly fall apart. Insofar, our thesis is that the current state of the art is neither in line with valuation theory nor does it help decision-makers in reality who are faced with future-oriented decisions and therefore decide under uncertainty.

A football manager has an inherent interest in knowing their subjective decision value (Matschke, 1972, 1975), which shows their maximum willingness to pay for an investment in a player from an economic point of view. On the one hand, this approach is important from a business economic perspective because it is the only way to ensure that the club does not make an economic loss on a deal. In this respect, the determination of a decision value, i.e. a concession limit, serves to ensure a certain rationality (e.g. Simon, 1997). This is particularly important because human decisions are often subject to certain biases (Tversky and Kahneman, 1974; Kahneman and Tversky, 1979). On the other hand, knowing the concession limit is crucial for sports managers from a legal perspective as well (e.g. Rapp, 2014). Many jurisdictions, such as the German stock corporation act (sec. 93 I), provide for board liability if the member of the board cannot prove that he or she acted on the basis of adequate information for the benefit of the company (e.g. Gurrea-Martínez, 2019) – here, the football company. The benefit of the company is impaired precisely where an economic disadvantage arises. In business economics terms, this would be a negative net present value (Olbrich and Rapp, 2013). This occurs when the decision maker pays a transfer for a player that is above the decision value (e.g. Follert, 2017). In this respect, however, the decision value must of course be calculated before the transaction.

To summarize our critique of the current state of the art in the sports economics literature, we would like to emphasize that empirical studies provide interesting results from a scientific

point of view. However, these methods do not address the parameters of real decision makers. This is particularly evident in two points.

(1) They do not consider the valuation-theoretical principle of subjectivity (e.g. Menger, 2007 [1871]; Schmalenbach, 1917/1918; Matschke *et al.*, 2024) concerning the target function and the decision field of the club. In particular, the dependent variable "market value" provided by users of an Internet platform does not include any club-specific determinants, decision fields or specific targets.

(2) Using past data negates uncertainty about the future, which is crucial for any investment decision (e.g. Hering, 2022).

In light of this research gap in the current literature, we introduce a new approach in the next section. First, we outline the theoretical framework for valuation in imperfect markets under uncertainty. Then, we present a general approach before applying it to the valuation of player investments.

3. A new approach to player valuation
3.1 Theoretical background: value, price, and uncertainty
At its core, investment theory aims to support decision makers in assessing the benefits of a future, uncertain stream of benefits; in this respect, scientific theory focuses on the formation of ex ante decision models (Matschke and Brösel, 2021; Hering, 2022). An investment is always based on a comparison between payouts and benefits. An individual will invest when the present value of future benefits exceeds the payouts, i.e. when the net present value is > 0, which means that the transaction is economically advantageous. Payouts directly associated with a player investment are primarily the potential transfer fee, fixed salary payments and variable payments (e.g. Martín Lozano and Carrasco Gallego, 2011; Leifheit and Follert, 2023). The benefit that a club expects from a player investment can be of a sporting nature or result from the marketability of the player. From a corporate perspective, each benefit component will appear in financial figures at the end of the day. We can basically distinguish between revenues from sports, from TV broadcasting, from ticketing, and from merchandising (e.g. Martín Lozano and Carrasco Gallego, 2011; Deloitte, 2023). The present value of these payments is the subjective value that the player has for the valuation subject (the club). This critical price (Matschke, 1972) represents the maximum willingness of the club to pay for the investment. If the club acts rationally, it should not exceed this decision value; otherwise, it will have an economic disadvantage from the transaction. The price is what the club actually pays after negotiating with the potential seller club. A negotiation only takes place if the decision value of the potential buyer is higher than the decision value of the presumptive seller (e.g. Follert *et al.*, 2018; Matschke and Brösel, 2021). The interval between the concession boundaries is the total economic advantage of the transaction. The final price of the transaction will be somewhere between the values of the parties (Speight and Thomas, 1997; Dobson *et al.*, 2000). Each party will use negotiation skills and argumentation values to try to push the transfer price as far away as possible from its own decision value since the economic advantage will then increase (Follert *et al.*, 2018).

We would like to point out the importance of differentiating between value and price for managerial decision-making following Matschke and Brösel (2021; see also Leifheit and Follert, 2023). In this case, V_B is the decision value of the potential buying club, and V_S is the value calculated by the selling club. To construct the model, both clubs are assumed to be profit maximizers, even if it is well known that a team is a sports results maximizer rather than a profit maximizer (Rottenberg, 1956; Sloane, 1969). If $V_B > V_S$, there is an *area of agreement* that symbolizes the total economic advantage $A = V_B - V_S$ of the transfer.

