

Munich Re  
Market Consistent Embedded Value Report  
2012

2012

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# 1 Introduction

## 1.1 Scope of disclosure

In June 2008, the European Insurance CFO Forum (CFO Forum) published the Market Consistent Embedded Value Principles<sup>®1</sup> (MCEV Principles) in order to bring greater consistency and improved disclosure to the European insurance industry's embedded value. Throughout this document, MCEV and embedded value refer to the above MCEV Principles.

In October 2009, the CFO Forum published an amendment to the MCEV Principles to allow for the inclusion of an illiquidity premium. However, as the full implications of the future European regulatory regime (Solvency II) are not known with sufficient certainty at this time, Munich Re continues to follow its prudent approach: it does not apply any yield curve adjustments such as illiquidity premiums or countercyclical premiums in its valuation. This is in compliance with the CFO Forum's revised transitional guidance dating from September 2012. The revised transitional guidance states that there is no requirement to make allowance for Solvency II and associated consequences when complying with the MCEV Principles. To illustrate the impacts on our business of applying an illiquidity premium and of basing the MCEV calculations on Solvency-II-like yield curves, however, we do state the corresponding sensitivities.

Munich Re does not report its Group MCEV. In all other respects, we fully comply with the MCEV Principles.

In this report, which is a supplement to the Munich Re Group Annual Report, the following topics are dealt with for the reinsurance and primary insurance business we cover:

- The Market Consistent Embedded Value as at 31 December 2012
- An analysis of embedded value earnings for 2012
- A reconciliation of embedded value with IFRS equity
- An analysis of the sensitivities of the embedded value and value of new business as at 31 December 2012
- A detailed description of the embedded value methodology applied

## 1.2 Business covered

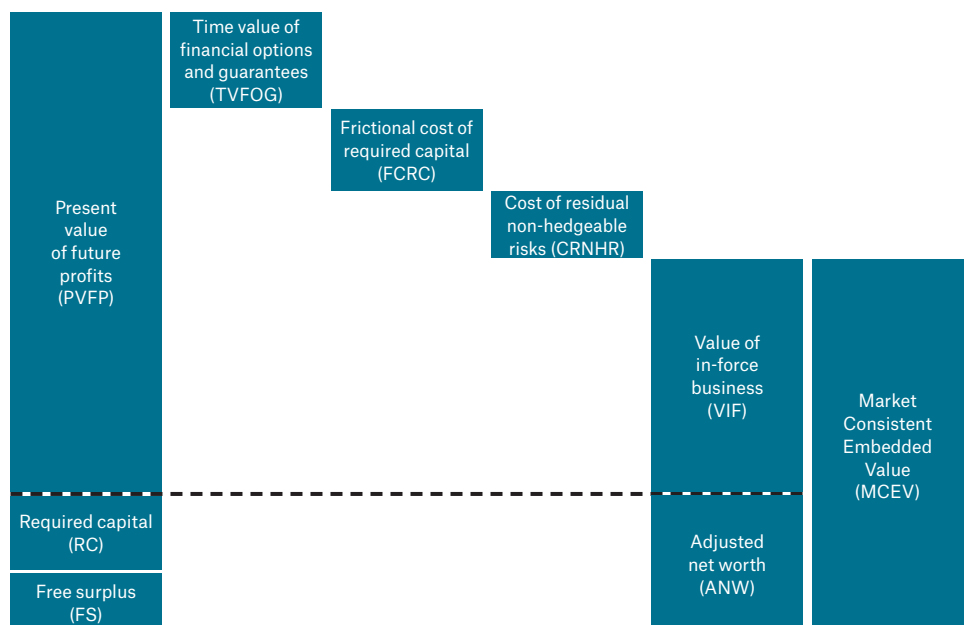
This embedded value report covers 100% of the life reinsurance business written by Munich Re and 97% of business written in the life and German health primary insurance entities of Munich Re. German health primary business is long-term business and is therefore included, whereas health reinsurance business is short-term in nature and therefore excluded. The increased share of 97% (94%) for the primary segment's business covered is attributable to the first-time inclusion of ERGO Direkt Krankenversicherung AG in the MCEV 2012 calculations. For a detailed list of Munich Re segments and entities covered in this report, please refer to Section 5.10.

<sup>1</sup> Copyright Stichting CFO Forum Foundation 2008, available online at <http://www.cfoforum.nl>

### 1.3 Definition of Market Consistent Embedded Value

Embedded value is the present value of shareholders' interests in the earnings distributable from assets allocated to the covered business after making sufficient allowance for the aggregate risks involved. The MCEV Principles distinguish between the following components of embedded value:

- Adjusted net worth (ANW) broken down into the components
  - Free surplus (FS) and
  - Required capital (RC)
- Value of in-force covered business (VIF), subdivided into
  - Present value of future profits (PVFP)
  - Time value of financial options and guarantees (TVFOG)
  - Frictional cost of required capital (FCRC)
  - Cost of residual non-hedgeable risks (CRNHR).



All components are net of taxes, minority interests and policyholder participations (where applicable). The present value of future profits (PVFP) already includes the intrinsic value of all financial options and guarantees; their time value (TVFOG) is disclosed separately. Any non-hedgeable risks that are not already reflected in the PVFP or TVFOG are covered by the cost of residual non-hedgeable risks (CRNHR). The CRNHR is calculated using a cost-of-capital approach, i.e. the product of projected risk capital for non-hedgeable risks and the respective cost rate. The frictional cost of required capital (FCRC) consists of the projected tax to be paid as well as fees for the management of the assets backing the RC and, only for our German health primary business, the policyholder participation in the earnings from assets backing required capital. A detailed description of the MCEV methodology used for preparing this supplement is given in Section 5.

## 2 Overview of embedded value results 2012

Since 2005, Munich Re has adhered to a strict market-consistent framework. As in previous years, we refrain from applying any yield curve adjustments in our valuation.

The change from the Market Consistent Embedded Value as at 31 December 2011 to the Market Consistent Embedded Value as at 31 December 2012 is driven by a high value of new business, especially in our reinsurance business, and positive economic variances, especially in our primary insurance business.

### Highlights

€m	Reinsurance	Primary insurance	Total
<b>Market Consistent Embedded Value 31.12.2011</b>	<b>9,992</b>	<b>875</b>	<b>10,867</b>
Opening adjustments	232	318	550
<b>Adjusted MCEV 31.12.2011</b>	<b>10,225</b>	<b>1,193</b>	<b>11,418</b>
Value of new business	573	146	719
Expected return at reference rate	267	19	286
Expected return in excess of reference rate	69	140	209
Experience variances	23	-468	-445
Assumption changes	146	-460	-314
Other operating variance	-139	296	157
<b>Operating MCEV earnings 2012</b>	<b>939</b>	<b>-328</b>	<b>611</b>
Economic variances	233	1,848	2,081
Other non-operating variance	-	5	5
<b>Total MCEV earnings 2012</b>	<b>1,172</b>	<b>1,525</b>	<b>2,697</b>
Closing adjustments	-781	10	-770
<b>Market Consistent Embedded Value 31.12.2012</b>	<b>10,616</b>	<b>2,728</b>	<b>13,344</b>
IFRS equity excluding goodwill	6,653	4,175	10,828
<b>Value not recognised in IFRS equity</b>	<b>3,963</b>	<b>-1,447</b>	<b>2,516</b>

Favourable total MCEV earnings of €2,697m were once again supported by strong operating MCEV earnings of €939m in our life reinsurance business.

The recovery of capital markets worldwide led to positive economic variances of €2,081m, for the most part in the primary insurance segment. Tightened credit spreads for both government and corporate bonds were the main driver of this positive development.

Total embedded value earnings in respect of business covered by Munich Re amounted to €2,697m. Our MCEV increased by 22.8% to €13,344m, and the value not recognised in IFRS equity was up by 130.8% at €2,516m.

## 3 Reinsurance

In 2012, the embedded value of our life reinsurance business again developed well, exceeding the threshold of €10bn for the first time. At €10,616m, it is well above the value published in 2011 (€9,992m). Besides moderately positive economic variances, solid operating MCEV earnings of €939m contributed to this success. The operating MCEV earnings were particularly driven by a strong value of new business of €573m (643m in 2011). The new business values of recent years have been buoyed by deals providing solvency relief, which came about as a result of Munich Re's financial strength. We again succeeded in closing a number of new such reinsurance deals in 2012, albeit to a lesser extent than in 2011. As in the past, the majority of our VNB emerged from the substantial volumes of recurring new business written across various geographical areas.

The embedded value components of our life reinsurance business are presented in the following table, which shows the MCEV as at 31 December 2012 and at 31 December 2011.

### MCEV components

	31.12.2012	31.12.2011	Change
	€m	€m	%
Present value of future profits (PVFP)	8,545	7,980	7.1
Time value of financial options and guarantees (TVFOG)	-114	-125	-8.9
Frictional costs of required capital (FCRC)	-490	-450	8.9
Cost of residual non-hedgeable risks (CRNHR)	-2,108	-2,125	-0.8
<b>Value of in-force covered business (VIF)</b>	<b>5,833</b>	<b>5,279</b>	<b>10.5</b>
Free surplus (FS)	819	862	-4.9
Required capital (RC)	3,965	3,852	2.9
<b>Adjusted net worth (ANW)</b>	<b>4,784</b>	<b>4,714</b>	<b>1.5</b>
<b>Market Consistent Embedded Value (MCEV)</b>	<b>10,616</b>	<b>9,992</b>	<b>6.2</b>

At €10,616m, the embedded value for Munich Re's life reinsurance business as at 31 December 2012 was 6.2% higher than last year's MCEV (€9,992m). A detailed explanation of the drivers of this increase in embedded value is given below.

