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Valuation of policyholder dividends in a market-consistent framework

(Working Paper)

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Table of Contents

Introduction

In many countries, traditional life policyholder dividends are broadly tied to a company's realized investment income and/or earned rate on a book-value basis. Dividends are often challenging to model under market-consistent valuation frameworks such as the European Insurance CFO Forum Market Consistent Embedded Value Principles[1] (MCEV Principles) and Solvency II, because the risk-neutral economic scenarios used in such valuations represent investment returns on a market-value basis and a book-value return is often not a natural byproduct of the calculations, as it requires an explicit asset modeling.

This report introduces modeling practices currently observed in France, Italy, and Japan in order to illustrate various issues that many companies are facing when modeling policyholder dividends under a market-consistent framework. Those modeling techniques include:

- Use of an asset and liability model (ALM) where both assets and liabilities are projected together to represent real-world dynamics
- Adjustment of projected real-world asset cash flows to meet market consistency (leakage test/Martingale test)

Background

Over the past decade, regulatory and internal financial reporting approaches have increasingly moved towards a market-consistent framework. In this context, because of the need to evaluate a time value of financial options and guarantees, the asymmetrical nature of cash flows associated with policyholder dividends requires careful consideration.

MARKET-CONSISTENT EMBEDDED VALUE

Market Consistent Embedded Value (MCEV) Principles and European Embedded Value (EEV) Principles are utilized in Europe, Japan, and other jurisdictions as an approach to valuation and performance measurement for the insurance business. MCEV Principles require a market-consistent valuation of future distributable earnings and net asset values, making an explicit allowance for financial options and guarantees, including those that arise from policyholder dividends. In projecting future distributable earnings, bonus rates should be consistent with investment returns, regulatory and contractual restrictions as they pertain to bonus participation rules, the company's stated bonus philosophy, and recent historical precedent.

SOLVENCY II

It is anticipated that Solvency II, the new capital adequacy regime for European insurers, will be fully implemented in several years. Under Solvency II, the value of technical provisions equals the sum of a best-estimate provision and a risk margin. Separate calculations of the best estimate and the risk margin are not necessary when insurance cash flows can be replicated reliably using financial instruments for which a reliable market value is observable. The best estimate corresponds to a probability-weighted average of future cash flows, taking into account the time value of money (expected present value of future cash flows), using the relevant risk-free interest-rate term structure. The value of financial guarantees and any contractual options included in insurance and reinsurance policies will be reflected in the technical provisions.

IFRS

The International Financial Reporting Standard (IFRS) for insurance contracts, or IFRS 4 Phase 2, has been discussed at the International Accounting Standards Board (IASB) for many years. Recent discussions at the IASB indicate that insurance liabilities should be measured as an expected present value of fulfillment cash flows employing a discount rate consistent with current observable market information and a residual margin introduced to avoid day-one gains. In principle, insurance liabilities should be measured independently from the assets actually

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held; however, for participating contracts where liability cash flows themselves are dependent on the performance of specific assets, those assets must be considered in the valuation of insurance liabilities. The discount rate used to measure participating insurance contracts should reflect this dependency as well as the time value of money. To mitigate accounting mismatch, a further adjustment to the value of the participating feature has been extensively discussed at the IASB. The details of adjustment methods are not certain at this time, but it is believed that the ultimate valuation approach will encompass a parallel approach to that employed for MCEV and Solvency II.

MCEV, Solvency II, and IFRS 4 Phase 2 have taken different routes but are largely moving toward the same goal: a market-consistent valuation of policyholder dividends.

Concept of market-consistent valuation

The objective of market-consistent valuation is to place a value on financial products by pricing cash flows in a manner consistent with values observed in the capital markets.

Market-consistent valuation is often employed in the valuation of over-the-counter financial derivatives, because the price of such instruments cannot be obtained from the market. A typical approach is to conduct a Monte Carlo simulation where a large number of economic scenarios are generated assuming that market participants are risk-neutral. Various inputs to the valuation (e.g., an interest rate model) are calibrated to the market price of financial instruments observed as of the valuation date.

In concept, a similar approach can be used to value the liabilities associated with a block of insurance products. Because an insurance product may be viewed as a financial product that produces a certain stream of cash flows, methods appropriate to the valuation of a financial derivative product may be employed.

This concept can be particularly useful because it allows the value of both balance sheet assets and balance sheet liabilities to be determined as an expected present value of cash flows employing the same set of discount rates, namely “risk-free rates.” Because assets and liabilities are valued in a consistent manner, one can, for example, easily quantify the interest rate sensitivity (e.g., a drop of 100 bps) of the overall balance sheet, and utilize this information for analysis of interest rate risk or as part of a comprehensive ALM process.

For this reason, market-consistent valuation is gaining traction, both in the context of internal risk management and for public disclosure purposes, as mentioned in the previous section.

General approach to market-consistent valuation

LIABILITY-ONLY PROJECTION

Where liability cash flows are independent of asset cash flows, assets and liabilities can be valued separately; assets are valued at market value and the value of liabilities is based on a present value of liability cash flows using risk-free rates.

It should be noted, however, that while the assets are priced at market value without an explicit consideration of future cash flows, under the market-consistent approach it is implicitly assumed that the expected present value of the asset cash flows ties back to the initial market value. Under the market-consistent approach, assets are assumed to earn only risk-free rates on average under the market-consistent approach and the asset mix will not affect a time-zero valuation.

ASSET AND LIABILITY PROJECTION

On the other hand, where liability cash flows depend on asset cash flows, asset cash flows need to be explicitly modeled in a manner that reflects a company's actual asset mix. This is typically true in the case of policyholder dividends, which is due to the fact that dividend rates may depend on actual realized-asset returns. In this situation, particular care needs to be exercised to assure that asset cash flows, discounted by risk-free rates, tie back to an initial asset market value.

Challenges

STOCHASTIC ALM PROJECTION

As described in the previous section, if liability cash flows depend on asset cash flows, an ALM projection explicitly tying asset cash flows and liability cash flows must be performed. In an ALM projection, the asset model needs to be based on the asset portfolio actually held by the company as of the valuation date. The model must incorporate the company's investment strategy as it pertains to both positive cash inflows and the cash outflows that may be needed to meet future liabilities. In some cases, the simulation will need to model book values according to local regulations, or will need to reflect unrealized gains and losses.

To capture the asymmetric feature of policyholder dividends, stochastic valuation is required. Because analytic solutions for the value of policyholder dividends option are rare, Monte Carlo simulation is applied in most cases.

A stochastic ALM projection demands much higher computing capability than is required for a deterministic liability-only projection. Therefore, efficient modeling techniques coupled with practical expedients need to be developed.