Through negotiation, the clubs ultimately determine a (market) price M. Obviously, there will be a transfer if $V_B \geq M \geq V_S$ (e.g. Speight and Thomas, 1997). The economic advantage (A_B) of the buying club is $A_B = V_B - M$, and the corresponding advantage of the selling club (A_S) is $M - V_S$. This is important for two reasons. First, it is easy to see that there cannot be a universally valid "market value". If $V_S = V_B = M$, then neither party would have an economic incentive to trade (e.g. Hering, 2021) or might have a sporting incentive. Such a situation would only exist in a perfect market that is in equilibrium. Obviously, however, real markets are imperfect, especially the market we are dealing with here. On the other hand, it becomes clear that for practical decision makers, however, the question arises of how to calculate V_B respective V_S. If the positive and negative components of success are known and certain, determining the value is a purely mathematical problem (Gleißner, 2019). In managerial reality, however, there are imperfections that relate in particular to the uncertainty of future states. For example, we do not know whether the player will perform as hoped, whether he will be injured, or the like. This leads to the fact that the input parameters cannot be given as point values but only as ranges. Business economics in general and risk management in particular provide tools and methods that enable adequate handling of uncertainty (e.g. Hering, 2022). We build our model on the so-called semi-investment-theoretical valuation approach used to derive decision values based on ideas from investment theory (e.g. Hirshleifer, 1958; Weingartner, 1963; Hax, 1964; Matschke, 1972, 1975; Hering, 2000; Klingelhöfer, 2009). Compared to neoclassical finance theory, such as the CAPM in particular, our approach does not assume a perfect capital market and derives decision values, i.e. maximum acceptable prices. The semi-investment-theoretical valuation methodology (see Dorfleitner and Gleißner, 2018) accepts certain simplifications compared to classical investment theoretical models – e.g. only two investment alternatives are used for the valuation, quasi risk-free government bonds with the best credit rating and a broad stock market index—and thus allows the common use of a present value calculus (see Gleißner and Follert, 2022). However, earning risks and insolvency risks are considered in the valuation. To this end, the risk factors are analyzed on a quantitative basis using Monte Carlo simulation (for see Dorfleitner and Gleißner, 2018; Dorfleitner, 2022). To date, the main field of application has been company valuation (e.g. Ernst, 2022).

3.2 General model

For our proposed model, we define some requirements. The model must be able to integrate the subjective circumstances of the football club, the future athletic and sales potential of the player, and the uncertainty of future revenues.

Real markets, including the player transfer market, are imperfect markets. The following approach does not make such restrictive assumptions as, for example, the capital asset pricing model (CAPM, Sharpe, 1964; Lintner, 1965; Mossin, 1966), which presupposes a perfect capital market and assumes homogeneous expectations of risk-averse market participants. Furthermore, decision makers must address uncertainty. For reasons of complexity reduction, it is adequate for practical valuation to assume uncertainty only with respect to future cash flows but not with respect to the other environmental parameters (Fama, 1977), thus reducing our model to financial valuation without considering sports issues. To calculate a risk-adequate value, we use the semi-investment-theoretical valuation concept based on imperfect replication (e.g. Gleißner, 2022; Dorfleitner and Gleißner, 2018; Dorfleitner, 2022). This method specifically allows the derivation of risk-adequate discount rates from a stochastic planning model and is thus based on a risk analysis, which describes uncertain planning premises through probability distributions ("simulation-based valuation", see Ernst, 2022). Based on Dorfleitner and Gleißner (2018), we assume that two cash flows $(\widetilde{CF}^1, \widetilde{CF}^2)$ to the valuation object (investment O) (at the same point in time t) have

the same value (V) if they match the expected value $E(\widetilde{CF_t})$ and in the chosen risk measure $R(\widetilde{CF_t})$, e.g. standard deviation σ (see Dorfleitner and Gleißner, 2018; Gleißner, 2019; Gleißner and Follert, 2022). The risk measure used for the purpose of determining the discount rate (the cost of capital) and thus for calculating the decision value can be selected by the valuation subject and should express their subjective risk preference (Dorfleitner and Gleißner, 2018). For example, the choice of value-at-risk is conceivable. In this case, risk is understood as the extent of possible losses that will not be exceeded by a given probability. The risk measure commonly used in finance and valuation theory is the standard deviation (e.g. Markowitz, 1952; Sharpe, 1964; Modigliani and Modigliani, 1997), which expresses the amount of risk via the extent of possible fluctuations around the expected value. The standard deviation is a coherent risk measure according to Artzner *et al.* (1999; see also Rockafellar *et al.*, 2002), and it meets the characteristics of homogeneity and position invariance, which makes it a suitable basis for a risk-adequate assessment using the method of imperfect replication (see Dorfleitner and Gleißner, 2018; Dorfleitner, 2022). Furthermore, we use this risk measure in the case study because it corresponds to the usual understanding of risk in a company and to investment valuation due to the μ,σ-principle on which the CAPM is based. The results of an application are therefore easier to compare with those of the CAPM. However, it should be emphasized that the choice of a different risk measure would be just as possible (for a comparison, see Gleißner, 2023).

$$E\left(\widetilde{CF}_t^1\right) = E\left(\widetilde{CF}_t^2\right) \text{ and } R\left(\widetilde{CF}_t^1\right) = R\left(\widetilde{CF}_t^2\right) \Rightarrow V\left(\widetilde{CF}_t^1\right) = V\left(\widetilde{CF}_t^2\right) \tag{1}$$

We limit the decision field and assume that the investor can make two alternative investments – the sum of the share x of a risk-free investment (r_f), e.g. an AAA bond, and the proportion y of a risky investment (r_m), e.g. an investment in the MSCI-World.

