The Position of the Swiss Association of Actuaries on Market-Consistent Valuation

Overview

1. **This paper describes the basics of market-consistent valuation.** In a first part, the basic idea is presented, which is based on the fact that one can in general divide the payment stream of an insurance liability systematically into two components that can be valued using unambiguous market prices. These two components correspond to the best estimate and the minimum amount in the SST. However, there are also insurance products that contain a third component - the residual component - which cannot be valued market-consistently. This is the case, for example, for insurance products with long maturities that cannot be produced with financial instruments.

2. **Market-consistent valuation is described in more detail for three types of insurance products:** Products without a residual component, with cash flows that do not depend on the financial market and those that do, as well as products with a residual component. We describe why market-consistent valuation relies on replicating with financial instruments with unique market prices and why illiquid financial instruments cannot be used for this purpose. The paper discusses the consequences of using illiquid financial instruments and why this would entail the risk of market-wide under-reserving with corresponding systemic risks. For products with a residual component, we describe how super-replication can be used to achieve a valuation that is consistent with the market-consistency. We address the problem of extrapolating a discount yield curve beyond a point where bonds with unique market prices exist, as well as the relationship of the choice of a yield curve to discount cash flows to the choice of replicating financial instruments.

Introduction

3. **The cash flows of insurance liabilities can generally be broken down into a replicable component and a component whose payments can be estimated and are expectation-free and whose fluctuations are essentially attributable to diversifiable insurance risks.** These components can be measured market-consistently. The cash flow of an insurance liability can generally be divided into two components. The first component can be replicated\(^1\) by cash flows from financial instruments that are traded in a deep and liquid market and therefore have reliable and unique market prices. The second component is a payment stream that depends essentially\(^2\) on insurance risks that can be assessed, and which investors can diversify, and whose payments have an expected value of zero. We refer to these components as the 'replicable component' and the 'insurance risk component'. These two components - and hence the insurance liability - can be unambiguously valued market-consistently.

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\(^1\) Replicating means that the cash flows are identical in every possible future state of the world, not just in expectation.

\(^2\) That is, the cash flow consists of payments that are a product of an expectation-free actuarial random variable that does not depend on the prices of replication instruments and a replication instrument.
4. **There are insurance products whose cash flows, after elimination of the replicable and insurance risk components, have a third component that do not have the characteristics of the insurance risk component.** For example, it may have an expected value that is not zero. This is the case for a cash flow that is so long that there are no liquid financial instruments available that are long enough to replicate it. They may also be exposed to risks that are not diversifiable, for example insurance of business interruption caused by a pandemic. They may also be impossible to model because no data or theoretical foundations exist. This component is referred to as the 'residual component'. It cannot be valued market-consistently. We deal with such insurance liabilities from paragraph 23 onward, while paragraphs 5-22 deal with insurance liabilities without a residual component.

5. **The basic idea of market-consistent valuation is that the replicable and the insurance risk components can be uniquely valued using financial market information.** The replicable component must be valued at the market price of the replicating portfolio, otherwise arbitrage opportunities exist. The valuation of this component is independent of the insurance company. The insurance risk component can be produced market-consistently by the insurer by holding capital to finance the potential fluctuations in the context of its other liabilities with sufficient certainty. This incurs a cost of capital that can be determined according to market expectations. This does not require any non-market or non-insurance assumptions. The sum of the market price of the replicating portfolio and the associated cost of capital yields the market-consistent value of the insurance liability. These two components of the market-consistent value are called the best estimate and the minimum amount in the SST. Here, we call the minimum amount the 'cost of capital provision'. We propose to use this term in the SST in the future.

6. **The measurement of the cash flow of the liabilities is carried out with predefined financial instruments, the replication instruments.** The replicating instruments must at least have unique market prices. This is clear, otherwise the measurement is not unambiguous. It makes no sense to carry out the replication with financial instruments that are so illiquid that they do not have reliable market prices, since no market-consistent value could then be assigned. This mismatch in terms of liquidity, i.e. the characteristic of being traded in a market at unique prices, is an integral part of market-consistent valuation. The cash flow to be replicated is never liquid.

