Credit and Capital Markets, 56 (2023) 3/4: 389–418
https://doi.org/10.3790/ccm.2023.1443401
Scientific Papers

The Value Impact of Using Total Market Return and its Implications for Valuation Practice

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Abstract

The objective of this paper is to analyze the suitability of the Total Market Return approach within the requirements of the capital asset pricing model, and for the purpose of business valuation, particularly in light of its endorsement by the institute of German auditors (IDW). First, we question the use of the total market return approach on a theoretical basis. Then, we analyze whether total market returns influence the institute's recommendation for the market risk premium in a meaningful way and show the implications of a rigorous application for a large sample of valuation reports authored by German auditors. Our results reject the suitability of the Total Market Return approach for the purpose of business valuation on theoretical grounds, show that its rigorous application would have led to much lower company valuations, and highlight the necessity of revising the reasoning behind the recommended bandwidth of market risk premia.

Keywords: Market risk premium, Total market return, Company valuation, Discounted cash flow

JEL Classification: G12, G32, G34

I. Introduction

Business valuation remains ever relevant, not only on the occasion of an IPO or M&A activity, but also in day-to-day business, due to value-based management or taxation. In its course, the discount rate takes on a central role for investors, auditors, financial analysts, creditors and not least shareholders. In this context, the recent change in the risk-free interest rate, with the European Central Bank raising rates by four percentage points between late July 2022 and late

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We would like to thank an anonymous referee, whose valuable comments and suggestions helped us to improve the quality of this paper.

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September 2023, at which level they have remained for the past six months, presents an interesting setting for business valuation. The institute of German auditors (Institut der Wirtschaftsprüfer in Deutschland, IDW) has used the historically low interest rates of the last decade to back increases in its recommendation for the market risk premium (MRP) (IDW 2012; IDW 2019; IDW 2022) and has yet to react to the recent development.

We would expect the MRP recommendation to be lowered, especially since *Castedello* et al. (2018) prominently feature the Total Market Return (TMR) approach, among others, in their article to justify a previous increase. This empirically motivated approach was used by *Wright* et al. (2003) in an expert opinion for British economic regulators and argues that real market returns are constant through time. Therefore, the historical average of the real market return minus the current real risk-free rate is supposed to be the best estimate for the future MRP according to these authors. *Wright* et al. (2003) base their argument on the empirical observation in *Siegel* (1998, pp. 11–13), that the geometric mean of real returns on equities had been more or less stable at 7 % p.a. for almost 200 years (arithmetic mean around 8.5 %). *Siegel* (1998, pp. 16–18) argues that bond returns in the 20th century were exceptionally low, so that rising bond returns would mean a lower expected MRP. In the newest edition (*Siegel* 2023, p. 29), the geometric mean of real market returns remains virtually unchanged at 6.9 % p.a. With even inflation-linked sovereign bonds yielding negative returns however, *Siegel* arrives at an MRP estimate of almost 6 % only after assuming a fall in the historical market return of 2 %, which he does not explicitly justify or explain (p. 32).

Castedello et al. (2018) have fueled a burgeoning discussion of the use of the TMR approach for business valuation in Germany. *Knoll* (2019) challenges the height of the MRP bandwidth recommended by the IDW generally, and presents some evidence for a positive correlation between risk-free rate and MRP (*Jopp/Knoll* 2021), in contrast to the TMR approach. *Kaserer* (2021), on the other hand, finds evidence for a negative correlation for Germany, the US, the UK and Japan, supporting the approach. A perfect negative correlation between MRP and risk-free rate had already been called into question (*Partington/Satchell* 2018; *Stehle/Betzer* 2019). While *Stehle* (2016) finds empirical support for the TMR approach in the US and UK markets, he rejects its applicability for Germany and Australia. Further, *Randl/Zechner* (2019) find no support for the approach in a sample of 20 countries based on the extensive time series of *Dimson* et al. (2015).

To assess the suitability and implications of the TMR approach within the framework of business valuation as required by German law, we formulate three research questions. First, does the TMR approach align with the requirements and propositions of the capital asset pricing model (CAPM)? This question is not addressed by the aforementioned literature. However, it is pivotal to clarify whether the TMR approach is consistent with the CAPM, because the CAPM is to be applied with a TMR-based MRP by the proponents of the TMR approach. The TMR-based MRP is multiplied by a company's beta to estimate the company-specific risk premium. Second, are the results of the TMR approach reflected in the MRP recommended by the IDW in a plausible way? If they are, this could have important consequences for the valuation framework endorsed by the IDW, especially in conjunction with our first research question. If they are not, their use would be redundant. Together with the observation that German auditors usually follow the IDW recommendation, this also leads to our third question: How much would company values calculated by German auditors change, if the TMR approach were rigorously applied? Our latter two – empirical – research questions concern a comparison of MRP and company values calculated with the TMR approach with those recommended by the IDW or cited in valuation reports, which regularly follow the IDW recommendations and methods. As such, we also follow the approaches devised by the IDW in our calculations to ensure comparability, even though these methods may be subject to criticism.

II. Theoretical Analysis (1st Research Question)

To answer our first research question, we question the ramifications of a constant market return, i. e., of a constant sum of risk-free rate and market risk premium, which is supposedly not affected by changes in the risk-free rate. *Drukarczyk/Schüler* (2021, pp. 264–266) reach the following conclusions in this regard:

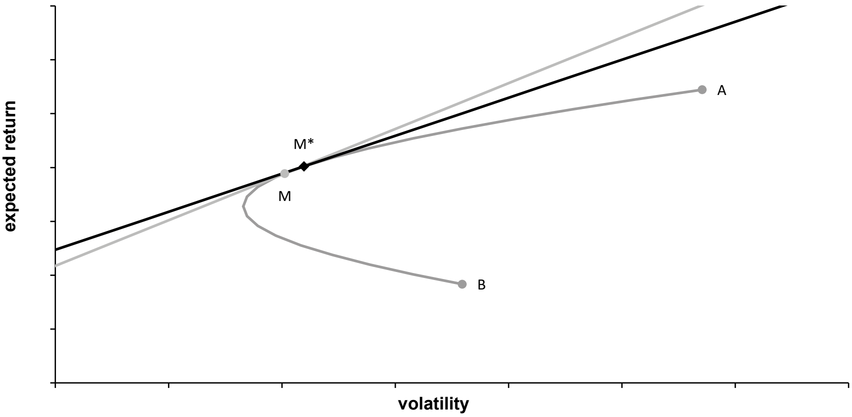
– In general, company value is influenced by the level of the risk-free rate, therefore also affecting returns based on the value of equity. If changes in the risk-free rate change the returns of most, if not all, companies, then the set of efficient portfolios (the efficient frontier) and the market portfolio cannot remain unchanged. Thus, a market return which remains unaltered by changes in the risk-free interest rate is inconsistent with the CAPM.

– Assuming that constant expected returns (μ) on the market portfolio, as required by the TMR approach, also imply a constant volatility (σ) of these returns, then the position of the market portfolio (M) would be fixed on the μ-σ-chart. Changes in the risk-free rate would then lead to M no longer being the tangential portfolio, or no longer being efficient, if changes in company values shift the efficient frontier as mentioned above. A new portfolio M* would take its place. Again, the notion of a constant expected market return is incompatible with the CAPM.