We choose x and y such that the expected value and the risk measure of this replication portfolio are equivalent to those of the cash flow from investment O; e.g. the value of the uncertain cash flow $\widetilde{CF}$ is equal to the sum of x and y.

$$V\left(\widetilde{CF}\right) = x + y. \tag{2}$$

with equations (1) and (2) for the value of the investment object (Dorfleitner and Gleißner, 2018), we can derive the risk-adequate cost of capital (c) as the discount rate for use in simple present value calculus (e.g. discounted cash flow, $t = 1$) [7].

$$V\left(\widetilde{CF}\right) = \frac{E\left(\widetilde{CF}\right) - \lambda \cdot R\left(\widetilde{CF}\right) \cdot d}{1 + r_f} = \frac{E\left(\widetilde{CF}\right)}{1 + c} \tag{3}$$

if we use the standard deviation as a risk measure, $R(\widetilde{CF}) = \sigma\left(\widetilde{CF}\right)$, and solve for c, we obtain

$$c = \frac{1 + r_f}{1 - \lambda^\sigma \cdot \frac{\sigma\left(\widetilde{CF}\right)}{E\left(\widetilde{CF}\right)} \cdot d} - 1 = \frac{1 + r_f}{1 - \lambda^\sigma \cdot Q\left(\widetilde{CF}\right) \cdot d} - 1 \tag{4}$$

The risk diversification factor d shows which share of the risk is relevant for the valuation subject when considering its diversification options (Gleißner, 2022). The parameter λ^σ is the ratio of the risk-return profile of the alternative investments, i.e. the market price of the risk.

We define the risk ratio of cash flow $R(\widetilde{CF})$ to the expected value of cash flow $E(\widetilde{CF})$ as the coefficient of variation $Q(\widetilde{CF})$. The approach is compatible with established valuation techniques and could be used accordingly. If $\widetilde{CF}$ is the free cash flow, we are able to calculate the weighted average cost of capital (WACC); if $\widetilde{CF}$ is the flow to equity (FTE), we can derive the cost of equity (Gleißner and Ernst, 2019) [8].

This valuation approach can be applied to any period t. Then, instead of (3), the following applies:

$$V\left(\widetilde{CF_t}\right) = \frac{E\left(\widetilde{CF_t}\right)}{(1+\text{c})^t} = \frac{E\left(\widetilde{CF_t}\right) - \lambda_t^\sigma \cdot \sigma\left(\widetilde{CF_t}\right) \cdot \text{d}}{(1+r_f)^t},$$ (5)

from which, we can again derive c.

$$c = \frac{1+r_f}{\sqrt[t]{1 - \lambda_t^\sigma \cdot \dfrac{\sigma\left(\widetilde{CF_t}\right)}{E\left(\widetilde{CF_t}\right)} \cdot d}} - 1 = \frac{1+r_f}{\sqrt[t]{1 - \lambda_t^\sigma \cdot Q\left(\widetilde{CF_t}\right) \cdot d}} - 1$$ (6)

For the valuation, we need to quantify the market return λ_t^σ. We assume that the return of the market index follows a log-normal distribution, which can be modeled via Brownian motion (Dorfleitner and Gleißner, 2018; Dorfleitner, 2022) [9]. We can describe λ_t^σ as

$$\lambda_t^\sigma = \frac{e^{t \cdot \mu'_m + t \cdot \sigma'^2_m} - e^{t \cdot r'}}{e^{t \cdot \mu'_m + t \cdot \sigma'^2_m} \cdot \sqrt{e^{t \cdot \sigma'^2_m} - 1}}$$ (7)

λ_t^σ expresses the additional return of an investment in the risky alternative investment (market index) compared to a risk-free investment (with interest r_f) per unit of risk. It indicates how much additional return per unit of risk would an investment in a stock market portfolio yield compared to a risk-free investment opportunity.

3.3 Model specifications and numerical example

3.3.1 General considerations. The valuation subject is the club, or more specifically spoken, the owners. A fundamental difference between U.S. professional sports and, for example, European football is pointed out by Sloane (1969, 1971). While Rottenberg's (1956) findings [10] concerning the transfer price refer to profit-maximizing clubs, Sloane (1969) argues that European football clubs act as utility maximizers, which can lead to different results. It is in fact true that there are owners acting as "sportsmen" (Vrooman, 1997). However, this distinction plays a rather minor role in our case. The aim of our approach is not to explain a transfer price from an ex-post perspective. If this were the goal, it would of course make a decisive difference whether the club pursues profit or utility maximization. However, the purpose of our approach is decision preparation. In fact, we determine the decision value for a profit-maximizing club. However, it is equally possible that a win-maximizing club uses the determined value as a starting point and adjusts it, e.g. if nonfinancial goals are also pursued.

Without going further into its asset structure, which can obviously vary from one club to another, and to reduce complexity, we assume a risk diversification factor $d = 1$ [11].

Let the valuation subject have two alternative investment options, a risk-free investment with interest rate r_f and a risky investment in a broad stock market index with uncertain

return $\widetilde{r}_m$ (with expected value $E(\widetilde{r}_m) = 8\%$ and standard deviation $\sigma(\widetilde{r}_m) = 20\%$). This results in a market price of risk λ_t^σ dependent on period (=year) t; see (7) and Table 1:

The proposed approach to value an investment in a player is based on a present value model comparable to a discounted cash flow model. Our numerical example is based on fictitious planning of revenues. A three-period planning model is used, and accordingly, uncertain planned figures for the years $t = (1, 2, 3)$ are specified in the initial period. Our planning model for the valuation of a football player consists of two elements:

(1) The planning of revenues and costs of the club and

(2) The planning of the contribution of a player (as the valuation object) to the success of the team (and thus to the profit).

