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MAXIMUM TECHNICAL INTEREST RATES IN LIFE INSURANCE: AN INTERNATIONAL OVERVIEW

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Abstract

We compare the regulatory environment for the maximum technical interest rate of life insurance contracts in four European countries and the United States. In Germany, Austria, and Switzerland, the maximum rate is driven by a long-term rolling average of government bond yields and is adjusted by the regulator. In the United States, corporate bond yields are used and the regulator is not directly involved in setting the maximum rate. The regime implemented in the United Kingdom is unique: instead of a rules-based 'one-size-fits-all' approach, the maximum rate is determined by a company-specific principle-based method. We provide a comparative analysis of the different systems and conduct a numerical analysis to investigate how the maximum rate will develop under predefined interest rate scenarios. The discussion is highly relevant in light of Solvency II, a regime that may fundamentally change regulation of the maximum technical interest rate.

Keywords

Life insurance; insurance regulation; interest rates; scenario analysis

1 Introduction

Life insurance is an interest-sensitive business. The sustained decline in interest rates in Europe and the United States over the last decade has affected this industry severely and is a major concern for life insurance managers and regulators. In life insurance, one of the key actuarial assumptions regarding the interest environment is the technical interest rate, which is used to determine the policy reserve in the balance sheet. The higher the technical interest rate, the lower the policy reserve, which is why regulators set an upper bound for the technical interest rate, called the 'maximum technical interest rate'. Regulation of the maximum technical interest rate is also relevant in that this rate is often related to minimum interest rate guarantees offered to customers (e.g., in Germany).

Both an increase and decrease in interest rates can have a negative impact on the business. Lower interest rates may adversely affect insurers' profitability since yields on new investments in their main asset class (fixed income) tend to be low compared to guarantees given in the past. The obligation to meet those guarantees puts serious constraints on insurers' investment policy. Higher interest rates may affect product demand and thus lead to increased lapse rates and costs,[1] eventually also resulting in adverse selection. Currently, it is the risk arising from low interest rates that is of special concern to the industry.

The implications of low market interest rates are thoroughly addressed in the literature. Various authors have analysed the risk resulting from interest rate guarantees under various settings,[2] risk-minimizing asset allocation strategies,[3] or contract mechanics induced by different types of interest rate guarantees and bonus schemes.[4] In professional insurance magazines, challenges for the life insurance industry arising from low interest rates are

[1] See, e.g., Kuo et al. (2003) and Swiss Re (2010a).
[2] Kling et al. (2007); Rymaszewski (2011).
[3] Graf et al. (2011).
[4] Cummins et al. (2007).

considered on a broader level, e.g., by Goecke[5] and Heinen.[6] They discuss how the diminishing attractiveness of traditional life insurance could be met by suitable product design. However, none of the existing papers focuses on the implications of low interest rates for the maximum technical rate for reserving.[7] Thus the aim of this paper is to present an overview and comparison of current regulatory systems and thereby contribute to the ongoing discussion on the future of life insurance.

The contribution of this paper is threefold. We first conduct a comparative analysis of the systems implemented in five important life insurance markets—Germany, Austria, Switzerland, the United Kingdom, and the United States. We then numerically analyse how the maximum rate would change under predefined interest rate scenarios developed by the German Actuarial Society. Using this scenario analysis, we evaluate the dynamics of different regulatory systems in a controlled environment, resulting in a better understanding of the differences between the systems. We find that due to the declining interest rates observed in the past, the maximum technical interest rate might have to be reduced even more in the future. Finally, based on these results, we discuss the implications of this development for life insurance companies from the perspective of life insurance managers and regulators.

Both in Europe and the United States there is currently an intense discussion over future product design and reform of interest rate regulation.[8] Solvency II will have especially far-reaching consequences for the European countries as it completely changes the valuation of life insurance liabilities, making the topic of interest rate regulation one of fundamental importance. Therefore, this article is of relevance to managers, regulators, and policymakers who are working on future product design and sound regulation in these important markets. Furthermore, the article may be useful to managers and regulators in other markets, either

[5] Goecke (2011).
[6] Heinen (2011).
[7] A discussion of this issue for single countries can be found, e.g., in Lencsis (1997) for the United States and in Braumüller (1999) for Austria.
[8] See, e.g., the American Academy of Actuaries (2010) for the United States and Pröhl (2012) for Germany.

because they face similar challenges or because they are thinking of moving into or out of one of the five analysed markets.

The remainder of the paper is structured as follows. In Section 2, we introduce and compare different legal foundations for setting maximum technical interest rates in life insurance. A numerical analysis of possible future developments of the maximum rate is performed in Section 3. In Section 4 we draw conclusions and identify areas for further research.

2 Comparative Analysis

In this section, we analyse the legal standards for setting (maximum) technical interest rates for reserve calculation in three of the world's largest life insurance markets—the United States, the United Kingdom, and Germany.[9] We also include Austria and Switzerland in the analysis, even though their markets are comparatively small, because their rules are very similar to the German ones and thus these countries are easily integrated in the analysis. The German, Austrian, and Swiss insurance markets are comparable with respect to insurance law, language, and geographical location. Due to their large market share in many countries, we focus on traditional life insurance contracts with interest rate guarantees.[10] As a result of the establishment of a common European insurance market in 1994, we observe a certain uniformity of provisions throughout Europe. Under this regime, national insurance regulation and supervision were undergoing significant changes and all members of the European Economic Community are obligated to determine maximum values for the technical interest rate using one of two methods (see Art. 18 para. 1 lit. B 92/96/EEC). The first method prescribes—with a few exceptions—60% of the average of historical yields of government

[9] In terms of annual premium income in life insurance, the United States is number 1 (506 b USD), the United Kingdom number 3 (214 b USD), and Germany number 7 (115 b USD) in the world. Switzerland is number 19 (29 b USD) and Austria number 28 (10 b USD). See Swiss Re (2011).
[10] We thus do not consider unit- and index-linked contracts, which typically have own retrospective reserving rules (see, e.g., Nguyen (2008, p. 343) for Germany). The market share for the traditional contracts can be found, e.g., in GDV (2011a, p. 31) for Germany, VVÖ (2011, p. 105) for Austria, and FINMA (2011, p. 12) for Switzerland.

bonds denoted in the contract's currency as an upper bound for the technical interest rate. Under the second method, the maximum rate is determined by the current and expected future earnings of the insurance company, taking into consideration margins for adverse deviation.

2.1 Germany

In Germany, the establishment of a common European insurance market resulted in § 65 of the Insurance Supervisory Act (Versicherungsaufsichtsgesetz, VAG), which entitles the Federal Ministry of Finance (Bundesministerium der Finanzen, BMF) to enact an ordinance specifying maximum technical interest rates for insurance contracts with an interest rate guarantee. Both methods provided by Art. 18 92/96/EEC can be found in § 65 VAG. The actual maximum technical interest rate, however, is set by the BMF through the Actuarial Reserve Ordinance (Deckungsrückstellungsverordnung, DeckRV) using the first method, i.e., 60% of the average of historical yields of government bonds form the basis.

According to § 2 para. 1 DeckRV, the maximum technical interest rate for contracts denominated in Euro is 1.75% effective January 1, 2012 (contracts denominated in a currency other than the Euro are treated separately). Certain contract types, such as short-term single-premium contracts and annuities without surrender value, are exempted from the provisions of §2 DeckRV. These contracts are instead subject to § 3 DeckRV, which prescribes different maximum rates.[11] In the past, the BMF used 60% of the rolling 10-year average of historical yields of German government bonds with maturities between 9 and 10 years to derive the maximum technical interest rate.[12] More recently, however, the methodology was changed to use a 5-year average to better reflect the current low interest rate environment and address the increased interest rate volatility. This change demonstrates that the methodology for setting the maximum rate can be changed within the limits of 92/96/EEC since the directive

[11] For the analysis in the subsequent sections, we restrict ourselves to traditional endowment policies with surrender value. Therefore, the exceptions mentioned in § 3 DeckRV are not further considered here.

