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Conceptual framework for real estate transactions

What risk metrics are needed as decision support system? Considerations for German market participants

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Abstract

Purpose – The purpose of this paper is the development for a conceptual framework with regard to the risk management of real estate positions as foundation for transaction decisions. In this context, the current market environment and legal obligations are the main drivers for market participants to improve their risk management practices. Based on this environment, a practical but science backed model is outlined.

Design/methodology/approach – The paper uses a conceptual approach based on the existing literature to develop a practical decision support system. In addition, the current risk management best practices are outlined to illustrate the corporate and methodological foundation for the decision support system.

Findings – The conceptual model development reveals a clear necessity for the supplementation of price to value measures. Additional measures are derived from theoretic considerations based on Monte Carlo Simulation approaches to the risk management of property investments. These additional risk metrics support investors in order make risk-appropriate decisions.

Practical implications – The resulting decision support system can be applied to the risk management of transaction decisions. Here, the model can be applied in any investment decision to support portfolio management considerations from a comprehensive risk management perspective. Investors can implement the system as part of their transaction procedure.

Originality/value – The existing body of literature mainly focuses on macroeconomic ratios in the context of decision support. In contrast, the present paper reveals a corporate decision support system, which is supposed to foster decisions of market agents especially with regard to potential price and value divergences and tightening legal obligations.

Keywords Real estate risk management, Asset price bubble, Risk aggregation, Property valuation, Downside risk, Transaction decisions

Paper type Conceptual paper

1. Introduction and risk management requirements

The central challenge for the risk management of institutional real estate investors is the idiosyncratic risk exposure from the individual property. Accordingly, the risk management of direct real estate assets focuses on the *ex ante* residual risk of the individual object's cash flows (in line with Azevedo-Pereira *et al.*, 2002) and differs largely from classic risk management techniques of for example equities (Booth *et al.*, 2002). For institutional real estate investors, the main requirements which determine the risk management of their real estate positions can be divided into two large tiers[1]:

(1) Asset characteristics and corresponding current market environment and

(2) Legal obligations.

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Most importantly, since real estate entails characteristics such as heterogeneity, low transparency as well as high complexity among others (Amédée-Manesme and Barthélémy, 2018), the risk management of those positions is highly challenging due to market incompleteness. Accordingly, in these incomplete markets the divergence of the intrinsic value and prices are a typical and potentially dangerous outcome, as outlined by Benning-Linnert (2018)[2]. The resulting price bubbles in real estate markets are typically driven by monetary expansion and expansion of lending[3].

The vast monetary stimulus of global central banks (especially in Europe as consequence of the debt crisis and subsequent "Quantitative Easing") represents this expansive policy, which causes real estate prices to be seen as detached from other determinants such as building costs of population growth, for example as displayed for the US housing market (see Figure 1).

The outlined characteristics of the asset class and the current market environment especially affect the most interesting situations within a property asset's life cycle: The buying or selling decisions. Since transactions of properties are cost- and time-intensive, and the assets also yield long maturity periods (Fabozzi and Xiao, 2019), misperceptions about the risk of the intrinsic value of an assets can have crucial consequences for the equity position of acquiring or selling investors.

In addition to the named fundamental asset characteristics and current market environment, the legal obligations for institutional real estate investors are of interest, since they experienced a tangible tightening in recent years based on Basel II and III or Solvency II. Accordingly, investors are now heavily urged to improve their risk management practice of real estate positions to avoid losses (Panagopoulos and Vlamis, 2009).

In Germany for example, most institutional real estate investors, such as real estate operating companies (REOCs) or REITs are legally subject to the "*Aktiengesetz*" (AktG). Central risk management related paragraphs are §91 and §93 AktG, which force corporations to implement proper risk management practices and gather appropriate information for business decisions, such as real estate transactions. Importantly, the following decisive detail needs to be underlined: Neither the named practices nor the term appropriate information are precisely defined, but are left subject to interpretation and individual business model design. The outlined legal freedom to design the individual risk management system, including transaction decisions is a central motivation for the present article from a legal point of view for corporations.

The second large group of investment vehicles, namely investment fund companies and their risk management is regulated by the *Kapitalanlagegesetzbuch* (KAGB), or more precisely by §29 KAGB. Interestingly, legislators introduced the supplementary minimum