– Changes in the risk-free rate also affect the market price of risk (λ), defined as the difference between expected market return and risk-free rate divided by the variance of the market return. Assuming, as before, that the TMR necessitates both constant returns and risk, a higher (lower) risk-free rate would lead to a lower (higher) λ. An inverse relationship between risk-free rate and market price of risk is not convincing. This is illustrated by a numerical example in *Drukarczyk/Schüler* (2021, pp. 266–268).

– If the market return was indeed (nearly) constant, the question arises how beta values derived via a regression using the market return as an independent variable can differ from zero.

The first two points can be shown even in a simple example, with only two risky securities – stocks A and B – whose expected returns are assumed preliminarily to be unaffected by changes in the risk-free rate for illustration purposes only. In this case, the risk and return of A and B do not change with a varying risk-free rate, and the efficient frontier defined by these two securities therefore cannot change either. Their positions on the μ-σ-chart are fixed. However, the respective weights of the two securities within the market portfolio will change, as they depend on the market price of risk λ and in turn the risk-free rate, as shown in the appendix. Therefore, the composition of the market portfolio M will change, shifting its position on the efficient frontier to M*, and affecting the capital market line as shown in Figure 1. The portfolio M is no longer the tangential portfolio, and thus cannot be the market portfolio after the change in the risk-free interest rate.



Note: The market portfolio M is composed of only two risky securities, stocks A and B, whose returns do not depend on the risk-free rate. Even so, changes in the risk-free rate change their respective weights in M, moving it on the efficient frontier to M* and creating a new capital market line.

Figure 1: Efficient Frontier and Capital Market Line for a Portfolio of two Stocks

For the realistic case, where company value and stock price depend on the level of the risk-free rate, the returns of A and B cannot be set exogenously, but require the stock price as an input, leading to a circular reference that could be solved by iterative calculation. However, if we expect company values to decrease with an increase in the risk-free rate, the position of the market portfolio would not only shift on the efficient frontier, but the whole efficient frontier would move and change its form as well.

Again, these considerations underscore that a constant, unchanging market return violates the CAPM. The market portfolio will change in response to a change in the risk-free rate.[1] However, this does not mean that the MRP is constant.

The assumption of a constant MRP is necessary when applying the unconditional CAPM, as is implicitly done by practitioners (*Ruiz de Vargas* 2020, 43c). A changing, time-dependent MRP would require the use of a conditional CAPM, in which parameters are allowed to vary over time, and for which additional risk factors have to be estimated (*Jensen* 1968; *Merton* 1973; *Jagannathan/Wang* 1996; *Lewellen/Nagel* 2006). Again, this does not justify the assumption of a constant TMR.[2]

We conclude that the TMR approach lacks a theoretical basis. Its proponents rather emphasize its alleged empirical validity. Not only because not all of the studies cited above are completely transparent regarding the data they use, do we refrain from replicating all of them in this paper. However, we consider it to be interesting to assess the value impact of using the TMR in practice. To this end, we analyze several hundred valuation reports authored by German auditors.

III. Sample

We start from a proprietary sample of 334 valuation reports for German listed companies as required by German law, for example due to a squeeze-out of minority shareholders, with valuation dates ranging from 2000 to end of 2022. The reports were hand-collected and then manually reconstructed to enable us to perform as-if-valuations in the following. 34 reports without a DCF valuation, and 9 reports which use foreign tax rates or foreign interest rates, or which have

[1] As also noted by *Merton* (1980), who uses this result to argue against a constant market return.

[2] *Ruiz de Vargas* (2023) further notes that it is inconsistent to utilize conditional market risk premia in an unconditional CAPM framework, and that this inconsistency in the TMR approach as shown in *Castedello* et al. (2018) may lead to the unfounded extrapolation of temporary effects into the future (*Ruiz de Vargas/König* 2024).

missing data, were excluded. Additionally, 64 valuation reports prior to the IDW's introduction of the Tax-CAPM[3] in 2005 (IDW 2005) were eliminated as well, as this new version of the valuation standard led to a large and sudden adjustment of market risk premia which would overshadow any results for that period. While the same might be true for the change in the German tax regime in 2008, we find the effects on the MRP to be both smaller and more gradual. Consequently, we decided against further reducing our sample. Our final sample thus comprises 227 DCF valuation reports for German listed companies from 2005 to 2022. The valuations are mostly (72 %) due to squeeze-outs (German Stock Corporation Act: § 327a ff. AktG), with other prominent purposes being domination and/or profit transfer agreements (22 %), for which shareholders of the dominated company have to be compensated, and mergers (5 %). The sample covers firms from seventeen industries, for example Technology (20 %), Industrial Goods and Services (17 %) and Real Estate (11 %). Panel A of Table 1 illustrates the sample breakdown by industry and Panel B by valuation year.

Table 1

Valuation Reports by Industry and by Valuation Date

*Panel A: Sample by industry**		*Panel B: Sample by valuation year*	
Technology	45	2005	8
Industrial Goods and Services	38	2006	6
Real Estate	26	2007	9
Health Care	18	2008	13
Media	13	2009	16
Consumer Products and Services	12	2010	13
Financial Services	12	2011	13
Energy	10	2012	22
Construction and Materials	10	2013	19
Automobiles and Parts	8	2014	22
Chemicals	8	2015	12
Others	8	2016	10
Telecommunications	7	2017	18

[3] Formulated by *Brennan* (1970). An early conversion to the German tax regime can be found in *Drukarczyk/Richter* (1995). For the approach recommended by the IDW, see *Jonas* et al. (2004).

*Panel A: Sample by industry**		*Panel B: Sample by valuation year*	
Travel and Leisure	5	2018	6
Retail	3	2019	10
Food, Beverages and Tobacco	2	2020	12
Basic Resources	2	2021	12
		2022	6
Total	227	*Total*	227

*Classification according to the Industry Classification Benchmark.

IV. Methodology and Parameters

1. Reconstruction of Real Returns

To derive the expected return on the market portfolio, we follow the approach outlined in *Castedello* et al. (2018; analogous to *Wagner* et al. 2013) for the sake of comparability. Accordingly, we start with the annual value-weighted real returns (r_R) on all German quoted stocks from 1955 to 2009 (*Stehle* 2004).[4] We extend this real return series to 2022 by deriving nominal returns (r_N) from the year-end levels of the CDAX and adjusting for actual inflation (π) according to the German Federal Statistical Office[5] with the Fisher equation (*Fisher* 1907, p. 359):

$$r_R = \frac{1+r_N}{1+\pi} - 1 \tag{1}$$

We want to stress that we refer to the CDAX as a proxy for the market portfolio only to reconstruct the returns given in *Castedello* et al. (2018), and do not recommend it for deriving market risk premia. The same is true for the DAX returns, which *Castedello* et al. (2018) show in the first half of their paper, but then substitute with the CDAX without further explanation. With integrated markets, a broad global index, such as the MSCI World or Datastream's DS

[4] This return series used to be available from Stehle's website at the Humboldt-Universität zu Berlin (https://www.wiwi.hu-berlin.de/de/professuren/bwl/bb/daten/dax/Stocks), which now (April 2024) has only data for German blue chip stocks (DAX). However, using the Fisher equation to calculate implied inflation from these nominal and real return series and applying the result to the nominal values provided in *Stehle* (2004) yields congruent values.