[12] This specification was made based on the average duration of the assets held by German life insurance companies. See BR-Drucksache 114/96 (1996).

prescribes the use of a historical average, but specifies neither the considered time horizon nor the maturity of bonds. Once assigned to a contract at inception, the maximum rate remains fixed until maturity and subsequent changes solely affect new business. Only in the event of an impending default and when avoiding insolvency will be in the best interest of policyholders, is the regulator entitled to reduce the guaranteed benefits by an amount appropriate to the company’s financial situation (see § 89 para. 2 VAG). In this case, at least theoretically, there are no limits on reduction of benefits, in contrast to the case when the contracts are managed by *Protektor*[13] after an insurer’s insolvency (see § 125 para. 5 VAG).

An important feature of German life insurance contracts is the cliquet-style interest rate guarantee where the guaranteed rate is applied to the customers’ savings premium and the previous years’ surplus. In principle, the guaranteed rate can vary from the technical rate used for reserve calculation. While the technical rate is explicitly bounded, the guaranteed rate is only limited by § 11 VAG, which requires premiums to be sufficient to allow for adequate reserves. Due to some features of the German GAAP, the two rates usually coincide and are equal to the legally allowed maximum value. If the guaranteed rate deviates from the technical rate, prospectively calculated reserves at contract inception are no longer zero, but either positive (guaranteed rate $>$ technical rate) or negative (guaranteed rate $<$ technical rate). Negative initial reserves imply a receivable against the policyholders but cannot be entered in the balance sheet due to the realization principle (see § 252 German Commercial Code, Handelsgesetzbuch). In this case, the reserve calculation must be performed either with a lower technical rate (so that it again equals the guaranteed rate) or a fictitious premium that is based on the technical rate. Positive initial reserves are usually not desirable as they have to be prefinanced.

[13] *Protektor* is the run-off vehicle of the German life insurance industry. It was founded in 2002 to avert the looming insolvency of Mannheimer Lebensversicherungs AG.

The adequacy of the maximum technical interest rate is subject to annual revision, especially in light of recent developments in the financial markets. This is particularly important as the technical rate implicitly determines the guarantees offered to customers. For each change the BMF drafts a revised version of the DeckRV which is usually preceded by a non-binding recommendation from the German Actuarial Society (Deutsche Aktuarvereinigung, DAV). DAV and BMF do not necessarily have to agree on the appropriate maximum rate, as demonstrated by the debate over the latest reduction from 2.25% to 1.75%.[14] As IT systems and business processes in the life insurance industry are often optimized for changes in tariff generation at the beginning of a calendar year, new maximum technical rates usually become effective at that time.

Along with the recent reduction of the maximum technical rate, the BMF introduced § 5 para. 4 DeckRV, the so-called Zinszusatzreserve (ZZR), another measure intended to improve the risk-bearing capacity of life insurance companies. This provision is designed to take lower interest rate income into account at an early stage by increasing the premium reserve on a single contract basis.[15] At each accounting date, the ZZR is calculated as the difference between a reference technical reserve and the conventional technical reserve. The reference technical reserve is calculated according to the same rules as the conventional technical reserve. However, for the subsequent 15 contract years, the applicable technical rate is replaced with the lower of the technical rate and a reference rate, which is defined as the 10-year rolling average of yields of AAA-rated European government bonds with a maturity of 10 years (§ 5 para. 3 DeckRV).[16]

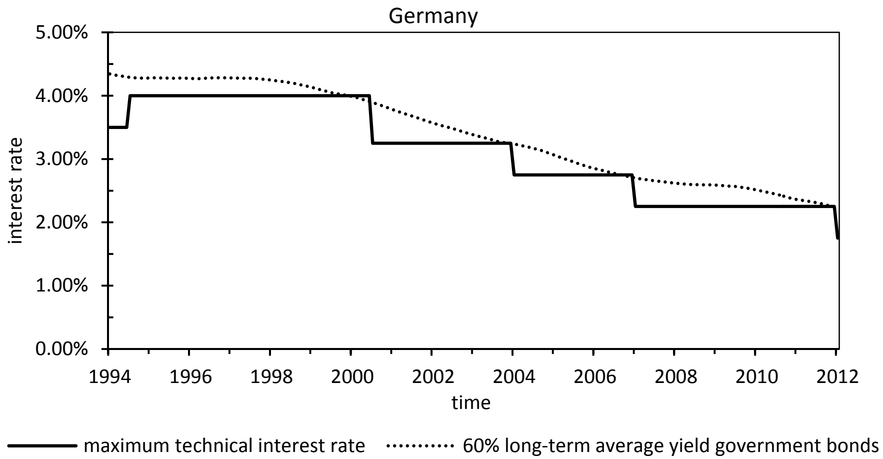
[14] GDV (2011b).

[15] § 341f HGB already prescribes a strengthening of reserves if low interest rate income is anticipated. However, this provision could be interpreted in different ways, so the regulator concretised it by introducing the ZZR.

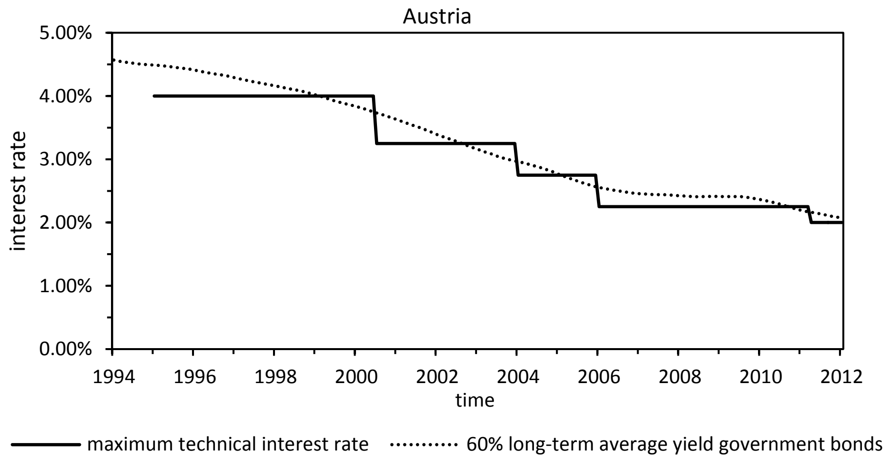
[16] These rates are published by the European Central Bank in its monthly bulletin. For 2011, the reference rate was 3.92%. Thus, for the first time, insurance companies have to set up additional reserves for old contracts with a guaranteed rate of 4%. According to a recent study of 54 German life insurers, the ZZR amounts on average to 0.24% of the total reserves. Based on 2010 figures, this corresponds to approximately 1.5 billion Euro for the total market. See Assekurata (2012).