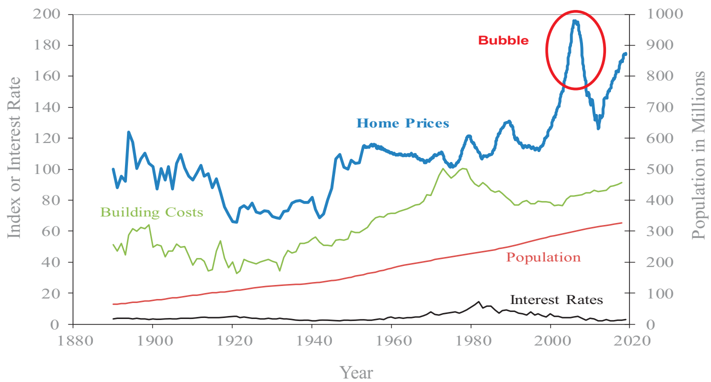

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Figure 1.
US residential property parameters as potential illustration of asset price bubbles (1890 – present)

requirements for risk management "*Mindestanforderungen an das Risikomanagement von Kapitalverwaltungsgesellschaften*" (KAMaRisk*)* for investment fund companies in 2017. The KAMaRisk concretize the requirements from §29 KAGB comprehensively. Nonetheless and decisively, legislators again allowed for individual risk management design, by not specifying the concrete models or systems for practical usage. Just like for corporations, this allowance for individuality drives the necessity for a practical risk management support system for crucial business decisions like property transactions.

In sum, and combining the above mentioned economic requirements and legal obligations for transaction decisions of institutional investors, the natural necessity for a conceptual framework as decision support system (DSS) appears to be logic. To be able to make well-founded decisions to buy or sell properties in actual incomplete real estate markets, more corresponding information is needed than just the market value appraisal or a forecast of the returns. Thus, the central research question can be summarized as such: *What risk metrics are needed for real estate investors to build a comprehensive practical DSS for (de-)investment decisions with regard to the associated risks?*

The present study contributes to the existing body of literature by developing a sufficient and scientifically-backed but explicitly practical DSS for institutional real estate investors, to effectively support transaction decisions. In addition, the study explains the interplay of the named concepts, and why their combination is crucial. To the best of the authors' knowledge, a DSS for the risk management of real estate positions with focus on potential pricing bubbles of property markets does not exist.

In order to provide insight, the present article is structured as such: Chapter two outlines the relevant related literature and states the essential hypothesis. The third chapter outlines the environment for a DSS as part of the real estate risk management. Chapter four develops a conceptual model as DSS for real estate investors. The final chapter concludes, outlines practical implications and describes further research possibilities.

2. Literature review and hypothesis derivation

The relevant articles for the present paper cover two large bodies of literature: Firstly, the general conception of a DSS in real estate is of interest. Secondly, the literature on mispricing or asset price bubbles in real estate are analyzed to outline relevant factors for a DSS for real estate investments in market phases of potential divergences of price and value of property assets. Both sections are then connected to outline the necessity of a DSS in real estate with special regard to risks caused by mispricing in incomplete markets.

Early research for DSS in real estate was predominantly focusing on the property level. In this context, Peterson (1998) introduced a spatial DSS for residential properties. The authors, however, focus on the geographic aspects of investments. Subsequently, Lam *et al.* (2009) outline a technical property valuation DSS based on a support vector machine approach.

Serrano-Cinca and Gutiérrez-Nieto (2013) formally highlight, that a DSS for investing is supposed to define criteria and indicators to formalize a well-structured impact on investing procedures. The closest study to the present one was provided by Pitros and Arayici (2016), introducing a DSS for the diagnosis asset price bubbles. Nonetheless, the specified study focuses on the identification of macroeconomic factors to detect potential bubbles. The present article, however, aims at introducing a DSS from a corporate point of view.

Lastly, the decisive and this article motivating remark in the context of a DSS in real estate was provided by Tidwell and Gallimore (2014). The authors point out, that the market value needs to be interpreted as "hypothetical construct", which needs additional metrics to be taken into consideration. We strongly follow their argument. From a theoretical point of view and in the context of valuation, it needs to be explicitly highlighted, that the market value of a property represents an estimate but not a value in the economic sense (Gleißner *et al.*, 2017).

Instead, the fundamental value of a real property has to be interpreted as the model-based calculated monetary amount, which is equivalent of the uncertain earnings received by the owner from the property. This judgement of values for properties is practically formalized by the standards and methods in the field of real estate valuation. Even though there are international valuation standards (IVS) for property assets, it remains a challenging discipline. The deviations of the results of the concepts vary depending on the investment project and are possible in both directions. Scientific studies on the "mean deviation" of the concepts are not available (yet). The stock market reveals that valuations of the concepts match "in the mean", but the income risk and insolvency risks on CAPM-based valuation lead systematically to mispricing when not taken into account properly, e.g. with so-called "quality companies" becoming manifest in risk adjusted excess returns in the stock market (see, e.g. Campbell *et al.*, 2008; Walkshäusl, 2013).

With regard to market imperfections or asset price bubbles in real estate literature, a vast body of literature has outlined the underlying mechanisms. Even though there is no single definition for the term, asset price bubbles are generally defined as divergence of fundamental factors of an asset's value and its price (Stiglitz, 1990). Various capital market imperfections may cause values and prices to split up, and thus create asset price bubbles (Shleifer and Vishny, 1997; Gromb andVayanos, 2010; Gleißner, 2019a).