[5] Available at https://www-genesis.destatis.de/genesis//online?operation=table&code=61111-0001&bypass=true&levelindex=1&levelid=1684310507705.

World, is preferable from a theoretical standpoint (*Stulz* 1995; *Sercu* 2009, p. 681; *Ruiz de Vargas/Breuer* 2018; *Drukarczyk/Schüler* 2021, p. 262). Therefore, the correlation between the return on the CDAX or other national indices and the risk-free rate, as shown in Overview 4 in *Castedello* et al. (2018), is not a theoretically appropriate measure for the empirical validity of the TMR approach.

We can then replicate and update the single-year arithmetic mean of the real market return, as well as the 30-year arithmetic and geometric means of the real market return presented in *Castedello* et al. (2018). For the single-year arithmetic means, we use the simple arithmetic mean of the single-year returns from the year 1955 up to the respective year of our sample period (2005 to 2022). For the 30-year arithmetic mean, we calculate arithmetic means over 30-year periods, the first of which begins in (and includes) 1955 and ends in 1984, the first year for which a 30-year return history is available. These 30-year means are again averaged (arithmetic mean) up to each year of our sample period, leading to overlapping time periods for this estimate. For the last measure, still following *Castedello* et al. (2018), we form two non-overlapping 30-year periods from 60 years of data up to each year in our sample period. We calculate geometric means for both 30-year periods, which are then averaged arithmetically. For example, for 2017 we calculate the geometric mean return from 1958 to 1987 and from 1988 to 2017, and take the arithmetic average of both returns. For years prior to 2014, the time series is not long enough to provide 60 years of data for two non-overlapping 30-year periods. To deal with this problem, we shorten both periods in a staggered fashion.[6] So, for example, while the geometric mean for 2010 is based on two 28-year periods ending in 1982 and 2010 respectively, the value for 2009 is based on the 27-year period from 1955 to 1981 and the 28-year period from 1982 to 2009. Utilizing these procedures, our results are congruent with those given in Overview 6 in *Castedello* et al. (2018)[7] and Overview 7 in *Wagner* et al. (2013). Table 2 presents annual real market returns for the years 2005 to 2022, calculated with the different averaging methods and investment horizons, as well as the 2017 results for the CDAX given in *Castedello* et al. (2018). The noticeable decline in the geometric 30-year return from 2018 onward is due to the fact that, with only the two most recent non-overlapping 30-year periods entering the calculation, the exceptionally high returns of the years 1958 and 1959 are no longer included in the averages from 2018 and 2019 forward.

[6] Because of their focus on the single years 2013 and 2017, *Castedello* et al. (2018) encounter this problem only with the Frankfurt "top segment" data for 2013, and use an analogous procedure.

[7] We can also replicate their results for the Frankfurt "top segment" time series using the procedures outlined. However, this series is only available until 2013, and is thus not investigated further.

Table 2

Arithmetic and Geometric Means of Real Rates of Market Return over 1-year and 30-year Investment Horizons Applying the Procedure of *Castedello* et al. (CDAX)

Final year of the average	*Arithmetic single-year means (%)*	*Arithmetic 30-year means (%, overlapping)*	*Geometric 30-year means (%, non-overlapping)*
2005	9.54	8.60	6.67
2006	9.79	8.70	6.99
2007	9.92	8.79	7.13
2008	8.94	8.81	5.90
2009	9.22	8.87	6.19
2010	9.36	8.95	6.40
2011	8.91	9.01	5.93
2012	9.21	9.08	6.27
2013	9.48	9.13	6.55
2014	9.36	9.16	6.48
2015	9.38	9.13	6.46
2016	9.32	9.10	6.70
2017	9.40	9.11	6.83
Castedello et al.	9.40	9.11	6.83
2018	8.95	9.08	5.61
2019	9.17	9.04	5.00
2020	9.10	9.02	4.56
2021	9.12	9.01	4.93
2022	8.66	8.98	4.96

Note: Results from *Castedello* et al. (2018) and our reproduction for 2017 are highlighted in gray.

We calculate geometric means only for the purpose of reconstructing the results in *Castedello* et al. (2018), and focus on arithmetic means in the following where possible. As the IDW based its initial MRP recommendation on the arithmetic average historical MRP calculated in *Stehle* (2004), and has not distanced itself from this approach, it seems reasonable to assume that the IDW implicitly favors arithmetic averaging. Because our aim is to compare MRP based on the TMR approach to those recommended by the IDW, our focus on arithmetic averages is warranted to ensure the highest comparability.[8]

[8] Following the arguments in *Merton* (1980), *Ibbotson/Sinquefield* (1989, pp. 99 and 137), *Fama* (1977; 1996) and *Cooper* (1996) we also consider the arithmetic average to be superior for the derivation of discount rates in the context of business valuation.

2. *Derivation of Nominal Risk Premia*

As German valuation practice relies on nominal parameters to determine company value, we utilize three estimators for expected inflation to retransform the real expected market return into a nominal rate. Following *Schüler/Wünsche* (2023), we use:

1. The longer term (five years ahead) estimates from the Survey of Professional Forecasters (SPF),[9] a quarterly survey of professional forecasters by the European Central Bank.
2. Monthly implied inflation rates derived from expected real interest rates and nominal interest rates on German government bonds with a remaining maturity of ten years,[10] employing the Fisher equation. The Deutsche Bundesbank uses survey data from Consensus Economics to calculate the real interest rate (Deutsche Bundesbank 2023), making this measure essentially survey-based as well.
3. Daily quotes on 30-year inflation swap rates,[11] which can be interpreted as the expected annual inflation rate over the next 30 years (Deutsche Bundesbank 2015).

This is a deviation from *Castedello* et al. (2018), who aggregate information from inflation-linked German government bonds, inflation swaps and analyst forecasts from Oxford Economics, Global Insight and Economist Intelligence Unit to derive their expected inflation estimate. We refrain from using these analyst forecasts as we do not have access to them. For the inflation-linked government bonds, we do not consider them meaningful estimators, as data is limited to only four German bonds from 2014 onwards (and will become irrelevant entirely, because no additional inflation-linked bonds will be issued for now). It remains unclear if we could reconstruct the inflation estimate in Overview 7 of *Castedello* et al. (2018), even if we had access to the data, as they do not specify the aggregation process. However, our estimates are reasonably close, if somewhat higher, as can be seen from Panel A in Table 3. Initially, we reproduce the retrograde derivation of the nominal MRP in Overview 7 of *Castedello* et al. (2018) by adding their inflation estimate to the real market return and subtracting the nominal risk-free rate. The next lines show the calculation using our three inflation estimators. We use the Fisher equation to transform expected re-

[9] Available at https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=138.SPF.Q.U2.HICP.POINT.LT.Q.AVG.

[10] Published by the Deutsche Bundesbank in time series BBK01.WZ8587 (real interest rates) and BBSIS.M.I.ZAR.ZI.EUR.S1311.B.A604.R10XX.R.A. A._Z._Z.A (nominal interest rates).