With the introduction of Solvency II, Art. 18 92/96/EEC will become obsolete, meaning that it will become necessary to reconsider the legal basis for the maximum technical rates (especially the DeckRV). Deleting the technical rate without a replacement in place is not an option since, according to German GAAP, technical reserves are important for the surplus declaration. The DAV addressed this issue by setting up a task force to draft a Maximum Interest Ordinance (Höchstrechnungszins-Verordnung, HRZ-VO), which, ultimately, is intended to replace the DeckRV. In the current version of the draft,[17] the technical rate is bounded by a two-stage maximum rate. For the first 15 contract years, the maximum is defined as 70% of the 5-year average of 10-year zero-coupon Euro swap rates, which must be determined as described in § 2 of the Discounting of Reserves Ordinance (Rückstellungsabzinsungsverordnung). For the remaining contract years, the maximum technical rate is set at 50% of the Solvency II ultimate forward rate.[18] In each case, the value is rounded to the lower multiple of 25 basis points. The decision to switch from market rates to a long-term equilibrium rate after 15 years was based on the observation that up to this maturity the market for low-risk fixed income assets is sufficiently deep and liquid. The HRZ-VO also provides for a revised Zinszusatzreserve. Its computation is similar to § 5 DeckRV; the applicable technical rate for the subsequent 15 contract years, however, is set at the lower of 97% of the 10-year average of the zero-coupon Euro swap rates with maturity 10 years and the current technical rate.

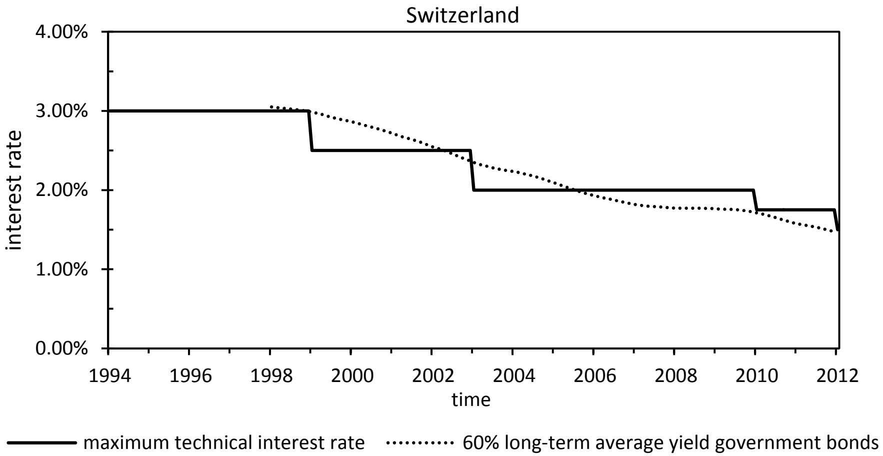
[17] As of April 2012; for details, see Pröhl (2012).
[18] For contracts denominated in Euro, the ultimate forward rate is 4.2%; see EIOPA (2010).



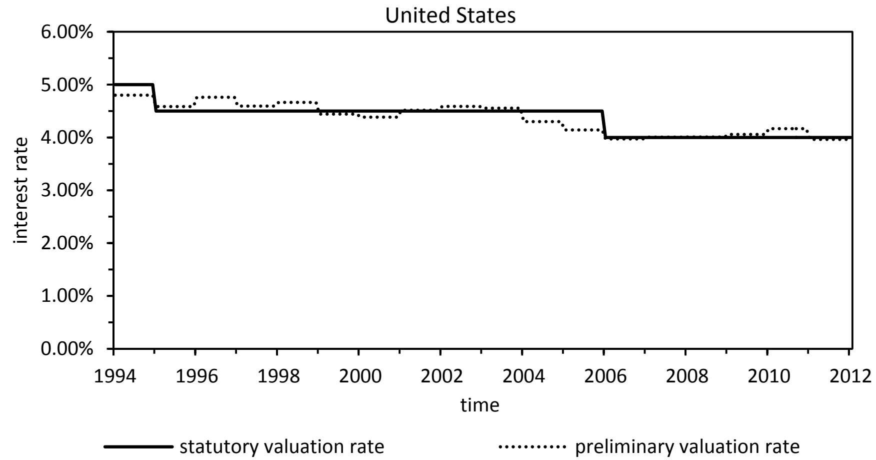
a: Maximum technical interest rate in Germany compared to 60% of the 10-year rolling average of 10-year government bonds yields.



b: Maximum technical interest rate in Austria compared to 60% of the 10-year rolling average of secondary market yields.



c: Maximum technical interest rate in Switzerland compared to 60% of the 10-year rolling average of 10-year government bonds yields.



d: U.S. statutory valuation rate compared to the unrounded preliminary valuation rate

Figure 1: Maximum technical interest rates since 1994.

2.2 Austria

Austria implemented the first method allowed by Art. 18 92/96/EEC and therefore sets one uniform maximum technical interest rate for all life insurance companies. The legal foundations are § 81k and § 85 of the Austrian Insurance Supervisory Act, which entitle the Austrian Financial Market Supervision (Finanzmarktaufsichtsbehörde, FMA) to enact an ordinance specifying the maximum technical interest rate for life insurance contracts. The Maximum Interest Ordinance (Rechtsvorschrift für Höchstzinssatzverordnung, HöchstzinssatzVO) is very similar to the German DeckRV.[19] The similarities between German and Austrian regulation are also demonstrated by recent discussion of introducing a Zinszusatzreserve in Austria.

In § 2 para. 1 HöchstzinssatzVO the regulator sets a fixed value for the maximum technical interest rate for life insurance contracts having an interest rate guarantee. To change this value, a new version of the ordinance must be enacted. Once assigned to a contract at inception, the maximum rate is fixed until maturity. Thus, subsequent changes of the ordinance only affect new business. However, in case of an imminent default, the FMA can reduce guarantees and benefits as required by the company's financial situation (§ 98 para. 1 Austrian Insurance Supervisory Act). Effective April 1, 2011, the maximum rate for traditional life insurance contracts was lowered to 2.00%. The FMA bases its decision on 60% of the 10-year rolling average of the secondary market yield of Austrian government bonds. Changes to the maximum rate are always multiples of 25 basis points. For contracts denominated in a foreign currency the maximum rate must not exceed 60% of the 10-year rolling average of yields of bonds issued by the respective government in the respective currency. The maturity to be used, however, is unclear.

[19] Braumüller (1999, p. 11).

Because the Austrian regulation is based on Art. 18 92/96/EEC, several contract types are exempted from the above provisions, namely, single-premium contracts with maturity up to 8 years, and contracts without profit sharing (see § 5 HöchstzinssatzVO). For these policy types, the maximum rate must be chosen such that it is adequately below the average net yield of assets typical for life insurance. Since market deregulation in 1994, overall development of the maximum rates is relatively similar to that observed for Germany (see Figure 1a and 1b).

2.3 Switzerland

Although Switzerland is not a member of the European Economic Community, the methods used to determine the maximum technical interest rate for reserve calculation are—due to several bilateral treaties—similar to those employed in Germany and Austria.

The legal foundation is § 36 para. 1 of the Swiss Insurance Supervisory Act, which entitles the Swiss Federal Council to enact an ordinance prescribing the method to be used in determining the maximum technical interest rate for life insurance contracts having an interest rate guarantee. This method is set out in more detail in the Supervisory Ordinance (Aufsichtsverordnung, AVO). According to § 60 AVO, the technical interest rate for reserve calculation is bounded from above by the technical interest rate for premium calculation described in § 121 para. 1 AVO. For traditional life insurance contracts, the technical interest rate for premium calculation may not exceed 60% of the 10-year rolling average of the reference rate which is defined by the Swiss Financial Market Supervisory Authority (Eidgenössische Finanzmarktaufsicht, FINMA) as the yield on Swiss government bonds with a maturity of 10 years. Based on these yields and its projections under certain scenarios, the FINMA quarterly sets the maximum technical interest rate. However, it reserves the right to change the limit of 60% under appropriate circumstances (see § 121 para. 2 AVO). Starting January 1, 2012, the maximum rate for single life insurance contracts denominated in CHF is 1.50%. After an adaption period of six months, during which the old maximum technical rate can still be used, this new rate of 1.50% becomes mandatory for all new contracts effective July 1, 2012. Figure 1c shows the reference rate and the maximum rate from 1994 onward. The above provisions do not apply to every product type or contract duration. Similar to German and Austrian regulation, there are several exceptions for which the FINMA may authorise a higher maximum technical rate.[20]

If a life insurance company suffers financial distress, the FINMA is entitled to undertake restructuring measures to protect the policyholders' interests. These include restricting access to the insurer' assets, deferring benefit payments, or transferring contracts and associated reserves to a more solvent company (see § 51 Swiss Insurance Supervisory Act).