The real estate literature has initially focused on rational bubbles based on trader assumptions (Blanchard and Watson, 1982). Diba and Grossman (1988) divided a property's price into a fundamental component and a bubble component under symmetric information, tested by the explosiveness of a stochastic price process across time. Similar empirical results for other asset classes have been provided for example by Campbell and Shiller (1988), Wu (1995) and Phillips *et al.* (2011). In empirical literature and mainly due to econometric modelling issues, the case of asymmetric assumptions of investors is rather scarce. Lei *et al.* (2001) are the only study to carry out an analysis here. The authors name judgmental errors as decisive factor for bubbles. The present study applies their explanation, since from an explicitly conceptual point of view, investors appear to be heterogeneous and also challenged by property assets' low transparency and complexity, eventually causing exactly the named judgmental errors. Regarding these judgmental errors in real estate, Hayunga and Lung (2011) mention the inflation illusion and overconfidence theory as typical mispricing and asset price bubble reasons. In this context, Abildgren *et al.* (2018) add overoptimism as driver for real estate mispricing.

Combining these articles on assumptions with the above-mentioned judgmental error thesis of Lei *et al.* (2001), we see reasonable evidence for potential investment mistakes, if solely market values are assessed. In real estate, wealth management and many sectors of the business economy, there is no clear enough distinction between the fundamental (intrinsic) value of an asset on the one hand and an estimated or actually realized price on the other, which favors illiquidity (in close reference to Gleißner, 2019a). The fundamental (decision) value corresponds to the safe amount of money that can be considered equivalent to the asset's future uncertain cash flows (Laux and Schabel, 2009). The (market) price is the result of a purchase or sale and, in the case of heterogeneous assets (such as real estate), the result of a negotiation process. The realized market price of a real estate transaction is below the "maximum purchase price" of the buyer and above the "minimum selling price" of the seller – i.e. within a range whose marginal points can be derived from the subjective decision values of buyers or sellers (Matschke and Brösel, 2013; Hering, 2014).

While the value is a model-based calculated quantity that reflects the level of information, options and preferences of the subject (buyer or seller) - individually or typed in the determination of objectified values–realized prices can be observed–they are not "only" objectified but objective. In practice, e.g. often called "real estate valuation" tries to estimate possible (virtual) buying or selling prices (virtual market prices). Also the traditional expert evaluation methods, such as, e.g. codified in §194 BauGB [Town and Country Planning Code], one can first of all (approximate) interpret as "price estimation procedure". This results from the fact that the determined "values" (more precisely: price estimation) are derived from realized prices of "comparable" properties whose "valuation level" is reflected in particular in the real estate interest rate.

These expert appraisal procedures are thus "comparison-oriented" procedures and their result is largely dependent on the current valuation level on the real estate market considered. As the experiences in the US but also in Spain and other countries have shown, the prices of real estate markets fluctuate quite (see Figure 1) – and often at a level that cannot be explained remarkably by an economic fundamental perspective (Shiller, 2003, 2008). Within real estate literature these deviations from fundamentals are captured by ratios, comparing prices and rents or incomes (Himmelberger, 2005). Alternatively regression analysis specifies models based on supply and demand, especially focusing on unit roots of market data (Yiu *et al.*, 2013), or methods from physics, focusing on the rate of growth in prices (Zhou *et al.*, 2006).

In sum, one may conclude from the existing literature that DSS need clear criteria and indicators about for financial risk management of real estate positions. In this context, purely market valuation-based DSS are subject to the specified potential misperceptions about the intrinsic value of real property assets and thus considered as insufficient. Consequently, from an economic point of view, the mispricing of assets has to be seen as one of the key features for real estate markets. Taking the bodies of literature into account, the following hypothesis for the conceptual model development section can be derived:

H1. Entirely market value driven approaches for the risk management for real estate investments do not provide a sufficient DSS for buy and sell decisions and need extension by other metrics.

3. Corporate environment, methodological foundation and problem set

Turning towards the actual model development of the DSS itself, two preparatory elements of practical risk management and decision-making are needed to outline the foundation of the DSS:

(1) Corporate environment for property transaction decisions,

(2) Current methodological best practices in real estate risk management and corresponding problem set of risk estimation in incomplete markets.

Firstly, the transaction decision environment needs to be outlined. In this context, the associated risk strategy and risk bearing capability are the most important restraining factors for the allocation towards risk exposure (Gleißner and Wolfrum, 2017). A graphical illustration of the named environment may be constructed within the usual risk-return space. Here, real estate investors typically chose from core, core plus, value add to opportunistic assets along the risk tolerance, leading to investment decisions or rejections (like investment A in favor of investment B), limited by the maximum risk (yellow line) and minimum return (black line; see Figure 2):

It needs to be highlighted, that these corporate parameters will be decisive for the acceptable ranges of the risk metric values of the DSS. Accordingly, the exact values for each metric differ across corporations and are subject to the individual risk strategy.

