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Predicting uncertainty: the impact of risk measurement on value of real estate portfolios

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1. Introduction and problem definition

Performance assessment and valuation of investments have always been critical issues in fund management. First of all, investors are interested in monitoring the performance of their portfolios and the financial status of their positions. In addition to measuring past performance of their assets, investors also rely on this information while conducting their (re)investment decisions for the future.

An assessment of expected risks and returns is a key element of investment appraisal and portfolio optimisation processes (Pagourtzi, Assimakopoulos, Hatzichristos, & French, 2003, Savvides, 1994). A proper performance evaluation, however, both ex post and ex ante, is only possible if risk exposure of the underlying asset, or portfolio, is known. While sensitivity to uncertainty might be relatively easy to assess in hindsight, it is important for investment decisions to capture it ex ante, by means of a useful rating. This rating should give an overview of the key risks of a specific investment.
Investments with an inferior rating should still be considered, as long as risk premiums and the prices are appropriate. Knowing that an asset is priced fairly requires accurate information about the asset’s quality. That is why in less transparent markets or institutional settings, rating is important for valuation. Given the relevance of performance assessments outlined above, a proper investment rating is critical for well-functioning resource allocation. This is particularly true for investments undertaken through intermediaries such as investment funds. Although intermediaries provide specialist knowledge and professional investment expertise, they give rise to a problem of asymmetric information regarding the quality of their assets and fund managers behaviour (Morgan, 2002).

In this article, we suggest a theoretical model of assessing performance from the perspective of investors as well as lending institutions. Because of the high relevance of fund-specific risks in the case of real estate, we suggest deriving the rating of a real estate investment portfolio as a function of cash flow volatility, i.e. its income risk. This approach would allow focusing on the risk of insolvency of a particular investment and assessing the probability of this particular hazard. This information can also be used for calculating discount rates used for valuation.

Apart from simple–multiple based valuations, real estate appraisal today is largely based on discounted cash flow (DCF) valuations (Pagourtzi et al., 2003). In many cases, variations of asset pricing models such as the capital asset pricing model (CAPM) (Sharpe, 1964) are used. Within these models, discount rates are typically derived from historic returns of similar assets (for larger funds or portfolios) or from comparable actual transactions (for individual deals). However, considering imperfections of real estate and capital markets, using historical data to estimate risk-adjusted discount rates for valuation of assets can be difficult (Chari & Henry, 2005; Weber, Siebenmorgen, & Weber, 2005). This is true especially for less diversifiable assets (such as real assets) given their exposure to other risk factors. In fact, a number of empirical studies point out problems with estimating an appropriate cost of capital for real estate investments (Ibbotson & Siegel, 1984; Quan & Quigley, 1991). Another issue follows from the risk of insolvency, which should be reflected in the rating but is not always apparent from market prices of listed real estate companies (Corgel, McIntosh, & Ott, 1995). As a result, an adjusted methodology for assessing real estate investments in funds is required. Ideally, it should account for cash flow volatilities as well as the impact of insolvency risk on value of a company, a fund or an asset.

This paper suggests a new approach to risk assessment by presenting a theoretical case for predicting future uncertainty rather than concentrating on its historical values. It begins with outlining the criteria relevant for estimating insolvency portability of funds (ratings). In particular, a distinction is made as to whether a closed-end fund should be assessed from the perspective of a creditor or the owner. In addition, methods which can be used to assess closed-end real estate funds are outlined with special attention given to the high degree of specificity of the funds that needs to be considered. In this context, simulation-based rating processes, which explicitly take into account the uncertainty of future developments are explained next. Finally, the theoretical findings of the two methodologies, rating and valuation of funds are combined and used to demonstrate how simulation of the frequency distributions of cash flows can be transformed into risk measures used for calculating a discount rate appropriate for real estate valuation.
2. State of research: how useful are capital market data for rating and valuation of real estate funds?

In a perfect capital market it would be natural to derive a rating and value of real estate funds or portfolios from the capital market data. For instance, Merton (1973) has shown how implied insolvency risk and/or its rating can be derived from a volatility of market value. Moreover, the beta parameter in asset pricing models depends not only on the correlation between the returns of an asset with those of the market, but also on their relative volatilities (Fama & French, 2004). Nevertheless, the underlying assumption is that stock price fluctuations reflect all risks that are considered relevant for valuation.