2.4 United States

Calculation of technical reserves for traditional life insurance products and annuities in the United States uses the Commissioner's Reserve Valuation Method. This method is comparable to the one employed in Germany, i.e., a static formula is used to compute the difference between the present value of future benefits and the present value of future premiums. The Standard Valuation Law (SVL) is the legal foundation for the calculation of the minimum reserves required. More specifically, this law defines minimum valuation standards based on certain mortality tables and valuation interest rates. The maximum interest rate that can be used is the 'statutory valuation rate'. Its function is very similar to the maximum technical interest rate in Germany.

Under the 1945 McCarran-Ferguson Act, most insurance regulation falls under the jurisdiction of individual states, leading to a certain non-uniformity across the United States. However, the National Association of Insurance Commissioners (NAIC) provides a general version of the SVL. Since the NAIC can be thought of as a substitute for a federal regulatory

[20] A list of these exceptions can be found, e.g., in FINMA (2008, p. 6).

agency,[21] its general version of this law has been adopted by the states without any or only little modification. For more detailed information on the role the NAIC plays in insurance regulation in the United States, the reader is referred to other literature.[22]

Before 1980, the maximum statutory valuation rate for life insurance was prescribed explicitly in the minimum valuation standards—depending on product type, issue year, and guarantee duration. Changes in the maximum rate therefore required a separate amendment to the SVL and hence did not occur very often. The situation improved with the 1980 Amendment to the SVL which provides for dynamic valuation interest rates. The maximum statutory valuation rate now varies from year to year depending on average yields of investment-grade-rated U.S. corporate bonds.

The SVL provides a detailed description of how to compute the maximum statutory valuation rate for different products and their variations (e.g., life insurance, (immediate) annuities with/without cash settlement option, etc.). For the sake of simplicity and consistency with the previous subsections, we restrict ourselves here to traditional long-term endowment policies. As described in § 4b para. A SVL, the statutory valuation rate is determined every calendar year based on the result of the following equation:

$$\boldsymbol{I = 0.03 + w(R_1 - 0.03) + \frac{w}{2}(R_2 - 0.09)}. \tag{1}$$

Here, I is the preliminary valuation rate, $R_1 = \min(R; 0.09)$, and $R_2 = \max(R; 0.09)$, respectively. R denotes the reference rate; w the weighting factor. The preliminary valuation rate I is rounded to the nearest one-quarter of 1%, values that fall exactly between two quarters are rounded to the lower quarter.[23] To decide whether a change of the current statutory valuation rate is necessary, it is compared to the newly calculated one. If the two rates differ by less than 50 basis points, the current rate is retained for the next calendar year.

[21] Lencsis (1997).
[22] See, e.g., Randall (1999); Graham and Xie (2007); Grace and Klein (2008); Eling et al. (2009); Landgraf et al. (2011).
[23] Towers Watson (2011).

Otherwise, the rounded result of Equation (1) becomes the new statutory valuation rate. Once assigned to a contract at inception, the valuation rate remains fixed until maturity. Subsequent changes of the valuation rate affect only new business. In the remainder of this section, we take a closer look at the individual components of Equation (1).

Together with the terms involving R_1 and R_2, the weighting factors determine the influence of the reference rate on the statutory valuation rate. For example, the impact of a high reference rate is mitigated by the use of the smaller weight $w/2$. The values for w vary by product type and guarantee duration. For traditional life insurance, the weights decline with increasing guarantee duration, as shown in Table 1, thus implying a lower statutory valuation rate for longer guarantees. However, for very low reference rates (below 3%), this relation is reversed.

Table 1: Weighting factors for traditional life insurance in the United States

Guarantee duration in years	Weighting factor
10 or less	0.50
More than 10, but no more than 20	0.45
More than 20	0.35

Computation of the reference rate R is described in § 4b para. D SVL. For traditional life insurance, the reference rate is the lesser of the average over a period of 36 months and the average over a period of 12 months of the monthly average of the composite yield on an index of seasoned corporate bonds. This index is published by Moody’s Investors Service Inc. and is composed of approximately 100 U.S. corporate bonds with an investment-grade rating and a maturity of 20 years or longer. The observation period for the reference rate ends on June 30 of the calendar year preceding the year of contract issue. Furthermore the reference rate is always rounded to the nearest basis point.[24] Figure 1d shows the preliminary and statutory valuation rates since 1994 for policies with a guarantee duration longer than 20 years (i.e.,

[24] Towers Watson (2011).

$w = 0.35$). Also, the results of the above described rounding rules become apparent, i.e., minor fluctuations in the preliminary rate do not trigger a change in the statutory rate.

This calculation of minimum reserves based on static formulas with prescribed interest rates and mortality is not well matched to modern product designs. The variety of embedded options and guarantees found in newer products cannot be captured properly by static formulas. To address this issue, several additional regulations have been enacted. The most important of these are Regulation XXX (term insurance) and the Actuarial Guidelines 38 and 39 (universal life and variable annuities). A more permanent solution is being sought; one idea is to replace the current approach with a new principle-based approach that mainly relies on stochastic simulation,[25] thus allowing better capture of individual-company-specific risks.

2.5 United Kingdom

In contrast to the above-discussed members of the European Economic Community, the United Kingdom follows the second method allowed by Art. 18 92/96/EEC. Thus the maximum technical interest rate for reserve calculation is not prescribed directly but instead determined on the basis of current and expected future earnings of the assets of the respective insurance company, taking into account sufficient margins for adverse deviation.

The principles for determining the maximum technical rate are prescribed by the Financial Services Authority (FSA) in Chapter 3 of the *Prudential Sourcebook for Insurers* (INSPRU) and vary depending on product class. For traditional long-term life insurance contracts, the valuation rate (i.e., the technical rate for reserve calculation) may not exceed 97.5% of the risk-adjusted yield that is assumed to be achieved on the assets covering the respective liability (INSPRU 3.1.28). This definition includes the reinvestment of future gains as well as the investment of future premium receipts.

[25] American Academy of Actuaries (2010).