MARKET CONSISTENCY

As described in the previous section, when asset cash flows are explicitly projected and used in the valuation of liabilities, the asset model that generates those cash flows needs to be calibrated to the market. The tests to ensure market consistency include a leakage test confirming that the average present value of stochastic liability cash flows plus earnings distributed to shareholders ties to the initial asset value. It is often challenging to achieve market consistency in a strict sense for every possible path (every possible point in time in the future with every possible maturity) with a practical number of economic scenarios.

In order to offer insights into the challenges discussed above, the following sections provide an overview of various approaches we have employed or observed in France, Italy, and Japan with regard to the market-consistent valuation of policyholder dividends.

Practice in France

GENERAL DESIGN OF POLICYHOLDER DIVIDENDS

In France, the main business of the life insurance industry consists of savings products, both unit-linked products where the policyholder bears the investment risk and "euros" products having a minimum guaranteed rate and financial profit-sharing rules. These savings contracts operate as deposit funds, entailing no insurance risk, and offer the option to surrender at any time. These contracts represent the industry norm; because of regulatory incentives they comprise the main portion of savings in France. In Europe, the French life insurance market is the second-largest after that of the United Kingdom.

For unit-linked products, policyholder dividends are not applicable because policyholders choose the assets and bear the risk. On the balance sheet, assets and liabilities are matched and are reported at fair value.

For euros savings products, a policyholder is granted a minimum guaranteed interest rate and a minimum profit-sharing rate on investment results. The profit-sharing rate is classified as discretionary because the insurer can determine it (respecting the minimum rate). Moreover, in France even the profit-sharing portion can be placed in a specific reserve instead of being directly incorporated into the value of the contracts. This reserve, referred to as PPAB, belongs to the policyholder. However, the insurer chooses the timing for incorporating this amount into the value of the contract. Therefore, it can be viewed as a resource to maintain competitive remuneration on contacts and/or an adequate level of profit in the future in the case that financial results decline.

French insurance regulations state that technical reserves shall be backed by the following asset categories: bonds, equities, units in undertakings for collective investment funds, property, loans, and deposits. All assets backing technical reserves must be from countries in the Organisation for Economic Co-operation and Development (OECD). French insurance regulations define limits expressed as percentages of the total book value backing technical reserves. Figure 1 shows the limits for each asset category.

Figure 1: Limits by Asset Category

Asset Category	% of Total Book Value*
Equities	65%
Real estate	40%
Loans and deposits	10%

**Detailed rules are defined in article R 332.3 of the French insurance regulations.*

These limits are very large and don’t reflect the actual portfolios of French life insurers, which are largely invested in bonds (more than 75% of the total portfolio). There are also limits for individual assets. The general rule is that assets from the same issuer may not exceed 5% of total book value with exceptions, notably for bonds issued by OECD governments.

The accounting basis that restricts policyholder dividends is defined by local insurance regulations and local general purpose accounting standards: assets are booked at amortized cost and insurance reserves at the accumulated savings amount. Profits available for policyholder dividend distribution are reported on a book-value basis.

MODELING PRACTICE

The introduction of stochastic ALM models by French life insurance companies dates back about 10 years; their use is now widespread among major companies.

Methodologies were first discussed in the context of the CFO Forum, the European professional body responsible for establishing standards for embedded-value calculations. The EEV Principles of May 2004 outlined the valuation of the time value of financial options and guarantees using stochastic techniques. For profit-sharing contracts, ALM models have emerged, which is due to the complexity of the contractual rules and asset-liability interactions that make assessment difficult with closed-end formulas. The MCEV Principles of June 2008 required that valuation methods be market-consistent.

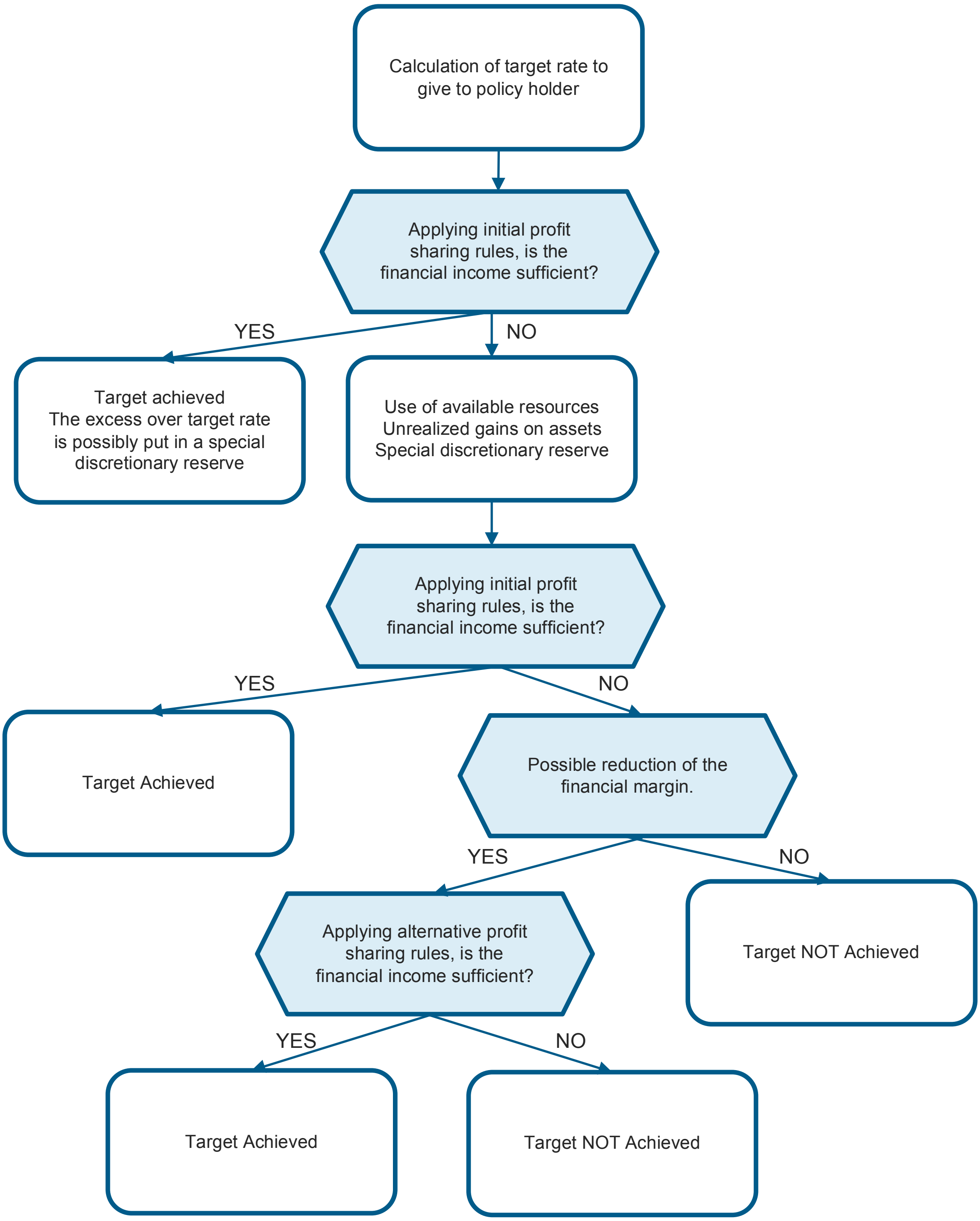
The use of ALM models has been promoted by the regulatory reforms envisioned under Solvency II and the IFRS draft standards for insurance contracts. An abundant literature is associated with these reforms. A primary motivation for ALM models is the need to value options and guarantees embedded in insurance contracts.