The time value of financial options and guarantees as at 31 December 2012 decreased slightly to -€114m (-€125m in 2011). This moderate value results from the fact that within life reinsurance we concentrate on assuming biometric risks, so that the business only has minor exposure to capital market risks.

The cost of residual non-hedgeable risks of -€2,108m remained largely unchanged compared with 2011 (-€2,125m). This reflects the increase in the economic risk capital due to the growth in the book of business, but also the higher discounting of the annual costs as a result of interest rates which, with reference to our reinsurance portfolio, were slightly higher overall.

The change in required capital from €3,852m as at 31 December 2011 to €3,965m as at 31 December 2012 was driven by three factors: new business written in 2012 led to an increase in required capital by €338m, the release of required capital from running off existing business brought about a reduction of €235m and, finally, changes in foreign-exchange rates increased the required capital in the reporting currency by €9m.

The total required capital of €3,965m for business covered as at 31 December 2012 exceeds by €617m the capital required at a life reinsurance level to cover all minimum solvency requirements.

The change in embedded value in 2012 is shown in the following table:

#### Analysis of MCEV earnings

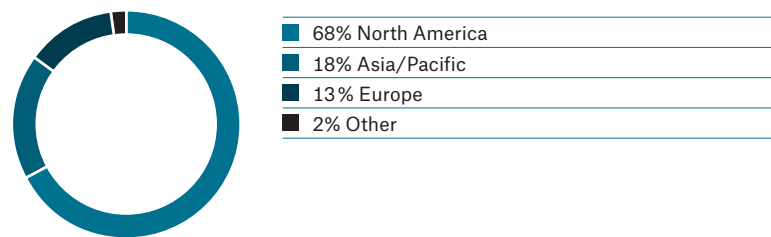
€m	Free surplus	Required capital	VIF	MCEV
<b>Opening MCEV</b>	<b>862</b>	<b>3,852</b>	<b>5,279</b>	<b>9,992</b>
Opening adjustments	-4	96	141	232
<b>Adjusted opening MCEV</b>	<b>857</b>	<b>3,948</b>	<b>5,420</b>	<b>10,225</b>
Value of new business	-407	338	641	573
Expected return at reference rate	8	35	224	267
Expected return in excess of reference rate	68	-	1	69
Transfers from VIF and required capital to free surplus	741	-251	-489	-
Experience variances	-170	87	106	23
Assumption changes	-79	138	87	146
Other operating variance	301	-315	-125	-139
<b>Operating MCEV earnings</b>	<b>463</b>	<b>32</b>	<b>444</b>	<b>939</b>
Economic variances	78	27	128	233
Other non-operating variance	-25	45	-19	-
<b>Total MCEV earnings</b>	<b>516</b>	<b>104</b>	<b>553</b>	<b>1,172</b>
Closing adjustments	-554	-87	-140	-781
<b>Closing MCEV</b>	<b>819</b>	<b>3,965</b>	<b>5,833</b>	<b>10,616</b>

The **opening adjustments** of €232m represent foreign-exchange adjustments from beginning-of-year exchange rates to average-of-year exchange rates used in the MCEV earnings analysis.



As in 2011, a strong **value of new business (VNB)** of €573m contributed to operating MCEV earnings of €939m. Compared with the extraordinary level in the record year 2011 (€643m), the VNB decreased by 11%. Recurring new business was again the main contributor. As in the past few years, Munich Re's VNB in addition benefited from capital relief and financing business opportunities, although to a lesser extent than in 2011. This is the main reason for the drop in VNB. However, the 2012 VNB fits well into Munich Re's long and successful track record of achieving sustainable profitable growth in life reinsurance.

#### VNB split by region



The **expected return** at reference rate (using assumptions as at the start of the year) was €267m (233m), due to a higher opening MCEV and the development of one-year interest rates for the major currencies. Because of our prudent asset allocation, the **expected return in excess of reference rate**, amounting to €69m (37m), is rather low.

Experience in mortality and disability business varied only slightly against expected values across all markets. Operating **assumption changes** led in aggregate to an increase of €146m (61m). Updates of assumptions have been made to reflect both past evidence and expected future experience for the business covered. In total, improved mortality and morbidity assumptions, particularly in North America, more than compensated for negative adjustments in several markets.

**Other operating variance** allows for model changes resulting from the continuous revision of embedded value calculation models across several markets, accounting for -€139m (113m) in 2012.

Overall, we observed strong operating embedded value earnings of €939m, measuring 9.2% of the adjusted opening MCEV.

A further slight fall in interest rates across Europe and tightened credit spreads in main markets (especially North America) led to overall positive **economic variances** of €233m. As our reinsurance business is dominated by insurance risks such as mortality risk, the impact of changes in the interest rate-environment has a much lower effect on the embedded value than for our primary business.

The total embedded earnings of €1,172m account for 11.5% of the opening MCEV after opening adjustments.

The **closing adjustments** of –€781m were dominated by capital repatriations of €561m from life reinsurance to the Group. In addition, foreign-exchange adjustments from the average-of-year exchange rates used in the MCEV earnings analysis to the end-of-year exchange rates accounted for –€219m. For the year 2012 as a whole, i.e. taking opening and closing foreign-exchange adjustments together, exchange rate effects had only an insignificant impact on the overall change in MCEV.

#### New business

	2012	2011	Change
	€m	€m	%
Value of new business (VNB)	573	643	-11.0
Present value of new business premiums (PVNBP)	9,804	10,175	-3.6
Annual premium equivalent (APE)	891	1,133	-21.4
%			
New business margin (VNB/PVNBP)	5,8	6,3	-7.6
VNB/APE	64,3	56,8	13.3

The present value of new business premiums and the annual premium equivalent are down on last year. Also, the new business margin decreased, whereas the VNB/APE ratio increased for 2012, mainly reflecting the drop in volume of financially motivated transactions that drove 2011's new business profitability ratios. Especially the profitability of financially motivated transactions, measuring the VNB in relation to the premium, can be within a wider range, as reinsurance solutions for this kind of business are specially tailored to meet clients' specific requirements.

#### IFRS reconciliation

	31.12.2012	31.12.2011	Change
	€m	€m	%
IFRS equity excluding goodwill	6,653	6,224	6.9
Market Consistent Embedded Value	10,616	9,992	6.2
<b>Value not recognised in IFRS equity</b>	<b>3,963</b>	<b>3,769</b>	<b>5.2</b>

The embedded value of business covered as at 31 December 2012 exceeds the relevant IFRS equity (excluding goodwill) by €3,963m, as against €3,769m in the previous year.

## Sensitivities for embedded value as at 31 December 2012:

## MCEV and VNB sensitivities

	MCEV		Change	VNB		Change
	€m	€m	%	€m	€m	%
Base case	10,616			573		
<b>Interest rates and assets</b>						
Interest rates -100 BP	11,004	388	3.7	612	39	6.8
Interest rates +100 BP	10,113	-503	-4.7	527	-46	-8.0
Equity/property values -10%	10,607	-9	-0.1	573	-	-
Equity/property-implied volatilities +25%	10,604	-12	-0.1	573	-	-
Swaption-implied volatilities +25%	10,615	-2	-	573	-	-
Illiquidity premium 10 BP	10,611	-6	-0.1	569	-4	-0.7
<b>Expenses and persistency</b>						
Maintenance expenses -10%	10,729	113	1.1	585	12	2.2
Lapse rates -10%	11,003	387	3.6	634	61	10.7
Lapse rates +10%	10,297	-319	-3.0	523	-50	-8.7
<b>Insurance risk</b>						
Mortality/morbidity (life business) -5%	12,484	1,867	17.6	697	124	21.7
Mortality (life business) +5%	9,101	-1,515	-14.3	483	-90	-15.7
Mortality (annuity business) -5%	10,546	-70	-0.7	556	-17	-3.0
No mortality improvements (life business)	5,929	-4,688	-44.2	239	-334	-58.3
Morbidity (life business) +5%	10,324	-292	-2.8	541	-32	-5.6
<b>Required capital</b>						
Minimum solvency capital	10,679	63	0.6	575	2	0.4
<b>Other</b>						
Value of original currencies -10%	9,658	-959	-9.0	524	-48	-8.5
Solvency II sensitivity	10,627	11	0.1	573	1	0.1

Our life reinsurance business is dominated by insurance risks, most notably mortality risk. Therefore, changes in mortality or morbidity assumptions strongly impact the embedded value and the value of new business. In contrast to our primary insurance business, changes in economic assumptions only have a minor effect on the overall MCEV of our life reinsurance business.

Since Munich Re discloses its embedded value without taking any adjustments such as illiquidity premiums into consideration, we show two sensitivities in this respect. The first sensitivity shows the impact of including an illiquidity premium of 10 BP. The second one gives an indication of what Munich Re anticipates its embedded value could look like under a future Solvency II regime. As the Solvency II specifications for measures to evaluate long-term guarantee products are still ongoing, the economic assumptions applied for this sensitivity reflect a Munich Re estimation based on the current discussions. The assumptions for this "Solvency II sensitivity" are described in detail in Section 6. The minor impact of both sensitivities on our life reinsurance business is due to the generally smaller influence of economic assumptions. Furthermore, there are offsetting effects between several markets.

The sensitivity of exchange rates relative to the reporting currency reflects the high proportion of business written in non-euro currencies. More than 80% of this business is denominated in foreign currencies, especially in Canadian and US dollars.