We assume that the two elements of planning are linked, as the performance of a player on the one hand affects the success of the club as a whole and the conditions in the club, specifically the playing strength of the team as a whole, as team performance influences on the other hand the player (and the value).

To reduce the complexity of our model concerning terminology, we do not differentiate here between figures from financial accounting, cost accounting, and investment valuation. We refer to revenues (T) as positive figures and costs (C) as negative figures. We further define payment (P) as the relevant valuation parameter: $P = T - C$. In our basic model, we assume P is equivalent to what we know as cash flow in corporate valuation practice [12].

In addition, we set the same symbol for the success factor at the club and the player level and distinguished the level with a "*". For example, S_t^* is the success indicator of the club, and S_t^i is the success indicator of player i in period t. Since we consider only one player in the example, we further simplify the notation and set $S_t = S_t^i$.

3.3.2 Club level. The starting points for the club's planning are two nonfinancial parameters, namely, the number of available players (n) and the success indicator S_t^* of the team as a whole, which captures the playing strength. When $S^* = 100\%$, the playing strength corresponds to the average playing strength of the teams in the league, which means that a "medium" ranking in the table can be expected. Due to the focus of this paper, the details of the measurement of the success indicator are not discussed in detail here. To be in line with sports economics and sports management practice (e.g. Drewes *et al.*, 2021; Deloitte, 2023), we assume that a club generates monetary revenues T_t^* from ticketing $T_{1,t}^*$, merchandising and TV rights $T_{2,t}^*$, and other sources (e.g. from sponsoring) $T_{3,t}^*$.

The sum of the revenues (T^*) is reduced by the costs (C^*). In our planning model, a simplified distinction is made between the costs directly associated with the players [13] $C_{1,t}^*$ and other costs $C_{2,t}^*$, e.g. the costs for the club's other employees or the operation of the stadium. With regard to the costs of the players, a distinction is made between the ongoing annual personnel costs and the amortization of the investment I_o in the player. For simplification, we further assume that the variable salary components of the players are proportional to their performance indicator.

The first two revenue components, $T_{1,t}^*$ and $T_{2,t}^*$, depend on the team success factor. The models are identical. The following applies:

t	1	2	3
λ_t^σ	25%	37.3%	48.2%

Source(s): Created by authors

Table 1.
Price for risk λ_t^σ for period $t = (1, 2, 3)$ with standard deviation (σ) as the risk measure

$$T_{1,t}^* = \overline{T}_1^* \cdot \left(1 + \alpha_1 \cdot \left(S_t^* - \overline{S}^*\right)\right) \tag{8}$$

$$T_{2,t}^* = \overline{T}_2^* \cdot \left(1 + \alpha_2 \cdot \left(S_t^* - \overline{S}^*\right)\right) \tag{9}$$

$\overline{S}^*$ is the average success of a team in the league (here: $\overline{S}^* = 100\%$). $\overline{T}_1^*$ are those revenues expected at the beginning of period $t = 1$ at expected success [14], i.e. $S_t^* = \overline{S}^*$. α_i is the elasticity of the revenues to the deviation of the success in a period to the expected success. The contract with a player begins with an initial investment, i.e. the transfer fee (I_0), at the beginning of period $t = 1$. Here, we assume that a club wants to sell the player before the end of the contract. Therefore, we assume a disinvestment (I_3), i.e. a repayment in $t = 3$. This uncertain "exit price" is also applied in the planning model if the existing contract with a player is to be extended by the club. The estimated exit price, i.e. the possible transfer proceeds, are the opportunity costs for a possible further employment of the player. At the club level, we assume the following simplified income statement, which serves as our starting point (Table 2).

3.3.3 Player level. The crucial problem of individual player (*i*) valuation is to allocate these figures to a single player (e.g. Leifheit and Follert, 2023). It is quite obvious that the value of the team does not result from the individual values of the players because one player alone cannot provide team performance (e.g. Leifheit and Follert, 2023), therefore, a team composition that covers all necessary positions is needed to include synergies between players. We suggest a rudimentary mechanism that is based on a second planning parameter, the success factor of player *i* in period *t*: $S_t = S_t^i$. The player success factor S_t is relative, i.e. normalized to the average success of the individual players of the team; i.e. $S_t = 100\%$ corresponds to the average player performance. To calculate S_t^i for player *i*, one needs to calculate for the whole squad [15]. S_0^i is the estimated success factor at the start of the contract, which is taken into account in the transfer price at the start of period 1 (I_0^i).