In contrast to the CFO Forum principles, these regulatory requirements are far more detailed as they pertain to ALM models. Both Solvency II Directive Article 124, "Validation Standard," and the regulatory application text require a model validation process. Some validation tools are specified: back-testing of the results against experience, knowledge of the sensitivity of the results to parameters, knowledge of the sensitivity of the results to associated management rules, analysis of stress scenarios, and identification of scenarios that could, if they occur, cause the ruin of the company.

As a result of our experience in the French market, we have been able to produce a benchmark of management rules based on the ALM models of a dozen major insurance companies. These companies account for more than 70% of the French market in terms of life mathematical reserves. In this report we describe our benchmark as it applies to policyholder dividends rules.

As they pertain to policyholder dividends rules, all French ALM models are based on the same general algorithm, shown in Figure 2. This algorithm has become the industry standard.

Figure 2: Decision Tree on Policyholder Dividends



While the decision tree is common, the parameters to formulate the decision are different, as shown in Figure 3.

Figure 3: Policyholder Dividends Rules in Detail

Traditional Life Insurer 1	**Target rate:** Target_rate (n) = 10% * Max(0,Rate_Equit(n))+ 90% * Rate_Bonds (n) with Rate_Equit (n) = X% * Rate_Equit (n-1) + (1-X%) * (Equit invest return(n)) with X% = 50% with Rate_Bonds (n) = Y% * Rate_Bonds (n-1) + (1-Y%) * ZC10Y(n) with Y% = 79% **Use of unrealized gains on equities to meet the target rate:** Yes with constraint to keep a minimum of 2% of unrealized gains compares to mathematical reserve	**Bankinsurer 1**	**Target rate:** Target_rate(n) = 90% * average_4 year (ZC10Y) **Use of unrealized gains on equities to meet the target rate:** Yes without constraint
Traditional Life Insurer 2	**Target rate:** Rate credited by a fictional insurance company representing the whole French life market (i.e. the model first runs with national data) **Use of unrealized gains on equities to meet the target rate:** Yes without constraint	**Bankinsurer 2**	**Target rate:** Target_rate(n) = Target_rate(n-1) + X% * (ZC10Y(n) – ZC10Y(n-1)) + Condition: average_3year(ZC10Y - Target_rate) < 80bp + If available resources < 2% of mathematical reserves, then Target_rate(n) = Target_rate(n) – 0.5% **Use of unrealized gains on equities to meet the target rate:** Yes with constraint to use 1/6 max of available unrealized gain on equities each year
Traditional Life insurer 3	**Target rate:** Target_rate(n) = Min(6%, ZC10Y(n) * profit_sharing_rate - 0.5%) **Use of unrealized gains on equities to meet the target rate:** Yes with constraint to use 50% max of available unrealized gain on equities each year	**Bankinsurer 3**	**Target rate:** Target_rate(n) = Moving Average 2 year of Reference_rate with Reference_rate(n) = Max [f(ZC10Y), f(ZC1Y), f(Moving_Average_3year (ZC10Y))] **Use of unrealized gains on equities to meet the target rate:** Yes with constraint to use 50% max of available unrealized gain on equities each year
Traditional Life insurer 4	**Target rate:** Target_rate(n) = Target_rate(n-1) + X% * (ZC10Y(n) – Target_rate(n-1)) with X% = 50% if increase or = 20% if decrease **Use of unrealized gains on equities to meet the target rate:** Yes without constraint	**Bankinsurer 4**	**Target rate:** Target_rate(n) = 90% * Max(Average_6year(ZC10Y) , Average(ZC10Y(n), ZC10Y(n-1) – 0.28%) **Use of unrealized gain on equities s to meet the target rate:** No (but each year, 10% of unrealized gains on equities are realized)
Traditional Life insurer 5	**Target rate:** Target_rate(n) = Target_rate(n-1) + X% * (ZC10Y(n) – Target_rate(n-1)) with X% = 50% if increase or = 20% if decrease **Use of unrealized gains on equities to meet the target rate:** Yes without constraint	**Bankinsurer 5**	**Target rate:** Target_rate(n) = ZC10Y(n) – 0,3% **Use of unrealized gains on equities to meet the target rate:** Yes without constraint

List of abbreviations: ZC10Y : 10-year rate ZC1Y : one-year rate f( ) : function

Traditional Life Insurer 1	**Discretionary reserve PPAB (belong to policyholder, but timing decided by insurer):** If excess of financial income (on target rate), added to the PPAB reserve with a maximum level of PPAB at year end equal to 5% of mathematical reserves. If resources needed to achieve the target rate, use of the PPAB without constraint. **Reduction of financial margin to meet the target rate:** Not allowed
Traditional Life Insurer 2	**Discretionary reserve PPAB (belong to policyholder, but timing decided by insurer):** If excess of financial income (on target rate), added to the PPAB reserve. If resources needed to achieve the target rate, use of the PPAB without constraint. **Reduction of financial margin to meet the target rate:** Not allowed
Traditional Life Insurer 3	**Discretionary reserve PPAB (belong to policyholder, but timing decided by insurer):** If excess of financial income (on target rate), added to the PPAB reserve. If resources needed to achieve the target rate, use of the PPAB with constraint: 50% max of the existing reserve each year + the remaining PPAB must be at least 0.2% of mathematical reserves. **Reduction of financial margin to meet the target rate:** Allowed with maximum reduction of 50%
Traditional Life Insurer 4	**Discretionary reserve PPAB (belong to policyholder, but timing decided by insurer):** If excess of financial income (on target rate), added to the PPAB reserve. If resources needed to achieve the target rate, use of the PPAB without constraint. **Reduction of financial margin to meet the target rate:** Not allowed
Traditional Life Insurer 5	**Discretionary reserve PPAB (belong to policyholder, but timing decided by insurer):** If excess of financial income (on target rate), added to the PPAB reserve with a maximum level of PPAB at year end equal to 10% of mathematical reserves. If resources needed to achieve the target rate, use of the PPAB with constraint: 50% max of the existing reserve each year. **Reduction of financial margin to meet the target rate:** Allowed with maximum reduction of 20%