Except for the stressed assumptions, the sensitivity calculations are performed analogously to the base case.

## 4 Primary insurance

The embedded value components of our primary business are presented in the following table, which shows the embedded value as at 31 December 2012 and at 31 December 2011.

### MCEV components

	Primary insurance (Total)		
	31.12.2012	31.12.2011	Change
	€m	€m	%
Present value of future profits (PVFP)	3,579	1,447	147.4
Time value of financial options and guarantees (TVFOG)	-1,723	-1,817	-5.2
Frictional costs of required capital (FCRC)	-393	-419	-6.0
Cost of residual non-hedgeable risks (CRNHR)	-1,260	-571	120.8
<b>Value of in-force covered business (VIF)</b>	<b>202</b>	<b>-1,360</b>	<b>-114.8</b>
Free surplus (FS)	434	137	217.0
Required capital (RC)	2,092	2,098	-0.3
<b>Adjusted net worth (ANW)</b>	<b>2,526</b>	<b>2,235</b>	<b>13.1</b>
<b>Market Consistent Embedded Value (MCEV)</b>	<b>2,728</b>	<b>875</b>	<b>211.8</b>

At €2,728m, the MCEV of our primary insurance business was 211.8% higher than last year's MCEV (€875m). A detailed explanation is given below.

Our primary insurance business benefited from the recovery of capital markets worldwide throughout the year 2012. The narrowing of credit spreads more than compensated for the effect of a further slight fall in interest rates. This led to overall positive economic variances of €1,848m. As the full implications of the future European regulatory regime (Solvency II) are not known with sufficient certainty yet, Munich Re continues to follow its prudent approach of not applying any yield curve adjustments in its valuation. To illustrate the potential impact of the application of Solvency-II-like yield curves on our business, we show a corresponding sensitivity calculation. According to this "Solvency II sensitivity", the MCEV of our primary business segment would increase by 72.5% to €4,707m, mainly driven by the German life primary business, which is particularly dependent on economic assumptions.

The present value of future profits (PVFP) increased by 147.4%, amounting to €3,579m (1,447m), largely as a result of tightened credit spreads for both government and corporate bonds. In particular, the narrowing of government bond spreads in many European countries had a positive impact. The time value of financial options and guarantees (TVFOG) recovered only slightly to -€1,723m (-1,817m), as large parts of the guarantees are in the money with the current low level of interest. After the allowance for frictional cost of required capital (FCRC) of -€393m and cost of residual non-hedgeable risks (CRNHR) of -€1.260m, the MCEV of the primary insurance business increased to €2,728m.

The value of our German life primary business is still severely affected by the unfavourable economic environment, as this segment is characterised by substantial financial options and guarantees. The MCEV of this segment increased from -€1,633m to -€970m. Most of this effect was driven by the increase in PVFP from -€717m to €345m, mainly as a consequence of positive economic variances.

	German life primary			International life primary			German health primary		
	31.12.2012	31.12.2011	Change	31.12.2012	31.12.2011	Change	31.12.2012	31.12.2011	Change
	€m	€m	%	€m	€m	%	€m	€m	%
	345	-717	-148.1	826	509	62.1	2,408	1,655	45.5
	-1,604	-1,682	-4.7	-119	-135	-11.4	-	-	-
	-161	-153	5.1	-46	-50	-6.7	-186	-216	-13.8
	-819	-331	147.2	-53	-57	-7.0	-388	-182	112.9
	<b>-2,239</b>	<b>-2,884</b>	<b>-22.4</b>	<b>607</b>	<b>268</b>	<b>126.7</b>	<b>1,834</b>	<b>1,256</b>	<b>45.9</b>
	106	32	231.8	216	105	105.2	113	-	-
	1,163	1,219	-4.6	407	388	4.8	522	491	6.4
	<b>1,269</b>	<b>1,251</b>	<b>1.5</b>	<b>622</b>	<b>493</b>	<b>26.2</b>	<b>635</b>	<b>491</b>	<b>29.4</b>
	<b>-970</b>	<b>-1,633</b>	<b>-40.6</b>	<b>1,229</b>	<b>761</b>	<b>61.6</b>	<b>2,468</b>	<b>1,747</b>	<b>41.3</b>

Our international life primary business also benefited from the recovery of the capital markets. The VIF more than doubled to €607m (268m). At €1,229m, the MCEV of the segment was 61.6% higher than in 2011 (€761m).

Our German health primary business is less exposed to capital market fluctuations, as technical interest rates are not guaranteed for the whole contract term. Instead, policyholder options have a significant influence on shareholders' cash flows. These policyholder options are covered by the MCEV model in accordance with current experience. As changed policyholder behaviour is still difficult to estimate in the long run, an alteration in assumptions according to future experience may lead to substantial future changes in our MCEV figures. Examples of policyholder options are:

- Lapses with transfer values
- Obligatory benefit for non-payers without possibility to cancel contracts
- Change of policy

There are ongoing discussions concerning the German healthcare system. If these lead to material alterations in legislation, our future MCEV figures are expected to change substantially.

The MCEV of our German health primary business increased by 41.3% to €2,468m (1,747m). The main driver was the growth in PVFP, which increased by 45.5% to €2,408m (1,655m). Economic variances, in particular reduced credit spreads, and other operating variance contributed positively to this development. At the same time, the CRNHR increased to -€388m (-€182m), having a negative impact on the MCEV. The increase in CRNHR was caused by increased economic risk capital for non-hedgeable risks, inter alia due to model improvements in our internal economic capital model.

This year, for the first time, Munich Re's embedded value report covers ERGO Direkt Krankenversicherung AG, which contributed positively to the German health primary segment's MCEV.

Details of changes from MCEV 2011 to MCEV 2012 are explained in the following analysis of MCEV earnings.

#### Analysis of MCEV earnings

€m	Primary insurance (Total)			
	Free surplus	Required capital	VIF	MCEV
<b>Opening MCEV</b>	<b>137</b>	<b>2,098</b>	<b>-1,360</b>	<b>875</b>
Opening adjustments	-	90	227	318
<b>Adjusted opening MCEV</b>	<b>137</b>	<b>2,188</b>	<b>-1,133</b>	<b>1,193</b>
Value of new business	-116	16	246	146
Expected return at reference rate	3	32	-16	19
Expected return in excess of reference rate	-	-	140	140
Transfers from VIF and required capital to free surplus	95	-33	-63	-
Experience variances	-164	-83	-222	-468
Assumption changes	1	-1	-460	-460
Other operating variance	15	-21	302	296
<b>Operating MCEV earnings</b>	<b>-166</b>	<b>-89</b>	<b>-73</b>	<b>-328</b>
Economic variances	446	-4	1,406	1,848
Other non-operating variance	5	-	-	5
<b>Total MCEV earnings</b>	<b>284</b>	<b>-93</b>	<b>1,333</b>	<b>1,525</b>
Closing adjustments	12	-3	1	10
<b>Closing MCEV</b>	<b>434</b>	<b>2,092</b>	<b>202</b>	<b>2,728</b>

**Opening adjustments** of €318m mainly reflect a change in scope due to the first-time inclusion of ERGO Direkt Krankenversicherung AG (€311m) in the German health primary segment. For our international life primary business, the buyout of minorities in our Austrian company ERGO Versicherung Aktiengesellschaft, foreign-exchange adjustments from beginning-of-year exchange rates to average-of-year exchange rates, and dividends paid in the first half of 2012, add up to €7m. As large parts of our primary business are denominated in euros, foreign-exchange adjustments in general do not have a material impact.

The **value of new business** amounted to €146m. More details are given on page 16.

The **expected return at reference rate** contributed €19m. The **expected return in excess of reference rate** shows additional earnings (€140m) in embedded value consistent with management expectations for the business. The assumed risk premiums are shown in Section 6.3.4.

**Experience variances** show the impact of differences between expectations (e.g. for mortality, disability and lapses) and actual experience in the year. Also included are variances arising from tax, where such variances are due to management action. For 2012, experience variances in our primary insurance segment were negative at -€468m. For our German life primary business entities, various positive and negative effects, e.g. with regard to profit sharing, lapses, expenses and taxation, totalled -€403m, with negative deviations in lapse rates being the main driver. Also, our German health primary business caused negative experience variances of -€46m, mainly due to discounting effects in pension obligations and changes in profit sharing.

**Operating assumption changes** led in aggregate to a decrease in MCEV of €460m. The revision of assumptions reflecting both past evidence and expected future experience for the business covered led to negative effects of -€170m from our German life primary business and -€306m from our German health primary business. For both segments, the economic risk capital for non-hedgeable risks increased, among other things due to changes in our internal economic capital model. This led to an increase in CRNHR.

	German life primary				International life primary				German health primary			
	Free surplus	Required capital	VIF	MCEV	Free surplus	Required capital	VIF	MCEV	Free surplus	Required capital	VIF	MCEV
	32	1,219	-2,884	-1,633	105	388	268	761	-	491	1,256	1,747
	-	-	-	-	-	10	-4	7	-	80	231	311
	32	1,219	-2,884	-1,633	106	398	264	768	-	571	1,488	2,059
	-21	-	3	-18	-71	16	114	59	-25	-	129	104
	-	17	-41	-23	2	6	4	13	-	8	21	29
	-	-	56	56	-	-	35	35	-	-	49	49
	-96	-17	113	-	-1	-7	9	-	193	-8	-185	-
	-167	-51	-184	-403	15	-3	-30	-19	-11	-28	-7	-46
	1	-1	-170	-170	-	-	16	16	-	-	-306	-306
	18	-	-271	-253	-3	-	26	23	-	-21	546	525
	-265	-52	-494	-811	-58	12	173	127	157	-49	248	356
	336	-	1,139	1,475	154	-4	169	320	-44	-	98	54
	-	-	-	-	5	-	-	5	-	-	-	-
	71	-52	645	664	101	8	342	451	113	-49	346	410
	3	-3	-	-	9	1	1	10	-	-	-	-
	106	1,163	-2,239	-970	216	407	607	1,229	113	522	1,834	2,468

For our German health primary business, additional assumption changes originate from an alteration in the profit-sharing method in 2012. Assumption changes in our international life primary business led to an increase of €16m. Updated assumptions on future lapses had a positive impact of €24m. Several other positive effects together with changes in assumptions on administrative expenses of -€22m added up to the overall positive impact.

