Embedded value as the value reporting tool of the life insurance companies

Tatiana Šoltésová[1], Erik Šoltés[2]

Abstract

The paper is focused on the explanation of the expression: embedded value, because it becomes more and more important in the life insurance market worldwide nowadays. The importance and usefulness of the embedded value is expressed by the fact that the embedded value is used as a basis to determine the value of a life insurance company, its efficiency and future expectations. The embedded value solves deficiencies of classic life insurance accounting systems that can often lead to uncertain results. In our work the differences between the European embedded value and the market consistent embedded value are specified and their individual components are described. The last part of the article deals with the method of cash flow. This method is used for calculation in a real-world example where the new value of business is determined by using the principles of market consistent embedded value (*MCEV*). Finally, the sensitivity analysis with respect to assumptions in calculations is performed.

Keywords: *market consistent embedded value, new value of business, endowment insurance, cash flow*

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AMS Classification: 62P05

1. The transition from *EEV* to *MCEV*

EV (*embedded value*) is a modern financial tool for the valuation of assets and liabilities and the subsequent effective management of insurance companies. The goal of the calculation *EV* is to inform analysts, investors and the insurance management about the life insurance value to provide information to determine the added value generated by new business during the accounting period and to inform about a rate risk using sensitivity analysis and also through the stochastic risk measure.

EEV (*European embedded value*) is the name given to *EV* (*embedded value*) calculated pursuant to guidance contained in a paper titled *European EEV Principles* issued in May 2004 by the CFO Forum[3]. The intent of these principles was to improve the transparency and the consistency of *EV* reporting in Europe. *EEV* is usually calculated by the deterministic method

[1] University of Economics in Bratislava, Department of Mathematics, Dolnozemská cesta 1, 852 35 Bratislava, Slovakia, soltesova.euba@gmail.com
[2] University of Economics in Bratislava, Department of Statistics, Dolnozemská cesta 1, 852 35 Bratislava, Slovakia, soltes.euba@gmail.com.
[3] The high-level discussion group composed of major European insurance companies.

of calculation, by discounting a constant risk discount rate and without taking into account all embedded options, guarantees and risks involved in closed contracts.

The CFO Forum published *MCEV Principles* (*Market Consistent Embedded Value Principles*) and associated *Basis for Conclusions* in June 2008 to harmonize principles with other progressing accounting and regulatory structures as Solvency II or IFRS phase II.

2. Embedded value components

EV of a life insurance company is the present value of future profits plus the adjusted net asset value. Note that:

$$EV = PVFP + ANAV$$

where: *PVFP* is a present value of future profits, *ANAV* is an adjusted net asset value.

PVFP considers the potential profits that shareholders will receive in the future, while *ANAV* considers the funds belonging to shareholders that have been accumulated in the past.

2.1. The appraisal value calculation

Shareholders of a life insurance company expect the profit from ownership of assets that amount depends on future activities of the insurance company and so it is not possible to determine its value exactly. That is why we have to estimate the future profit value at first and then we discount it. Such calculated present value is called *appraisal value*.

Appraisal value is the embedded value adjusted by adding the expected value of future new business (*goodwill value*):

$$appraisal\ value \ = \ EV \ + \ goodwill\ value\,.$$

We estimate three sources of the profit insurance:

I *Net asset value* that consists of two parts:

- *free capital* which is not associated with any insurance business,
- *required capital* which is decreased in the price for its holding.

II *Expected profits in the future from current insurance activities.*

When we want to estimate future profits from current insurance activities, at first we determine cash flows in the future and then we discount them to the present.

Let PR_t is the profit in time *t:*

$$PR_t = CF_t + I_t - \Delta V_t\,,$$

where: CF_t is the cash flow from all insurance contracts in the portfolio in a year *t*, I_t is the investment income in a year *t*, ΔV_t is difference between the reserve at the end of a year *t* and the reserve at the beginning of a year *t*.

We calculate the present value of future profits so that each future cash flow is discounted by appropriate the discount factor $DF_t = \prod_{k=1}^{t} \frac{1}{(1+i_k)^t}$ on the date of valuation. We get:

$$PVFP = \sum_{t=1}^{\infty} DF_t \cdot PR_t = \sum_{t=1}^{\infty} \frac{PR_t}{\prod_{k=1}^{t} (1+i_k)^t},$$

where i_k is a rate in a year *k*. The choice of the discount rate depends on that whether we calculate *EV* according to the traditional approach or the market consistent approach. We take into account the risk discount rate in the traditional approach and the free-risk discount rate in the market consistent approach.

III ***Expected profits in the future from future insurance activities***.

It is necessary to create new life insurance products in the future to calculate them.