However, especially over the past twenty years, empirical capital market research has shown that expected returns are influenced by more factors than just market risk. For instance, the three-factor model of Fama and French (1993) draws a link between return premiums and the size of the firm and its intellectual capital. These factors are proxies for the economic risk, the default risk and can be extended to include the momentum effect. Typically, discount rates decrease with company size, while the higher default risk momentum factor is more distinct in small companies than in large ones (Fama & French, 2012).

Although known in academia for over two decades, these factors have been ignored in valuation practice. Their importance can be illustrated by the so called ‘profitability anomaly’ (Fama & French, 2006, 2012 as well as Chen, Novy-Marx, & Zhang, 2011). The term describes a phenomenon where portfolios with ‘high profitability’ (according to the methodology of Fama and French (1993)) are on average, observed to exhibit an excess return which is not explained by the CAPM. In addition, the insolvency risk has also been observed to have a similarly significant impact (Dichev, 1998). In the traditional capital market view, risk is always seen as being linked to the (symmetric concept of) volatility of prices or returns with idiosyncratic volatility. In contrast to the traditional perspective, the relevance of idiosyncratic risks is supported by more recent empirical research. In their ‘new’ three-factor model, Chen et al. (2011) explain the expected excess return of a portfolio based on three factors: (1) the excess return of the market portfolio (market excess return, MKT), (2) the difference between the return of portfolios with low and high investment intensity ($R_{inv}$) and (3) the difference of the returns of portfolios with companies exhibiting a high vs. low equity return, respectively.

Altogether, this research shows that there is a need for an explanation of shareholder returns and alphas better than the three-factor model of Fama and French (1993). This may be especially true in the case of real estate, due to the high influence of asset-specific factors on performance (Esrig, Hudgins, & Cerreta, 2011).

Moreover, the impact of probability of default on asset value does not seem to be covered appropriately in market prices (Chan & Chen, 1991; Dichev, 1998). In fact, expected profitability of shares in companies with a distinct and above-average insolvency risk tends to be below average (Campbell, Hilscher, & Szilagyi, 2008). This has also been shown to be the case in real estate (Wheaton & Nechayev, 2005). In conclusion, the distress factor does not appear to reflect a rational price of risk (Chen et al., 2011; Walkshäusl & Lobe, 2014).

When examining the real estate market in particular, it has been known for a long time that returns from US REITs cannot be explained well by the CAPM. As in other industries, empirical studies show that the Fama and French (1993) three-factor model has a higher explanatory power. Pai and Geltner (2007) find that it is a good predictor of the cross-section...

In his study, Zajonz (2010) demonstrates the significant fluctuations of market prices around the net asset value (NAV) of European real estate companies. In the empirical analysis for the period from 2000 to 2007, the author states that company-specific aspects suggested by literature (debt ratio, size, etc.) only explain 14% of the NAV dispersion. By including sentiments, however, 76% of the difference between price and value of European real estate shares can be explained. According to Zajonz (2010), his results are definite evidence against the capital market operating rationally and efficiently. This finding is also confirmed by results from other markets (Anderson et al., 2005; Gentry, Jones, & Mayer, 2004; Ooi et al., 2007).

These results once again show that for a risk-adequate assessment of real investments, such as real estate or infrastructure, it is necessary to examine the (uncertain) cash flows of assets. Focusing on returns is not appropriate as they do not entirely reflect the cash flow risk of underlying assets. Therefore, capital market research emphasises the necessity to address income risks of an asset (e.g. cash flow volatility) as the basis for rating and valuation. What is more, recent studies show that the relationship between fundamental income risks (or debt ratios) and returns, which is expected in the case of efficient capital markets, may not exist (Beaver, McNichols, & Rhie, 2008; Hillegeist, Keating, Cram, & Lundstedt, 2004; Walkshäusl, 2012). Conversely, companies with a low fundamental risk (low debt, high yield stability) may show an above-average yield.

For real estate as an asset class, the conclusions regarding valuation can be summarised as follows: standard factor models are of limited use for calculating risk-adequate discount rates. Therefore, it is necessary to develop a proper risk analysis methodology that is based on income risks. Starting with investor expectations regarding real estate rating and valuation methods (Section 3), this article will explain how risk analysis and simulation can be used to construct such ratings (Section 4) and how it can be used in valuations (Section 5).