**Other operating variance** allows for model changes resulting from the continuous revision of embedded value calculation models across all companies. The positive overall impact of €296m is mainly due to a large favourable effect of €525m in German health primary business, driven by various model refinements, including an improved calibration of capital market scenarios. For our German life primary business, the improved calibration of capital market scenarios was the dominating effect for other operating variances (-€253m). For international life primary business, several model improvements had a positive impact on other operating variance (€23m). In particular, a further refined modelling of insurance riders in Belgium now better reflects the value of the business. In Austria, models have been improved to better account for the cost of external guarantees included for the "Zukunftsvorsorge" products. Additionally, the Belgian "Knipperlichten" reserves have been included in the MCEV calculation.

Overall, we observed negative operating MCEV earnings of -€328m, representing -27.5% of the adjusted opening MCEV.

The embedded value earnings for 2012 are dominated by positive **economic variances**. Favourable financial market developments led to an increase of €1,848m for our primary insurance business. Tightened credit spreads, both for government and corporate bonds, were the main driver of this positive development. Under our prudent approach, the valuation of liabilities is based on pure swap rates. Therefore, deviations in bond spreads do not affect the liabilities side. On the other hand, the assets side is affected, as market values of bonds increased. Taken together, this results in a positive impact on VIF and MCEV.

In particular, our German life primary business benefited by €1,475m from the financial market developments. In this business segment, slightly decreased interest rates had a negative impact, which was more than compensated for by the effect of narrowing spreads, especially for government bonds in many European countries. Most of this increase is reflected in a higher VIF, which rose by €1,139m. Due to fewer earning restrictions and different legal frameworks, international life primary business is less exposed to changes in economic assumptions. The main driver for international business was the appreciation in value of government and corporate bonds as a result of tightened spreads, accounting for €503m, which more than offset the further decrease in interest rates. At €54m, the economic variances for German health primary business were minor. The main reason for this is that technical interest rates are not guaranteed for the whole contract term, but can be changed through a premium adjustment process.

Changes in Italian law on the taxation of reserves (legge 265) had an effect of €5m, shown as **other non-operating variance** for international life primary business.

Altogether, total MCEV earnings amounted to €1,525m (or 127.8% relative to the adjusted opening MCEV).

In 2012, we changed our methodology regarding the treatment of capital movements in the MCEV. Profit transfers and dividends are now treated on a unified basis in a manner that best reflects the economic return. Therefore, profit transfers now remain in the MCEV at the end of the year, and are shown as an opening adjustment in the next year. As a consequence, **closing adjustments** of €10m for our primary insurance business consist only of foreign-exchange adjustments from average-of-year exchange rates to end-of-year exchange rates (€2m) and of capital flows from our international life primary business (€8m).

#### New business

	Primary insurance (total)		
	2012	2011	Change
	€m	€m	%
Value of new business (VNB)	146	37	293.0
Present value of new business premiums (PVNBP)	7,984	8,189	-2.5
Annual premium equivalent (APE)	733	783	-6.5
%			
New business margin (VNB/PVNBP)	1.8	0.5	303.1
VNB/APE	19.9	4.7	320.3



The **value of new business** for our primary insurance increased from €37m to €146m. The improvement mainly stems from our German life and health primary business. As the present value of new business premiums and the annual premium equivalent remained stable, the new business margin of our primary insurance business increased from 0.5% to 1.8%.

For our German life primary business, the reduction of the actuarial interest rate from 2.25% to 1.75% had a positive impact. The value of new business and the new business margin improved. However, the values are still negative at -€18m for the VNB and -0.5% for the new business margin.

The value of new business of our international life primary business slightly decreased from €63m to €59m. Considerable contributions derived especially from Belgian business, due to the sale of high volumes of very profitable classic life policies including a unit-linked element. Besides this, Italian, Austrian and Polish business performed well in 2012. Despite the drop in VNB, the overall new business margin increased from 4.1% to 4.8%.

For our German health primary business, the value of new business rose from €50m to €104m. The new business margin increased from 2.1% to 3.5%, thanks to a favourable business mix. Also, the first-time inclusion of ERGO Direkt Krankenversicherung AG had a positive effect on the new business figures.

	German life primary			International life primary			German health primary		
	2012	2011	Change	2012	2011	Change	2012	2011	Change
	€m	€m	%	€m	€m	%	€m	€m	%
	-18	-76	-76.8	59	63	-5.2	104	50	107.9
	3,769	4,207	-10.4	1,249	1,544	-19.1	2,967	2,439	21.7
	410	463	-11.4	146	170	-13.9	176	150	17.2
	-0.5	-1.8	-74.1	4.8	4.1	17.3	3.5	2.1	70.9
	-4.3	-16.3	-73.8	40.5	36.8	10.2	59.3	33.4	77.3

## IFRS reconciliation

	31.12.2012	31.12.2011	Change
	€m	€m	%
IFRS equity excluding goodwill	4,175	3,554	17.5
Market Consistent Embedded Value	2,728	875	211.8
<b>Value not recognised in IFRS equity</b>	<b>-1,447</b>	<b>-2,679</b>	<b>-46.0</b>

The embedded value of the primary insurance business covered as at 31 December 2012 is still below the corresponding IFRS equity (excluding goodwill). The value not recognised in IFRS equity as at end of 2012 is -€1,447m, having improved by €1,232m compared with the end of 2011.

## MCEV and VNB sensitivities

	MCEV			VNB		
	€m	€m	%	€m	€m	%
Base case	2,728			146		
<b>Interest rates and assets</b>						
Interest rates -100 BP	-1,041	-3,769	-138.2	-63	-209	-143.3
Interest rates +100 BP	5,027	2,298	84.3	258	112	76.3
Equity/property values -10%	2,552	-176	-6.5	145	-1	-0.8
Equity/property-implied volatilities +25%	2,638	-91	-3.3	150	4	2.5
Swaption-implied volatilities +25%	2,542	-186	-6.8	136	-10	-6.8
Illiquidity premium 10 BP	3,317	589	21.6	151	5	3.4
<b>Expenses and persistency</b>						
Maintenance expenses -10%	2,798	70	2.6	148	2	1.1
Lapse rates -10%	2,577	-151	-5.5	139	-8	-5.2
Lapse rates +10%	2,868	140	5.1	136	-10	-7.2
<b>Insurance risk</b>						
Mortality/morbidity (life business) -5%	2,835	107	3.9	154	8	5.3
Mortality (life business) +5%	2,686	-42	-1.5	140	-6	-4.0
Mortality (annuity business) -5%	2,548	-180	-6.6	139	-7	-4.6
No mortality improvements (life business)	2,728	-	-	146	-	-
Morbidity (life business) +5%	2,655	-73	-2.7	142	-4	-2.9
<b>Required capital</b>						
Minimum solvency capital	2,791	63	2.3	138	-8	-5.6
<b>Other</b>						
Value of original currencies -10%	2,720	-8	-0.3	146	-1	-0.4
Solvency II sensitivity	4,707	1,979	72.5	234	88	59.9

Compared with our reinsurance business, most of our primary business is characterised by substantial financial options and guarantees. Therefore, the main drivers are economic assumptions; non-economic assumptions are of far less significance.

As in previous years, we do not apply any yield curve adjustments in our base case calculation. To show the impact on our primary insurance business of taking yield curve adjustments into consideration, we calculate the following two sensitivities. The first one demonstrates the effect of including an illiquidity premium of 10 BP for the whole portfolio. The second one gives an indication of what Munich Re's embedded value is anticipated to look like under a future Solvency II regime. Discussions on the Solvency II specifications for measures to evaluate long-term guarantee products are still ongoing. The economic assumptions applied for the Solvency II sensitivity therefore reflect a Munich Re estimation based on the current discussions. Our assumptions for the Solvency II sensitivity are described in detail in Section 6 of this report.

Particularly for our German life primary business, embedded financial options and guarantees have a strong asymmetrical and non-linear impact on cash flows to shareholders. Falling interest rates thus have a higher impact on embedded value than rising interest rates. The effect increases for each further step down. For large parts of our German life insurance portfolio, current risk-free interest rates as used in our valuation are below guaranteed interest rates. All in all, the effects of all economic and non-economic sensitivities are fairly high. This is especially true for the sensitivity to interest rates, illiquidity premium and the Solvency II sensitivity.

As an increase in volatilities leads to a higher TVFOG for traditional participating business, embedded value decreases for an increase in swaption-implied volatility, as well as for an increase in equity and property-implied volatility. But because of low exposure to equity and property, the effects of the corresponding sensitivities on the MCEV are moderate.

The substantial effects of cross-subsidisation between new and in-force participating business (especially in German life and health primary insurance) are reflected in the approach we used to calculate the VNB sensitivities.

Except for the stressed assumptions, the sensitivity calculations are performed analogously to the base case.