2.2. The assumptions of embedded value calculation

The determination of assumptions is very important for the embedded value calculation. This value is sensitive to the assumptions underlying the calculation. Therefore, for the sake of consistency in future embedded value recalculation, it is important that the methodology used to set the assumptions produces realistic assumptions and that it is objective.

These assumptions can be divided into two categories:

- *economic assumptions*,
- *non-economic assumptions*.

The economic assumptions are all the assumptions related to the economic market such as future reinvestment rates on fixed income assets, future returns on variable income assets (such as stocks and real estate), currency exchange rates, default rates, inflation rates and investment expenses. Because economic assumptions have a high level of correlation, it is very important to ensure consistency in their setting.

The non-economic assumptions generally relate to the existing and expected future operating environment. The non-economic assumptions include: future mortality and

morbidity rates, lapses, future expense rates (excluding inflation) and future interest crediting strategies.

The embedded value is the best estimate but this is only one vision of the future. In the future, there may be differences between the assumptions used in the calculation and the reality.

3. *MCEV* components

The Principles define *MCEV* as being composed of *free surplus* (*FS*), *required capital* (*RC*) and value of in-force covered business (*VIF*): $MCEV = FS + RC + VIF$.

The *MCEV* Principles describe separately the components of *VIF* as [6]:

- the present value of future profits (*PVFP*),
- the time value of financial options and guarantees (*TVFOG*),
- the frictional costs of required capital (*FC*),
- the cost of residual non hedgeable risks (*CRNHR*).

VIF can be expressed as follows: *VIF*, *VFP*, *TVFOG*,*FC*, *CRNHR*.

We can calculate *MCEV* in two ways which are equivalent, namely the direct and the indirect method (fig.1).

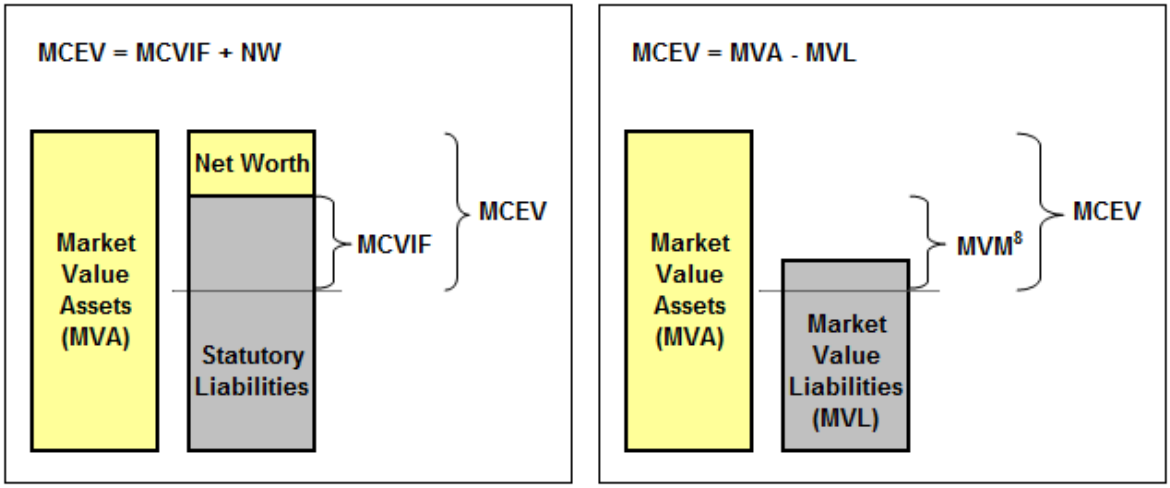

Fig. 1. The direct and the indirect method of the *MCEV* calculation.

Source: Mueller, H., 2008. Recent Trends with Market-Consistent Embedded Value (MCEV)

4. Value of new business calculation

Value of new business (*VNB*) is determined when the contract is signed. Its amount and the premium amount are used to calculate profitability of products. The calculation of *VNB* is based on the market value of assets and on the market value of liabilities as follows:

$$VNB = MVA - MVL ,$$

where: *VNB* is the value of new business, *MVA* is the market value of assets, *MVL* is the market value of liabilities.

We focus on insurance contracts only at time of sale so $MVA = 0$. Therefore:

$$VNB = -MVL .$$

According to *MCEV* Principles *market value of liabilities* consists of the frictional costs of required capital, the time value of financial options and guarantees, cost of residual non hedgeable risks and the best estimate liabilities:

$$MVL = FC + TVFOG + CRNHR + BEL .$$

We will consider that all the model contracts are without share of profits and so $TVFOG = 0$. Because of simplicity, next two components *FC* and *CRNHR* are not considered.