### 3. Rating methodology of fund risk

For a comprehensive risk rating of a fund it is important to combine the initial evaluation of the probability of success, with an assessment of qualitative success factors (‘soft criteria’) such as experience of the fund initiator. Yet, ‘success’ remains a very elastic concept; hence a clear specification is required. Hereby, ‘fund rating’ stands for a properly outlined and defined aspect of ‘success’, while the term ‘rating’ is defined as a measure of the probability of insolvency and default (PD) to mirror the creditors’ perspective.
Key indicators such as ‘value’ or ‘performance’ of a fund, which serve as a basis for the assessment from the owner’s perspective, must be distinguished from the above. These success criteria will be discussed in Section 5. At this point it is important to precisely determine the term ‘rating’. In order to achieve this some key questions need to be considered. Is rating taking into account only the level of information that a financial institution has or will information of the management also be evaluated? Is the rating related to current or future time periods? Is the probability of default an annually calculated value (one-year probability of default) or is it a probability of default over the next five years? Is the rating based on a statistically inductive model, as used by financial institutions, or on a causal explanatory model (structural model) which is required in order to plausibly derive alternative measures for stabilising the rating?

In addition to a precise definition of what a fund rating should be able to communicate, a process for evaluating the rating is required. Due to the high degree of specificity and the typically limited amount of historical default data from comparable properties, ratings based on empirical inductive insolvency, forecast procedures can be significantly biased. Hence, accessible historical default rates are not necessarily representative in the case of a real estate rating. According to the representativeness, requirements for a statistical inductive rating procedure the following conditions must be satisfied:

- a company or fund on which the rating process was developed is representative of the population with respect to causes of insolvency,
- the history of the company or fund is representative of what can be expected to prevail in the future,
- the impact of random risk on the most recent annual accounts is representative of the impact this risk expected in the future.

These prerequisites are generally not fulfilled in closed-end funds and even less often in closed-end real estate funds.

A precise assessment of ‘success’ and ‘rating’ requires an analysis of the specific strategy of the fund, by examining the profit and loss account and, possibly, the balance sheet more closely. Considering the long-term nature of investments in closed-end funds, particular attention has to be paid to risks that potentially trigger necessary changes in fund’s strategy. At the same time, risks must be understood as the possibility of deviations from the plan, which includes both positive and negative possible outcomes. Therefore, a more comprehensive assessment of a fund’s potential success often requires application of ‘stochastic planning techniques’, which provides a better overview of probabilities associated with the fund’s strategy.

### 3.1. Simulation-based rating

For an assessment of a closed-end investment fund, simulation-based rating forecasts and investment appraisal processes can be used. This is true both from the perspective of a creditor (rating) as well as an investor (project or enterprise value). In relation to rating forecasts, several development stages may be distinguished. In the simplest case, ‘deterministic’ rating forecasts are prepared. In these, the expected development of key indicators, based on fund’s strategy which are material to the (financial) rating, is estimated. This corresponds to the rating that financial institutions prepare for
companies, where data from historical annual reports are used. However, a forecast of a development of the rating is calculated here, which is based on the assumption that the development of the company, real estate property or portfolio, actually corresponds to its strategy (‘conditional rating forecast’).

The second stage consists of a stochastic rating forecast, based on the same set of the key financial indicators. In this forecast, each possible risk-induced scenario is analysed in a Monte Carlo simulation (Figure 1). This requires a forecast of the key indicators, so that a probability distribution of the rating’s development can be generated. Possible ranges of the forecasted values, which results from internal and external risks, can thus be determined.

In the third stage, a simulation-based rating forecast, i.e. a rating completely independent of actual financial indicators is derived, in which the probability of over-indebtedness and illiquidity is based solely on a simulation. Irrespective of the development of the key financial indicators, a check is carried out in all generated simulation outcomes, as to whether over-indebtedness and/or illiquidity would occur. That way, a company’s or a closed-end fund’s probability of insolvency can be directly determined and converted into a rating. This methodology is explained below.