## 5 Embedded value methodology

The embedded value methodology adopted by Munich Re is in accordance with the Market Consistent Embedded Value Principles® (MCEV Principles) published by the European Insurance CFO Forum (CFO Forum) in June 2008. We do not apply any yield curve modifications such as illiquidity premiums as permitted by an amendment to the MCEV Principles, published by the CFO Forum in October 2009. In this section, we specify the methodology used in preparing this supplementary report.

The embedded value results and IFRS equities are presented at a consolidated Group level. Results are presented net of minority interests and policyholders' interests. Intra-Group reinsurance ceded from primary insurers to reinsurers is shown in the reinsurance segment.

The embedded value reporting currency is the euro. Calculations are undertaken in the original currency of the business covered and converted to euros for consolidation purposes. In converting original currency embedded values and their components into euros, the exchange rates as at the relevant valuation dates are used. Changes in the embedded value due to changes in foreign-exchange rates are part of opening and closing adjustments. For converting embedded value earnings based on the original currency into euros, average-of-year exchange rates are used.

### 5.1 Look-through principle

The assets related to the business covered are mainly managed by the Group's asset management units. The costs and profits from managing these assets are included in the embedded value on a look-through basis.

Where material, costs of other service companies, such as administration and IT, are also included in the embedded value on a look-through basis. Costs of holding companies related to the business covered have been allowed for in the embedded value calculations as well.

### 5.2 Adjusted net worth (ANW)

The adjusted net worth (ANW) of our business covered is defined as follows:

- For pure life reinsurance entities, the ANW equals the local regulatory net worth adjusted to reflect the market value of assets.
- For composite reinsurance entities, the allocated required capital is used.
- For primary insurance entities, the ANW is based on the local regulatory net worth. Profit transfers and dividends are treated on a unified basis. Therefore, the ANW also includes profit transfers.

Differences between IFRS and statutory pension liabilities are included in the MCEV as an adjustment to net assets.

The required capital (RC) is defined as follows:

- For reinsurance entities, the RC is derived taking into account both regulatory requirements and internal objectives (e.g. rating requirements, internal economic capital model).
- For German primary insurers, the RC is set to statutory net worth adjusted for differences between IFRS and statutory pension liabilities. With their statutory net worth, all German primary insurers covered in this report have statutory solvency ratios above 150%.
- For international primary insurers, the RC is equal to 100% of the EU minimum solvency requirements. This simplified assumption has little impact on the MCEV.

The free surplus (FS) is defined as the adjusted net worth less the required capital.

### 5.3 Value of in-force covered business (VIF)

A bottom-up approach to allow for risk is adopted for the calculation of the present value of in-force covered business. The economic assumptions and discount rates used are calibrated applying a market-consistent methodology to allow for financial risk. In principle, each cash flow is valued according to its inherent financial risk.

For business without significant financial options and guarantees, the certainty-equivalent technique is used. Under this valuation approach, the reference rate is used for both the projection of assets and the discounting of all cash flows. In particular, it is assumed that all assets earn the reference rate.

For business with significant financial options and guarantees, a stochastic model using market-consistent scenarios is applied to determine the VIF. The stochastic models take interactions of assets and liabilities into account and include expected management behaviour, e.g. regarding the investment strategy, the management of unrealised capital gains, and the determination of bonus rates for participating business. In addition, dynamic policyholder behaviour with respect to lapses and surrenders is allowed for.

In some territories where life reinsurance business is written, only limited policy data is available to the reinsurer. In such cases, projections are made on a portfolio basis to reflect expected profitability ratios and all other relevant information.

For our German life primary business, it is assumed that in the case of severe financial distress, approval from the regulator is granted to restrict policyholder participation and to cover policyholder guarantees by the free RfB and the terminal bonus fund. Besides this, we do not model any limited liability put options and assume that guarantees are not changed, even in Japanese-like scenarios.

For our German health primary business, the development of healthcare costs is based on general inflation assumptions adjusted for higher health inflation in some parts of the business. Premium rates are assumed to increase in line with these developments.

The VIF is broken down into the following items that are exemplified in the sections below:

- Present value of future profits (PVFP)
- Time value of financial options and guarantees (TVFOG)
- Cost of residual non-hedgeable risks (CRNHR)
- Frictional cost of required capital (FCRC)

### 5.3.1 Present value of future profits (PVFP)

The PVFP is the present value of future local statutory shareholder after-tax profits emerging from the business covered on the condition that all economic and non-economic assumptions are met.

In this respect, the PVFP already includes the intrinsic value of financial options and guarantees of the business covered. The time value of financial options and guarantees arising from the uncertainty of economic assumptions is disclosed separately.

### 5.3.2 Time value of financial options and guarantees (TVFOG)

Participating life business is generally characterised by the following key features:

- A minimum interest rate or a minimum level of bonus is guaranteed to the policyholder. Hence, whenever the investment return on the allocated assets does not exceed the necessary minimum and other means of funding the guarantees are depleted, the shareholder will bear the cost of maintaining the guarantees.
- Generally, bonuses and crediting rates exceed minimum guaranteed levels. In this case, the amount credited will be based on profit-sharing rules which involve a degree of management discretion.

The participating features are usually a combination of contractual or legal constraints, and management discretion that has to take competitive pressure or market practice into account. The participating business has been modelled to reflect both contractual and regulatory constraints as well as management discretion. Projected surrender rates depend dynamically on the difference between the reference rate and the credited rate.

In our market-consistent calculation, we allow for the potential impact on future shareholder cash flows of all financial options and guarantees within the in-force covered business. This allowance is based on stochastic techniques using methods and assumptions consistent with the underlying embedded value. All projected cash flows are valued using economic assumptions in line with the price of similar cash flows that are traded in the capital markets.

Stochastic models are used for all significant life primary and health primary insurance business. The time value of financial options and guarantees is determined as the difference between the average present value over all stochastic scenarios and the present value for the certainty equivalent scenario. The stochastic model is run using 1,000 scenarios based on an econometric model and takes the following explicitly into account:

- Management discretion concerning bonus policy and profit-sharing rules
- Timing of realisation of unrealised capital gains
- Dynamic asset allocation (in particular, management of the equity-backing ratio)
- Dynamic adjustment of technical interest rates for German health primary business
- Surrender rates dependent on the capital markets

It is predominantly life primary business that is exposed to financial options and guarantees. The following aspects of financial options and guarantees are of particular relevance:

- All policyholder options (such as full or partial surrender, premium discontinuance and annuitisation) combined with policyholder guarantees (like interest-rate guarantees, guaranteed surrender values or guaranteed annuity rates) have a large influence on the VIF.
- On the other hand, companies are able to substantially influence the value of financial options and guarantees, for example by changing their bonus policy for participating life business or by adjusting the long-term asset allocation. Such management discretion is subject to any contractual guarantees and regulatory or legal constraints.

The TVFOG published in this and other Munich Re documents reports the net effect.

Our life reinsurance portfolio has only a very limited exposure to financial options and guarantees.

### 5.3.2.1 TVFOG in German life primary business

In German life primary business, by far the biggest share of the time value of financial options and guarantees results from the guaranteed interest rate together with legal restrictions for minimum policyholder participation.

The maximum actuarial interest rate in life insurance (commonly referred to as the “guaranteed interest rate”) is laid down in the German federal ordinance concerning actuarial assumptions for future policy benefits (“Deckungsrückstellungsverordnung”).

The German federal ordinance relating to minimum policyholder participation in life insurance (“Mindestzuführungsverordnung”) applies rules concerning customers’ minimum participation in statutory profits that strongly restrict loss offset from the different profit sources (investment result, risk result, other result).

### 5.3.2.2 TVFOG in German health primary business

For participating German health primary business, minimum profit-sharing rules are set according to current legal requirements. Management discretion is relevant for the use of free policyholder funds in order to reduce future premium increases necessary to cover the assumed development of healthcare costs. Furthermore, management decisions on how to proceed with changes in technical interest rates are taken into account, subject to legal restrictions.

The impact of financial options and guarantees in German health primary business varies from that in German life primary business. Beside options of the policyholder, there are also options of the company. Policyholder behaviour is modelled in accordance with current experience. However, changed policyholder behaviour is difficult to estimate in the long run. Options of the company mainly involve the following factors:

- Technical interest rates are not guaranteed for the whole contract term, but can be changed through a premium adjustment process. In the event of an interest-rate reduction, this leads to higher premium rates for the policyholder.
- If future investment returns are expected to be below the guaranteed interest rate, the German Federal Financial Supervisory Authority (BaFin) demands in accordance with the “Aktuarielle Unternehmenszins-Verfahren (AUZ-Verfahren)” a reduction in the interest-rate guarantee which corresponds to premium rate increases.

### 5.3.3 Cost of residual non-hedgeable risks (CRNHR)

The cost of residual non-hedgeable risks reflects the impact of risks not already allowed for in the TVFOG or the PVFP. For determining the CRNHR, we use a cost-of-capital approach.

For all businesses, the amount of economic risk capital for non-hedgeable risks (ERCNHR) is determined by our internal economic capital model and projected over the run-off of the business. In the context of the ongoing uncertainty over standards and guidance under Solvency II, we keep the methodology of past years so as to reflect our integrated risk management process and do include the diversification between our covered and non-covered business. Diversification between hedgeable and non-hedgeable risk is disregarded. The economic risk capital corresponds to the value at risk over a one-year time horizon with a confidence level of 99.5%. CRNHR is the present value of the future ERCNHR of the covered business times the cost rate of 7%.