The player-specific success factor S_t can record common sports-related key performance indicators (KPIs), such as playing time, goals, and assist in an assessment scheme that is not considered in detail here (see, e.g. Sæbø and Hvattum, 2019). The player-specific success factor calculated in this way is the basis for determining the share of revenues *T* generated by

Period (*t*)		1	2	3
Number of players in the team (*n*)	n_t	15	15	15
Performance indicator (team)	S_t^{*a}	100%	100%	100%
Revenues				
Revenues (tickets)	$T_{1,t}^*$	15,000	15,000	15,000
Revenues (merchandising, TV rights)	$T_{2,t}^*$	25,000	25,000	25,000
Revenues (other)	$T_{3,t}^*$	5,000	5,000	5,000
Total revenues		45,000	45,000	45,000
Costs				
Player salaries	L_t^*	−20,000	−20,000	−20,000
Amortization player investments	A_t^*	−8,000	−8,000	−8,000
Others	$C_{2,t}^*$	−12,000	−12,000	−12,000
Profit		*5,000*	*5,000*	*5,000*

Note(s): [a]$S_0^* = 100\%$
Source(s): Created by authors

the club attributed to player i. Only T_1^* and T_2^* (ticketing, merchandising and TV rights) are regarded as revenues dependent on the players and their success. The share of revenues attributable to a player i in period t is accordingly

$$T_t = \left(T_{1,t}^* + T_{2,t}^*\right) \cdot \frac{S_t}{n} \tag{10}$$

with an average success ($S_t = 100\%$), a player in a team with n players is assigned just $1/n$ of the revenues. Of course, costs are also assigned to the player. The costs considered here are the salary, whereby a distinction is made between the fixed salary and performance-related components (L_t^{fix}, L_t^{var}). The transfer fee I_0 at the beginning of the player's activity is also assigned to the player on a period-specific basis. The three years considered correspond to the (assumed) planning period ($m = 3$) [16]. The variable salary depends on the fixed basic salary and the player's success factor (v is the proportion of the variable to the fixed salary for a given $S_t = 100\%$; in the example: $v = 0{,}2$).

$$L_t^{var} = v \cdot L_t^{fix} \cdot S_t \tag{11}$$

The following applies to the salaries of all players:

$$L_t^* = \sum_{i=1}^{n} \left(L_i^{fix}(1 + v \cdot S_t)\right) \tag{12}$$

Finally, allocations for the general costs of the club are assigned to the player according to the club's planning (see Table 3). The other costs of the club (C_t^{other}) are assumed to be proportional to the number of players n.

$$C_t^{others} = \frac{C_{2,t}}{n} \tag{13}$$

in addition to the period-specific costs and revenues, a potential transfer price plays a role in the valuation if the player leaves the club before the end of the contract and the club reaches an agreement with a buying club ($I_{t=m} = I_m$). With respect to this, we suggest a simplified calculus for the transfer price based on the original initial investment (I_0). Therefore, we note

$$I_m = I_0 \cdot \frac{(S_3 \cdot \beta_3 + S_2 \cdot \beta_2 + S_1 \cdot \beta_1)}{S_0} \cdot \frac{S_3^*}{S_1^*} \cdot \frac{D - m}{D} \quad \text{with } \beta_1 + \beta_2 + \beta_3 = 1 \tag{14}$$

D is the player's estimated further active time dependent on the player's age (e.g. $D = 18$ for an 18-year-old player with an expected age of retirement of 36) (for example, $\beta_3 = 0{,}5$,

Player i Period (t)		1	2	3
Success indicator (player)	S_t	100%	100%	100%
Success share (player)	$S_t : n$	6.7%	6.7%	6.7%
Revenue share (player)	T_t	2,667	2,667	2,667
Investment (player)	I_t	−4,000	0	3,333
Salary (fix)	L_t^{fix}	−1,000	−1,000	−1,000
Salary (variable)	L_t^{var}	−200	−200	−200
Allocation other costs	C_t^{other}	−800	−800	−800
Payment	P_t	*−2,533*	*1,467*	*4,800*
Source(s): Created by authors				

Table 3.
Fictitious forecast
player level

$\beta_2 = 0.3$, $\beta_1 = 0.2$, $D = 18$ and $m = 3$). This results in an annual (not cash effective) planned depreciation/amortization A of I.

$$A = \frac{I_0 - I_m}{m}$$

The difference between the revenues T and the costs C is the value-relevant payment P. As already explained, the current costs for the players' salaries contain a fixed and a variable component, whereby the latter depends on (1) the success of the team as a whole (see team success indicator S^*) and (2) the individual performance of the player S_t. The individual player's contribution to overall economic success, i.e. the individual payment P_t, is the difference between the revenues (T_t) allocated to the player and the costs ($C_t^{others} + D_t^{var} + D_t^{fix}$) directly allocated to the player as well as the costs of capital (based on I_o).

From a business economics perspective, we interpret P_t as the payment, which is the final basis of our player valuation. Due to the uncertainty of P_t, we need the expected value of the player's contribution to the overall financial success $E(P_t)$ according to our model from 3.1, as well as the risk (see 3.2.4), expressed as $R(P_t)$. As explained in section 3.2, we use the standard deviation as a risk measure; therefore, we note $R(P_t) = \sigma(P_t)$.

3.3.4 Risk consideration. At this point, the question arises which risks must be considered within the valuation process. To determine the plan values that are true to expectations and the risk measure required to derive a discount rate (c), we use the techniques of risk analysis and simulation-based risk aggregation. We point out the uncertain parameters with "~"; that is, e.g. $\widetilde{S_t^*}$ is the uncertain success in period t (while S_t^* is the planned success). Accordingly, every planning risk must first be identified and then quantified [17]. First, the development of the team's success indicator (S_t^*) is obviously uncertain over time. In our example, we model as a random walk with $\sigma_S = 20\%$; thus,

$$\widetilde{S_t^*} = \widetilde{S_{t-1}^*}(1 + \sigma_s \cdot \varepsilon_t), \forall t > 0 \text{ and } \widetilde{S_{t=0}^*} = S_0^* \tag{15}$$

with ε_t distributed $N(0,1)$, i.e. normally distributed.