3.2. Simulation-based rating forecast

A foundation of such structural and simulation-based rating forecast models is the expected profit and loss statement, or cash flow and balance sheet. Unlike traditional company planning processes, an examination of risks to individual planning variables is necessary. Planning items are thus described through probability distributions. For example, in a real estate fund the range of the vacancy rate is described by (a) minimum value, (b) most probable value, and (c) maximum value.

Here, the uncertainty regarding significant assumptions (e.g. operating costs) is taken into account just as much as (exogenous) economic influences, i.e. uncertainty of the development of rental indices, inflation rates, interest and exchange rates, or energy prices. Through an informed economic evaluation, it is possible to capture the potential impact of
changes in interest rates or energy prices on the success of the fund. By calculating a large number of possible risk-induced scenarios of the fund's development, a realistic range of cash flows can be estimated.

By developing these scenarios, an (often unrealistic) point forecast is replaced by a more realistic range of potential outcomes. All difficulties with determining an appropriate rating, explained earlier in this section, can be addressed by using a probability distribution calculation. The simulation (Monte Carlo simulation) is thus a key methodology for valuation and derivation of the rating. It is thus possible to calculate in what percentage of the simulated scenarios a fund is expected to report losses and how much equity would be required in order to compensate for possible losses given a default probability accepted by investors. Hence, the probability of insolvency or illiquidity depends on the results of the simulation, while the fund's rating depends on the probability of insolvency. In this case, calculations of individual risks are aggregated and reflected in the 'equity requirement', which is necessary in order to bear risk-induced losses. The equity requirement is a measurement of risk, which is based on the value-at-risk or conditional-value-at-risk.

4. Value of funds

In the real estate industry (as in many areas of business administration), very often a distinction between the fundamental value of an asset and its price is an important point. Value is an outcome of an appraisal process and often corresponds to future (uncertain) cash flows of an asset. Conversely, price is a result of purchase and sale transactions and for heterogeneous assets (such as real estate) an outcome of a negotiation process.

Therefore, the term 'value' should be considered somewhat more closely. In contrast to the DCF model-based real estate property value, price shows at what amount of money a purchase or a sale of an asset is possible today. The DCF value should be independent of preferences (utility function), level of information and any restrictions of the appraiser. A match between DCF values and prices only occurs in perfectly efficient markets, in which all investors have homogeneous expectations, share the same information and access to the same assets, and where markets can quickly adjust to new information.

4.1. Discounted cash flow valuation

If value is defined as the present value of insecure payments related to the object of valuation, the problem becomes obvious: value critically depends on underlying assumptions. When determining values for corporate-level decisions, e.g. the purchase or sale of real estate, it is necessary that those assumptions are accepted. When determining value for a specific type of buyers or sellers, it must be established whether the assumptions are true for that agent.

In order to determine the value of a volatile stream of payments in a single period model, an 'imperfect' replication is executed (Gleißner, 2011). It is assumed that the same risk measure \( R \) and the same expected value of payments imply an identical value. Thus, a \((\mu, R)\) decision criterion is implied, which includes the \((\mu, \sigma)\) principle. Furthermore, two alternative investments in addition to the valuation object shall exist, e.g. a broad market index (proxy for the market portfolio) with a risky yield \( r_M \) and a (virtually) risk-free investment with an interest rate \( r_f \). Then, exactly the amount of capital \( x \) is invested in the market index and capital \( y \) in the risk-free investment, so that the risk of this portfolio corresponds to the
risk of payments related to the subject of valuation \( Z \). In this context the risk is measured with a risk measure \( R(Z) \), e.g. with the standard deviation or the (relative) value at risk.

\[
R(Z) = \mathcal{R}(x \cdot (1 + r_M) + y \cdot (1 + r_f))
\]

The expectation value of the repayment of the investment in the replication portfolio (market index plus risk-free investment) shall correspond to the expectation value \( E(Z) \).

\[
E(Z) = E(x \cdot (1 + r_M)) + E(y \cdot (1 + r_f)) = x \cdot (1 + E(r_M)) + y \cdot (1 + r_f)
\]

The value \( W \) of payments \( Z \) corresponds precisely to the sum of \( x \) plus \( y \).