### 5.3.4 Frictional cost of required capital (FCRC)

The cost of holding capital derives from taxes on profits of assets backing required capital and from the cost of their management. For our German health primary business, investment income on shareholder funds is subject to policyholder participation and thus also included in the FCRC.

## 5.4 Change in embedded value

The change in embedded value from one valuation date to the next comprises the following elements:

- Opening adjustments
- Embedded value earnings
- Closing adjustments

The value of acquired or divested business (including the change in stakes of Munich Re in companies covered in this report) as well as capital movements, especially dividends, are shown either as **opening adjustment** or **closing adjustment** in a manner designed to best reflect the economic return Munich Re has achieved in the period. Additionally included in the opening adjustments are changes in scope as well as the impact of changes in currency exchange rates from the end of last year to the average of the reporting year. Closing adjustments furthermore contain the changes in currency exchange rates from the average-of-year to the end of the reporting year.

**Embedded value earnings** are stated at average-of-year currency exchange rates and at average share of Munich Re in the respective companies. They are explained in more detail in the following section.

## 5.5 Embedded value earnings

The embedded value earnings can be split into the following components:

- Value of new business
- Expected return at reference rate
- Expected return in excess of reference rate
- Transfer from VIF and required capital to free surplus
- Experience variances
- Assumption changes
- Other operating variance
- Economic variances
- Other non-operating variance

The sum of the first seven components of embedded value earnings is referred to as operating embedded value earnings.

The **value of new business** is explained in the following section.

The **expected return at reference rate** – “expected existing business contribution (reference rate)” according to the MCEV Principles – is calculated assuming a risk-free roll-forward of the embedded value at the beginning of the year.

The **expected return above reference rate** – “expected existing business contribution (in excess of reference rate)” according to the MCEV Principles – reflects management’s expectation for one year with regard to asset returns above the reference rate. The parameters used for 2011 and 2012 are shown in Section 6.3.



The **transfer from VIF and required capital to free surplus** shows the release of expected profits from the value of in-force covered business to the free surplus as well as the projected release of required capital to free surplus during the year. The underlying expectation is based on the models as at the beginning of the year. Involving only a shift between MCEV components, there is no impact on the embedded value within this line item.

The **experience variances** summarise the prospective and retrospective outcome of differences between the actual operating experience in the reporting year and the operating result assumed in the previous embedded value calculation.

**Assumption changes** represent the aggregate impact on the embedded value of changes in the operating assumptions within the reporting year. All operating assumptions are subject to an active review at each valuation date.

**Other operating variances** comprise model changes or model refinements as well as the effect of tax planning action.

The **economic variances** describe the aggregate impact on the embedded value of changes in economic assumptions (including reference rate and implied volatilities) during the reporting year and in the projections years. They are the net effect of a change in economic parameters on the assets and the liabilities.

**Other non-operating variances** summarise the impact of changes in the regulatory framework such as taxation or legislation concerning policyholder participation.

## 5.6 Value of new business (VNB)

The VNB is the present value as at the end of the reporting year of the future local statutory after-tax profits in respect of new business written in the reporting year, reduced by the time value of financial options and guarantees, cost of residual non-hedgeable risks and frictional costs associated with the new business. Additionally, after-tax regulatory profits in respect of this business during the reporting year are included in the reported VNB. The calculation is consistent with the methodology outlined for the value of in-force business.

For reinsurance business, the value of new business can be calculated on a stand-alone basis, as there are no material interactions between in-force and new business. New business is defined as business arising from new reinsurance contracts as well as that from the sale of new contracts on existing reinsurance treaties by our customers during the reporting period. Due to the nature of life reinsurance, the value of new business includes the value of expected renewals on those new contracts and expected future contractual alterations to those new contracts. New life reinsurance business comprises:

- For individual business, new cessions in the year on either new or existing treaties
- For group business, new group schemes on either new or existing treaties, and also new members in existing group schemes
- For annually renewable reinsurance contracts (e.g. stop-loss and other non-proportional reinsurance business), new treaties and renewals of existing treaties

For primary insurance business, because of material interactions between existing and new business, a marginal approach is used, i.e. the difference between the embedded value with and without new business. The marginal approach helps to capture the effect of interactions between in-force and new business. New business is defined as business arising from the sale of new contracts during the reporting period. The value of new business includes the value of expected renewals on those new contracts and expected future contractual alterations to those new contracts. For German life primary business, new business includes the current year's increments on existing policies.

## 5.7 Operating assumptions

Operating assumptions describe expected future operating experience. They refer mainly to mortality, morbidity, persistency, expenses and – in primary insurance business – to policyholder participation. The operating assumptions are based on best-estimate assumptions derived from company experience and/or market experience. They are in line with management expectations and reflect recent operating experience of the entities concerned.

All costs related to the business covered are split into acquisition, maintenance and investment-related expenses and are fully allowed for in the embedded value. We use a going-concern approach in line with the MCEV Principles. Future productivity gains are not anticipated in the embedded value calculations beyond what has been achieved.

## 5.8 Tax assumptions

Taxation assumptions included in the embedded value models reflect local taxation rates and bases, including future changes that are at an advanced stage of legislative implementation. Tax modelling also includes the valuation of existing tax losses carried forward. No withholding taxes on dividends from subsidiaries have been allowed for.

Within the business covered of ERGO, tax grouping effects are taken into account.

## 5.9 Economic assumptions

The economic assumptions are derived following a market-consistent valuation approach. Many asset classes and economic assumptions are modelled stochastically. These include equity and property returns, bond yields, interest rates and inflation.

The construction of risk-neutral economic scenarios requires careful calibration to the underlying market parameters to ensure that the valuation replicates the market prices of assets. The key areas for calibration are initial yield curves, implied market-consistent volatilities of all relevant asset classes, and correlations between asset classes. The interest-rate model used considers both parallel shifts and twists to the yield curve.

The economic scenarios have been calibrated to the market conditions at the valuation dates, i.e. reference rates, swaption prices and equity option prices. Generally, swap rates have been used as an approximation of the risk-free yield curves. In countries without deep and liquid swap markets, government bonds were used instead.

The calculations of the time value of financial options and guarantees are based on stochastic simulations. The calibration has been provided by Barrie & Hibbert (Moody's Analytics), a UK-based financial consulting company. An Economic Scenario Generator (ESG), also provided by Barrie & Hibbert, has been used to centrally generate the stochastic scenarios. Risk-free nominal interest rates are modelled using a LIBOR market model.

The parameters used for year-end 2011 and 2012 are shown in Section 6.3.

## 5.10 Business covered

The MCEV reported for 2012 covers 100% of the life reinsurance business written by Munich Re. With regard to our primary insurance business, the MCEV 2012 covers 97% of our business written in the life and the German health primary insurance entities of Munich Re.

Reinsurance companies, major branches writing covered life reinsurance business, and primary insurance companies writing covered primary insurance business, are listed in the following table:

### Business covered

<b>Life reinsurance business</b>
Reinsurance companies writing covered life reinsurance business
Munich Reinsurance Company of Australasia Ltd, Sydney
Münchener Rück do Brasil Resseguradora S.A., São Paulo
Münchener Rückversicherungs-Gesellschaft AG, Munich
Munich Reinsurance Company of Africa Ltd, Johannesburg
New Reinsurance Company, Zurich
Munich Re of Malta p.l.c., Floriana
Munich American Reassurance Company, Atlanta, Georgia
Major branch offices writing life reinsurance business
Munich Reinsurance Company Canada Branch (Life), Toronto
Munich Reinsurance Company United Kingdom Life Branch, London
<b>German life primary business</b>
ERGO Lebensversicherung Aktiengesellschaft, Hamburg
VICTORIA Lebensversicherung Aktiengesellschaft, Düsseldorf
ERGO Direkt Lebensversicherung AG, Fürth
Vorsorge Lebensversicherung Aktiengesellschaft, Düsseldorf
Vorsorge Luxemburg Lebensversicherung S.A., Munsbach
<b>German health primary business</b>
DKV Deutsche Krankenversicherung Aktiengesellschaft, Cologne
ERGO Direkt Krankenversicherung AG, Fürth
<b>International life primary business</b>
ERGO Previdenza S.p.A., Milan
Sopockie Towarzystwo Ubezpieczen na Zycie Ergo Hestia Spolka Akcyjna, Sopot
ERGO Life Insurance SE, Vilnius
ERGO Insurance N.V., Brussels
ERGO Versicherung Aktiengesellschaft, Vienna
Bank Austria Creditanstalt Versicherung AG, Vienna

In 2012, Munich Re closed its Russian subsidiary Munich Reinsurance Company Life Reinsurance Eastern Europe/Central Asia. The transaction became effective as of 9 October 2012.

The MCEV of ERGO Direkt Krankenversicherung AG has been included for the first time in this report.

## 6 Assumptions

### 6.1 Tax rates

#### Long-term tax rates

%	Reinsurance		Primary insurance	
	31.12.2012	31.12.2011	31.12.2012	31.12.2011
Germany	33	33	32	32
Italy	34	34	35	35
US	35	35		
UK	23	25		
Canada	27	26		

Within the business covered, tax grouping effects at ERGO are taken into account. The above tax rates show the company tax rates.

### 6.2 Currency exchange rates

#### Currency exchange rates

€1 = ... foreign currency	31.12.2012	2012	31.12.2011
		average year	
US\$	1.318	1.286	1.296
£	0.811	0.811	0.833
Can\$	1.313	1.285	1.324

Munich Re's reporting currency is the euro. Embedded value earnings based on the original currency are converted using average-of-year currency exchange rates. In the table above, the average-of-year exchange rates and the period-end exchange rates for the valuation year 2012 as well as the exchange rates from the end of last year are shown for the major currencies.