4.1. The definition of the model portfolio

We consider the portfolio of 3 700 policies of the endowment insurance. The insured pay the anticipative premiums annually. The insured has a claim for redemption value in amount of 90% of the reserve that is created till a moment of contract cancellation (10% makes cancellation fee). The insured does not have a claim at a share of profit. Next we will consider the interest rate at 2.5%, the return on assets at 3.5% and the inflation of costs at 1.8%. We will use mortality tables for the Slovak republic for 2010.

***Assumptions of calculation VNB*:**

1. We will consider the probability of death in amount of 90% of standard mortality. Insurance companies determine this coefficient on basis of the information from the past and from mortality tables.
2. The lapse rates in particular policy years are in Table 1.

Policy year	Lapse rates
1	13.5%
2	9.7%
3	8.1%
4	7.3%
above 5	4.0%

Table 1 The lapse rates by policy duration.

3. The kind of costs and the way of their calculation to the premium are presented in Table 2.

The type of costs	The costs	The way of calculation
Initial costs (IC)	75 €	
Initial commission (InC)	60%	from the first premium
Marketing costs (MC)	45%	from the commission of the first premium
Administrative costs (AC)	12 €	from the second year, they are subject to inflation
Renewal commission (ReC)	5%	from the annual premium (except of the first)
Terminal costs (TC)	25 €	they are subject to inflation

Table 2 The costs for the model portfolio.

4. The risk-free interest rate is 3%.

4.2. *VNB* calculation

The portfolio of insurance policies is divided by parameters: *Age, Term of insurance, Sum insured, Time premium payment.* Insurance contracts with the same parameters form one group. For the group of model contracts is used an abbreviation MC. We calculated the gross premiums and gross reserves for each group (see Table 3).

Best estimate of liabilities (*BEL*) for the particular insurance contracts and for the whole portfolio is calculated by the method of cash-flow as follows: we add costs to the sum insured then subtract both the premium income and the interest of difference between the premium income and costs. So the calculated cash-flow is discounted every year and by means of this procedure we get $PVPR_t$. By sum of $PVPR_t$ we get

$$BEL = \sum_{t=1}^{35} PVPR_t = -2\,894\,329.46\ €\,.$$

Due to the maximum likelihood estimate of obligations of the insurance company being negative, the expected value of income premium exceeds the expected value of costs. The value of new business is

$$VNB = -BEL = 2\,894\,329.46\ €\,.$$

MC group	Number of contracts	Age	Term of insurance	Time premium payment	Sum insured (in €)	Premium for MC (in €)	
						Netto	Brutto
1	385	20	30	15	10 000	146 889.90	187 084.62
2	490	20	35	25	12 000	134 963.82	164 165.20
3	575	25	25	25	11 000	184 308.02	215 547.75
4	625	25	30	20	8 500	162 435.79	202 258.49
5	565	30	20	15	13 000	319 025.70	426 462.11
6	480	30	30	25	15 000	190 227.25	222 991.89
7	330	35	15	15	10 000	182 562.11	213 955.87
8	250	35	20	15	12 000	147 696.36	176 321.65

Table 3 The model policies of the endowment insurance.

4.3. The sensitivity analysis

In following part of the article we focus on the influence of the factors such as mortality, lapse rate, costs, inflation of costs and return on assets on value of new business. Effects of these factors will be quantified through the sensitivity analysis.

The sensitivity analysis allows to find how the value of new business reacts to changes of assumptions. It is important to emphasize that in the analysis is changed only one assumption and all other remain constant. According to Tables 4-7 it is obvious that the biggest negative effect on *VNB* had the decrease of all the kinds of costs. Due to the increase of costs, the value of new business declined in about almost 45%. Conversely, the biggest positive change was caused by decrease of values of the lapse rate in each year of insurance. These decreases of the lapse rate caused the increase of *VNB* about almost 20%.

Mortality	*VNB* (in €)
87%	2 894 329.46
92%	2 876 370.34
80%	2 919 511.00

Table 4 The sensitivity analysis for the mortality.

	Lapse rate					*VNB* (in €)
	1st year	2nd year	3th year	4th year	From the 5th year	
I.	15.20%	12.10%	10.30%	8.90%	5.40%	1 982 452.34
II.	12.80%	8.90%	7.50%	6.20%	3.20%	3 462 311.68

Table 5 The sensitivity analysis for the lapse rate.

	Costs						*VNB* (in €)
	IC	InC	MC	AC	ReC	TC	
I.	82 €	70%	50%	18 €	7.50%	33 €	3 274 488.59
II.	68 €	55%	37%	10 €	3.80%	20 €	1 601 143.18

Table 6 The sensitivity analysis for costs.

Inflation	*VNB* (in €)	Asset returns	*VNB* (in €)
1.8%	2 894 329.46	3.50%	2 894 329.46
3.3%	2 693 193.29	2.75%	2 789 792.45
1.2%	2 954 877.76	4.50%	3 033 712.13

Table 7 The sensitivity analysis for inflation and asset returns.

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