Secondly, the methodological foundation for the risk metric selection and DSS construction is essential. In this context, real estate investors usually apply the DCF method, based on a risk-adjusted discounting of future expected cash flows (Gleißner *et al.*, 2017). Unlike real estate interest, which is derived from other transactions, the discount rate is

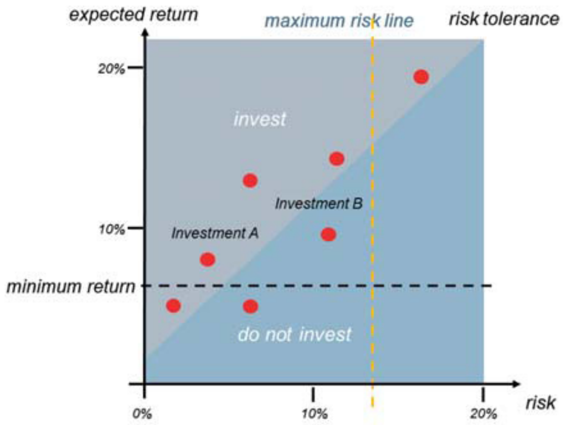

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Figure 2.
Conceptual framework for risk tolerance, minimum return and maximum risk in the risk-expected return space

intended to explicitly capture the risk of the future cash flows of an asset. This is characteristic of a valuation method and the valuation result is thus relatively independent of a possible mispricing in a market.

The biggest problem in the practical application of the traditional, deterministic DCF method for valuing companies or real estate assets is that in practice today the discount rate is still estimated using the Capital Asset Pricing Model (CAPM) based on capital market data. Even more than equity markets, real estate markets must be seen as imperfect and incomplete, as outlined above. The CAPM[4], which is based on the hypothesis of perfect markets, leads–as empirical studies show–to no adequate explanation of expected returns (discount interest rates).

Alternatively, real estate investment valuation derives discount rates from weighted average cost of capital (WACC), or target rates based on prime objects and additional risk premia (including sector, town and property risk premia). WACC approaches are generally problematic for property investments, since the individual costs of capital do not necessarily price the associated risks correctly. Lastly, target rates can be criticized for "double counting" of risks, as well as potentially doubtful risk premia based on heuristics.

The underlying assumptions are also empirically easy to falsify. Are only risks, which are fundamentally not diversifiable relevant to the evaluation and thus neglecting the risks specific to the individual business?[5] Are historical fluctuations in the price the risks of future cash flows? It can easily be shown that a risk-adjusted valuation of a property based on historical capital or real estate market data–compressed, e.g. in the beta factor of the CAPM, or a comparable rate–is not effective.

For a fundamental and risk-appropriate valuation of a real estate or other real assets, it makes sense to start from a quantitative risk analysis to derive the value–recourse to often missing and also for the future little representative historical capital market data is not required. As a further development of the traditional, univalent DCF method, simulation-based stochastic DCF methods are named as best practice here–these ensure transparency about individual risks and the aggregated risk scope. Thus, Monte Carlo Simulation (MCS)-based stochastic DCF models can be considered as business standard (e.g. French and Gabrielli, 2004; Hoesli *et al.*, 2006; Baroni *et al.*, 2007; Szumilo *et al.*, 2016; Gleißner *et al.*, 2017).

By means of MCS, a large representative number of possible future scenarios that result from risks (planning scenarios) are analyzed in the risk aggregation. This way, a distribution and thereby a realistic bandwidth of the future cash flows and earnings is indicated, thus describing the planning certainty or the scope of potential negative plan deviations. Also, e.g. the probability that covenants are violated or a required target rating will not be reached again in the future can be derived directly[6].

Based on these considerations, the question arises, why a purely market value driven approach may be problematic for transaction decisions. As outlined above, decisions to buy real estate are a particular challenge especially in a situation like the current one when it must be feared that many properties are already "overvalued", i.e. that the realizable price P is above the fundamental earnings value, V (thus, $P/V > 1$). Given the current low interest level, misvaluations and asset price bubbles (with $P/V >> 1$) can be assumed[7].

It is firstly often overlooked that P does not represent a value in the economic sense but an estimated price (Gleißner *et al.*, 2017). The market value, following from the property yield derived from market data, is an estimation of the price (Gondring, 2013; Creutzmann, 2017; Pohnert *et al.*, 2015) – as also clearly stated in §194 BauGB – that can be expected in case of a sale of a property in the near term under regular market conditions.

In fact, realizable market prices and fundamental capitalized earnings values can also substantially deviate from each other as regularly occurring real estate bubbles show. The fundamental value of a real property represents the model-based calculated monetary amount that is equivalent of the uncertain earnings received by the owner from the property[8]. It is irrelevant for the fundamental value which – possibly excessive – prices are paid in a concrete market situation.

This has fundamental significance for the decision proposal: a purchase price must not only be justifiable in consideration of the current market conditions (market value), but must also be economically reasonable in a sustainable consideration, i.e. it must not be higher than the fundamental earnings value (as present value of the future cash flows). Only the fundamental earnings value – not the current value – considers risks explicitly, plausibly and comprehensively.

Thus, as preliminary result, one can conclude, that purely market value-based approaches are in doubt. Consequently, the following conceptual model for a DSS will address a larger combination of risk metrics to account for the named problem.