In general, the risk-adjusted yield is to be determined with prudence and sufficient margins for adverse deviation and credit risk (INSPRU 3.1.41). Equity and real estate are considered separately from other assets (INSPRU 3.1.34). The assumed risk-adjusted yield for future (re)investments of sterling sums more than three years after the valuation date is capped by the lower of 6.5% and gilt yields (British government bonds) with matching maturities. The actual formula is more complex as it includes reference to forward gilt yields and forward rates on sterling interest swaps (for details see INSPRU 3.1.46). For with-profits contracts a simpler formula applies. The assumed risk-adjusted yield for future (re)investments of sterling sums is bounded from above by the maximum of the corresponding forward gilt yields and forward swap rates, the latter of which must also be adjusted for potential credit risk (INSPRU 3.1.45). For investments in other currencies, similar provisions apply, but are based on yields and swap rates of the respective currency. Following the twin peaks approach,[26] insurance companies having with-profits liabilities in excess of £500m are required to carry out a second liability valuation on a realistic basis to ensure adequate reserves for future discretionary benefits. This calculation has to be performed market-consistent and in accordance with the company's Principles and Practices of Financial Management (PPFM). According to U.K. law, all with-profits businesses are required to define PPFM to be applied in the management of their with-profits funds and make this information publicly available. For fiscal years 2010 and 2011, typical values of the technical interest rate for long-term non-profit life contracts ranged between 2.5% and 3.5% and 1.8% and 2.25%, respectively.[27]

2.6 Comparison of the Five Markets

The five systems discussed above can be subdivided into three groups: partially formula-based (Germany, Austria, and Switzerland), fully formula-based (the United States), and

[26] See, e.g., Patel and Daykin (2010).
[27] See, e.g., the 2010 and 2011 annual reports of Aviva and Legal & General.

principle-based (the United Kingdom). Both formula-based types feature a ‘one-size-fits-all’ maximum technical interest rate, i.e., the value is set uniformly for all life insurers and thus is independent of the company-specific risk situation. In the partially formula-based systems, the upper bound for the maximum rate depends on a formula; the final value, however, is set by the regulator. In contrast, fully formula-based systems set the final value solely based on computational results and the regulator is not involved. Principle-based systems determine the maximum technical interest rate individually for each company, taking into account the specific risk arising from the asset allocation. The characteristics of the three different system types are summarised in Table 2.

Table 2: System Comparison

System	Partially formula-based	Fully formula-based	Principle-based
Countries	Germany, Austria, Switzerland	United States	United Kingdom
Characteristics	‘one-size-fits-all’ approach	‘one-size-fits-all’ approach	individual approach
individual situation	no recognition	no recognition	full recognition
role of regulator	sets the rate	no influence on rate	no influence on the rate
underlying rate	AAA-rated government bonds*	corporate bonds of maturity 20+ years (rated AAA to BAA)	depends on the company-specific investment strategy
length of time series	5/10 years**	12 to 36 months	depends on the company-specific investment strategy

* In Germany and Switzerland, bonds with a maturity of 10 years are used, whereas in Austria, various maturities are considered.

** All three countries formerly based their maximum technical rate on 10 years of historical data. However, for the most recent reduction in Germany, the methodology was changed, and now only 5 years of historical data are used for the calculation.

Based on the previously discussed legal foundations, we identify three main aspects in which the analysed formula-based systems differ: (1) relation between guarantee duration and maximum rate, (2) credit quality and maturity of the underlying assets, and (3) length of the time series used for computation of the maximum rate.

Specifically, in the United States we observe an inverse relation between maximum rates and guarantee duration, i.e., lower maximum rates for longer guarantees. From a risk-management perspective, this conservative approach is reasonable since longer guarantees imply a higher risk for the insurance company. Aside from a few exceptions (see Sections 2.1 to 2.3), the maximum rate in the European countries is independent of the guarantee duration. However, with the introduction of Solvency II, this is likely to change, at least for Germany. As discussed in Section 2.1, the current suggestion is a two-stage maximum rate depending on market rates and the ultimate forward rate. Thus, it is not possible to clearly state the relationship between guarantee duration and maximum rate. Figure 2 shows the maximum technical rates for the selected countries from 1994 onward.[28]

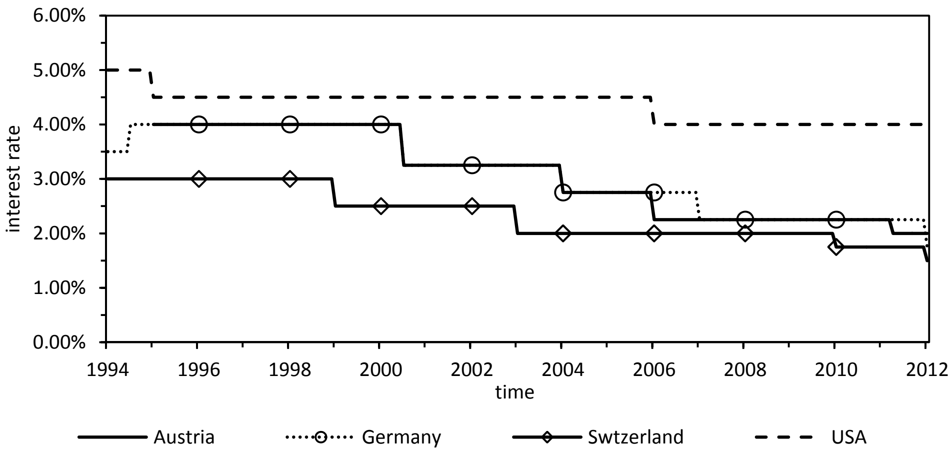


Figure 2: Maximum technical interest rate for all countries since 1994.

When comparing the different regulatory systems, the fact that regulation of the technical rate might be substantially driven by the country-specific situation (guarantee types and typical asset allocation) cannot be ignored. In the German-speaking countries, traditional products feature a cliquet-style interest rate guarantee where the guaranteed rate (usually coinciding with the technical rate) is applied to the savings part of the premium as well as to the previous years' surplus. This rather strong guarantee results in a very conservative asset allocation. In 2010, only 3% of German life insurers' investments were in stocks; the majority was in bonds and debentures (the statistics for Austria and Switzerland are similar).[29] In the United Kingdom, the guarantees offered are typically lower with respect to amount and type.

[28] For Austria, data were available only from 1995 onward.
[29] See GDV (2011a) for Germany, VVÖ (2011) for Austria, and FINMA (2011) for Switzerland.

Usually, only the sum of premiums paid is guaranteed, and this is not on an annual basis, but only at maturity. As consequence, British life insurers have a less conservative asset allocation featuring a much higher equity portion.[30] This difference in guarantee type and asset allocation is reflected in regulation of the technical rate. The conservative, fixed-income-focused investment policy of the German-speaking countries is supported by a technical rate based on the very same asset class. In the United Kingdom, the insurers' earnings are more volatile due to higher equity exposure. This is taken into account by the regulator through a volatile technical rate that directly depends on the individual insurer's earnings (see the comparison between the values for 2010 and 2011 in Section 2.5). The potential dependence between regulation of technical rates and the country-specific situation must be kept in mind when interpreting the outcomes of the scenario analysis in Section 3.

3 Scenario Analysis

Based on the results of the previous section, we now conduct a systematic scenario analysis for the regulatory systems under consideration. Even though the methodology in Germany was changed for the most recent reduction, we continue to base the numerical analysis on 10 years of historical data—for two reasons: first, the decision to use a 5-year average does not appear to be a unanimous one[31] and, second, a 10-year average allows us to use Germany as a representative for all three partially formula-based systems, which contributes to the clarity of the analysis. The results and implications derived for Germany should thus also be applicable to Austria and Switzerland. We also calculated all results for the new methodology with the 5-year average, and obtained comparable results. However, as the maximum technical rate follows the market rate more directly, it changes more frequently. These results are available upon request. The British company-specific approach cannot be incorporated into our

[30] See, e.g., Figure 5 in Swiss Re (2010b).
[31] See GDV (2011b) and DAV (2011).

numerical comparison, which is why the United Kingdom is excluded in the following discussions.

3.1 Design of the Scenario Analysis

We evaluate the dynamics of different regulatory systems by projecting the maximum technical interest rate for the next 10 years based on a set of nine scenarios. These scenarios were developed by the DAV for use in deriving recommendations for the future maximum technical rate and they cover a broad range of potential interest rate developments.[32] Using the same scenarios for all regulatory systems creates a controlled environment and thus allows insight into the differences between the systems. Table 3 shows for each scenario how the underlying rates, i.e., the yield on 10-year government bonds (Germany) and the seasoned corporate bond index (United States), develop over time.