### 6.3 Economic assumptions

The embedded value results for 2012 are based on economic market conditions as at 31 December 2012.

In the following sections, the key economic assumptions, i.e. the reference yield curve, implied volatilities for each asset class, and correlations between different asset classes, are described for the major currencies.

#### 6.3.1 Reference rates

Generally, swap rates have been used as an approximation of the risk-free yield curves. In countries without deep and liquid swap markets, government bonds were used instead.

For interpolation, a regression spline technique is used, and extrapolation is done using the Nelson-Siegel form.

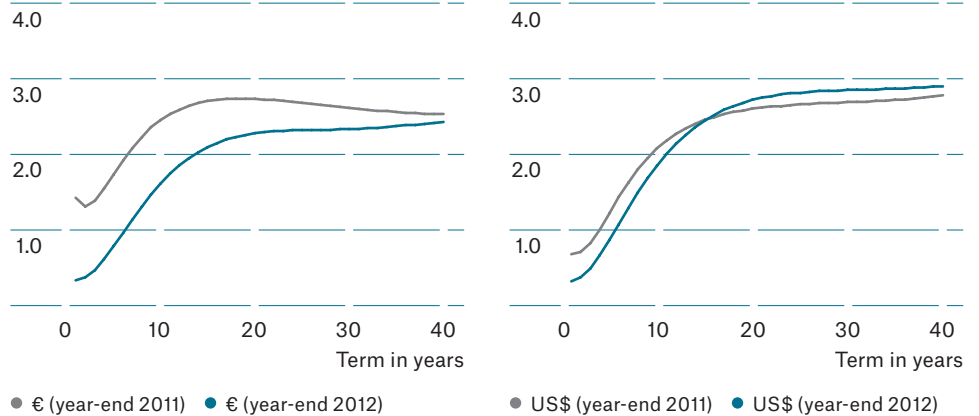
The table below shows the zero spot rates at the relevant valuation date for the major currencies.

**Zero spot rate**

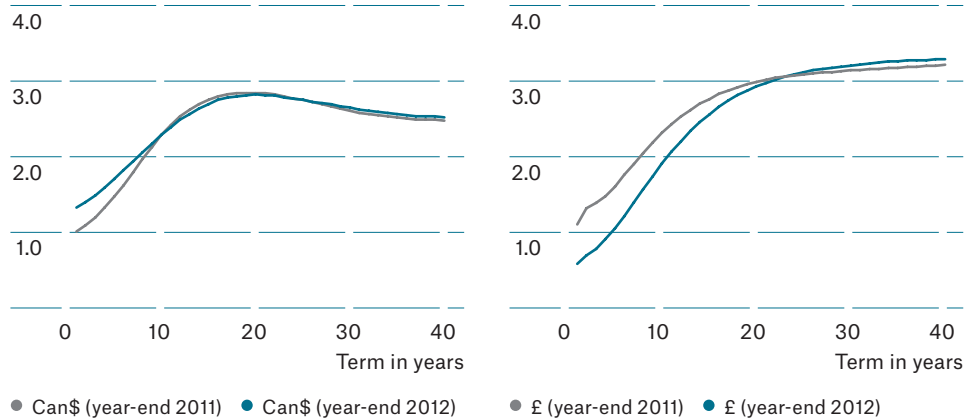
Term	31.12.2012				31.12.2011			
	€	US\$	£	Can\$	€	US\$	£	Can\$
1 year	0.33	0.32	0.57	1.33	1.42	0.68	1.09	1.02
2 years	0.37	0.37	0.67	1.41	1.31	0.71	1.30	1.10
3 years	0.47	0.49	0.77	1.50	1.39	0.82	1.37	1.21
4 years	0.61	0.66	0.90	1.60	1.54	1.01	1.47	1.33
5 years	0.78	0.86	1.04	1.71	1.73	1.22	1.61	1.48
6 years	0.96	1.08	1.21	1.83	1.92	1.44	1.75	1.63
7 years	1.14	1.29	1.39	1.95	2.09	1.63	1.91	1.80
8 years	1.31	1.49	1.57	2.07	2.23	1.80	2.06	1.97
9 years	1.47	1.68	1.75	2.18	2.36	1.95	2.20	2.14
10 years	1.61	1.85	1.92	2.30	2.46	2.08	2.32	2.29
15 years	2.10	2.45	2.58	2.71	2.70	2.45	2.79	2.76
20 years	2.28	2.72	2.96	2.83	2.73	2.60	3.02	2.86
25 years	2.32	2.81	3.14	2.76	2.68	2.66	3.12	2.76
30 years	2.34	2.85	3.24	2.66	2.61	2.69	3.17	2.62

The following graphs illustrate the zero spot rate curves.

**Zero spot rate (%)**



**Zero spot rate (%)**



### 6.3.2 Volatilities

The interest-rate scenarios have been generated to replicate at-the-money swaption prices. The implied volatilities for these swaptions are outlined in the following table:

Target swaption implied volatilities (tenor of 20 years)

Term	31.12.2012		31.12.2011	
	€	US\$	€	US\$
1 year	30.1	28.4	38.5	40.2
2 years	29.1	27.8	35.3	36.9
3 years	27.8	26.3	32.9	34.5
4 years	26.8	25.0	31.2	33.2
5 years	25.9	24.0	30.3	32.2
10 years	23.5	21.2	28.7	28.4
15 years	22.7	20.1	29.3	27.4
20 years	20.9	18.8	29.2	26.9
30 years	16.7	22.3	23.3	32.8

The equity models have been calibrated to implied volatilities of at-the-money equity index options observed in the OTC market. The ten-year implied volatility (the longest maturity option available) is shown in the table below.

Target equity implied volatilities

Equity index	31.12.2012		31.12.2011	
	EURO STOXX	S&P 500	EURO STOXX	S&P 500
%	24.7	26.6	27.9	31.0

### 6.3.3 Correlation coefficients

Our models have been calibrated to the coefficients shown in the table below, reflecting global long-term assumptions concerning the correlations between equities and interest rates. The coefficients have been estimated from historic market data.

Target correlation coefficients

Correlation pair	31.12.2012	31.12.2011
Equity and ten-year government bond	0.17	0.13
Equity and nominal short rates	-0.07	-0.09
Equity and real short rates	-0.04	-0.07
Equity and ten-year inflation-linked government bond	0.11	0.10

### 6.3.4 Expected return in excess of reference rate

The table below shows management's expectations for assigning excess return expectations to all equities, real estate and fixed income securities differentiated by their rating.

#### Expected return in excess of reference rate

	2012	2011
BP		
Equities	450	440
Real estate	300	300
Fixed income		
AAA	-	-
AA/A	170	110
BBB and worse	240	170
All other assets	-	-

### 6.3.5 Solvency II yield curves

Since there is still uncertainty about relevant standards and guidance for Solvency II, Munich Re continues to follow its approach of not taking any yield curve adjustments into consideration for the base MCEV calculations. However, to give an indication of what Munich Re anticipates its MCEV will look like when this includes elements of a future Solvency II framework, we publish a corresponding sensitivity calculation.

For the Solvency II yield curve sensitivity, the respective parameters have been set according to the state of debate at the time of calculating the 2012 MCEV results, taking into account specifications of the Long Term Guarantee Assessment<sup>1</sup> to be conducted by EIOPA in 2013 and from quantitative impact studies (QIS). This covers:

- swap rates as the basis for deriving risk-free term structures from
- credit risk adjustment (CRA)
- countercyclical premium (CCP)
  - applied to all products of the relevant currencies
  - assuming that for all EEA currencies<sup>2</sup> there is a stressed financial situation, but not for any third-country currencies
  - application to the liquid part of the yield curve
- extrapolation according to the Smith-Wilson methodology, comprising parameters for last liquid point (LLP), convergence speed (CS) and ultimate forward rate (UFR)

The parameters for the Solvency II yield curves for the major currencies are displayed in the table below.

#### Parameters for the Solvency II yield curves

Currency	CRA bp	CCP bp	LLP years	CS years	UFR %
€	-10	29	20	10	4.2
US\$	-10	-	30	10	4.2
£	-10	28	50	10	4.2
Can\$	-10	-	20	10	4.2

We did not include any matching adjustments for calculating this sensitivity and it is assumed that all other economic assumptions (e.g. volatilities) are equal to the base MCEV calculations.

<sup>1</sup> Methodology according to the draft version dated 24 August 2012. Parameters set as at 31 December 2012.

<sup>2</sup> The EEA consists of the 27 EU member States (Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom), and the three EEA/EFTA States, Iceland, Liechtenstein and Norway.

## 7 Independent assurance report

### Introduction

Based on the engagement letter dated 15 and 22 November 2012, KPMG has been engaged to audit the Market Consistent Embedded Value (MCEV) of Münchener Rückversicherungs-Gesellschaft Aktiengesellschaft, München, (Munich Re) as at 31 December 2012 as stipulated in the accompanying MCEV Report of Munich Re. Munich Re is responsible for the preparation of the MCEV Report including the calculation of the MCEV. This includes particularly setting the operative and economic assumptions, the explanation concerning the determination of the MCEV and its roll forward, the implementation and the operativeness of the system which ensures the completeness and correctness of the data which are necessary for the calculation of the MCEV. Our responsibility is to express an opinion on the calculation of the MCEV as to whether the methodology and the assumptions used comply with the Market Consistent Embedded Value Principles<sup>®</sup> as published by the CFO Forum on 4 June 2008 and amended in October 2009 (Market Consistent Embedded Value Principles) except principles 17.3.37 to 17.3.45 (Group MCEV). Munich Re does not apply an illiquidity premium in the calculation of the MCEV but discloses additional sensitivities which allow to understand and to assess the impact of applying an illiquidity premium as well as Solvency-II-like yield curves on the MCEV of Munich Re.