Bankinsurer 1	**Discretionary reserve PPAB (belong to policyholder, but timing decided by insurer):** If excess of financial income (on target rate), added to the PPAB reserve. If resources needed to achieve the target rate, use of the PPAB without constraint. **Reduction of financial margin to meet the target rate:** Not allowed on main asset pools
Bankinsurer 2	**Discretionary reserve PPAB (belong to policyholder, but timing decided by insurer):** If excess of financial income (on target rate), added to the PPAB reserve with a maximum level of PPAB at year end equal to 10% of mathematical reserves. If resources needed to achieve the target rate, use of the PPAB with constraint: 1/3 max of the existing reserve each year. **Reduction of financial margin to meet the target rate:** Variable financial margin (up to contractual terms) not in order to meet the target rate but in order
BBankinsurer 3	**Discretionary reserve PPAB (belong to policyholder, but timing decided by insurer):** If excess of financial income (on target rate), added to the PPAB reserve. If resources needed to achieve the target rate, use of the PPAB with constraint: 50% max of the existing reserve each year. **Reduction of financial margin to meet the target rate:** Allowed with a minimum margin of 0.2%
Bankinsurer 4	**Discretionary reserve PPAB (belong to policyholder, but timing decided by insurer):** If excess of financial income (on target rate), added to the PPAB reserve with a maximum level of PPAB at year end equal to 10% of mathematical reserves. If resources needed to achieve the target rate, use of the PPAB without constraint. **Reduction of financial margin to meet the target rate:** Allowed with a minimum margin of 0.7%
Bankinsurer 5	**Discretionary reserve PPAB (belong to policyholder, but timing decided by insurer):** If excess of financial income (on target rate), added to the PPAB reserve. If resources needed to achieve the target rate, use of the PPAB without constraint. **Reduction of financial margin to meet the target rate:** Allowed with maximum reduction of 30%

CHALLENGES

The brief overview of the policyholder dividend rules shows the variety of rules implemented. However, the impact of overall management rules could have an even more significant effect on the results. From our experience with the Solvency II framework, the coverage ratio (Solvency Capital Requirement/eligible own funds) can vary, which is due to many causes depending on the rules and parameters implemented in ALM models. Thus the regulator has required that companies establish a model validation process, which will include, for example, the back-testing of results against experience or the measurement of the sensitivity of results to different management rules.

It is important to note that it is not always easy to measure the sensitivity of models to management rules and parameters. Indeed, we are dealing with nonlinear models, and the impact of the management rules applied independently can vary materially from the case where rules are applied in combination.

MARKET CONSISTENCY

The market consistency of a model can be assessed with the leakage test. The test verifies that the average present value of all outflows over the stochastic simulations, including shareholders dividends, converges towards the initial market value of the assets.

An example of the leakage test is shown in Figure 4.

Figure 4: Leakage Test (€ millions)

Market value of assets, start of projection	971
+ Present value of benefits including policyholder dividends	1,144
- Present value of premiums	(377)
+ Present value of shareholder dividends	26
+ Present value of taxes	13
+ Present value of expenses and commissions	58
+ Present value of residual mathematical reserve[2] (at amortized cost)	111
- Present value of unrealized gains and losses on assets[3]	(7)
Total outflows	**970**
Leakage test	**(0.19)%**

Because a market-consistent valuation makes a risk adjustment so as to remove, on average, any future returns in excess of the reference rate, each bond's "implicit spread" observed in the market must be eliminated. The implicit spread is the spread that is added to the risk-free rate so that the present value of future cash flows is equal to the market value. The elimination is done by modifying the coupon and/or redemption amount of each bond. This adjustment needs to be made even to (high-grade) government bonds if the reference rates are swap rates and different from the government bond yields. We call this adjustment on the coupon and/or redemption amount the "risk-neutralization" of bonds.

It should be noted that, under risk-neutral valuation (the main technique to ensure market consistency), results can only determine a price and do not show coherent outputs in a real-world environment.

[2] This is the mathematical reserve remaining at the end of the projection if the projection is not conducted until the life of all the business.

[3] This is the unrealized gains and losses remaining at the end of the projection, with the book value of assets always made equal to mathematical reserves at the end of each year.

This is one reason why non-market-consistent real-world techniques are used for purposes such as liquidity gap analysis. Another example is the case in which an internal model approach is adopted for Solvency II; in this situation, real-world stochastic simulations are performed in the first year of the projection, after which risk-neutral valuations are performed under each scenario in order to calculate the distribution of basic own funds in one year. This case is interesting as it mixes real-world and risk-neutral techniques, under the nested stochastic approach:

- The first year of the projection is made in a real-world environment in order to obtain a distribution of real-world balance sheets after one year (primary simulations).
  - "Risk-neutralization" of bonds is not applied, i.e., bonds' cash flows remain the nominal ones. Because the model calculates the market value of bonds at each date by projecting the cash flows (coupons and redemption amounts) and discounting them at the current curve, for each bond the implicit spread is set in the model so that the model calculates the correct market value at the start and end of the first year by adding this implicit spread to the curve.
  - For all other classes of assets modeled, the earned rate and/or market value growth of the first year includes a risk premium; higher volatilities are assumed accordingly, based on the real-world expectations.
- Moreover, to obtain a distribution of balance sheets after one year, we also need to calculate the best estimate of liabilities after one year, which requires a market-consistent valuation. Under the nested stochastic approach, the model uses market-consistent "secondary simulations," which are adjusted according to each primary simulation. Indeed the model automatically calculates the "risk-neutralization" adjustment on bonds (see above) so that the market value at the end of the first year with the risk-neutral secondary simulation is correct.

Practice in Italy

GENERAL DESIGN OF POLICYHOLDER DIVIDENDS

In Italy savings products fall into two main groups: *rivalutabili* and *linked* (both unit-linked and index-linked).

This research paper does not address linked products, because under such products policy benefits are directly linked to asset values, and both assets and liabilities are accounted for at fair value.