Table 3: Description of the scenarios used for the numerical analysis

Scenario	Changes of the underlying rate
A	No change
B+/–	+/– 50 basis points every year for ten years
C+/–	+/– 100 basis points every year for the first five years, then –/+ 100 every year for the second five years
D+/–	+/– 200 basis points in the first year, afterward no change
E+/–	+/– 25 basis points every year for five years, then no change

In its most recent study, the DAV bounds the yields from below at 1.00% or 1.50%.[33] Due to the recently observed low yields on German government bonds, it seems appropriate to use the more conservative 1.00% for our analysis. For the upper bound, we follow the DAV suggestion and use 8.00%. To apply these scenarios to the United States, we need to determine suitable upper and lower bounds for the seasoned corporate bonds index. To obtain values consistent with our assumptions for Germany, we compute the ratio of the new lower (upper) bound and the observed historical minimum (maximum) of German 10-year

[32] DAV (2009).
[33] DAV (2011).

government bonds. The new lower (upper) bound for the United States is determined such that it is in the same proportion to the observed historical minimum (maximum) of the corporate bond index. That is, we choose the bounds such that the equations $\frac{1.00\%}{1.90\%} = \frac{min_{US}}{4.39\%}$ and $\frac{8.00\%}{10.70\%} = \frac{max_{US}}{16.26\%}$ are satisfied.[34] Using this method, we obtain 2.25% as the lower and 12.00% as the upper bound for the United States. As we will see in the results section, the upper bounds for both Germany and the United States play only a minor role in our analysis.

The historical maximum technical interest rates used in the scenario analysis range from 1994 to 2011, and are then followed by a 10-year forecasting period. The required underlying yield data were taken from the German Federal Bank (time series WU8612 for German government bonds) and the Bloomberg database (ticker MOODCAVG for the seasoned corporate bond index).

For the partially formula-based systems, we also need to model the regulator's future decisions as to changes in the maximum technical interest rate. One option is suggested by Rymaszewski.[35] However, his formula always rounds the maximum rate downward to the nearest quarter and thus does not exactly reproduce the development observed in the past (where most changes have been 50 basis points). In our analysis, we set the future maximum rate based on the spread between 60% of the 10-year rolling average and the current maximum rate and take additionally the slope of the 60%-curve into account. Past experience shows that whenever the spread becomes negative, the rate is lowered. We follow this practice, but keep the current maximum rate stable in case the slope indicates a positive development of the 10-year rolling average at the end of the year. To have changes occur mostly at the end of a calendar year, we tolerate short periods of negative spreads. To model increases in the maximum rate, we follow a more conservative approach and raise the

[34] The time series used for the estimation ranges from January 1979 to December 2011. For Germany, we observe $[min; max] = [1.90\%; 10.70\%]$, for the United States $[4.39\%; 16.26\%]$.
[35] Rymaszewski (2011).

maximum rate only when the spread is above 50 basis points and increasing at the end of a calendar year.

3.2 Results of the Scenario Analysis

First we first analyse the base scenario A, which is shown in Figure 3. We use historical data up to December 2011 and then model the future yields for the next 10 years according to the scenarios described in Table 3. Along with the future development of the maximum technical interest rates for Germany (solid black line) and the United States (solid grey line), we also consider 60% of the 10-year rolling average of German government bond yields and the U.S. preliminary valuation rate (dashed lines) in order to illustrate when changes of the maximum rates are necessary. The vertical line through the end of 2011 separates the historical data (left) from the forecast produced by our model (right). The 10-year rolling average of German government bonds reacts rather slowly to changes as yields have been declining for almost two decades. Since we keep the current value of the underlying rate constant for the next 10 years at the current low level, the result for Germany predicts another reduction around 2016. If the initial value of the underlying rate in 2011 was only slightly lower, the maximum rate would need to be lowered a second time at some point within the forecasting horizon (around 2020 or 2021). For the United States, the maximum rate will need to be lowered in 2013. However, due to its specific computation rules, it remains rather robust against small changes of the initial value.

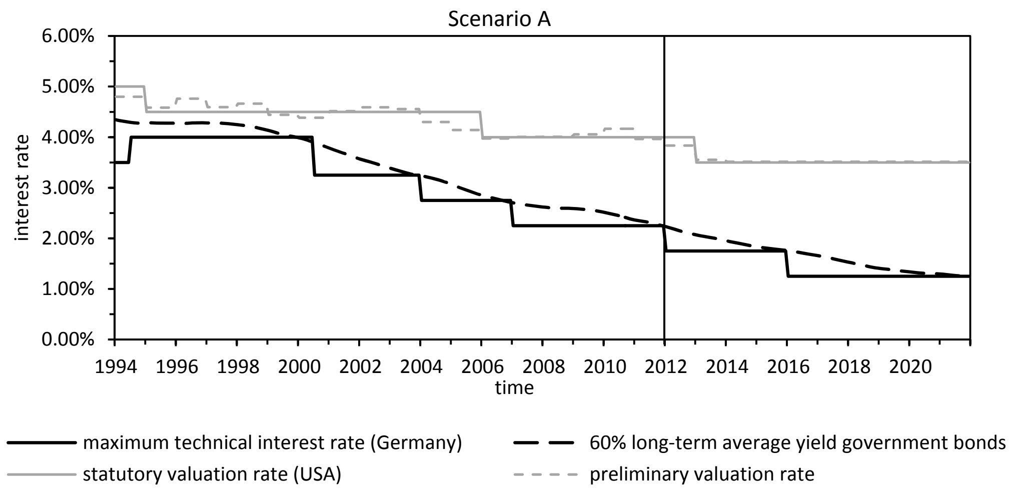


Figure 3: Base scenario (underlying rates are kept constant from December 2011 onward).

Figure 4 shows the results for the scenarios with increasing interest rates. Generally, we observe that in the case of Germany, only strong positive interest rate trends can prevent a further reduction in the future (see Figure 4a, 4b, and 4c). A weaker positive trend is not sufficient to stabilize the maximum rate, as shown in Figure 4d. In contrast, the U.S. system more directly incorporates interest rate changes into the maximum rate (see, e.g., Figure 4b). The delay of approximately four years is caused by the specific way of calculating the reference rate. However, not all changes in the interest rate environment are incorporated into the maximum technical rate. Due to the linking to the previous year's value, changes in the reference rate need to overcome a certain threshold to have any effect (see Figure 4c). In fact, this restriction can lead to a—theoretically permanent—gap between technical rate and earnings on the assets (represented by the underlying rate) since it is possible to have a change in interest rates that does not suffice to trigger a change in the maximum technical rate.

We next examine the subset of scenarios that assume declining interest rates. As we observe a falling trend toward the end of the historical data time series for both Germany and the United States, the lower bounds defined in Section 3.1 have a significant influence on the results as the trend of declining government bond yields is intensified (see Figure 5). This leads to rather low values of the maximum technical rate in Germany. As technical rate and guaranteed interest rate are closely connected in German life insurance, this situation has serious implications for the attractiveness of these products to policyholders. This becomes especially apparent when older bonds with higher interest rates have to be replaced with new lower yielding bonds. Furthermore, the sharply dropping bond yields in the scenarios C– and D– (Figure 5b and 5c) might cause a temporary gap between earnings on the insurers' assets and the maximum rate, and thus the guaranteed rate, in the case of Germany. Since this situation continues for several years, the regulator might take action, e.g., lower the maximum technical rate further than the usual practice would require.

In the United States, these scenarios intensify the negative trend observed toward the end of the historical data time series, too. Compared to Germany, the technical rate is reduced more quickly, but less frequently—leaving a several-years-long gap between it and the underlying rate, as our numerical results indicate for scenarios C– and D–. Again, it seems safe to assume that the regulator will intervene. When comparing Figure 4c with Figure 5c, we see how always taking the lower of two averages affects the maximum rate in the United States. The downward jump is incorporated rather quickly and pronounced, whereas the corresponding upward jump merely stabilises the technical rate.