The frequency distribution of earnings, or cash flows, calculated in the simulation of \( \tilde{Z} \) (e.g. profit, earnings, cash flows) results in an expected value \( E(\tilde{Z}) \) and a risk measure \( R(\tilde{Z}) \). Through the combination of \( E(\tilde{Z}) \) and \( R(\tilde{Z}) \), an (ex ante) measurement of performance as well as value \( V(\tilde{Z}) \) of the cash flow can be determined.

### 4.2. Treatment of risk in DCF calculations

Formula 1 shows (for a payment in a single period at time \( t \)) that the value – e.g. of real estate with uncertain cash flows – can be calculated by discounting \( \tilde{Z} \) with a risk-adjusted capitalisation rate \( k \) or with a risk discount from the expected value of \( \tilde{Z} \). In this case, certainty equivalents can be discounted with a risk-free interest rate \( r_f \) (Rubinstein, 1973).

**Formula 1: DCF valuation and risk measure \( R(Z) \)**

\[
V(\tilde{Z}) = f[E(\tilde{Z}), R(\tilde{Z})] = \frac{E(\tilde{Z})}{1 + k} = \frac{E(\tilde{Z}) - \lambda \cdot R(\tilde{Z})}{1 + r_f}
\]

Valuation equations (such as Formula 2) – and therewith the specification of \( \lambda \) – are based on the methodology of ‘imperfect replication’. The basic assumption is simple: two cash flows have exactly the same value (at the same time) when their expected payments adjusted for their respective risk levels, e.g. the standard deviation of cash flows, correspond (for more on this methodology, see Gleißner & Wolfrum, 2008, 2009; Gleißner, 2011). Thus, risk can be derived without any reference to an individual utility function (for more information, see paragraph 6, especially regarding the interpretation of lambda, which covers the risk aversion or the return/risk profile of alternative investments such as the market risk premium in relation to the market risk).

The general valuation approach has to be adjusted to specific valuation cases. This refers in particular to determination of a risk measure and (usually two) alternative investments (available on the market or fictitious ones) which have to be specified with regard to the parameters ‘\( \mu \)’ (expected value) and ‘\( R \)’ (risk measure). A ‘risk diversification factor’ \( (d) \) arises from the asset structure of the party performing the valuation. It exists independently from the valuation object and the stochastic dependency between the payments of the valuation object and the ‘remaining’ portfolio. However, only risks which directly affect the asset being valued are relevant for an objective process.

Valuation should be based on risks that can affect a particular investment in the future. A greater level of risk also leads to higher risk-induced losses, which implies a larger equity requirement. Higher risk leads to higher requirements for an expected return (discounting
interest rate, capital cost rate) and possibly a lower net income value of the investment. Unless expected income values rise substantially, increasing the level of risk very often leads to lower net income value and a less favourable rating.

These considerations can lead to deviations of a value calculated by the DCF method from market value stated in official expert reports and market price, which can be regarded as a purchase or sales signal. Whether this ultimately leads to a transaction depends on specific market opportunities.

4.3. Asset-specific discount rate

In order to reflect cash flow volatility in a real estate portfolio, the DCF model may apply discount rates which are based on a risk analysis and associated simulations. Consequently, for a representative period, the value can be calculated in two ways: discounting with a risk-adjusted cost of capital rate or with a risk deduction (certainty equivalent). The latter refers to the concept widely used in finance, in which risk deduction depends on volatility of cash flows ($\sigma(\text{Cashflow})$). Since in this method risks are taken into account in the numerator, certainty equivalents have to be discounted with the risk-free interest rate $r_f$, as already argued above.

**Formula 2: valuation**

$$W(E(\text{cashflow})) = \frac{E(\text{cashflow})}{1 + k} = \frac{E(\text{cashflow}) - \lambda \cdot \sigma(\text{cashflow}) \cdot d}{1 + r_f}$$

Formula 2 includes a risk diversification factor ($d$). This needs to be considered because the party interested in valuation (e.g. a buyer) is not affected by all risks of the valuation object. This factor shows the share of risks that the interested party is impacted by. In the CAPM, $d$ is equal to the correlation coefficient $\rho$. For a market portfolio and a risk-free investment as alternative investments the ‘market price of risk’ (measured by $\lambda$) equals the Sharpe ratio:

**Formula 3: lambda as a sharpe ratio**

$$\lambda = \frac{r_M - r_f}{\sigma_M}$$

Under usual market portfolio assumptions, the parameter is around .25. In the CAPM, as can easily be seen, the following applies: with $\sigma_i$ as the standard deviation of the return on stock $i$. Now we can solve Formula 4. With the expected value of cash flows and the standard deviation $\sigma(\text{Cashflow})$ as a risk measure, the following expression results for the cost of capital $k$:

**Formula 4: discount interest rate**

$$k = \frac{1 + r_f}{1 - \lambda \cdot \frac{\sigma(\text{cashflow})}{\text{cashflow}} \cdot d} - 1$$

The ratio of sigma and the expected value of cash flows is called the coefficient of variation. It covers the cash flow risk of the evaluated asset and results directly from the risk simulation discussed earlier. The risk-adjusted discount rate $k$, calculated with Formula 6, can now be used for valuation of uncertain payments of real estate by applying the DCF
method. If the valuation subject (e.g. a buyer of real estate) bears all the risks and if risk diversification effects are disregarded, this means that $d$ equals 1. As one can see, this capital cost rate deviates clearly from the one derived using CAPM. This is due to the fact that all asset-specific risks of future cash flows are taken into account, including the risk estimated from (historical) return volatilities that would primarily be useful for short-term investors. The discount rate represents volatility risk, asset-specific risk and risk diversification benefit for a particular real estate portfolio and is unaffected by potential sentiment that may be prevailing in the real estate market. This allows a more rigorous and structured valuation process than the capitalisation approach.

In summary, historical capital market data about valued assets is not required. Capital market data concerning available alternative investments, risk-free assets and market portfolios are used instead. The risk level of the property cash flow replaces the beta factor and can be converted, according to Formula 6, into a discount interest rate for the DCF rating. In addition, it should be noted that the likelihood of insolvency (corresponding to the rating, see Section 3) should be considered in the DCF valuation, because it acts as a negative growth rate supplement to $k$ (Gleißner, 2011).

Unlike traditional valuation processes, which are based on capital market data (such as the beta factor of the CAPM), the risk-adequate requirements for the yield are thus directly derived from ‘earnings-risk’ as a result of the strategy and risk analysis. With the net income value (DCF or cash value) it is possible to calculate a ratio showing the relative value added. The so-called ‘Tobin’s Q’ in the context of real estate investments can be interpreted as the ratio of net income value to the necessary investment volumes ($I_0$).

**Formula 5: Tobin’s Q**

$$\text{Tobin - Q} = \frac{\text{earned value}}{\text{total investment}} = \frac{V(\tilde{Z})}{I_0}$$

A Tobin’s Q above 1 indicates that an investor gets more ‘value’ through an investment in a fund than he or she has to invest – which constitutes the necessary condition for an economically meaningful investment.

Valuation of individual real estate property portfolios is generally based on a DCF model, in which the proceeds from the sale and the costs of the real estate property are stated. Based on the traditional DCF models, it is necessary for a risk-adequate valuation to explicitly model the probability distribution of the cash flows (payments $\tilde{Z}$) and thereby allow estimation of individual risks and the success probability of an overall strategy. The DCF methods based on stochastic planning make it possible to carry out a risk-adequate valuation, i.e. to derive a corresponding NAV, and thus to implicitly determine risk-adequate required property returns (discount rates). The specific implementation of the methodology for a portfolio of real estate properties will be discussed later in greater detail.

Hence, valuation and rating both require precise knowledge of relevant risks and asset specific strategy. The rating (creditor perspective) and the fundamental discounted earnings value (owner perspective) are derived consistently from the cash flow probability distribution in the risk simulation. Furthermore, based on future-oriented planning and taking into account the risks that can trigger variances to the plan, the probability of insolvency estimation as well as a valuation of the fund can directly be carried out with the help of the simulation processes explained. Due to the different perspectives of the involved agents,
rating and valuation are thus not exchangeable concepts, but they can be consistently derived with an identical information set based on the same methodology.

### 4.4. Expert knowledge in risk rating

In the context of a portfolio management system, a valuation performed by an expert can be integrated as a second valuation technique in open-end funds, in addition to the DCF model. In many countries this procedure is a legal requirement for determining current market values of funds and has great practical value. Variables used in this technique are specified by professional surveyors.