Rivalutabili business generally consists of a wide variety of savings products, differing by:

- Type of benefit (deferred annuity, endowment, pure endowment, etc.)
- Term (limited duration or whole life)
- Death coverage
- Premium payment (single, annual, recurring)
- Formula used for profit sharing

Common to all *rivalutabili* business is a link to a *segregated fund* (SF) with the following characteristics:

- Typically there is an observation period each year, e.g., (1.November.y - 31.October.y+1) or (1.January.y - 31.December.y).
- At the end of each observation period, the fund return for that period is calculated and certified.
- There is usually a time lag of two to three months between the end of the observation period and the period for application of the profit sharing (which is usually annual4).
- Sometimes the fund return is calculated monthly, taking into account the previous 12 months, so that a different profit-sharing yield is available every month.
- Profit-sharing rules are generally applied as follows:

  Dividend = max(min(Gross Rate * Profit Sharing , Gross Rate – Min AMC) , Min Guar)

[4] This means that the policyholder dividend is paid at the policy anniversary, and the dividend rate changes usually annually based on the fund return in the recent observation period.

where

Gross Rate is the annual fund return

Profit Sharing is usually between 80% and 100%

Min AMC (minimum annual management charge) is usually between 0% and 1.5%

Min Guar (minimum guarantee) is typically between 0% p.a. and 4% p.a. (though for policies issued in recent years it is now more usually between 0% p.a. and 2% p.a.)

The profit-sharing mechanism has undergone various modifications over the last decade or so. The majority of new single-premium products no longer follows the traditional approach of having profit-sharing expressed as a percentage of the total fund return. The dividend yield is instead obtained after deduction of a management charge, which is expressed as a fixed percentage (i.e., *Profit Sharing* is always set equal to 100% instead of, for example, 80% in the dividend formula above). This provides insurers with more stable financial margins.

Around 80% of new business has a fixed management charge, which varies from 0.25% to 1.5%. The remaining products are still based on paying a percentage of the fund return (which can vary between 80% and 95%) to policyholders.

It should be noted that the calculation of the fund return (i.e., *Gross Rate* in the dividend formula above) is based on strict accounting rules. Indeed, in addition to the usual financial accounting bases (local GAAP, IFRS, etc.), assets invested within an Italian segregated fund are subject to specific accounting requirements. Therefore each asset has at least two different values, i.e., one for the local GAAP balance sheet and another for the segregated fund accounting.

Segregated fund accounting is essentially based on an asset's amortized book value (and historical value for equities), where any subsequent movement in the market value is not recognized unless the asset is sold.

Generally speaking, the segregated fund return is calculated as follows:

$$\frac{\sum(coupons + dividends + SF\ book\ value\ amortization + RCGL + interest\ on\ cash)}{average\ SF\ book\ value + cash\ weight}$$

where

$RCGL$ denotes the realized capital gains and losses in the segregated fund accounts.

Under local GAAP accounting, invested assets are split into two categories: *immobilizzati* (i.e., held-to-maturity, or HTM) and *circolanti* (i.e., available for sale, or AFS):

- Assets classified as *immobilizzati* are accounted for at amortized book value, so their local GAAP book value is generally the same as their book value under the segregated fund accounting.
- The local GAAP book value of *circolanti* assets, however, is equal to the lower of market value and historical book value.

Because most assets tend to be classed as *circolanti* (primarily because *immobilizzati* assets should not be sold unless there are particular reasons to do so), a significant gap may emerge between the book values of the local GAAP balance sheet and those of the segregated fund accounting.

As a consequence, Italian insurers need to exercise caution when it comes to investment strategy, especially under market conditions leading to a significant amount of unrealized capital losses within the segregated funds.

MODELING PRACTICE

A practical approach to the modeling of policyholder dividends for profit-sharing business where supporting assets are bonds, equities, and mutual funds is described below.

DOUBLE ACCOUNTING METHODOLOGY

The two distinct accounting bases are modeled by creating a separate, "parallel" accounting structure to calculate the segregated fund returns used to determine policyholder benefits.

In other words, in addition to the variables in the model used to calculate values for the local GAAP balance sheet, an additional set of variables is defined in order to calculate book values under the segregated fund accounting and the related segregated fund capital gains and losses, which are used by the segregated fund return formulae.

As described in the following sections, the asset cash flows used within this double accounting structure must be adjusted in order to ensure market consistency of the asset-liability model (ALM).

POLICYHOLDER DIVIDEND POLICY

In Italy, as described above, dividend policy is only partially discretionary for a company. In fact, the only way for a company to adjust the segregated fund return is through the sale of assets.

If local GAAP balance sheet accounting has recorded significant losses over past periods (which are due to large declines in market values), and correspondingly there is a high level of unrealized losses within the segregated funds, companies need to manage their disinvestment strategies carefully to achieve segregated fund returns that are in line with the local GAAP accounting results.

Actuarial modeling practice in Italy, in line with the introduction of MCEV and the path towards Solvency II, is moving towards stochastic ALM models. Some larger companies are already advancing in this direction, although in many cases the modeled interaction between assets and liabilities is still quite simplistic and requires further improvement.

MARKET CONSISTENCY

As noted previously, in a market-consistent framework it is fundamental that the probability-weighted average of asset cash flows—allowing for the time value of money—equals the market value of invested assets. A general condition applying to ALM models in order to manage market consistency is risk-neutrality. For certain asset classes (e.g., equity and mutual funds), it is generally sufficient if their average returns are set equal to that of the risk-free asset. For the asset class of bonds, instead, appropriate adjustments to the projected cash flows are necessary (i.e., coupon payments and settlement at maturity), because accounting for the asset cash flows at their nominal values generally fails to fulfill the market-consistency requirement that the present value of future asset cash flows discounted at risk-free rates should reproduce the initial asset value.

This point is doubly relevant in the case of ALM models that also project segregated fund returns for the modeling of policyholder dividends, because these models usually deal with a twin projection of asset cash flows. Cash-flow adjustments must be made consistently. With respect to the dividend yields projected by the model, it is appropriate that the underlying calculations take into account all actual asset features (nominal yield, market value, book-value amortization in the SF accounts, etc.) in order to determine the accounting yield, as well as the exact timing and amount of gains and losses to be realized, which depends in turn on the interaction of assets and liabilities.

CALIBRATION OF ASSET MODELS TO REPRODUCE THE INITIAL ASSET VALUE

The gap between the market price of a certain bond and the “fair value” of its corresponding risk-free substitute, which is the present value of the asset cash flows discounted at risk-free rates, can generally be explained by two elements: illiquidity premium and credit-risk premium. Once the illiquidity premium has been quantified in some way (and the calibration of the illiquidity premium is usually performed at the portfolio level), the residual component can then be viewed as the premium for credit risk, which will be attributed to each individual bond. The credit-risk premium is therefore taken as the credit spread that is implied by the market price and the methodology chosen for quantifying the illiquidity premium.

The ALM models used by the Italian insurance industry generally deal with credit risk in only a static way, i.e., the implicit credit spread is usually assumed not to evolve stochastically over time. More sophisticated models could allow for the possibility of the rating class of the bond issuer changing over the projection period, in which case the associated credit spread would move accordingly, and could also vary from one economic scenario to another.