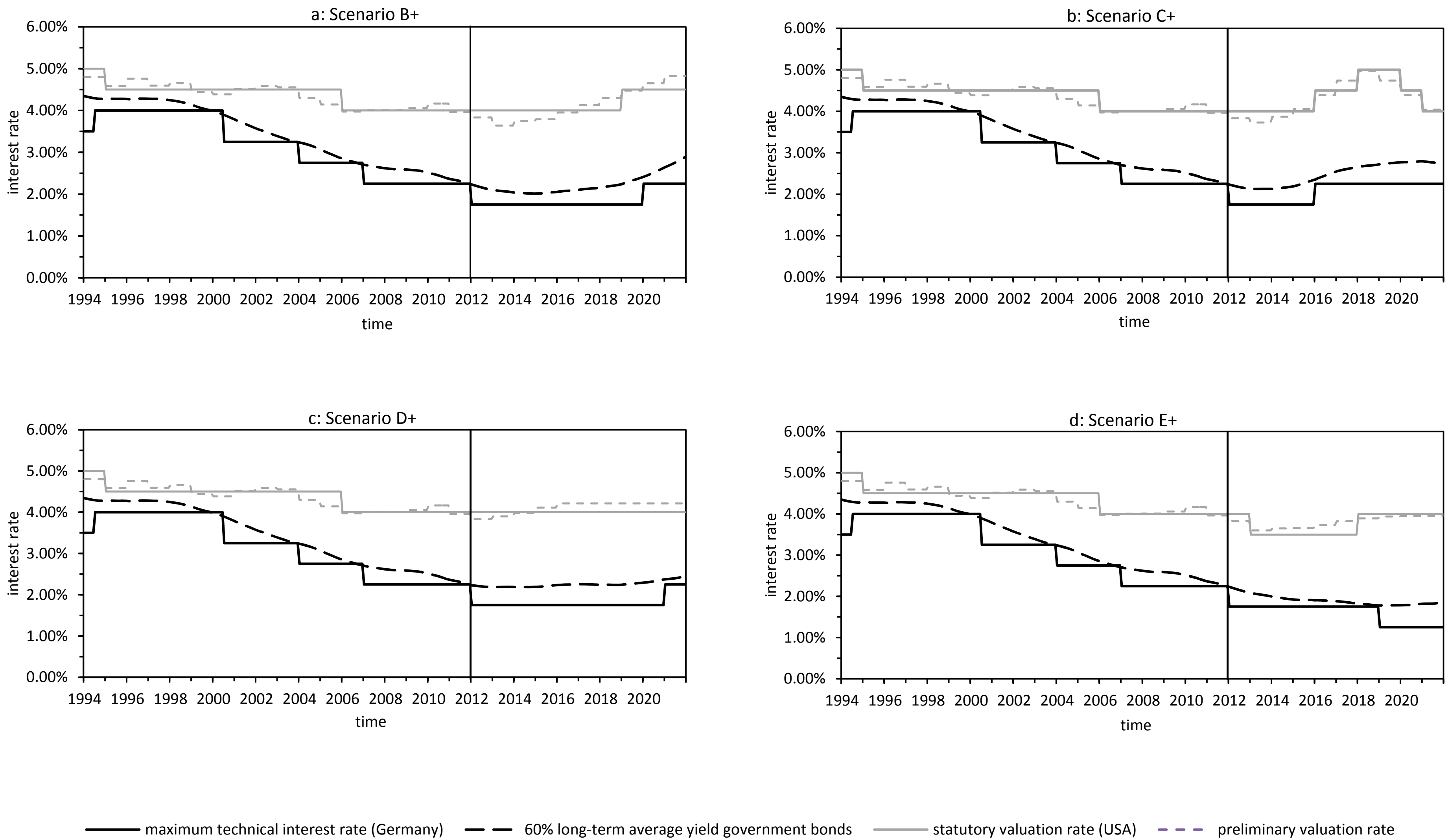


Figure 4: Scenarios that assume (initially) increasing interest rates.

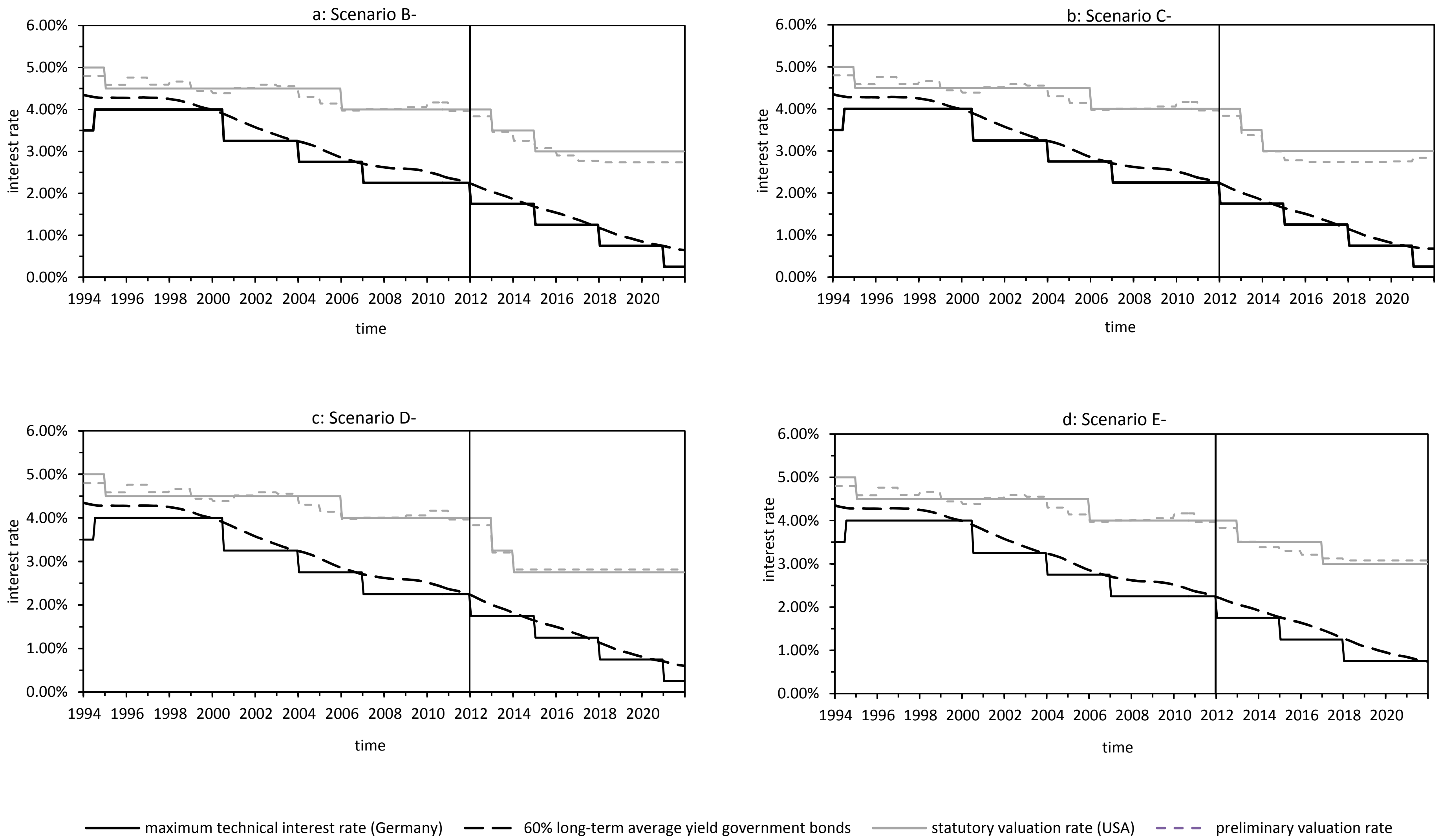


Figure 5: Scenarios that assume (initially) decreasing interest rates.