The difficulty with making predictions, and thus with portfolio management, when procedures are specified by surveyors is forecasting property returns. Experts usually base their assessment on market observations taking both growth and risk into account. The process of estimating property returns cannot be easily described since a large number of property and report-specific aspects have to be taken into account. Quantification of these variables relies on practical experience and is difficult to generalise.

### 5. From individual real estate properties to real estate property portfolios

So far, mainly individual real estate properties (although as part of real estate portfolios) have been considered. In the following section, it is shown how the presented methodology can be applied to rating risk and calculating risk-adjusted NAV in a portfolio context. This
is done by taking into account diversification effects as well as risks that affect cash flows and value development of many or all real estate properties.

5.1. A portfolio model

A portfolio model of a real estate property fund (closed-end or open-end) can be used, as early as, the initiation or concept development phase to optimise the structure of the fund (composition of the portfolio, financing structure, rental commitment periods) with regard to the risk-return ratio. In addition, portfolio models inform decisions and can be used to derive risk ratings by taking into account the risk diversification effect in the portfolio context. As shown above, assessment of a portfolio is possible both from the perspective of an owner (net income value, Tobin’s $Q$) as well as a creditor (rating).

Furthermore, real estate property portfolio models can enable investors to estimate both value generation ability (measured, e.g. by Tobin’s $Q$) as well as probability of insolvency (the rating) in a well-informed manner while taking into account relevant future risks. Such a portfolio system is an instrument that shows the expertise of the initiator and contributes to obtaining better financing conditions by illustrating efficiency of the planned fund or portfolio to professional investors. After initiation and formation of a fund (or a real estate property company), the portfolio model can be used to regularly optimise the structure of the portfolio. A good example would be assessing potential purchases and sales in the context of their consequences for future return and risks after adjusting for account diversification effects. However, such portfolio systems will primarily be useful for those open-end funds or real estate investment trusts (REITs) whose objective consists of achieving added value, compared with a ‘buy and hold strategy’.

In this section, a portfolio model for real estate properties is developed in three steps:

1. A valuation procedure for individual properties is defined (e.g. DCF model). A uniform valuation algorithm contributes to a high level of transparency of assessment, comparable valuation results for individual real estate properties and above all shows that certain ‘value drivers’ (such as the interest rate) have an impact on all real estate properties.

2. Based on the property valuation model, factors that influence value but cannot be seen as certain can be identified. These can be systematic variables like inflation rates, interest rates or a ‘general rent level’ (mostly considered separately), but also unsystematic ones like fluctuations of the vacancy rate or costs of changing tenants. For each of these general and property-specific risks the best possible description of the degree of their uncertainty (according to their probability distribution) must now be established.

3. The property-level valuation model can now be expanded to a technique suitable for an entire portfolio. The basic structure is generated from the so-called ‘economic balance sheet’, which describes all individual properties through a uniform valuation function (see Figure 2 and CEA-Groupe Consultatif, 2007). The model uses market values as a basis and adjusts them for risk factors that are reflected on the assets side of the balance sheet. This may be used to derive the respective risk–return structure. In this case the NAV, as a control parameter of the portfolio,
is a balance sheet item on the liabilities side: \( \text{NAV} = \text{total equity and liabilities} - \text{provisions} - \text{loans} \).

### 5.2. Estimating and using a portfolio-specific risk rating

There are several portfolio valuation possibilities. Some methods are based on distributions of individual asset values, while other techniques use valuations of payments related to individual real estate properties. In the first case, values of individual real estate properties are aggregated. This is the most common approach. Individual real estate property values are calculated from cash flows of these properties and summed up. In the second case, cash flow payments are added across all properties. In both versions, measurement of risk is crucial to determine a discounting factor. However, only in the second approach diversification effects of property values can be taken into account. In this case, estimating a discount rate requires a (Monte Carlo) simulation as there generally is no unique solution. A large number of possible future scenarios need to be calculated and analysed, so that the realistic range of future cash flows or values is displayed. As a result, the risk diversification effect, i.e. the value added due to risk diversification, can be calculated (by using Formula 6).