[11] Available from Bloomberg with the ticker EUSWI30.

al rates of return on the market into expected nominal returns more precisely. The risk-free rate (r_F) is the uniform interest rate according to the IDW recommendation (*Castedello* 2018, p. 139), though without averaging or rounding, and all values are for year-end 2017.[12] As we start from the same real TMR, the deviation between the resulting MRP can only be due to differences in the expected inflation (a difference of 0.17 % for implied inflation and SPF, 0.26 % for swaps) and our use of the Fisher equation (a difference of 0.13 % for geometric means, 0.18 % for arithmetic means). Panel B presents updated results for year-end 2022. We find no significant differences between either the arithmetic single-year real market returns or the geometric 30-year returns for year-end 2017 and 2022 (t-test, Wilcoxon-Mann-Whitney-test).

Table 3

Retrograde Calculation of the Nominal MRP for Year-ends 2017 and 2022

Approach	*Average*	*Real market return (%)*	*Estimated inflation (%)*	*Nominal r_F (%)*	*MRP (%)*
Panel A: Nominal MRP calculation for year-end 2017					
Castedello et al.	arith. single-year geom. 30-year	9.40 6.83	1.70	1.30	9.80 7.23
Implied infl.	arith. single-year geom. 30-year	9.40 6.83	1.88	1.31	10.15 7.52
SPF	arith. single-year geom. 30-year	9.40 6.83	1.88	1.31	10.15 7.52
Swaps	arith. single-year geom. 30-year	9.40 6.83	1.97	1.31	10.25 7.62
Panel B: Nominal MRP calculation for year-end 2022					
Implied infl.	arith. single-year geom. 30-year	8.66 4.96	3.27	2.39	9.82 6.00
SPF	arith. single-year geom. 30-year	8.66 4.96	2.18	2.39	8.64 4.86
Swaps	arith. single-year geom. 30-year	8.66 4.96	2.62	2.39	9.12 5.33

Notes: Nominal MRP calculated by transforming real market returns using an inflation estimate, and subtracting the nominal risk-free rate (r_F), using data from *Castedello* et al. (2018, highlighted in gray) as well as three inflation estimators (implied infl., SPF, swaps). Differences to the deviations given above are due to rounding.

[12] *Castedello* et al. (2018) also use the risk-free rate for December 2017, and mention the 'current' inflation estimate, though it is unclear which point in time they are referring to. Using inflation estimates from the first half of 2018, closer to their publication date, would lead to our results matching theirs more closely.

One can also subtract the real risk-free rate from the real market return directly, to arrive at the real MRP. *Castedello* et al. (2018) assume a long-run real risk-free rate based on inflation-linked German government bonds of around zero percent and infer an MRP of at least 7 %. However, considering the zero-coupon inflation-linked bond with the longest remaining maturity of 29 years, which exhibits a return of –0.49 % at the end of 2017,[13] the real MRP based on arithmetic averaging would be 9.89 % and 7.32 % based on the geometric mean. This aligns more closely with the results of their retrograde calculation. *Castedello* et al. (2018) acknowledge in a footnote that both approaches should ideally yield the same MRP.

For 2022, the real return on the same inflation-linked bond is 0.09 %, leading to an arithmetic MRP of 8.57 % and a geometric MRP of 4.87 % through direct calculation. These outcomes, as well as the retrograde MRP shown in Panel B of Table 3 above, differ, in parts substantially. This highlights another problem in the application of the TMR approach: because one uses real market returns as the starting point, differing estimates of expected inflation can lead to highly divergent MRP estimates, especially, but not only, in times of volatile expected inflation.

As we use real returns calculated by applying observed inflation rates to observable nominal returns (*Stehle* 1999) and subsequently retransform them into nominal returns, one might ask why we do not use observed nominal returns directly. Opting for this approach, and utilizing these returns to calculate the future MRP with the TMR approach, implicitly assumes that the average historical inflation rate is the best estimate for future expected inflation. Untabulated results show that our measures of expected inflation are consistently lower than the average historical inflation rate throughout our sample period, leading to higher nominal returns calculated with historical inflation than those calculated with our inflation estimators. We do not consider historical values to be an appropriate estimator, and thus do not apply them any further.

3. *Extension to After-tax Risk Premia*

Finally, as all valuations in our sample incorporate the effects of personal taxation, but all values – including those reproduced from *Castedello* et al. (2018) – are pre-tax values, we compute after-tax market risk premia from the respective pre-tax nominal market returns at the reference date via the Tax-CAPM. The IDW recommends a bandwidth of after-tax market risk premia for this purpose,

[13] Deutsche Bundesbank time series: BBSSY.D.REN.EUR.A640.DE0001030575.A.

which is used by most auditors.[14] Our sample encompasses valuations prepared under two different tax regimes: 22 cases under a regime which imposes half the income tax rate on dividend payments (Halbeinkünfteverfahren), and 205 valuations where a flat rate income tax is applied to dividends (fully) and to capital gains (assuming an effective rate of only half the standard rate) (Abgeltungssteuersystem).

During the former (Halbeinkünfteverfahren), the after-tax MRP was calculated as follows (*Drukarzcyk/Richter* 1995; *Jonas* et al. 2004):

$$MRP_n = k_M + d_M\left(1-\frac{\tau_H}{2}\right) - r_F\left(1-\tau_H\right) \tag{2}$$

Where MRP_n denotes the after-tax market risk premium, k_M the nominal return on the market portfolio due to capital gains, d_M the dividend yield on the market portfolio, r_F the nominal risk-free rate and τ_H the income tax rate. According to the recommendation by the IDW, τ_H is set equal to 35 % and capital gains are treated as tax exempt.

For the flat rate tax regime (Abgeltungsteuersystem), in effect since 2008, the after-tax MRP is calculated by German auditors as follows (*Zeidler* et al. 2008):

$$MRP_{n,2} = k_M\left(1-\tau_k\right) + d_M\left(1-\tau_A\right) - r_F\left(1-\tau_A\right) \tag{3}$$

Where τ_A denotes the new tax rate on dividends of 25 % (plus solidarity surcharge)[15] and τ_k the effective tax rate on capital gains. As capital gains are only taxed when they occur, investment periods exceeding one year imply a declining effective tax rate τ_k, with a common (though not definitive) assumption being that long holding periods lead to an effective tax rate that is half as high as the flat rate tax (*Zeidler* et al. 2008; *Wagner* et al. 2008; *Jonas* 2008; *Castedello* 2018, p. 103). Further, to decompose the nominal market return into a dividend yield and a capital gains portion, we assume a payout ratio of 50 %, another widely used convention, which e. g. *Castedello* et al. (2018) employ in their example of the link between pre-tax and after-tax market risk premia. Based on figures for average dividend payments of German listed companies by *Wagner* et al. (2004), the IDW considers payout ratios of 40 – 60 % to be reasonable (*Castedello* 2018, pp. 98 – 99). This use of fixed payout ratios geared to a market average has been criticized (*Knoll* 2005; *Gröger* 2008; *Diedrich* 2013), and newer

[14] Only 11 cases in our sample use an MRP up to half a percentage point outside of the bandwidth recommended by the IDW at the respective valuation date.