4. Conceptual DSS development

Ultimately, the following section aims at developing a real estate-related, adaptable, individually adjustable, interpretable and implementable DSS as part of the investment process of institutional investors. Based on the specified environment and the problem set of market incompleteness, the following aspects of the practical DSS development are described:

(1) Individual risk metric legitimization in the real estate risk management context,

(2) Interplay of the risk metrics and collection in DSS (constraints and target).

As a yield indicator that is independent of financing, it is recommended to indicate the expected total return on investment besides the expected return on investment. It permits an assessment of investment options that is explicitly independent of the financing structure. However, solely from the fact that, e.g. the expected total return on investment of investment A (8 percent) is higher than that of investment B (4 percent), it cannot be concluded that A is in fact more attractive than B. That is to say, both investment options can differ quite significantly from each other in terms of the risks.

In consideration of existing opportunities and risks, which indeed do not cancel each other out completely on average, initially an expected return on investment must be indicated by means of a risk analysis and risk aggregation. It describes which return on investment can be expected on average due to risk in light of the possible future scenarios. It thereby permits taking unavoidable risks into account for business decisions and enables a comparison of risks between the different investment alternatives.

Taken for itself, however, also the expected return on investment is not sufficient as a basis for decision because of a missing risk reference. Additionally, P is not sufficient, because it may be much higher than V; it is suggested to consider further key figures that help estimating the earnings-to-risk profile of the options for action.

It is widely known that the return on equity (RoE) is strongly dependent on the debt ratio (financial leverage). Accordingly, under normal conditions, an increase of the debt ratio of a vehicle leads to higher returns on equity – but the leverage has the same effect on the scope of risk, which rises at the same rate as the debt. The advantage of the return on investment is to be independent on debt ratio. But return on investment does not reflect income risk. This is only taken into account inadequately in a comparison of the return on investment against the scope of risk. Ultimately, an evaluation of the earnings-to-risk profile is always required and one key figure that expresses both aspects in condensed form is precisely the fundamental earnings value mentioned above.

Four further risk-specific key figures are expected to help evaluate a planned investment. Moreover these figures can be used as constraints for the selection of investments. In the case of a debt-financed investment (e.g. a real estate fund with outside capital), a debt rating should be stated first of all (credit rating or issue rating). This permits evaluating the investment from the creditors' perspective. In the simplest case, the debt rating expresses the probability of the special purpose vehicle going bankrupt[9]. This key figure is of course also interesting for the owner: On the one hand, the insolvency probability determines the value of shares in a fund while, on the other hand, it is hardly acceptable to conservative investors if there is any high default risk at all (e.g. more than about 1 percent per year, which equates to a BB rating).

Another possibly essential key figure, especially for institutional investors, is the so-called equity rating. The equity rating indicates the probability that a prescribed (1) target yield or (2) minimum yield will be reached by the investment. If an institutional investor, e.g. a pension insurer, is reliant, for example, on reaching at least a yield of 3 percent[10], the probability in which this target will be reached is important information. This key figure is useful especially in the context of safety first decision-making approaches[11].

The fifth key figure is the variation coefficient of the earnings (or cash flows), a key figure for the earnings-risk profile. This indicator also results directly from the risk analysis and risk aggregation explained in chapter three. The variation coefficient of earnings[12] expresses a typical uncertainty in percent; it is therefore a value for planning reliability. Accordingly, a variation coefficient R = 20 percent expresses that deviations from the planned result are usually to be expected on a scale of 20 percent. Formally, the variation coefficient is the ratio of the standard deviation to the expected value of a profit or cash flow. What is helpful is that the variation coefficient can be converted into a requirement for the expected return, which represents the discount rate or the cost of capital respectively (Gleißner, 2011, 2014). A higher income risk or higher variation coefficient respectively, is economically only justified if it is associated with a higher expected return and so higher cost of capital (Gleißner, 2011; Dorfleitner and Gleißner, 2018).

The costs of capital (or the security equivalent) represent the bridge from the aggregated overall risk scope, e.g. expressed in the standard deviation of cash flows, to the value of a real estate investment. In contrast to the traditional "capital market oriented" valuation, the costs of capital can be derived in bandwidth planning directly from the cash flows risk and not perhaps from historical dividend yield fluctuations, as is commonly done for the beta factor of the CAPM (Gleißner, 2011 and 2014). Often assumed in simplification as a constant discount interest rate, these can be derived specifically, e.g. from the standard deviation of cash flows $\sigma_{cash\ flows}$ as a risk measure. Based on a risk-free interest rate r_f and together with the expected value of cash flows C^e, the following equation results for the risk-appropriate capitalization rate (cost of capital, cf. on derivation through "incomplete replication", Gleißner, 2011):

$$k = \frac{1 + r_f}{1 - \lambda \cdot \frac{\sigma_{cash\ flows}}{C^e} \cdot d} - 1 = \frac{1 + r_f}{1 - \lambda \cdot R \cdot d} - 1 \quad (1)$$