Additionally, the revenues from ticketing and from merchandising and broadcasting ($T^*_{1,t}$ and $T^*_{2,t}$) are uncertain. We model these risk parameters analogous to the "success risk" as a random walk with the same standard deviation; thus,

$$\widetilde{T^*_{1,t}} = T_{1,1}\left(1 + \alpha_1\left(\widetilde{S_t^*} - \overline{S}_0^*\right)\right) \cdot (1 + \varepsilon_t \cdot \sigma_{T1}), \forall t > 0 \tag{16}$$

$$\widetilde{T^*_{2,t}} = T_{2,1}\left(1 + \alpha_2\left(\widetilde{S_t^*} - \overline{S}_0^*\right)\right) \cdot (1 + \varepsilon_t \cdot \sigma_{T2}), \forall t > 0 \tag{17}$$

in addition to these risks at the club level, three specific risks are considered at the individual player level. First, analogous to the success risk of the team as a whole, the success factor S_t of the player is uncertain. The modeling corresponds to that of the team's success factor. Therefore, we assume a random walk as well (again with a standard deviation of 20%). Furthermore, we consider uncertainty about the possible transfer price in period $t = m = 3$, i.e. at the end of the planning period (I_3). We assume that the factor (ε_t, σ_I) in (16) is normally distributed with a standard deviation of $\sigma_I = 20\%$.

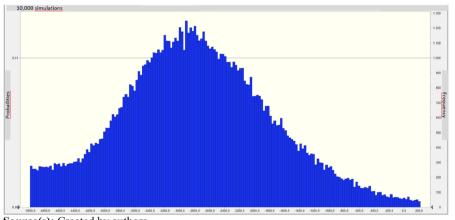$$\widetilde{I_3} = I_3 \cdot (1 + \varepsilon_t \cdot \sigma_I)$$

Finally, at the player level, we consider the risk of a possible temporary absence of the player, e.g. due to an accident or illness ("default risk"). This event-oriented risk can be described by the time-invariant default probability of a year (here, $p = 20\%$) and the uncertain default duration. The latter is modeled by a (uniformly distributed) default duration as a percentage of the possible playing time of a year (i.e. by a default duration in the range from 0% to 100%).

3.3.5 Results from planning, simulation, and final player's value calculation. With the data from our assumed planning and risks explained above, we are now able to compute a risk-adequate value for player i. The calculation is based on the frequency distributions of the players' payments $\widetilde{P}_t$ (Figure 1).

All relevant information for the final valuation can be found in Table 4.

The first line shows the expected value of the player's profit contribution per period $(E(\widetilde{P}_t))$. At $t = 1$, we consider the initial investment I_0, and at $t = 3$, we consider the "exit price" I_3. The second line shows the risk $R(\widetilde{P}_t) = \sigma(\widetilde{P}_t)$ of the player's profit contribution for each period, where the standard deviation is used as a risk measure. Taking into account the parameter λ_t, the ratio for the risk-return profile of the alternative investment, the certainty equivalent (CE) of the player success contribution in each period can be calculated as

$$\mathrm{CE}\left(\widetilde{P}_t\right) = \mathrm{E}\left(\widetilde{P}_t\right) - \lambda_\mathrm{t}\sigma\left(\widetilde{P}_t\right) \tag{18}$$

Figure 1.
Simulation of $\widetilde{P}_t$ for
period $t = 1$ (10,000
simulations)

Source(s): Created by authors

Period (t)	1	2	3
$E(\widetilde{P}_t)$	-2739.3	1299.8	4341.0
$R(\widetilde{P}_t)$	1061.6	1321.9	2639.8
λ_t^σ	25.0%	37.3%	48.2%
$CE(\widetilde{P}_t)$	995.2	806.8	3068.6
	-3033.7	760.4	2808.2
Value (V)	*534.9*		
… in % I_0 (NPVR)[a]	13.4%		
Gross value $(V + I_0)$	4534.9		

Note(s): [a]NPVR, Net present value rate
Source(s): Created by authors

Table 4.
Valuation (discounted
cash flow)

The gross value of the player is obtained by discounting the certainty equivalents with the risk-free rate (r_f) to the present [18], i.e.

$$V\left(\widetilde{P}\right) = \sum_{t=1}^{3} \frac{E\left(\widetilde{P}_t\right) - \lambda_t \cdot \sigma\left(\widetilde{P}_t\right)}{\left(1 + r_f\right)^t}$$

$$= -4000 + \frac{1261 - 0,25 \cdot 1062}{\left(1 + 3\%\right)} + \frac{1300 - 0,373 \cdot 1322}{\left(1 + 3\%\right)^2} + \frac{4341 - 0,482 \cdot 2640}{\left(1 + 3\%\right)^3}$$

$$= 535\,\text{MU} \tag{19}$$

The value of 535 MU calculated in this fictitious example corresponds to 13.4% of the initial investment I_0 (net present value rate). The gross net present value is calculated as the net present value plus the initial investment (4,000 MU + 535 MU). The positive net present value shows that, according to the planning and taking into account the risks associated with any planning, an investment in player i in period $t = 0$ of 4,000 MU makes sense for the club from an economic perspective when considering the future revenues and costs of the player (including salary).