With respect to possible approaches employed within ALM models, the most common technique involves the calculation of a reduction factor (equal to the actual market value of the bond divided by the "fair value" of the corresponding risk-free bond), which is then applied to all future coupons and the final settlement at maturity. The main advantage of this methodology is the relative ease of coding the cash-flow adjustments within the model. Although an ALM model adopting this methodology can be perfectly market-consistent, in our opinion it leads to rather unrealistic asset cash flows. Given a single reduction factor that is applied to all cash flows, i.e., both coupon cash flows and the much larger redemption cash flow, the recognition of defaults will happen mostly at maturity, leading to significant distortions in the timing of the realization of capital losses caused by default events. For valuation models that calculate dividend yields payable to policyholders, this effect will not necessarily be negligible and will depend on the level of credit risk.

An alternative methodology that is more sophisticated (and more realistic) is to calculate the expected loss that is due to default and to model this loss as incurred at the end of each calculation cycle under the condition that market consistency is preserved. As described in detail in the next section, this amount is obtained using a deterministic *certainty-equivalent* scenario with the expected credit loss amount at each point in time being derived from the principal remaining at that time and the default probability that is implied by the "fair value" at that time of each bond and the corresponding risk-free bond. The adjustments made within the model to the bond cash flows can be seen as a timely recognition of the average cost of defaults. In other words, the ALM model allows for default events, measuring their impact on the local GAAP balance sheet as well as on the segregated fund accounts, in a more reasonable way.

A more general approach can involve stochastic modeling of credit spreads, by featuring the probabilistic generation of upgrade and downgrade events (and hence ultimately default events) affecting bond issuers. Here credit spreads would only be used to calculate the market value of modeled assets, and no adjustments would be made to the asset cash flows until a default event is projected to affect a specific bond under a specific probabilistic scenario. The market consistency of the model is achieved by proper calibration of the utility that drives the transitions between the distinct rating classes, including the incidence of default. However, this calibration is rather harder and more difficult to understand than that of the other methods described above. Practitioners should therefore consider an appropriate balance between accuracy, practicality, and transparency.

A TECHNIQUE TO REFINE MARKET CONSISTENCY OF ASSETS

With respect to a projection based on a deterministic *certainty-equivalent* scenario, the average cost of defaults within each projection period (e.g., monthly) is allowed for in both the local GAAP balance sheet and in the segregated fund accounting. Two components of the default cost can be identified: a reduction in the coupon payment and a capital loss that is due to the recognition of a partial failure of the principal.

Let $\widetilde{P}(t,T)$ denote the market price at time t of a risky zero-coupon bond having face value equal to 1 and maturity T. At the same time, $P(t,T)$ denotes the price of a risk-free zero-coupon bond with the same characteristics. Assuming that L_t is the effective redemption value paid by the risky bond at maturity (i.e., after accounting for the default costs), then we have:

$$\frac{L_T}{\widetilde{P}(t,T)} = \frac{1}{P(t,T)}$$

When considering a model set up in discrete time, a default probability p_{t_i} can be defined, such that:

$L_{t_i} = L_{t_{i-1}} \cdot (1 - p_{t_i})$ where $i = 1, 2, \dots, N$

$t_0 = t$ and $t_N = T$.

From the equations above, an iterative formula can be derived for the default probability:

$$p_{t_i} = 1 - \frac{\tilde{P}(t_0, t_i)}{P(t_0, t_i) \cdot L_{t_{i-1}}}$$

The adjustments to the projected cash flows can therefore be introduced into the ALM model for generic bonds based on this implied default probability at each point in time. The adjustment to coupons, taking into account the actual payment frequency for each bond, can be defined as follows:

$$C_{t_i} = -c \cdot \left(1 - L_{t_i}\right) \cdot I_{t_i} \text{ where } i = 1, 2, \dots, N$$

where I_{t_i} is an indicator function that is equal to 1 at the coupon payment dates (and 0 otherwise) and c is the nominal coupon rate

The adjustment representing a loss recognition for a partial loss of the principal can be calculated as follows:

$$R_{t_i} = -p_{t_i} \cdot L_{t_{i-1}} \cdot P(t_i, t_N) \text{ where } i = 1, 2, \dots, N$$

It is worth noting that the proposed market-consistent adjustments are based on a methodology consistent with what actually happens when default events impact the investment portfolio of an insurance company in Italy. Indeed, if a very large portfolio of independent bonds (all sharing the same characteristics of our reference bond) were evaluated using a probabilistic method (e.g., Monte Carlo simulation), the above equations would describe the average cost of defaults within the portfolio.

Practice in Japan

GENERAL DESIGN OF POLICYHOLDER DIVIDENDS

In Japan, methods for calculating policyholder dividends on traditional products are typically based on a source-of-earnings approach, reflecting investment spread, mortality/morbidity spread, and expense spread.

Insurance premium rates for traditional products are computed using commutation tables. Each assumption is set conservatively to allow for a certain degree of unfavorable experience. Therefore, in normal circumstances, a positive profit will arise from the difference between the pricing assumption and the actual experience in each source of earnings. Dividend rates for investment spread, mortality/morbidity spread, and expense spread are determined annually at the discretion of each company based on actual experience. The total amount of dividends allocated to policyholders may not exceed a prescribed accounting profit for the year, both at a segment level and at an entity level.

The accounting basis that restricts policyholder dividends is defined by local insurance regulation and local general purpose accounting standards. In Japan, a single set of financial statements is used for both regulatory and general purposes. Insurance reserves are established on a net premium reserve basis with assumptions locked in at inception. Financial assets other than those for variable contracts are held mainly in available-for-sale or held-to-maturity (including bonds-backing-insurance-reserve) categories; in either case, the profits that are available for policyholder dividends are reported on a book-value basis.

In recent years, semi-participating contracts have become more common. These contracts distribute earnings every five years based only on an investment spread. Under typical semi-participating contracts, the dividend spread, positive or negative, is determined at each year-end. On each fifth anniversary, accumulated dividends over the previous five years, if positive, are distributed to policyholders.

Some contracts have other types of discretionary or performance-linked payments to policyholders, such as interest-sensitive fixed annuities and interest-sensitive whole life insurance. A crediting strategy is defined by the company based on a reference market index or rate, or on the actual performance of assets backing liabilities.

MODELING PRACTICE

The following paragraphs illustrate the valuation of a Japanese policyholder dividend option in the case that supporting assets are invested primarily in government bonds. The method illustrated is employed by some insurers for both semi-participating business and interest-sensitive insurance, provided that supporting assets are segmented and attributed to the relevant business, and an investment policy for the asset segment is well-defined (for example, buy-and-hold).