The relation of the cash flows risk $\sigma_{cash\ flows}$ to the expected cash flows C^e, both of which are dependent on opportunities and risks, is the variation coefficient R (as risk measure). The variable λ indicates the excessive yield per risk unit (e.g. the Sharpe ratio).

$$\lambda = \frac{market\ risk\ premium}{\sigma_{r_m}} = \frac{r_m^e - r_f}{\sigma_{r_m}} \quad (2)$$

It is dependent on the expected yield of the market index r_m^e, its standard deviation σ_{r_m} and r_f, and it expresses the risk profile of the alternative investments: valuing means comparing. Since not necessarily the owners bear all risks of the enterprise $\sigma_{cash\ flows}$, the risk diversification factor (d) must be considered in addition (Gleißner, 2009; Gleißner, 2017). It indicates the percentage of risks that must be borne by the owner in formula 1. The risk diversification factor d in a real incomplete market is dependent on the possibilities of the owner of the property at the level of its portfolio to reach risk diversification effects. To calculate the variation coefficient R, a risk aggregation with reference to the financial planning model of the real estate investment is necessary.

The following plausible magnitude can be used to state the parameters for calculating the discount rate: Taking government bonds of best validity and a broad stock index as alternative investment possibilities, there is a market price of risk (λ) of about 0.25 (depending on the portfolio of the investor; see Arnott and Bernstein, 2002, for the American market). The risk diversification factor d equals for a not diversified investor 1. For a good diversified investor in terms of Markowitz values around $d = 0.5$ are plausible when, based on data of the stock market, one is acting on the assumption that often about half of all risks are idiosyncratic and thereby diversifiable. The variation coefficients of (big) companies are about 0.4 and are usually clearly lower with real estate investments (e.g. below 0.2). So for real estate there are risk premiums (meaning premium on the risk-free rate) in a typical spread from 1 to 6 percent (scientific studies to that numbers with a sufficient population do not exist (yet)).

There is a necessity to aggregate the risks (in an integrated planning model) also over several years. The most profound crises, "existence-threatening developments" or even insolvencies are notably not caused when risks trigger losses in a single year. Usually, the risk coverage potential (for equity and liquidity reserves) is sufficient to survive a thus resulting "temporary stress scenario". The realization of risk-related losses, e.g. in the year 2020, meanwhile entails that the risk coverage potential for the year 2021 is reduced (equity and liquidity reserves are reduced). The correct calculation of the named risk coverage potential, however, remains challenging especially for open-ended real estate fund vehicles, since the funds of the vehicle and its liquidity are dynamic across time, and may also be subject to mass redemption due to herd behavior of investors.

Even more serious is often that also the credit limit for the subsequent year is reduced upon a drop in earning power in a given year and that this entails a deterioration of the rating. Occurred risks therefore not only result in a higher liquidity requirement but simultaneously also in a reduction of the available liquidity reserve, which results into a "refinancing risk". Developments threatening existence and insolvencies are mostly due to illiquidity, which in turn often occurs precisely when existing credit lines are reduced or cancelled – or when loans or issued bonds have to be refinanced.

With a reduction of the equity ratio and the profitability of the company, also the insolvency profitability that is perceived by banks is increased, which is expressed through the rating. An associated increase of the interest rates for borrowed capital and an often simultaneously higher percentage of outside capital both lead to an above average increase of the interest expense in the subsequent year. This weakens the earning power further and promotes the creation of "existence-threatening developments".

The central entrepreneurial task is a well-founded weighing of expected income and risks for important decisions ("valuation" in the value-oriented management, cf. Sinn, 1980, on the bases). For the preparation of business decisions, a well-founded strategy, operative planning based thereon and an analysis of opportunities and risks are required. Quantified and aggregated risks are easier to calculate when the overall risk scope is expressed by a risk measure. At the same time, it is required that risk analyses are made in the preparation of business decision to show how the company's risk scope would change through the decision on an option for action, which is also known as "What if analysis". In result, the risk analysis and the risk aggregation thus lead to the costs of capital, which express the risk-appropriate requirement for the return of an asset.

Knowing this necessary risk premium and thus, the capital cost rate, which is understood as an expected minimum requirement for the return, it is now possible to assess the returns stated in the table. For an investment with a good earnings-to-risk profile, it is required that the expected return on investment is greater than the equity cost rate that depends on the income risk (variation coefficient).

All information is aggregated in the fundamental value of the real property (Gleißner, 2017). In it, the future expected cash flows of the property are discounted by a risk-appropriate discount rate – instead of the property yield for determining market values. Attractiveness is then evaluated by means of the so-called price-value relation (P/V).

The last and most important target figure of the "investment traffic light" expresses the price P that one would have to pay in relation to the value (or reverse V/P). Accordingly, the key figure $V/P = 1.3$ expresses that for each euro invested (at the price P) 1.3 is received as value; which of course indicates an alternative investment. If one knows the current market price (P), then the price-value ratio (P/V) - or conversely the capital gain rate (V/P) - can be derived which shows over- or under-valuation[13].