4 Conclusion and Policy Implications

The aim of this paper is to compare different regulatory systems for setting the maximum technical interest rate in life insurance contracts and analyse future development of the maximum rate under different economic scenarios. The analysis is motivated by recent discussions in many countries regarding how the existing system could be reformed to cope with the pressures being felt by the life insurance industry due to the current environment of very low interest rates. Solvency II adds another facet to the reform debate as this new regulation will fundamentally change the valuation of insurance liabilities.

Our main results can be summarised as follows. In Austria and Switzerland, the maximum technical interest rate is oriented at the 10-year rolling average of government bonds yields, whereas Germany recently switched to using a 5-year average instead. Common to all three countries is the regulator's ultimate decision on the maximum rate. In the United States, corporate bond yields are used and the regulator is not directly involved in setting the maximum rate. The maximum rate in the United Kingdom is determined by a company-specific principle-based method, which is quite different from the 'one-size-fits-all' approach used in the other four countries analysed here. We also analyse the future maximum technical rate under a range of predefined future outcomes, resulting in "likely" or "expected" technical interest rates. Note, however, that only some of the considered deterministic scenarios lead to a further reduction and that no probabilities can be derived from this deterministic analysis. In a stochastic framework, the probability of a further reduction would be highly dependent on the model and parameters chosen, particularly whether or not mean reversion is considered. We emphasize, however, that it is not our intention to derive probabilities of certain events from our results.

Especially in regulatory systems featuring a close relation between maximum technical rate and guaranteed rate (such as Germany) low technical rates can have severe consequences for the life insurance industry. In our numerical analysis, we investigated two possibilities: a low technical rate combined with low market interest rates and a low technical rate combined with higher market interest rates. When both rates are rather low, companies' earnings will also be quite low as German life insurers mostly invest in fixed-income assets. Thus it becomes increasingly difficult to meet higher interest rate guarantees in old contracts. However, new contracts are also affected by low earnings. A substantial part of the earnings is needed to cover the costs associated with an insurance contract so that the policyholder benefits are adversely affected. So even ensuring a gross premium payback guarantee at maturity might become difficult for the company. In anticipation of such a scenario, some German life insurers have already stopped writing new business for traditional type contracts.[36]

If it is only the technical rate that is low, but the market rates return to a higher level, the situation is still critical since the policyholders have limited ability to immediately participate in the higher market rates through increased surplus payments. Due to the rather long duration of assets, the surplus increase will occur only with a certain, potentially significant, time lag as the insurer's returns increase only gradually when investing in higher yielding bonds. Additional problems may arise from guaranteed surrender values (as, e.g., in Germany). If market rates rise, the insurer's bonds drop in value, but surrender values may not be reduced. Thus each surrendering client will cause a loss and therefore reduce the insurer's ability to generate surplus.[37] The Zinszusatzreserve (ZZR) recently introduced in Germany may provide a surplus increasing effect in this scenario. With market rates picking up, the ZZR reference rate will rise as well. Thus a portion of the additional reserves can be released and used to increase the surplus. However, even if the surplus eventually increases, the attractiveness of

[36] See, e.g., Baltzer (2010) and Langenberg (2010).
[37] In a scenario of increasing interest rates, lapse rates may grow according to the interest rate hypothesis (see, e.g., Kuo et al., 2003). The resulting adverse effect might be mitigated by adjusting surrender values to the interest rate development, as is already done in Switzerland. For more details, see FINMA (2008).

traditional life insurance is adversely affected since, at least for the German market, there is a significant positive dependence between surplus participation and new business growth and a significant negative dependence between surplus participation and growth of lapse volume.[38]

This article is not meant as an argument in favour of any particular type of regulation, but as an outline of alternatives that regulators might consider in their efforts to improve interest rate regulation. As such, the article is of relevance to managers, regulators, and policymakers who are discussing the future of life insurance and related reforms. The systems in Germany, Switzerland, and Austria are designed to follow long-term trends. Using a long-term rolling average produces a rather stable maximum technical rate but causes it to react more slowly to changes in the interest rate environment. Moreover, changes are incorporated in a less pronounced manner. All this allows for greater planning reliability, but the system does not well reflect abruptly changing market conditions. In contrast, the maximum rate in the United States is mainly driven by short- and middle-term trends, i.e., changes are incorporated rather quickly given they cross a certain threshold.

In general, a backward-looking (i.e. based on historical yield data) estimation procedure for the maximum technical rate, such as the 10-year rolling average, seems not always to be the ideal choice. Especially when maximum technical rate and guaranteed interest rate are directly related, the maximum rate should reflect the insurers' future earnings sufficiently well as it determines the future guarantees. Historical estimators cannot completely satisfy this requirement. However, due to the long-term nature of the insurers' investments they provide at least an indication of the earnings in the immediate future. Furthermore, the current approach has the advantage of being fast and objective. Combining expectations about the future yield development with today's backward-looking estimation procedure to a two-component maximum rate can provide an alternative. The first component is based on

[38] Eling and Kiesenbauer (2011).

historical yield data in order to account for the average asset portfolio currently held by the insurance companies. The expectation about future earnings is expressed through the second component. Amongst others, the possible future yield development can be either derived from a set of yield curves (which contain the markets' expectation via the implied forward rates) or from a set of scenarios determined and weighted by a panel of experts.[39] Breaking down this approach to the level of individual companies leads eventually to a principle-based system for which the United Kingdom can serve as example.

In contrast to the rules-based systems used in continental Europe and the United States, the principle-based approach implemented in the United Kingdom accounts for the individual situation of the insurance company. It is less restrictive, and allows for a broader range of technical interest rates in the market (i.e. there exist many technical rates versus only one rate for all companies). While this might be more complex for regulators and customers, a positive aspect is that it sets economic incentives in the sense that good managers are rewarded, whereas bad managers are sanctioned. Notable in this context is that in other fields of insurance regulation there is a trend from more rules-based regulation toward more principle-based regulation. This does not necessarily mean that the principle-based approach is the optimal approach for setting the maximum interest rate, but it is certainly well worth considering in designing new types of regulation.

Solvency II will profoundly change insurance regulation. In particular, European regulators must revise national regulation on maximum technical rates when the directive 92/96/EEC becomes obsolete. The question of whether or not to retain the current form of a maximum technical rate for reserve calculation is the subject of intense debate between regulators and the insurance industry. In Germany, e.g., there are proposals to maintain a

[39] One possibility for taking the expected future yield development into account is described in Pröhl (2012) and involves connecting the technical rate and the Solvency II ultimate forward rate. In any case, scenario analyses are helpful for better understanding the dynamics of the system and the range of possible outcomes.

maximum technical rate, but in a revised two-stage form so to allow for greater flexibility and more modern product design.[40]

A natural extension of our analysis would be to consider additional countries, such as the world's second largest life insurance market, Japan, or rapidly emerging countries such as China or India. Japan might prove to be an especially interesting case study on how insurance companies deal with notoriously low interest rates. It would also contribute to a better understanding of the effects of changing interest rates if we investigated in more detail how the value of proportional interest rate guarantees interacts with the overall interest rate level. The analysis presented in this paper thus suggests many avenues of future research.

[40] See Pröhl (2012).

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