[15] The actual tax rate applied to the risk-free rate and dividends is therefore $\tau_A = 0.25 \cdot (1 + 0.055) = 0.26375$.

calculations arrive at substantially higher ratios until the early 2000s, and somewhat higher averages since then (Deutsche Bundesbank 2019). As the valuation reports usually follow the IDW recommendation, the average payout ratio in the terminal value for our sample – excluding 7 missing observations – is 48 % (median 50 %). Because the change in the tax system had been announced in advance and guidance for its implementation in business valuation was available (*Wiese* 2007), some valuation reports dating from 2007 – prior to the change taking effect – already considered its influence on future cashflows and returns.

V. Empirical Results

1. General Results on the Market Risk Premium

The valuation reports in our sample adhere to the IDW recommendation regarding the MRP, with most (over 80 %) using the midpoint of the recommended bandwidth, and the rest usually not choosing values outside of the interval. Consistent with the IDW recommendations, practitioners use an after-tax MRP of 5.5 % until 2008, 4.5 % until the beginning of 2012, then 5 %, followed by 5.5 % from the end of 2012 and 5.75 % after 2019.[16] The reports also follow the IDW recommendation for deriving the risk-free rate by utilizing data on the term structure of interest rates provided by the Deutsche Bundesbank, based on the Nelson-Siegel-Svensson (NSS) method (*Nelson/Siegel* 1987; *Svensson* 1994). Instead of utilizing spot or forward rates at the valuation date directly, the IDW recommends averaging interest rates over the preceding three months, calculating an equivalent uniform rate and rounding to the nearest 0.25 percentage points, or to the nearest 0.1 percentage points for interest rate results below 1.0 % (*Castedello* 2018, pp. 136 – 140). This approach has garnered substantial and theoretically sound criticism (*Reese/Wiese* 2007; *Knoll/Kruschwitz/Löffler* 2019; *Drukarczyk/Schüler* 2021, pp. 254 – 255), which we assent to, though we do not correct the valuations in this regard here. As such, the risk-free rate follows a declining trend from over 3 % before 2010 to 0 % in 2020. These developments are also evident in Table 4, which provides descriptive statistics for the risk-free rate and the MRP given in the reports, along with our calculated MRP in Panel A and the respective annual means in Panel B. We compute the MRP based on the TMR approach with arithmetic and geometric averaging for all three inflation estimators, but present only the results for the implied inflation rate and inflation swaps. Results utilizing SPF estimates are generally similar to

[16] The corresponding recommended after-tax bandwidths are: 5.0 % – 6.0 % from 2005 until 2008; 4.0 % – 5.0 % until early 2012; the maximum 5.0 % until the end of 2012; 5.0 % – 6.0 % until 2019; 5.0 % – 6.5 % currently.

those with implied inflation, with both being somewhat lower than the results employing inflation swaps. As we do not consider geometric means to be applicable to business valuation, we do not present results for geometric MRP based on implied inflation or SPF estimates, and only those based on inflation swaps are shown for illustration purposes.

As a point of reference, we also compute an MRP based on historical data following *Stehle* (2004). That is, we calculate the difference between nominal CDAX returns and the risk-free rate for each year beginning in 1955, and then form a single-year arithmetic average up to each year of our observation period. Because the risk-free rate as a stand-alone CAPM parameter and the risk-free rate included in the MRP determination should be the same conceptually, an equivalent uniform rate calculated from spot rates derived from NSS parameters, published by the Deutsche Bundesbank,[17] is used as a proxy for the risk-free rate for this purpose. As mentioned above, and even though we share the criticism levied against the uniform rate, the valuation reports in our sample period follow the IDW in using it as the risk-free rate, so that we too base our historical MRP calculation on the uniform rate for consistency. Because NSS parameters are only available from 1972 onward, we extend our risk-free time series backwards to 1955 using returns on the index of German sovereign bonds (Deutscher Rentenindex, REXP), to match the CDAX time series utilized here and in the prior calculation of MRP based on the TMR approach.

Panel A of Table 4 shows that the MRP calculated from historical CDAX returns and a uniform risk-free rate is close to the MRP used in the valuation reports – and therefore the IDW recommendation – on average, with respective means of about 5 %. However, the lower median and higher maximum and standard deviation signals differences in the distribution. Panel B confirms that while this reference MRP exceeds the MRP used in valuation reports until 2012, subsequent increases in the IDW recommendation – to compensate for the declining interest rate – reverse this relation.

[17] Available at https://www.bundesbank.de/dynamic/action/de/statistiken/zeitreihen-datenbanken/zeitreihen-datenbank/759778/759778?listId=www_skms_it03c.

2. TMR vs. Recommended MRP Bandwidth and other Approaches to the Market Risk Premium (2nd Research Question)

Since 2012, the IDW advocates for the utilization of the Total Market Return approach alongside other valuation methods (IDW 2012; IDW 2019), but does not disclose how they come up with the recommended bandwidth from differing results generated by several methods. Consequently, we are unable to ascertain directly to what extent the recommendation aligns with the TMR approach. We can, however, analyze the difference between the recommended MRP and the MRP according to the TMR, in order to get a better understanding of how the former aligns with the latter.

First, returning to Table 4, one can see that the MRP based on the TMR approach (arithmetic single-year mean) exceed those used in the reports, which regularly follow the IDW recommendation, and our calculated historical MRP markedly in each year, regardless of the inflation estimate used. Interestingly, the TMR-based MRP with geometric averaging, shown only for illustration purposes, does not seem to show a clear trend, often falling below the reported MRP, but sometimes exceeding it. The noticeable reduction in all MRP estimates observable from 2007 to 2009 is due to the change in the tax regime. The differences between the MRP used in the reports and the calculated MRP based on the TMR approach show that the TMR is not the only driver of the recommendation. We assume it is one driver among others, because otherwise the discussion in *Castedello* et al. (2018) would be of no purpose.

For further analysis we focus on the period from October 2012 forward, the period for which the TMR appears to be a possible source for the recommended MRP (IDW 2012). We calculate relative differences to examine the deviation between the MRP given in the valuation reports, which regularly utilize the midpoint of the IDW recommendation, and the calculated MRP based on historical data or the TMR approach. As can be seen in Table 5, the MRP based on historical data, which does not refer to the TMR approach, shows a mean deviation of almost -5 %. The MRP based on the TMR approach (arithmetic mean) are significantly higher than the MRP used in the reports over this period for all inflation estimators (t-test, 1 % significance), exceeding the reported MRP by around 45 % on average. The results using geometric means are closest to the IDW recommendations, but significantly lower (t-test, 1 % significance), with a mean deviation of about –2 % for inflation swaps.