For example: Assuming a risky real estate developer project, certainly € 6.25 million must be invested ("purchase price"). Due to the uncertain revenue and cost development, a return of at least € 2 million and a maximum of € 12 million is expected after one year (under symmetrical triangular distribution, expected value = 7). In the example, the value would only be $V = 5.75$[14]. This results in a P/V of over 1.09, this means an overvaluation. One should not invest, even though "comparison" and the (market value) and "multiples" would show that the price is "market-driven".

As final constraining risk metric it is recommended to calculate the downside risk (R^*) of the real estate investment. The "downside risk" depends on P/V and can be expressed by a risk measure (e.g. VaR or expected shortfall). The easy example shows the relation between P/V and R^*: If one starts from fluctuations of P_t/V_t in the market, e.g. in the bandwidth from $(P/V)^{\min} = 0.5$ to $(P/V)^{\max} = 2$, the downside risk R^* is even at the current (assumed) $P_t/V_t = 1.5$:

$$R_t^* = \frac{P_t/V_t - (P/V)^{\min}}{P_t/V_t} \tag{3}$$

At, e.g. $P_t/V_t = 1.5$:

$$R_t^* = \frac{1.5 - 0.5}{1.5} = 67\% \tag{4}$$

The downside risk (R^*) is thus 67 percent. A bubble, that is high levels of P/V, also imply high (downside) risks, due to market correction. Thus, the assumptions about the variation in potential outcomes determine R^*. The specified risk metrics complete the individual presentation of the DSS metrics.

In order to account for the potential threats from market incompleteness, and in line with the above-mentioned criteria design of Serrano-Cinca and Gutiérrez-Nieto (2013), the named metrics support the investment decision. Since human-users of risk management systems are exposed to cognitive-psychological biases (e.g. Gigerenzer, 2004), a standardized and visually appealing representation is supposed to minimize potential cognitive misperceptions and ensure interpretability (Havard, 2001; see Figure 3):

Lastly, the interplay of the constraining risk metrics needs clarification. Essentially, similar to statistical measures, the specified metrics are supposed to protect the deciding institution from biased measures with regard to:

(1) Measure of location,

(2) Dispersion or variation,

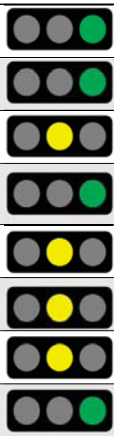
(3) Bandwidth and

(4) Left tail exposure.

By incorporating the named risk metrics, the possibility for false investment decisions based on stochastic DCF modelling outputs narrows. Overall, the key figures presented here create a comprehensive data base enabling an economic rational decision (in consideration of risks), which simultaneously meets the requirements for decision proposals that have become stricter in the recent case law. Thus, decision-makers are provided with a set of information, which is closer to the ideal situation of "adequate information" in the sense of §93 AktG ("Business Judgement Rule").

It is decisive to highlight the importance of the combination of risk metrics, since each metric contributes to the minimization of misjudgment from a different angle: Expected

Constraints	*Expected total return on investment*	3,7%	
	Expected return on equity	5,6%	
	Debt rating	BB+	
	Equity rating[2]	93,5%	
	Earnings risk: Coefficient of variation total return (R)	12,7%	
	Cost of equity (k)	4,3%	
	Downside-risk (R)*	0,32	
Target	***Capital market rate (V / P)***[1]	**1,17**	



[1] Or price-value-ratio (P / V) [2] Probability return on equity over 2.5%

Source(s): Own presentation

Note(s): Displayed values for are for illustrative purposes only. They do not represent fixed and justified values. Individual values are subject to the individual risk strategy.The essence of the figure is the conceptual collection of the risk metrics and the graphical presentation

Figure 3.
The "Investment traffic light" as DSS in real estate investment[15]

total return on investment and return on equity are both alternative return indicators, which yield additional information about the location of the return and are especially resilient to the financing structure. Debt and equity ratings are useful probability indicators based on binary metrics for bankruptcy or minimum return on equity to ensure a limit to risk exposure.

Secondly, the dispersion or variation-related metrics contain information about the potential variance of income, such as the presented income risk (*R*). Thirdly, the cost of equity limits the possibility of misjudgment by a bandwidth. Lastly, the left tail risk is minimized by the Downside-Risk (R^*) indicator to limit the exposure to heavy downside risk for the value of a property. This measure is especially important in market phases of potential extreme mispricing.

Practically, the DSS should be implemented as part of the investment process for institutional investors based on an independent risk management unit to monitor the portfolio management section of the corporation or investment fund, respectively. The outlined investment traffic light is an easily understandable decision foundation, which can display unbearable or unwanted exposure stopping a transaction decision from a risk management point of view (e.g. by a red light). Operationally, veto rights, in line with the organizational architecture description of the KAMaRisk are a thinkable way for implementation.