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3 The provision for the cost of capital has many names: In Solvency II it is called risk margin, the IAIS calls it Margin Over Current Estimate, the IASB the Provision for Risk.
otherwise one would not need to replicate it but could simply take its market price. See also the quote below from Robert Kosowski and Salih N. Neftci in Principles of Financial Engineering, Academic Press, 2004\textsuperscript{4}. The question of whether insureds have the option of cashing out a portion of the technical provisions that are part of their policy is somewhat different. Such insurance liabilities are sometimes incorrectly referred to as "liquid" even though they also have no market price. We address this difference in paragraph 22.

7. **Cash flows that are similar have prices that are not materially different.** Different replicating portfolios with different replicating financial instruments can generate cash flows that are 'close'\textsuperscript{5} to the cash flows of the insurance liability. This implies that the resulting valuations, or equivalently, the amount of the best estimate of the insurance liabilities, are close. It follows that the level of the best estimate is not sensitive to the replication instruments as long as the replicating cash flows are similar.

8. **The cost of capital is part of the production costs of insurance liabilities that are not yet incurred and is therefore part of the technical provision.** The minimum amount of capital necessary to adequately buffer the uncertainty and variability of claims and costs is the regulatory target capital. The costs of this capital are necessarily incurred in the future if the insurance liabilities are properly produced. They are therefore part of the technical provisions and are to be financed proportionately by the policyholders.

9. **The value of the cost of capital provision is determined by the cash flow of the cost of capital required to be held for the insurance risk component of the cash flow of the insurance**

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\textsuperscript{4} The notion of a synthetic instrument, or replicating portfolio, is central to financial engineering. We would like to understand how to price and hedge an instrument, and learn the risks associated with it. To do this we consider the cash flows generated by an instrument during the lifetime of its contract. Then, using other simpler, liquid instruments, we form a portfolio that replicates these cash flows exactly. This is called a replicating portfolio and will be a synthetic of the original instrument. The constituents of the replicating portfolio will be easier to price, understand, and analyze than the original instrument.

Second, the instruments themselves may exist, but they may not be liquid. If the components of a theoretical synthetic do not trade actively, the synthetic may not really replicate the original asset satisfactorily, even though sensitivity factors with respect to the underlying risk factors are the same. For example, if constituent assets are illiquid, the price of the original asset cannot be obtained by “adding” the prices of the instruments that constitute the synthetic. These prices cannot be readily obtained from markets. Replication and marking-to-market can only be done using assets that are liquid and “similar” but not identical to the components of the synthetic. Such replicating portfolios may need periodic adjustments.

\textsuperscript{5} The notion of 'close' is intuitively clear, but can be mathematically complex, and it takes too long to elaborate in this paper.
liabilities. The cost of capital is an integral part of the cash flow of insurance liabilities, as are the costs of payments to policyholders or administrative and other costs directly associated with insurance liabilities. The cash flow of the cost of capital is an annual distribution from the provision for the cost of capital to the equity of the insurance company. It may form a part of the annual dividend payment to the investors providing the capital. The annual distribution to equity must be commensurate with the realistic return expectation by the capital markets for the risk assumed and the frictions associated with the business operations. Each individual distribution at any future date is given as the product of an appropriate cost of capital rate and the capital that must be held in the future year while the insurance liabilities are unwound. The total cost of capital - i.e., the amount of the cost of capital provision - is thus the value of this cost of capital payment stream. It should still be taken into account that the distributions are taxed as corporate profit. The provision for the cost of capital, like any other part of the provisions, must be replicated and protected by capital.

10. **The provision for the cost of capital and the best estimate are defined by the choice of replicating financial instruments.** The choice of financial instruments eligible for replication defines the separation of the cash flow of the liabilities into the component that can be perfectly replicated by the financial instruments and the component that remains, i.e. the replicable and the insurance risk components. These two components determine the best estimate and the provision for the cost of capital.

Insurance liabilities with cash flows that do not depend on financial market risks

11. **Insurance liabilities whose payments do not depend on market risks have a replicating portfolio consisting of risk-free bonds.** The replicable component consists of the expected value of the individual payments, and the insurance risk component is expectation-free and depends only on diversifiable underwriting risks.