Table 4

Descriptive Statistics and Annual Means for Parameters given in Valuation Reports, Calculated from Historical Returns, or via the TMR Approach

	Parameters from valuation reports (%)		*Arithmetic single-year mean MRP from historical data (%)*	*Arithmetic single-year mean MRP from TMR approach (%)*		*Geometric 30-year mean MRP from TMR approach (%)*
	r_F	*MRP*	*CDAX, uniform rate*	*Implied infl.*	*Swaps*	*Swaps*
Panel A: Descriptive statistics of nominal after-tax parameters						
Min	–0.2	4.5	4.8	5.2	5.9	3.4
Mean	1.8	5.3	5.4	7.4	7.7	5.1
Median	1.8	5.5	5.3	7.6	7.9	5.2
Max	3.5	6.5	7.5	9.2	9.2	6.5
Std. dev.	1.1	0.5	0.6	1.0	0.8	0.7
Panel B: Annual means of nominal after-tax parameters						
2005	3.0	5.5	7.2	7.1	8.0	5.3
2006	2.7	5.5	7.4	7.9	8.6	5.9
2007	3.2	5.2	6.7	7.1	7.7	5.2
2008	3.5	4.9	5.2	6.0	6.6	4.0
2009	3.1	4.5	5.0	5.8	6.4	3.9
2010	2.9	4.5	5.1	6.0	6.7	4.3
2011	2.6	4.5	4.8	6.3	6.6	4.2
2012	1.8	5.0	5.1	7.3	7.7	5.2
2013	1.7	5.4	5.3	7.7	7.9	5.5
2014	1.9	5.5	5.3	7.2	7.4	5.1
2015	1.0	5.5	5.3	7.9	8.1	5.7
2016	0.7	5.6	5.3	8.1	8.1	6.0
2017	0.9	5.6	5.4	8.3	8.3	6.2
2018	0.9	5.6	5.1	7.8	8.0	5.2
2019	0.5	5.5	5.3	8.3	8.2	4.8
2020	0.0	5.8	5.3	8.8	8.5	4.8
2021	0.1	5.8	5.4	8.9	8.9	5.4
2022	0.6	5.8	5.1	8.6	8.5	5.5

Notes: Parameters include the risk-free rate (r_F) and MRP given in the valuation reports, the MRP based on CDAX returns and a uniform risk-free rate, as well as MRP calculated via the TMR approach, based on arithmetic single-year and geometric 30-year nominal market returns, with up to two different measures of expected inflation (implied infl. and swaps). All values are nominal and after personal taxes.

Table 5

Descriptive Statistics for Relative Differences Between the MRP given in the Valuation Reports and Calculated MRP from October 2012

	Arithmetic single-year mean MRP from historical data (%)	*Arithmetic single-year mean MRP from TMR approach (%)*		*Geometric 30-year mean MRP from TMR approach (%)*
	CDAX, uniform rate	*Implied infl.*	*Swaps*	*Swaps*
Min	–18.9	28.0	30.4	–26.5
Mean	–5.0	44.6	45.7	–2.2
Median	–4.5	45.2	44.8	–2.2
Max	18.2	75.0	76.3	22.9
Std. dev.	4.2	9.5	8.0	9.6

Notes: Calculated MRP include the MRP based on CDAX returns and a uniform risk-free rate, as well as MRP calculated via the TMR approach, based on arithmetic single-year and geometric 30-year nominal market returns, with up to two different measures of expected inflation (implied infl. and swaps). Relative difference defined as: $MRP_{calc}/MRP_{report} - 1$.

We further subdivide the period for which the IDW has endorsed the TMR approach into two periods according to changes in the IDW recommendation, as outlined above. These two periods follow the two most recent changes to the MRP bandwidth recommended by the IDW in 2012 and 2019. Table 6 shows the recommended bandwidth, information given with the recommendation, the number of valuation reports in our sample for each period and general results of significance tests on the difference between the recommended MRP and calculated MRP based on the TMR approach.[18]

[18] We performed t-tests for differences in means and nonparametric sign tests for differences in median between the midpoint of the IDW recommendation and calculated MRP based on the TMR approach with arithmetic and geometric means for each period.

DOI https://doi.org/10.3790/ccm.2023.1443401 | Generated on 2024-10-02 14:12:52

Table 6

Subdivision into two Periods According to new IDW Recommendations

Period	Oct 2012 to Oct 2019 (IDW 2012)	Nov 2019 to Dec 2022 (IDW 2019)
Recommended after-tax MRP	5 % to 6 %	5 % to 6.5 %
Additional information published with the change	Incorporation of the TMR approach; reaction to declining risk-free rates	Reaction to declining risk-free rates
Number of valuation reports	102	33
Significance of differences	arithmetic means, all inflation estimates	both arithmetic and geometric means, all inflation estimates

We find that the means and medians of calculated MRP based on the TMR approach with arithmetic averaging are statistically different from the IDW recommendation at the 1 % significance level for both periods and all inflation estimates (t-test, nonparametric sign test). For calculated MRP based on the geometric mean, we find no significant difference at the 1 % level between their means and the recommended MRP for the period between late 2012 and late 2019 regardless of inflation estimate (t-test), and no difference in medians when utilizing inflation swaps (nonparametric sign test). For the period from late 2019 until end of 2022, all differences are significant, likely due to the strong decline in MRP based on the TMR approach with geometric averaging seen in Table 2 from 2018 forward.

Overall, these results for the subperiods provide weak evidence that the TMR approach can explain the level of the recommendation for some years, albeit only with regard to the geometric means. It should also be noted that statistical tests and regressions are only weak tests of similarity or interrelation between calculated MRP and the IDW recommendation, due to the sporadic adjustment of the latter. In summary, the evidence at hand is insufficient to affirmatively answer our second research question regarding the influence of the TMR approach on the IDW recommendations.

As mentioned, the IDW purports to use MRP estimates produced by several methods to derive its MRP recommendation. As stated in IDW (2012) and reaffirmed in IDW (2019), these are: MRP based on historical data, implicit MRP derived from (inter alia) financial analyst forecasts for DAX firms, and the TMR approach.[19] Because the actual procedure used to arrive at the recommendation

[19] *Castedello* et al. (2018) also present a zero-beta CAPM as an additional method. Because our aim is to relate our findings to the market risk premium recommended by the

bandwidth is not disclosed, assumptions are necessary to shed some light on the influence of the TMR.

First, one could assume that the IDW recommendation reflects a 'bandwidth' between the different estimates generated by the three approaches. Such an aggregation would be questionable, as the historical and TMR approaches necessitate mutually exclusive assumptions, so that a bandwidth formed from the results of both cannot be conceptually consistent. Even the bandwidth of MRP estimated from historical data mentioned in IDW (2012) is problematic, as it is unclear how such a bandwidth can be formed without combining incongruous results.[20]

Secondly, one might suppose that estimates from the three approaches (historical, implicit and TMR) are aggregated with differing weights to justify each possible element within the MRP bandwidth recommended by the IDW. Such a procedure would again be subject to the criticism raised above, that mutually exclusive approaches cannot be combined consistently. *Castedello* et al. (2018) declare that they disclose and explain the analyses and calculations underlying the IDW recommendation, and proceed to show the derivation of estimates with the individual approaches, but do not reveal their aggregation into the final recommendation.[21] Therefore, we use their results for the implicit market return and the MRP based on the TMR approach to analyze the implications of these results in Table 7. Panel A reproduces the pre-tax MRP based on the TMR approach with arithmetic and geometric averaging, and on the implicit market return for end of 2017 given in *Castedello* et al. (2018). In Panel B we infer how high the MRP based on historical data would have to be to arrive at the endpoints of the pre-tax bandwidth recommended by the IDW, given the MRP from the other approaches in Panel A and assuming equal weights. In Panel C we reverse this analysis, and derive the necessary weights of the MRP based on the TMR approach shown in Panel A, assuming a historical pre-tax MRP of 6.2 %,[22] and again referring to the endpoints of the pre-tax IDW bandwidth of 5.5 % to 7 %.