5. Conclusion, practical implications and further research

The present paper outlined the necessity for a DSS for real estate investors from a financial risk management point of view. Therefore, the relevant literature was described. In order to provide insight, a conceptual model was developed to show the necessary DSS metrics for real estate investors, facing a macroeconomic environment which shows the typical characteristics for asset price bubbles.

Consequently, the sole assessment of the attractiveness of a real property based on the market price (expected price) and planned return (on equity) is inadequate. What is generally needed is a quantitative risk analysis and risk aggregation in the portfolio context and if necessary up to the corporate level. It is the basis for deriving key figures that are needed to evaluate the returns-to-risk profile, as displayed in Figure 3. Comparable figures for the expected return on investment initially require identical assumptions. Thus, the central hypothesis can be confirmed.

It is important to look at the current market value (*P*), as estimated price, and the fundamental value of the cash flows, that are generated by the real estate (*V*). The minimum requirement for the expected return (discount rate) and the value of the cash flows depends on the scope of income risk (variation coefficient of cash flows). Additional requirements often result for institutional investors: they require a key figure for the equity rating, which expresses the probability in which a prescribed target or minimum return will be reached or the downside risk, that depends on P/V. The specified system of risk measures enables market participants to protect themselves from potential threats against the economic sustainability of the cash flows of property investment positions.

As practical implication, the present study suggests the application of the specified metrics as supplementary DSS for real estate transactions. Any institutional investor may use the named metrics as part of their risk management unit in order to support the asset allocation and investment process. In this context, the organizational embedding of the outlined DSS is highly advised. In line with the German legislation a monitoring function for the risk management unit including the DSS could be beneficial. Especially in the current times of low interest rates and potential divergence of fundamental economic determinants of capital values and prices, a DSS with special regard to asset price bubbles should be urgently implemented. From a legislative point of view, further tightening of the existing framework appears to be necessary, especially if the low interest rate prevails. Interestingly, a tension between legislators and central banks arises. On one hand, financial supervision urges market participants to increase underlying equity and minimize tail risk exposure, on the other hand quantitative easing and according yield compression of property investments forces investors to accept higher risks of their positions. From an academic point of view, this development will be interesting to monitor and analyze.

Further research is supposed to address two questions within the above-mentioned field of decision-making in real estate: risk coverage potential calculation of vehicles with dynamic liquidity as well as diversification benefit of investments within the context of real estate or multi asset portfolios. Firstly, especially for open-ended funds and their special liquidity dynamics, the quantification of the correct risk coverage potential benchmark is challenging, and needs further empirical studies. Secondly, the parameter d in equation (1) may be subject to further research. A real estate-related model to quantify the diversification portion of investments for existing portfolios remains an unsolved gap within the field of real estate research.

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Notes

1. In line with Oertel (2019). The author names various other determinants. Nonetheless, these parameters are beyond the scope of the present study, since the two named ones are the most dynamic in recent market phases.
2. With reference to various further literature: Goodhart and Hofmann (2008). Wölfle and Löffler (2017), Meltzer (1995) – to the effects of monetary expansion – Favara and Imps (2015) and Setzer and Greiber (2008) – for lending – Raftery and Runeson (1997) to the importance of money illusions on real estate markets – Granziera and Kozicki (2015) to herd behavior or positive feedback purchases on the real estate market such as Thoma (2013) to information cascades.
3. Lending and property price development reinforce each other, see Favara and Imbs (2015) and Setzer/Greiber (2008).
4. For a recent summary of the literature on the CAPM, see Rossi (2016).
5. This only applies to a perfectly diversified investor. See Gleißner, 2014; Dempsey (2013); Shleifer (2000); Rossi (2016), and Fernández (2017).
6. Violation of covenants is in most cases an "existence-threatening development" in the sense of §91 (2) AktG.
7. Regarding the fundamental problem of the asset illusion and misvaluation, see Gleißner (2014) and the empirical studies summarised there.
8. Accordingly, the uncertain earnings are discounted as appropriate to risk; regarding the method, see Gleißner (2011), 2017a and Gleißner *et al.* (2017) with a valuation example.
9. In real estate ratings, you can frequently also see debt ratings based on the so-called expected loss as a specific project rating, which considers the probability and the loss in the event of default. Regarding this project, see Gleißner (2009).
10. This applies analogously to foundations pursuing a certain foundation purpose.
11. Roy (1952); Telser (1955); Kataoka (1963).
12. Analogously, the variation coefficient of the return or the cash flow.
13. See Gleißner, 2017b, for use in the further development of value investing strategies.

14. Calculation V = Expected value − 0.25 · risk = 7–0.25 · 5 = 5.75 with $r_f \approx 0$ and risk = 5 (the standard deviation, compare to the method Gleißner, 2011 and Gleißner, 2014).
15. In Figure 3 it is presumed that the investment can be done with price *P*. Thereby "expected total return on investment", expected return on equity, equity rating, debt rating and downside-risk depend on *P*. Income risk and cost of equity are independent on *P* but determine value *V*.

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