12. **For such insurance liabilities, it is common to express the prices of the risk-free bonds as a yield curve** that is used to discount the expected cash flow. It allows to easily calculate the market price of the replicating portfolio, and thus the value of the best estimate, if it replicates the expected value of the cash flow of the insurance liabilities, by discounting the expected cash flow.

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6 A yield curve is a representation of the prices of bonds. It shows the interest rate structure of bonds of the same risk class - for example government bonds or junk bonds - which is defined by their prices. The risk-free yield curve is defined by the prices of default-risk-free government bonds.
13. The cost of capital provision for such insurance liabilities consists of distributions that are interest rate dependent. It is possible to determine the value of the cost-of-capital provision by discounting the expected distributions; however, this representation suggests a false interest rate sensitivity because the distributions are interest rate sensitive not only in their timing, but also in their amount. This is because the future principal to be held depends on the interest rates in the future of that distribution. We explain this in more detail in paragraph 20.

14. If the expected cash flow is produced with financial instruments subject to market risk, this also leads to a decomposition into two cash flow components, which we call the "expected component" and the "modified insurance risk component". However, the latter term is misleading because the modified insurance risk component is market risk dependent. This decomposition does not meet the requirements necessary for a market-consistent valuation. Nevertheless, both cash flows can be valued. The value of the first component is the value of the expected cash flow discounted by the yield curve expressing the prices of the risk-bearing instruments. The adequate valuation of the modified insurance risk component must take into account that investors are exposed to its market risk. Thus, their realistic expected return will include full compensation for the market risk to which they are exposed. This compensation is precisely the liability reduction due to discounting with the non-risk-free yield curve. This difference must be added to the provision for the cost of capital in order to meet the realistic return expectations of investors. In other words, the sum of the modified best estimate and the modified cost of capital provision is equal to the sum of the non-modified quantities from the market-consistent valuation.

15. A valuation using "replicating" financial instruments subject to default and spread risk or a corresponding yield curve without correctly including these risks in the cost of capital provision is wrong and leads to under-reserving. The fact of under-reserving is evident because
the use of risky financial instruments leads to a lower best estimate - the implied discount rate curve is higher than the default risk-free curve - while the cost of capital provision is not adjusted because it does not include the default and spread risks of the replicating financial instruments and is therefore too low. If such a procedure were mandated by regulation, insurance liabilities would be under-reserved across the market. The Swiss Actuarial Association would like to emphasize that this is not an issue where there can be different views and opinions: such a procedure is objectively wrong and leads to unacceptable under-reserving.

16. **In the EU, but also in other jurisdictions, market-consistent technical provisions for certain insurance products are lowered in a non-transparent way, so that insurance companies artificially report more capital than they realistically have.** This is done by the method described above, but in different guises, such as by introducing an illiquidity premium (see paragraph 21), by a de facto hold-to-maturity valuation, or by replicating with risky bonds without reflecting these risks in the provision for cost of capital. All of this leads to non-transparent under-reserving, which jeopardizes policyholders' claims in the event of surrender or insolvency or liquidation. Insurers thus report a falsely high solvency ratio.

17. **If the Federal Council and Parliament wish that certain risks do not affect the capital position of insurers, this should only be done by authorizing a virtual component for risk-bearing capital or, better, by lowering the confidence level of solvency capital.** Under no circumstances should technical provisions for insured claims be lowered below their market-consistent levels, as they then would not cover the obligations to the policyholders. It is a political decision whether to make it easier for insurers to invest in risky assets by ignoring certain risks. Under no circumstances, however, should this be done at the expense of policyholders' technical provisions. Instead of reducing market-consistent technical provisions and thus generating fiat capital in a non-transparent way, one should transparently allow a virtual balance-sheet item - a positive virtual asset or a negative virtual liability - that compensates for these risks. This would result in a higher reported solvency ratio, but would not reduce the claims of insureds against policyholders in the event of insolvency or portfolio transfer. However, even with this procedure the security of the obligations to the insured would be reduced by the de facto reduction in solvency.