IDW, and this approach is mentioned in neither recommendation (IDW 2012; IDW 2019), we do not consider it here.

[20] *Böck* et al. (2018) suggest a three-step process starting from the MRP bandwidth based on historical data, and try to support this with a semantic argument based on the wording in IDW (2012). However, their approach does not reveal any information on the actual analytical procedure applied by the IDW.

[21] *Castedello* et al. (2018) also cover an approach without a risk-free rate. Since this is not mentioned in IDW (2012) or IDW (2019), it does not appear to be incorporated into the IDW recommendation and is not pursued further here.

[22] The arithmetic average CDAX return from 1955 to 2017 is 12.2 %, the average uniform risk-free rate is around 6 %.

Table 7

Implications for Possible Aggregation Through Weighting of MRP based on Different Approaches, given the data in *Castedello* et al. (2018)

Panel A: Relevant data from Castedello et al. (2018)

	Nominal market return (%)	Nominal risk-free rate (%)	MRP (%)
TMR arith. single-year	11.10	1.30	9.80
TMR geom. 30-year	8.53	1.30	7.23
implicit	8.25	1.30	6.95

Panel B: implied MRP based on historical data to arrive at IDW recommendation (5.5 % to 7 %) with equal weighting of approaches

	MRP from historical data to min. IDW recommendation (%)	MRP from historical data to max. IDW recommendation (%)
TMR arith. single-year	–0.3	4.3
TMR geom. 30-year	2.3	6.8

*Panel C: implied weight of TMR approach to arrive at IDW recommendation (5.5 % to 7 %) in combination with an MRP based on historical data of 6.2 %**

	min. IDW recommendation (%)	max. IDW recommendation (%)
TMR arith. single-year	–20.2	21.7
TMR geom. 30-year	–71.9	77.1

* With an arithmetic average CDAX return of 12.2 % and an arithmetic average uniform risk-free rate of around 6 % since 1955.

Note: All returns and MRP are nominal pre-tax values for end of 2017. TMR, implicit market return, risk-free rate and MRP based on the TMR approach in Panel A according to *Castedello* et al. (2018).

The results based upon these assumptions are not plausible and cannot explain the IDW recommendation. Assuming equal weighting of the three approaches, the pre-tax MRP based on historical data, the only approach for which no results are given in *Castedello* et al. (2018), would have to be only 4.3 % to arrive at the maximum pre-tax IDW recommendation of 7 %, if we refer to arithmetic averaging for the MRP based on the TMR approach.[23] For the minimum recommendation, the MRP based on historical data would even have to be negative. Only a TMR with geometric averaging leads to a plausible result for

[23] (7 % – 1/3 · 9.8 % – 1/3 · 6.95 %) / 1/3 = 4.25 %. The weights of 1/3 are due to the assumed equal weighting of the three approaches.

the pre-tax MRP based on historical data, but only for the maximum IDW recommendation.

Reversing the analysis does not suggest a consistent influence of the TMR approach on the IDW recommendation either. Because the implicit market return is close to the geometric mean TMR, we only focus on the TMR approach here. The weights on the MRP based on the TMR approach would have to be negative in order to arrive at the minimum IDW recommendation.[24]

These rough calculations indicate that the gap between the TMR and the recommended MRP implies some implausible results for the other methods which are supposedly also being used. A more precise analysis would require the disclosure of the approach applied by the IDW.

3. *Implications for Company Values and Fair Compensation of Minority Shareholders (3rd Research Question)*

Finally, to answer our third research question, we calculate relative differences between company values (value of equity) using the MRP estimates discussed above and those given in the valuation reports. While we have mainly discussed pre-tax MRP in the preceding sections for comparability with the results in *Castedello* et al. (2018), German auditors take personal taxation into account in their valuations. As such, again to ensure comparability of our results, we utilize after-tax MRP and calculate company values after personal taxes in this section. For doing so, we reconstructed all valuations manually and validated them with the reported company values. This procedure is necessary to derive as-if company values for different MRP. Then, we substitute the MRP based on the TMR approach (with different averaging methods and inflation estimates) for the MRP given in the report, which usually follows the IDW recommendation, as shown in Table 4 above. Next, we compute the ratio of the resulting company value to the reported value (minus one). We also calculate value differences for the historical MRP in this manner. Relative differences are used to avoid distortions based on different magnitudes of values. As we do not alter any other valuation parameters, positive (negative) deviations from the MRP will generally lead to negative (positive) deviations in the resulting company value. Table 8 presents descriptive statistics for the relative differences in value in Panel A and their annual means in Panel B.

[24] E.g. for the minimum IDW recommendation of 5.5 %, the historical MRP of 6.2 % and the arithmetic mean MRP based on the TMR approach of 9.8 % we can solve for the TMR-weight (x):

$$5.5\,\% = x \cdot 9.8\,\% + (1 - x) \cdot 6.2\,\%$$

$$x = (5.5\,\% - 6.2\,\%) \,/\, (9.8\,\% - 6.2\,\%) \approx -20\,\%$$

Table 8

Descriptive Statistics and Annual Means for Relative Differences Between Company Values given in Valuation Reports and those based on Calculated MRP

	Arithmetic single-year mean MRP from historical data (%)	*Arithmetic single-year mean MRP from TMR approach (%)*		*Geometric 30-year mean MRP from TMR approach (%)*
	CDAX, uniform rate	*Implied infl.*	*Swaps*	*Swaps*
Panel A: Descriptive statistics of relative value differences				
Min	–32.4	–60.2	–59.3	–18.9
Mean	0.2	–28.8	–31.4	4.4
Median	3.2	–28.0	–31.5	4.3
Max	34.5	–3.0	–3.8	54.6
Std. dev.	10.6	11.1	9.4	11.8
Panel B: Annual means of relative value differences				
2005	–21.0	–20.5	–29.0	2.8
2006	–24.0	–29.1	–34.3	–6.6
2007	–16.9	–21.4	–26.9	0.0
2008	–1.7	–14.4	–20.8	17.7
2009	–6.6	–17.0	–22.7	11.0
2010	–10.0	–21.8	–29.0	4.4
2011	–3.9	–22.2	–25.4	6.5
2012	–0.5	–29.6	–32.6	–3.3
2013	1.7	–27.9	–29.9	–0.7
2014	3.8	–22.1	–24.3	6.9
2015	4.2	–33.2	–34.3	–3.6
2016	6.5	–38.8	–38.7	–8.4
2017	4.4	–36.7	–37.1	–11.1
2018	10.6	–28.6	–29.7	7.1
2019	5.3	–38.3	–37.6	16.6
2020	13.3	–45.1	–41.9	31.3
2021	10.4	–43.6	–43.4	9.3
2022	18.9	–41.4	–40.4	6.1

Notes: Company values based on calculated MRP include those utilizing the MRP based on CDAX returns and a uniform risk-free rate, as well as those derived with the MRP calculated via the TMR approach, based on arithmetic single-year and geometric 30-year nominal market returns, with up to two measures of expected inflation (implied infl. and swaps). Relative difference defined as: $Value_{calc}/Value_{report} - 1$.