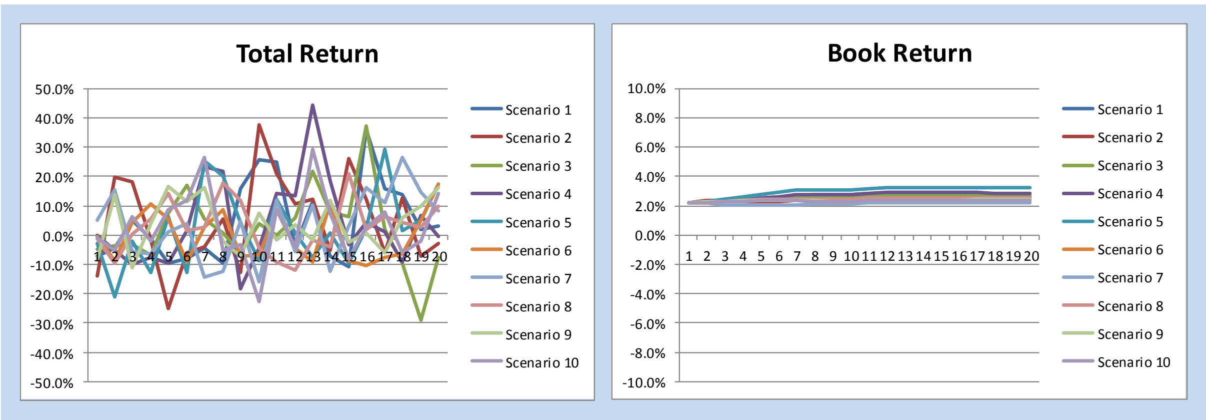
POLICYHOLDER DIVIDEND POLICY

In Japan, a dividend based on investment results is generally determined as the difference of a reference dividend return, less the guaranteed interest rate of a given policy.

Although management decisions regarding policyholder dividends may be influenced by many factors, such as market competitiveness, target profit, solvency position, or fair and equitable treatment of policyholders, for modeling purposes it is reasonable to define the "reference dividend return" in terms of the performance of the supporting assets.

Under a market-consistent framework, stochastic scenarios generated by a risk-neutral scenario generator may be used to simulate liability cash flows that are tied to the return of a portfolio of supporting assets. For variable (unit-linked) business, it would be typical to simulate account value movements over risk-neutral scenarios in order to simulate liability cash flows on a total return basis. However, this approach is not able to capture the dynamics of a dividend rate derived from reported gains on an asset portfolio composed primarily of bonds. This is due to the fact that the fluctuation of the total return on bonds is usually much larger than that of the book return (see Figure 5); the time value of the policyholder dividend option calculated under such an approach would be significantly higher than it actually is. This is especially true if bonds are held to maturity. Therefore, it is necessary to model asset portfolios to reflect such dynamics; this will promote a better understanding and better management of the policyholder dividend option.

Figure 5: Comparison of Fluctuation: Total Return vs. Book Return



In this illustrative case, we define a company's reference dividend return as a fixed percentage of the average yield-to-maturity of the bond portfolio backing insurance liabilities, where it is anticipated that most bonds are held to maturity (i.e., not actively traded in an effort to gain short-term market opportunities). The average yield-to-maturity is calculated as a weighted average over the face value for each bond in each future year.

Under this dividend policy, the company will consider only average yield-to-maturity, which is determined at the time of purchase and remains unchanged though the holding period. Realized gains and losses are assumed to be immaterial under the buy-and-hold strategy. This assumption significantly simplifies the calculations because it obviates the need to calculate a market value for the bonds and means that we do not need to adjust bond cash flows to assure that the present value discounted by swap rates can reproduce the initial market value, as bond cash flows or realized gains/losses are not required to arrive at the reference dividend rate. Here, only the simulated book values of the bond are needed. Often the so-called leakage (Martingale) test[5] is very hard to pass in a strict sense, and a small bias (e.g., 1% to 2% of assets) could significantly distort the present value of profits, so that an adjustment is necessary. This method is very convenient as this onerous test can be skipped with the balance sheet approach,[6] rather than the distributable earnings approach, used to calculate the present value of profits.

However, if the company adopts a more complex investment policy or holds a material amount of equities, as observed in France and Italy, it will be necessary to perform a leakage test—for example, by developing a more robust ALM model and simulating both assets and liability cash flows in order to calculate the book basis return without violating market-consistency requirements.

STRUCTURE OF THE MODEL

In order to calculate option values in the situation where lapses are sensitive to market interest rates, it is necessary to stochastically project liability cash flows under a large number of interest rate scenarios. In addition, to calculate a reference dividend return and the option value associated with policyholder dividends, the bond portfolio needs to be stochastically projected reflecting the underlying liability cash flows and an explicit investment strategy. Put simply, a full stochastic ALM projection is needed.

A stochastic ALM projection can be performed within a reasonable time frame by utilizing a sophisticated ALM platform, in combination with an efficient model compression technique such as a cluster modeling.

When a number of sensitivity analyses are needed within a limited time frame, a practical expedient could be:

- Perform a stochastic ALM projection using a compressed liability model, and then store a set of yields-to-maturity calculated from the bond portfolio for each economic scenario
- Perform a stochastic liability-only projection on a compressed or seriatim liability model, applying the stored set of yields-to-maturity to calculate policyholder dividends

INVESTMENT AND DISINVESTMENT POLICY

Consistent with the investment policy, the following rules are set up to model the bond portfolio:

- The basic investment strategy is buy and hold to maturity.
- The asset mix at the projection date for each business segment is imported from the asset in-force data as of the projection date.
- Investment and disinvestment rules are as follows:
  - The cash balance after distributing profit or compensating for losses at the end of each year is calculated. Distributing profit or compensating for losses should be conducted so that the asset and liability balances on a book-value basis are equal at the beginning of the next year.
  - If the cash balance is positive, bonds are newly purchased according to the defined proportion.
  - If the cash balance is negative, the bond portfolio is sold proportionally.
- Investment policy for new cash flow is defined for each business segment. One example is shown in the table in Figure 6.

[5] The leakage test is to confirm that the average present value of stochastic liability cash flows and earnings distributed to shareholders ties to the initial asset value.

[6] Under the balance sheet approach, the present value of future profits can be calculated as initial assets minus present value of future liability cash flows, which ensures there is no bias that is due to not strictly meeting the leakage test.