**Insurance liabilities with cash flows that do depend on financial market risks**

18. **Insurance liabilities where the payment stream depends on the value of financial instruments or financial market parameters are produced with suitable financial instruments that do not have to consist solely of bonds.** This is the case, for example, for unit-linked insurance, where the payout depends directly on the value of a fund consisting of financial instruments, for example equities, futures, but also real estate or private equity. Another example is the provision for the cost of capital. Their individual capital distributions depend on the yield curve.

19. **The case of replication and the capital cost provision of a pure unit-linked insurance.** As an example, consider an insurance product that transfers a certain security, e.g., a bond or a share, to the insured at a defined point in time if the policyholder is still alive at that time. The cash flow of this product can be replicated with the quantity of the security corresponding to the
probability of survival of the policyholder. To discuss the cost of capital provision, let us consider an insurer that has exclusively sold this product to a large group of customers. For simplicity, let us assume that the time of transfer is always the same. Then, again, a varying quantity of the same security must be held as capital during settlement. The quantity is calculated from the shortfall of the survival probabilities at the corresponding points in time. The relevant cost of capital rate is that for products without market risks, since investors are not exposed to any market risks with this replication, neither on the best estimate nor on the provision for the cost of capital. Similar products are unit-linked insurance policies, or products that include profit sharing in the investment performance of the insurance company.

20. **The provision for the cost of capital for products whose cash flows do not depend on market risks also consists of distributions that are interest rate-dependent and must be replicated accordingly.** Products whose cash flows do not depend on market risks and whose provisions are subject to settlement risk have a provision for the cost of capital whose individual distributions are interest rate dependent. Each distribution is the product of the cost of capital rate and the capital to be held in the period before the distribution. However, this capital depends on the uncertainty of all payouts that are included in the provisions. These are payments in the future of the distribution, and these are discounted at the appropriate forward rate. Therefore, the capital to be held in the period before the capital cost distribution is always interest rate dependent.

**The interest rate dependency of the cost of capital rate**

21. **The cost of capital rate depends on many parameters and is also a stochastic variable.** The cost of capital is defined by the compensation investors require to provide capital to the insurer. It depends approximately proportionally on the risk-free interest rate, on the capitalization of the insurer, and on the tax rate. It becomes greater in times of market uncertainty and liquidity constraints and lower in times of market exuberance. Some of these dependencies, especially the one on the risk-free interest rate, will be made explicit in the future. The current target of a constant cost of capital reflects a long-term average and a capitalization according to a solvency ratio of 100%.

**Insurance liabilities with technical provisions that are at least partially callable by policyholders**

22. **The market-consistent value of an insurance liabilities depends on whether insureds have the option of having part of the technical provisions pertaining to their contracts paid out.** This is the case, for example, if insureds can easily cancel the product. Such insurance liabilities are incorrectly called "liquid" and "illiquid" when the beneficiary obtains the money only if the insured event occurs. It is important to always keep in mind that this term has nothing to do with the common use of the term liquidity in investments. The cash flows of two insurance products that differ only in their "liquidity" - that is, in the contractual agreement on the ability to lapse - are obviously different. The different payment flows result in different replications

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7 This term became popular during the Solvency II development to suggest that 'illiquid' insurance products could be produced with illiquid assets. This was done either for obfuscation reasons, or out of an honest but mistaken belief that valuation through illiquid instruments was possible and could be done at a lower market-consistent value. This is not the case, as explained in paragraph 14.
with different financial instruments, so that their market-consistent values are not identical. A product which is described as "liquid" - i.e. which, for example, contains lapse risk - must be replicated with so-called "putable bonds", also known as "retractable bonds" or "put bonds". Alternatively, the insurer can ensure that it meets the payment requirements of the insured at all times by means of appropriate liquidity management. Such a product has a higher market-consistent value than the otherwise identical product, which cannot be lapsed.

Insurance liabilities with a material residual cash flow component

23. **Insurance products whose cash flows include a material residual component often cover non-insurable risks.** This is certainly the case for products that insure risks for which there is no actuarial basis for their valuation, such as insurance against certain emerging risks. There are also products whose payment stream is so long that it cannot be reproduced by bonds traded in the market. This means that there is no basis for a market-consistent valuation, and the insurance company has to make assumptions about the financial markets far in the future, for which there is no basis. Other products are such that they contain risks that cannot be diversified. What these products have in common is that they tend to be gambles, because the liabilities cannot be produced effectively and at the same time safely and cannot be diversified.