Similar to some of our results in Table 4, Panel A shows that company values derived using the MRP based on historical CDAX returns and a uniform risk-free rate are closest to those cited in the reports, which follow the IDW recommendation, on average, with mean relative differences in value of 0.2 %. This small overall mean difference is misleading, since Panel B reveals that the yearly deviations can be substantial. Company values for the TMR based on geometric means are higher than reported company values, with the estimate from inflation swaps leading to a mean relative difference of 4.4 %.[25] If companies would have been valued by taking the TMR approach fostered by the IDW seriously, and using MRP based on arithmetic means, the resulting company values would have been substantially lower than reported, regardless of inflation estimator, with mean (median) differences ranging from –28.8 % (–28.0 %) to –31.4 % (–31.5 %) and estimates from swaps being lowest on average.

As mentioned above, Panel B contextualizes the aggregate results shown in Panel A. Company values derived with the historical MRP were lower than those given in the valuation reports until 2012, when the IDW endorsed the TMR approach and raised its recommended MRP above the level justified by historical data. The effect of the changing tax system around 2008 can also be seen, leading to relatively higher valuation results than in previous years. Even so, the very high MRP estimates resulting from the TMR approach based on arithmetic means lead to company values substantially below those given in the reports in every year, with company values being on average at least 14.4 % lower in 2008 and up to 45.1 % lower in 2020.

As for the whole sample period, the TMR approach based upon geometric means and inflation swaps makes for an interesting case. Year to year, these results show the factors affecting a valuation based on the TMR approach quite well. From the aforementioned value increase due to the change in tax regime in 2007 and 2008, with company values up to 17.7 % higher than the reported values on average, values of equity decline with the decreasing risk-free rate, dipping below those in the valuation reports in 2012 and 2013. The stabilization of the interest rate and lower inflation expectations lead to an average surge in company value (6.9 % in 2014), but subsequently the interest rate and company values decrease further, to a mean of 11.1 % (in 2017) below the reported values. Finally, the sharp fall in the real TMR from 2018 forward leads to elevated company values, averaging an increase of up to 31.3 % compared to the reported values in 2020, though this is attenuated by rising inflation expectations.

[25] Because MRP based on inflation swaps are higher than the other estimates in most years, mean value differences based on implied inflation and SPF are even more positive, at 9.2 % and 8.0 % respectively.

VI. Conclusions

Our conclusions are as follows:

- The TMR approach is not compatible with the CAPM.
- Because of this lack of theoretical support for the TMR approach, we advise against its use. The IDW should no longer consider the TMR approach as one of the instruments for deriving a recommendation for the MRP.
- Geometric means over 30-year periods are methodically inappropriate as an averaging method for the purpose of business valuation and as such should not be considered for the derivation of a recommended MRP.
- Applying the TMR approach requires the estimation of expected inflation. The relevance of a consistent and verifiable estimation procedure is illustrated by the vaguely motivated real MRP of 7 % in *Castedello* et al. (2018) and our analysis of nominal and real MRP in Table 3. As can be seen there, pre-tax MRP based on the TMR approach with arithmetic averaging declined from around 10.2 % in 2017 to between 8.6 and 9.8 % in 2022, while the spread between differing inflation estimates widened. These developments are even more pronounced when using geometric averages.
- The comparison between the TMR-based MRP and the MRP recommended by the IDW raises doubts whether there is a clear link between them. Considering estimates for the MRP based upon historical data and the implied MRP, given the recommended MRP and equal weights for all estimates, reveals some implausible implications in terms of the historical MRP implied or the weights for the TMR-based MRP.
- The application of the TMR approach based on single-year arithmetic means would have led to much higher market risk premia across the whole sample period. These would ceteris paribus result in much lower company values and compensations of minority shareholders in each year of the sample, with values of equity being reduced by around 30 % on average.
- The application of the TMR approach based on geometric means would have led to lower market risk premia on average. As a consequence, company values would be about 4.4 % to 9.2 % higher on average, and much higher in the years between 2008 and 2011, and since 2018.
- Overall, if one would walk the walk and apply the TMR approach, instead of only using a supposedly constant TMR to justify an increase in the MRP due to lower risk-free rates, company values would have been much lower than reported.
- If the IDW still continues to advocate for the TMR approach despite our results, the recommended MRP would have to be lowered, if the other compo-

nents and the unknown aggregation process behind the recommended MRP have remained unchanged: The rise in interest rates since July 2022 more than compensates for the increase in expected inflation. The resultant drop in TMR-based risk premia in the second half of 2022 can already be seen in our data. Thus far, the IDW recommendation has not been changed in spite of higher risk-free rates.

Appendix

Changing market portfolio weights with changes in the risk-free rate.

Our illustrative example assumes only two risky securities A and B, with returns independent of the risk-free rate, that make up the market portfolio. Their portfolio weights (x_A and x_B) are determined as follows (*Schüler* 2016, pp. 206, 249 – 251):

$$x_A = \frac{z_A}{z_A + z_B} \; ; \; x_B = \frac{z_B}{z_A + z_B}$$

$$\text{with } z_A = \frac{(E[r_A] - r_F)\sigma_B^2 - (E[r_B] - r_F)\sigma_{AB}}{\sigma_A^2\sigma_B^2 - \sigma_{AB}^2} \tag{4}$$

$$\text{and } z_B = \frac{(E[r_B] - r_F)\sigma_A^2 - (E[r_A] - r_F)\sigma_{AB}}{\sigma_A^2\sigma_B^2 - \sigma_{AB}^2}$$

With $E[r_A]$ being the expected return of stock A, σ_A^2 its variance, σ_{AB} the covariance of stocks A and B and r_F denoting the risk-free rate.

Following from their definition, the weights x_A and x_B will remain unchanged only if neither z_A nor z_B change in response to a change in r_F, or if both change in the same proportion.

Focusing on z_A, the expected stock returns, variances and covariances do not change with a varying risk-free rate by assumption. Therefore, only r_F in the numerator can cause changes in z_A. This numerator consists of the expected excess return on A multiplied by the variance of B minus the expected excess return on B multiplied by the covariance of A and B. As the two excess returns are affected by changes in r_F to the same degree, they will cancel each other out if the weights are the same, that is $\sigma_B^2 = \sigma_{AB}$. If $\sigma_B^2 \neq \sigma_{AB}$, varying r_F will lead to changes in z_A, the magnitude and direction of which are determined by the heights of returns and variances relative to each other.

The results are analogous for z_B. Therefore, even if one of the variances is equal to the covariance, the weights x will change, as long as the other variance is not also equal to the covariance. In that case, with $\sigma_A^2 = \sigma_B^2 = \sigma_{AB}$, z_A and z_B become undefined, as their denominators become zero. Thus, a change in r_F will lead to a change in the composition of the market portfolio M.

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