To assess the robustness of the respective sensitivities to the model parameters, the variance explanation shares of the individual parameters can be calculated with the software *Crystal Ball*, as shown in Table 5.

The exemplary parameterization shows that the first three factors are particularly large and explain approximately half of the scatter (total risk). It should be noted, however, that due to the conceptual approach and exemplary parameterization in this paper, this evaluation is intended only to show how the robustness of the model can be assessed with respect to deviating parameterization.

4. Discussion and implications

In this paper, we present a decision-oriented player valuation that is forward-looking and thus has to address uncertainty. In this respect, we go further than the previous literature, which is mostly empirical and therefore analyzes the topic of player valuation from an ex-post perspective. Nevertheless, it must be emphasized that we had to make simplifications for didactic reasons.

On the one hand, our model focuses purely on the action of valuation and disregards the forecast of revenues. We have taken these forecasts as given and use a fictitious numerical case to illustrate the valuation technique. To this end, we have made some simplifications so that practical particularities may be less taken into account. For example, there are sporting successes or failures where revenues change, such as reaching the next round in a competition or being relegated from the league (e.g. Leifheit and Follert, 2023). Future

Input	Explained variance (cumulative)
SF_Team_t1	29.67%
SF_Team_t2	58.40%
SF_Team_t3	70.97%
SF_Player_t1	80.34%
SF_Player_t2	88.58%
SF_Player_t3	93.17%
Transferprice Risk	96.16%
Source(s): Created by authors	

Table 5.
Exemplary sensitivity analysis

research will have to address these mostly sports-related issues to make our model applicable in the field. On the other hand, it should be emphasized once again that this calculation does not consider interactions between the additional player and the other players of the team or their sporting successes, which in turn influence the financial revenues of the club.

However, elsewhere, we have tried to consider other practical specifics. For example, we have added an exit price to our model. The easier case would be a valuation without sales proceeds. This would always be the case if the contract expires and the player transfers without a transfer fee. The central aim of the approach is to present a general valuation model for decision-making purposes that can be completed by clubs with their own subjective data and according to their own risk appetite. The following aspects can be emphasized for practical use in football clubs:

(1) In contrast to econometric price estimates, the approach fulfills the necessary future reference requirements and can therefore be used to prepare decisions.

(2) Managers can use our valuation approach to determine subjective decision values for player investments.

(3) Managers receive an economically sound benchmark that supports their position in transfer negotiations with other clubs. The model can also be helpful for helping player advisors prepare for negotiations on the player's behalf.

(4) This approach goes hand in hand with a forward-looking assessment of the risks resulting from the investment so that managers can address in detail the chances and risks of the transfer and quantify them.

(5) Managers can meet the requirements of the "business judgment rule" by documenting the determination of an economically comprehensible subjective decision value, considering the relevant risks resulting from an investment.

(6) The approach contributes significantly to connecting academic research and (sports) management practice, as it is able to integrate the real conditions under which managers have to make decisions more than previous empirical literature (e.g. Müller *et al.*, 2017; Thrane, 2024), as well as few analytical contributions, which often assume highly idealized conditions (e.g. Tunaru *et al.*, 2005) or cannot determine point values (e.g. Leifheit and Follert, 2023).

However, the approach presented can only be a starting point for further research to possibly design a practically applicable valuation tool in the future that also takes sporting characteristics into account. We would like to emphasize that empirical testing is explicitly not the goal of an (*ex ante*) decision model. However, there are several points where we see the possibility to build the bridge to empirical approaches found in sports economics literature. In particular, it could be useful to draw on empirical studies that explain transfer prices to provide an empirically supported estimate of future exit prices.

Our main point that makes our approach unique compared to previous research efforts is the consideration of uncertainty through risk analysis to avoid sham inaccuracies. The aim is to assess the player's relative advantageousness for the club. Thus, a discussion about different courses of action in the club's personnel policy can be clearly focused on the assumptions that are decisive for the decision between two players. It should be noted that in the chosen stochastic approach, a consensus on certain (deterministic) assumptions is not required since the probability distributions are assigned to all uncertain assumptions. Therefore, it should be easier for managers to achieve consensus on bandwidths. Additional evaluations via sensitivity analyses can also reveal which of the (uncertain) assumptions are of particular relevance for the assessment.

While the methodological basis for our risk-adequate player valuation has been extensively developed in recent years (and is being used in other application fields), the primary problem with its application in clubs seems to be the availability of data on risk. It is important to improve the scope and quality of the available data on relevant risks and, if possible, to provide benchmark information for specific risk categories. However, despite the current limited data availability, the application of the methodology is already possible because decisions under risk supported by the assessment procedure can never be based on comprehensive or even objective data, specifically about risks.