Figure 6: Investment Policy: New Cash Flows

Bond Maturity	Weight
5-year	10%
10-year	10%
15-year	10%
20-year	10%
30-year	40%
40-year	20%

- The coupon rate of the bonds to be purchased at each future date is set at par, which equates the purchase price and the face value of the bond, derived from a forward rate curve at the time of the purchase. Par rates for interest-bearing bonds with the maturities of five, 10, 15, 20, 30, and 40 years are generated by an economic scenario generator and derived from the following formula:

$$s(t) = \frac{P(t,T_0) \quad P(t,T_N)}{\bullet_{i=0}^{N \;\; 1} \; {}_i P(t,T_{i+1})}$$

where

$s(t)$ = swap rate at time t

$T_t, T_{2,}, \ldots, T_N$ = interest payment dates

${}_i$ = 0.5 (constant), assuming semiannual payment

$P(t,T)$ = the price at time *t* for a zero-coupon bond that matures at time *T*

- Theoretically, for corporate bonds and other types of securities subject to default risk, even if realized gains/losses need not be considered, defaults should be modeled to ensure market consistency. However, as a simplification, those securities could be treated as if they were government bonds of the same coupon rate and the same maturity, as long as those securities are highly rated and the effect of ignoring defaults is not material. The modeling of defaults requires that a certain percentage of corporate bonds be terminated during each projection period, and requires the cash-flow implications of these terminations to be appropriately reflected. If the default percentage is very small, the effect on the average yield-to-maturity is limited. Of course, if a portfolio contains a significant volume of lower-grade securities, it will be necessary to model the effect of defaults.

MARKET CONSISTENCY

Because the coupon rate on bonds purchased at any future date is a par rate tied directly to forward rates, the market consistency of model bond purchases depends on the underlying forward rates. To ensure market consistency, the following three tests are performed using the forward rates generated by an economic scenario generator:

- Compare the market price of zero-coupon bonds at the projection date with an average of the price of zero-coupon bonds calculated using one-year forward rates as discount rates. This test is conducted for a number of maturities up to 100 years.
- Martingale test for zero-coupon bonds for various maturities including five, 10, 15, 20, 30, and 40 years. This test is conducted for up to 100 years.

- Compare the theoretical value of swaptions calculated using the market swap rate and the market-implied volatility at the projection date with the swaptions value calculated using a Monte Carlo simulation of interest rate scenarios. This test is conducted for combinations of several swap tenors and several option terms. An example is shown in Figure 7.

Figure 7: Comparisons of Values

Swap Tenor	Option Term	Model Price	Monte Carlo Payer Prices	Monte Carlo Receiver Prices	Fit
1	1	0.09%	0.09%	0.09%	100.2%
5	1	0.91%	0.94%	0.94%	102.8%
	5	2.62%	2.58%	2.60%	98.9%
	7	3.14%	3.08%	3.12%	98.9%
	10	3.59%	3.50%	3.57%	98.4%
	15	3.79%	3.67%	3.77%	98.2%
	20	3.66%	3.51%	3.57%	96.6%
10	1	2.16%	2.22%	2.23%	103.0%
	5	5.27%	5/17%	5.23%	98.5%
	7	6.10%	5.96%	6.04%	98.4%
	10	6.76%	6.56%	6.69%	98.1%
	15	6.98%	6.74%	6.91%	97.8%
	20	6.70%	6.42%	6.51%	96.4%
15	1	3.19%	3.26%	3.28%	102.4%
	5	7.36%	7.18%	7.27%	98.2%
	7	8.39%	8.18%	8.31%	98.3%
	10	9.21%	8.92%	9.11%	97.9%
	15	9.45%	9.11%	9.30%	97.5%
	20	9.00%	8.59%	8.70%	96.1%
20	1	3.96%	4.00%	4.05%	101.8%
	5	8.92%	8.68%	8.80%	97.9%
	7	10.12%	9.85%	10.00%	98.1%
	10	11.05%	10.69%	10.94%	97.8%
	15	11.25%	10.81%	10.99%	96.8%
	20	10.68%	10.18%	10.32%	96.0%

APPLICATION TO OTHER TYPES OF PRODUCTS

As described above, there are other types of discretionary or performance-linked payments to policyholders, such as those associated with interest-sensitive fixed annuities and interest-sensitive whole life insurance. When the crediting strategy can be modeled in a manner similar to the rule for policyholder dividends outlined in the previous example, the same approach can be applied.

Conclusion

Market practices vary between France, Italy, and Japan, which is due to differences in products, investments, bonus policies, regulatory and accounting requirements, and other factors. However, there are a number of common aspects as well:

RISK-NEUTRAL STOCHASTIC MODEL

To capture the asymmetric nature of policyholder dividends, stochastic valuation is required. Because it is rare that an analytic solution exists for the value of a policyholder dividend option, Monte Carlo simulation is required in most cases.

Risk-neutral valuation, which is widely used in pricing financial derivatives, is a common approach to ensure market consistency in valuing policyholder dividend options. In risk-neutral valuation, risk-free rates are used for investment returns and discount rates.

INVESTMENT RETURN ON A BOOK-VALUE BASIS—ALM PROJECTION NEED

In many cases, policyholder dividends are based on a book-value investment return. To properly reflect the linkage between an investment portfolio and the funds required to meet liability cash flows, asset modeling will be required.

Asset models are based on an actual investment portfolio as of the valuation date, with investment and disinvestment strategies specified. Because an ALM projection needs to reflect the dynamic linkage (iteration process) between assets and liabilities, when compared to a liability-only projection, it demands a flexible and efficient platform with high computing capability. Thus, additional techniques may be required such as model compression techniques (e.g., cluster modeling), replicating portfolios, and least-squares Monte Carlo methods.

MARKET CONSISTENCY

Economic scenarios should be calibrated for market consistency. This calibration is typically conducted by comparing the actual market prices for typical asset types, including derivatives, with the values produced averaging over the economic scenarios generated.

In addition, asset models should be calibrated for market consistency. There could be a gap between the market price of a certain bond and the present value of the asset cash flows discounted at risk-free rates. This gap represents an unwarranted gain or loss in the valuation, and therefore should be removed, for example by adjusting coupon and/or principal payment cash flows. Even government bonds could produce such a gap, which would be due to the difference between government bond yields and swap rates, where swap rates are used as discount rates.

Further, the leakage test is conducted to evaluate whether the average present value of all outflows, including shareholders dividends (distributable earnings) over the stochastic simulations, converges toward the initial value of the assets.

Because it is difficult to achieve market consistency in a strict sense and even a small bias in market consistency (e.g., 1% to 2% of asset value) could significantly distort the valuation, techniques to further refine market consistency or obviate the need itself have evolved in each country.

Market-consistent valuation represents one important advance in the communication of performance results to the financial community. As with other financial measures, it should be viewed as one of many tools available to support the needs of management and investors.

We hope that this working paper will help promote a discussion and refinement of market-consistent techniques and will facilitate ongoing efforts to improve risk management, efficiency, and profitability.