### Subject matter and criteria

For the calculation of the MCEV, Munich Re applies criteria as set out in the Market Consistent Embedded Value Principles except principles 17.3.37 to 17.3.45. The calculation of Market Consistent Embedded Values is necessarily based on numerous assumptions with respect to economic conditions, operating conditions, taxes, and other matters. Many of these are beyond the Company's control. Actual cash flows in the future are likely to be different from those assumed in the calculation and such variation may be material.

### Work performed

We conducted our audit of the MCEV in accordance with the International Standard on Assurance Engagements (3000): "Assurance engagements other than audits or reviews of historical financial information", issued by the International Auditing and Assurance Standards Board. The effectiveness of the accounting-related internal control system in the MCEV calculation is examined primarily on a test basis within the framework of the audit. The audit includes assessing the MCEV principles used and significant estimates and assumptions made by management. As a result of determining our audit strategy and audit objectives we have established Market Consistent Embedded Value Principles 3, 6, 7, 9, 11, 12, 13, 14, 15 and 16 as well as the "Solvency II sensitivity" as the special focus of our audit.

We believe that our audit provides a reasonable basis for our opinion.

Regarding our independence, we comply with the requirements of the IFAC Code of Ethics for Professional Accountants.



## Conclusion

In our opinion, the methodology and the assumptions used comply with the Market Consistent Embedded Value Principles except principles 17.3.37 to 17.3.45. Munich Re does not apply an illiquidity premium in the calculation of the MCEV but discloses additional sensitivities which allow to understand and to assess the impacts of applying an illiquidity premium as well as Solvency-II-like yield curves on the MCEV of Munich Re. In particular:

- The calculated MCEV is the present value of shareholders' interests in the earnings distributable from assets allocated to the covered business after sufficient allowance for the aggregate risks in the covered business. Section 5 sets out the methodology of making allowance for the aggregate risks. In particular by the use of
  - a level of required capital derived from internal risk models and additional regulatory restrictions,
  - a market-consistent assessment of the time value of financial options and guarantees, and
  - a deduction for frictional cost of required capital based on the cost of double taxation, investment expenses and, where applicable, policyholder participation on assets backing the required capital,
  - a deduction for the cost of residual non-hedgeable risks.
- The operating assumptions have been set with appropriate regard to past, current and expected future experience.
- The economic assumptions used are internally consistent and consistent with observable market data.
- For the primary participating business, the assumed bonus distribution, asset allocation, allocation of profit between policyholders and shareholders, and other management actions are consistent with other assumptions used in the projections, and with local market practice.
- We have also performed limited high-level checks on the results of the calculations. We have not, however, performed detailed checks on all the models and processes involved.

We have provided the services described above on behalf of Münchener Rückversicherungs-Gesellschaft Aktiengesellschaft, München. We have carried out our engagement on the basis of the General Engagement Terms included in our engagement agreement dated as of 1 January 2002. By taking note of and using the information as contained in our Assurance Report each recipient confirms to have taken note of the terms and conditions stipulated in the aforementioned General Engagement Terms (including the liability limitations to €4m for negligence specified in item No. 9 included therein) and acknowledges their validity in relation to us.

Cologne, 11 March 2013

KPMG Bayerische Treuhandgesellschaft Aktiengesellschaft  
Wirtschaftsprüfungsgesellschaft  
Steuerberatungsgesellschaft



**Hanno Reich**  
Partner



**Stefan Hensen**  
Manager

## 8 Statement by directors

I confirm that the MCEV of Munich Re as at 31 December 2012 has been prepared in accordance with the Market Consistent Embedded Value Principles® (MCEV Principles) issued by the CFO Forum on 4 June 2008 and amended in October 2009. In particular, I confirm that

- Non-economic assumptions for future experience have been set with regard to past, current and expected future experience and to any other relevant data.
- The economic assumptions used are internally consistent and consistent with observable market data.
- Management actions are consistent with other assumptions used in the projections and assumptions used for other purposes, e.g. projections required in the annual planning of profits and losses. The investment strategy and the realisation of unrealised capital gains are in line with management's expectations. For participating business, assumptions on future bonus rates and profit allocation between policyholders and shareholders are made on a basis consistent with the projection assumptions, established company practice and local market practice.
- Dynamic policyholder behaviour is, where material, taken into consideration in the time value of financial options and guarantees.

However, the following Group-wide items of non-compliance exist:

- Munich Re does not publish a Group MCEV in line with MCEV Principles 17.3.37 to 17.3.45

Munich, 11 March 2013



**Dr. Jörg Schneider**  
CFO

## 9 Disclaimer

This report contains forward-looking statements that are based on current assumptions and forecasts of the management of the Munich Re. Known and unknown risks, uncertainties and other factors could lead to material differences between the forward-looking statements given here and the actual development; in particular the results, financial situation and performance of our company. Munich Re assumes no liability to update these forward-looking statements or to conform them to future events or developments.

## 10 Glossary and abbreviations

- Aa** **Acquired (divested) business** Business acquired (divested) through acquisition (sale) of stakes in insurance or reinsurance companies
- Adjusted net worth (ANW)** Also known as shareholders' net worth or adjusted net asset value. MCEV Principles distinguish between free surplus and required capital.
- Assumption changes** Aggregate impact of changes in the operating assumptions on the embedded value
- Bb** **Best estimate assumption** An assumption that represents the expected outcome from the range of possible outcomes of future experience
- Cc** **Capital movements** Dividends and capital contributions
- Costs of residual non-hedgeable risks (CRNHR)** Allowance for risks not already included in the PVFP or TVFOG. Munich Re uses a cost-of-capital approach with a unique cost rate applied to the projected risk capital for non-hedgeable risks.
- Covered business** The business for which the embedded value is reported
- Currency movements** Aggregate impact of currency movements on the embedded value
- Ee** **Economic assumptions** These include reference rates, discount rates, inflation rates and assumptions on the volatility of economic parameters
- Economic variances** Sum of the difference between projected and actual investment return in the reporting year and effects on the embedded value from changes in capital market parameters
- Embedded value** Present value of shareholders' interests in the earnings distributable from assets allocated to the business covered after sufficient allowance for the aggregate risks in business covered
- Expected return at reference rate** Return for the reporting year if all assumptions of the previous year would remain constant (risk-free roll-forward of the embedded value at the beginning of the year).
- Expected return in excess of reference rate** Additional return for one year expected by the management due to assumed risk premiums for certain asset classes
- Experience variances** The impact on the embedded value of differences between the actual operating experience in the reporting year and the operating result assumed in the previous embedded value calculation

- Ff** **Free surplus (FS)** Amount of capital allocated to the business in excess of the required capital
- Frictional costs of required capital (FCRC)** Allowance for taxation and investment costs on the assets backing required capital. Additionally, for German health primary business FCRC includes the cost of profit sharing of investment income on assets backing required capital.
- li** **IFRS** International Financial Reporting Standard
- LI** **Look-through basis** A basis on which the impact of an item on the whole Group, rather than on a particular part, is measured
- Mm** **Market Consistent Embedded Value (MCEV)** Embedded value according to the European Insurance CFO Forum Market Consistent Embedded Value Principles ('MCEV Principles'), Copyright Stichting CFO Forum Foundation 2008. Published in June 2008, available online at <http://www.cfoforum.nl>. Currently we do not make use of any illiquidity premiums in line with to the amendment to the MCEV Principles, published by the CFO Forum in October 2009.
- Oo** **Opening/closing adjustments** Change in embedded value due to capital movements, foreign exchange variance or acquired/divested business
- Operating assumptions** All assumptions relating to demographic assumptions (e.g. mortality, morbidity), expenses, policyholder participation and policyholder behaviour
- Operating MCEV earnings** The sum of expected return, value of new business, experience variances, assumption changes and other operating variance
- Other operating variance** Effects from a change or improvement in models and tax planning action
- Other non-operating variance** Impacts of legal or regulatory changes including taxation
- Pp** **Participating business** Primary insurance business in which policyholders have the right to participate in the performance of a specified pool of assets or contracts
- Present value of future profits (PVFP)** The value of future profits from the in-force covered business and the assets backing the associated liabilities; net of tax, policyholder participation and minorities
- Present value of new business premiums (PVNBP)** Present value of future premiums from new business

- Rr** **Reference rate** Proxy for a risk-free rate
- Required capital (RC)** The amount of surplus assets whose distribution to shareholders is restricted
- RfB** The “Rückstellung für Beitragsrückerstattung (RfB)” is the provision for premium refunds in German primary insurance
- Risk-free (interest) rates** Prospective yields on securities considered to be free of default and credit risk
- Ss** **Solvency II** EU legislative programme introducing a new, harmonised EU-wide insurance regulatory regime
- Statutory basis** Valuation basis used for reporting financial statements to local regulators
- Tt** **Time value of financial options and guarantees (TVFOG)** The time value of financial options and guarantees is part of the VIF; the VIF before deduction of the allowance for the time value of financial options and guarantees reflects their intrinsic value
- Vv** **Value of in-force business (VIF)** The value of in-force covered business is the present value of future shareholder cash flows (PVFP) reduced by costs of residual non-hedgeable risks (CRNHR), the frictional costs of required capital (FCRC) and the time value of financial options and guarantees (TVFOG)
- Value of new business (VNB)** The value added through the activity of writing new business

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**Responsible for content**

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