5. Conclusion

The sports economics and sports management literature is dominated by studies that use sophisticated econometric methods to estimate transfer prices or "market values" published by web portals on the basis of past data. This paper takes a completely different approach. Managers who are faced with an investment decision need calculation tools that support them in preparing an informed decision. If a football manager wishes to know what price he or she can be paid for a player without the club suffering an economic disadvantage, our approach can provide decision support. Therefore, the model proposed in this article can be interpreted as a first step to support the calculation of a financial decision value, which can be interpreted as the maximum willingness to pay. The basis for determining such a subjective value from a club's perspective is the additional payment, i.e. the marginal utility generated by a player (as a valuation object) for the valuation subject (club) (e.g. Sloane, 1969). To determine the financial value of a football player, we apply for the first time a semi-investment-theoretical approach and go further than Leifheit and Follert (2023), who determine a range of possible values in an initial approach to football players' investment valuation. The basis for our model is a two-step planning in which the first step is internal planning of the club as a whole and, based on this, the contribution of a player to the (financial) success of the club, which in most clubs cannot be viewed in complete isolation from sporting success. Since the future is obviously uncertain, we analyze and aggregate the risks associated with each uncertain plan assumption by a Monte Carlo simulation to take into consideration the implications for the player's value: Higher risks affect the expected value of payments and therefore lead to higher requirements for risk-adjusted discount rates (cost of capital).

The computed value can be understood as an approximation of the marginal price and thus as a decision criterion in the managerial decision. Nevertheless, our approach should not be misunderstood as a normative requirement for the decision maker. A club can, for instance, supplement the calculus with nonfinancial objectives. Although the value is determined from the perspective of a profit-maximizing club, this does not mean that the approach cannot be useful for managers in clubs with other objectives.

Notes

1. We refer to football in this paper and understand this term synonymously with soccer.

2. It should be noted that the following considerations are based on a purely economic view. It is absolutely clear that the registration of the player cannot be done against his/her will. So even if two clubs agree to transfer a player, players must give their consent to play for the buying club as well. However, if the player enters into a contract with a club, then it is "the player's registration which binds a contracted player to perform solely for one club under the terms of the contract" (Carmichael *et al.*, 1999, p. 125).

3. Tunaru *et al.* (2005, p. 286) themselves refer to further conceptual challenges, such as the lack of consideration of synergies and the fundamental problem in dealing with the assumed geometric Brownian motion.

4. Franck and Nüesch (2012) argue that market values are more appropriate because transfer fees are the result of a negotiation. This is true, but it must be taken into account that the fee is usually in the interval between the subjective values, while a "market value" is only a hypothetical construct.

5. On the background of calculative (e)valuation metrics on digital platforms see, Begkos and Antonopoulou (2020).

6. And age^2.

7. If $E(\widetilde{CF}) - \lambda \cdot R(\widetilde{CF}) \cdot d > 1$ (cf. Gleißner, 2019).

8. For further explanation see footnote 12.

9. Where μ'_m und σ'_m denote expected value and standard deviation of the one-year log-normally distributed returns of the market portfolio and $r'_f = \ln(1 + r_f)$ and $r'_m = \ln(1 + r_m)$.

10. "The selling price will be not less than the player's capitalized value to the team that owns his contract (the difference between his average yearly product to it and his average yearly salary, multiplied by the estimated number of remaining years of his playing life and appropriately discounted). It will not be more than his capitalized value to the team for which his product would be higher than for any other team. The price will fall between these limits, at a point determined by bargaining strategies and the player's capitalized value to other would-be buyers." (Rottenberg, 1956, p. 256).

11. We use this factor because it seems plausible, in line with the common valuation practice of medium-sized companies, that soccer clubs also neglect risk diversification effects at a higher level, i.e. the level of their owners. Whether this is true, however, is a question for future research in company valuation. With the chosen valuation approach, the consideration of other diversification options (and thus d < 1) is also possible without any problems. It is also possible to typify a "medium risk diversification", e.g. d = 0.5, or to derive d using risk factor models (see Gleißner and Ernst, 2023, with a case study).

12. We use this term for the uncertain outcome variable to be discussed as a proxy for an uncertain stream of benefits that the valuation subject uses as a basis for the calculation of the decision value. A precise operationalization is not necessary for the methodology, because the operationalization chosen in the following is exemplary. However, it is essential to ensure that the calculated cost of capital accurately reflects the risk content of the selected result variable, i.e. P. If an earnings figure such as the free cash flow is selected, which includes payments to equity and debt capital providers, the risk-adequate discount rate is accordingly a weighted average cost of capital (WACC). WACC results from the risk of this earnings figure (measured by a suitable risk measure) if the free cash flow accruing to the equity and debt capital providers is discounted. The cost of equity is calculated accordingly if the results and risks are considered to which only affect the owners. If only the flow of benefits to the valuation subject (owner) is considered, as in the case of a flow to equity, the discount rate – as in our case study – is to be interpreted as the cost of equity.

13. $C^*_{1,t}$ contains player salaries (L^*_t) and amortization of player investments (A^*_t).

14. Considered to be time-invariant.

15. $S_{i,t} = \frac{F_i \cdot n}{\sum_{j=1}^{n} Fj}$ with F_i an indicator of absolute success (e.g. number of goals plus assists, playing time, etc.).

16. To reduce complexity, a valuation of possible extension options is neglected here.

17. For the sake of simplicity, the risk associated with the parameters $T^*_{1,b}$ $T^*_{3,b}$ $C^*_{1,b}$ $C^*_{3,t}$ is not taken into account here.

18. See equation (5) and Table 1.

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Corresponding author
Florian Follert can be contacted at: florian.follert@uni-seeburg.at