In addition, at a portfolio level, payments not assigned to individual properties must also be taken into account. This is true for interest payments, interest income as well as portfolio management costs (see Figure 2).

Based on the portfolio model, the fund initiator or the board of directors of a real estate property company can derive and communicate an appropriate rating. Furthermore, if outsiders such as a fund rating agency, an auditor or a potential investor, wish to use portfolio models for deriving a fund rating, there are two common ways to do this. The first approach involves an external rating analyst who uses his own portfolio model to analyse the public portfolio structure of the fund in question. Unpublished information (e.g. regarding risks, such as fluctuations in the vacancy rate) is approximated with benchmark values. The second method is preparing a rating evaluation in close collaboration with the fund by (a) assessing their portfolio model and (b) using the model to estimate expected portfolio return scenarios based on the analyst’s assumptions regarding the future (e.g. the real estate property markets and the macroeconomic risks). Both methods can be used effectively, however the second one is more straightforward and generally corresponds to the approach rating agencies use in corporate ratings when companies (such as banks and insurance companies) use internal risk models.

### 6. Conclusion

This paper presented a conceptual framework for assessing real estate investment funds based on modern stochastic DCF model, which explicitly demonstrates the nature and extent of related risks.

Traditional DCF valuations were shown to be subject to several problems when applied to real estate. This is mainly due to the fact that such techniques are focused on a cost of capital derived from asset pricing models based mostly on historical capital market data.

The first challenge to the traditional model is that the risk of a shortfall in cash flow targets and ultimately insolvency is, in general, not well reflected. This is due to the fact that,
in most cases, only expected cash flow is used and only its risk is reflected in the discount rate. However, risk is often asymmetric and the risk premium calculated with traditional models does not account for this fact. In practice, despite these issues, traditional approaches remain important investment criteria, especially for private or institutional investors.

Another problem of current valuation methods is the fact that in reality idiosyncratic, or specific, risks are typically not as well diversifiable as it is assumed in CAPM. Academic literature has shown that even for liquid financial markets specific risks are often offering a persistent financial premium. This is even more relevant for real estate due to restricted diversification possibilities in this asset class.

The final challenge is the perception of stock market risks as the main type of systematic (and hence pricing-relevant) risks for financial assets. In fact, they seem to have little relevance for real estate investment. This is due to the fact that the real estate market operates differently than the stock market. As a result, various specific risks of real estate investments need to be considered.

These findings call for considering a broader spectrum of possible cash flow outcomes while estimating value of a real estate investment. In addition, a method of rating investments seems necessary to reduce information costs for investors. In particular, the rating should help investors capture asset-specific risks.

This article suggests a method of deriving such rating from cash flow volatility. Calculating the range of potential outcomes using different cash flow paths can offer valuable information for rating risk and estimating investment value. This paper concludes that a methodology of simulation-based rating and valuation can be highly relevant for real estate investments. This appears to hold true not only for individual properties, but also for a more general case of a fund, or a real estate property company, with a larger number of properties in their portfolios.

A clear distinction must be made between two perspectives on any assessment of real estate properties, portfolios or funds. While owners are interested in net income or NAV and Tobin’s Q, creditors are concerned mainly with insolvency probabilities or risk ratings. The simulation-based (stochastic) DCF model developed in this paper shows that it is possible to construct a procedure enabling simultaneous and consistent valuation of closed-end funds from both perspectives. Furthermore, simulation results can be used to show which financial policy a fund should adopt in order to maintain or achieve a certain rating.

The basic logic used to create the presented valuation methodology was based on the replicating portfolio approach. Two simultaneous payments were assumed to have the same value if their expected levels and risk measures (e.g. standard deviations) were equivalent. This valuation function is independent of expected utility and the results are only consistent under certain assumptions (e.g. assuming normally distributed payments).

Specifying parameters and assumptions for the simulation are critical parts of the valuation procedure presented in this paper. All further results are contingent on those steps and can only be as good as the derived risk measure and rating. Empirical tests should be performed in order to establish correct parameters. It would also allow validation of the approach presented in this work and assessing its ability to capture risk more effectively than current methods. Nevertheless, simulation-based techniques can contribute to an improved understanding of uncertainties of real estate investments, by displaying a realistic range of cash flow developments and performance outcomes.
Disclosure statement

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