24. **The valuation of insurance liabilities that cannot be produced is problematic.** Insurance liabilities with a cash flow that is longer than the longest replication instrument have a residual cash flow that cannot be produced and that has a positive expected value. For this, assets must be provided that are sufficient to purchase replication instruments in the future that can then produce the cash flows of the two components at that time. This requires assumptions about the existence, costs and risks of replication instruments that may exist in the future. The model and valuation uncertainty is very high. When operating with fictitious replication instruments that will exist in the future with an unknown price and that may or may not be available in the future, capital must be held in case such instruments are not available or their price is higher than assumed today. It is also not possible to reliably estimate the cost of such future market risks, since these risks are not present in current markets. There may also be cases where the assumptions are so complex and uncertain that actuarial standards require that an actuary cannot assume responsibility for the valuation.

25. **There are no risk-free yield curves beyond the last liquid point.** Risk-free yield curves are constructed with the help of government bonds and, if necessary, suitable proxies such as interest rate swaps. For maturities beyond which safe market prices of these instruments are available, the risk-free yield curve no longer exists. Any extrapolation beyond times when safe market prices are available is based on assumptions and models and induces model risks and, strictly speaking, one can no longer speak of a 'risk-free yield curve'. The use of an ultimate forward rate, for example, makes assumptions about economic growth and long-term inflation decades into the future.
26. The cash flow of an insurance liabilities that extends beyond cash flows that can be generated by financial instruments traded in the market can be over-replicated. This can be achieved by investing enough in the longest bond at time 0. If longer bonds are available at a later point in time, the longest bond up to that point is partially or fully sold, and the insurance liabilities are optimally replicated with the bonds then available. If there are still parts of the cash flow beyond the limit of replicable cash flows, again enough is invested in the longest bond. If there are still functioning bond markets in the future, the cash flow will eventually lie entirely within the range of replicable instruments. In the other case, when the last bond expires, there will be no bonds available. The funds then available must be sufficient, with a given degree of certainty, to be able to produce the remaining payment stream of liabilities. This condition defines the "sufficient" investment in the longest bond in each case. In this way, the payment stream is safely produced in line with the financial market. However, if functioning investment markets are available in the future, a larger payment stream will be produced. This is why we speak of over-replication.

Conclusions

a) For the market-consistent valuation of insurance liabilities whose cash flows do not depend on market risks, only replication with default-free financial instruments, or discounting the expected cash flow with the risk-free interest rate curve is acceptable. Discounting with a yield curve with a spread above the risk-free curve leads to an unnecessary shift of provisions to the provision for cost of capital, if the latter is calculated correctly, or to a market-wide under-reserving, if the financial risks of the replication instruments are not reflected in the provision for the cost of capital.

b) If the Federal Council and Parliament consider it opportune for insurers to invest more in risky assets without this being reflected in the target capital, then under no circumstances should the market-consistent technical provisions be reduced by using a discount rate curve with a spread above the risk-free curve. It would be more appropriate (and this is to be understood as a relative statement) to instead introduce a virtual balance-sheet item or reduce the level of protection to increase the SST ratio.

c) The choice of the 6% cost of capital rate to determine the provision for the cost of capital for expectation-free, market-risk-free residual cash flows is a long-term approximation. At a minimum, its interest rate dependence should be made explicit. It should also be reviewed on a regular basis. Where necessary and appropriate, there should be the possibility of moving to a cost of capital rate that is stochastic in the medium or longer term.
d) The AVO should clearly define the methodology of the market-consistent valuation and specify those components that are elements of this methodology, such as replication with financial instruments traded in a deep and liquid market, or discounting with the risk-free interest rate curve, and the cost-of-capital provision as the value of the cash flow of the cost of capital for hedging the insurance risk component of the cash flow of insurance liabilities.

e) However, the AVO is not intended to specify elements that are simplifications or approximations of the market-consistent valuation, such as a constant cost-of-capital rate, or the provision for the cost-of-capital as the sum of the expected target capital discounted at the risk-free interest rate for the insurance risk component of the cash flow of insurance liabilities.