Measures of Profitability in Life Insurance Product Management

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Abstract
One important part of strategic management of any business is about how to make the business more profitable. For example, in life insurance business, the source of profit is life insurance products. One of them is also loan protection insurance or credit insurance as a special type of term insurance product. Although we know that there exist many business strategies to improve the profit, in this article we introduce profit test, the main idea of which is to determine the price of a product (premium) so as to meet company's profit requirement. The aim of this article is firstly to describe credit insurance on Slovak insurance market and then, using method of profit testing, state a price of the model credit insurance product. At the end of the article we carry out sensitivity analysis for one special profit criterion - profit margin - varying in each analysis only one element of the pricing basis.

1. Loan protection insurance as a type of term insurance product

Term insurance is one of the simplest forms of life insurance contract. It provides a protection for a limited number of years and pays a sum assured on the death of the policy holder in the case that death occurs within this limited period of time. But in the case that the policyholder survives till the end of the limited period, no benefit is paid (the contract expires). The benefit may be a level sum assured, or a sum increasing or decreasing with time from the beginning of the contract. A decreasing term insurance can often be used to repay the outstanding part (balance) of the loan. An increasing form is used to provide an income for a family until the time as the children begin to work.

One disadvantage of the term insurance is that if the policyholder survives until the end of the limited period, it expires. But then if a further cover is required, a new contract can be concluded. Obviously is in term insurance contract so called renewable option, which allows the insurer to take out at the expiry date of the original term insurance a new contract (without medical underwriting). The new contract can also be a different type of a contract (endowment contract). This case is called convertible option.

A significant part of term insurance policies are used to pay off outstanding part of the loan, for example mortgage protection term contracts or if the policyholder is a corporate body, this contract is used to provide also protection against the financial loss in the case of the death of a key person in a certain organisation. Credit insurance is becoming popular also in Slovakia. It is a useful tool for all parties involved in the transaction. For the providers of the loan it makes protection in recovering the loan especially in the case of the unfortunate death of the borrower. It can also assist the family of the borrower by repayment of the loan (e.g. allowing them to retain house or car). But there are benefits also for the insurer (such as lower distribution costs, potentially less

anti-selection and possible better mortality experience).

Credit insurance indemnifies losses from non-payment of commercial debt. Credit life cover is provided to cover many risks, but primarily death. These products are sold to cover personal consumer (car, credit card), mortgages and small corporate loans. For self employed businessman the aim is to avoid catastrophic losses, grow profitability and minimize losses. In Slovakia, there exist two basic types of business loans. First is so called bank overdraft loan (short term period loan or credit – approximately one year). This is account with authorised overdraft. In our article we will work with the second type, long term period, so called instalment loan. This type is used by companies and business persons to finance machines, technologies etc. The main difference between these loans is in interest rate, which is connected with the risks covered by the loan. Interest rate also depends on whether the loan is secured or unsecured. For unsecured credits interest rate on Slovakia credit market is 7 % p. a. and more. For secured debt that means in majority cases guaranteed by real estate property or corporate body the interest rate is 3 % p. a. and more (Poláček & Páleš, 2012). For example value of these type of loans in one Slovak bank moves from 3 500 € to 1 000 000 €.

Credit insurance provides sometimes some cover not only in the case of the death but also in the case when borrower cannot meet the repayments on the loan because he loses his job, or is sick or injured. Approximately three types of the packages of the risks are available on insurance market in Slovakia. The first – basic package – contains basic risks: death and invalidity. The second package contains basic risks plus sickness absence. The third – complex package – contains also risk of unemployment with previously mentioned risks. There may be many limits to what is covered and also some policy exclusions. For example, most consumer credit insurance products cover only for involuntary unemployment (when creditor is fired or loses his job in a similar fashion) and not when creditor decides to end his job. Next possibility is that customer may only be paid a percentage of the outstanding balance. Another possibility is that customer may not be able to use the policy in the case of a pre-existing medical condition.

The premium is mostly regular. Single premium contracts are also popular. In this case the bank/loan provider adds the amount of a single premium to the loan. Of course it is administratively simpler for the bank. The cover is usually decreasing, but some companies also offer level cover. In each case the loan (amortization) schedule is usually fixed at outset.

The main distribution channel is bank insurance. This is natural because the credit is usually offered by banks. Also it becomes very easy for banks to sell this type of insurance by showing it as an additional benefit to the loan. The benefit for the bank is that it increases their income. The benefit for the borrower is that in case of bank insurance the bank offers the client lower interest rate on the loan (about 0,1 − 0,5 % on the Slovak insurance market). An alternative approach is to make insurance compulsory for anyone taking the loan. In some countries customers seeking loan must purchase bank insurance to get the loan. Another different possibility is that customer can buy the credit insurance voluntarily and sometimes also by any life insurance company.

Underwriting is also interesting aspect of this product. Underwriting is different for this type of a product because of the following factors. Of course the reason for insurance is a loan. Hence there is limited anti-selection. Secondly the borrowers usually have some financial standing and some minimum level of income. The loan provider (bank) will check the credentials of the potential borrowers before giving the loan. This can be called preliminary underwriting. So up to a certain limit, the underwriting at this type of product is simplified.

2. Amortization of loan. Annual percentage rate.

Amortization is the process of decreasing the amount of the loan (debt) over the life of the loan. So all repayments of debts (which are interest-bearing) by a series of payments which are made at equal units of time is called amortization. Many consumer loans (for example mortgages) are repaid by this method. Each repayment of the loan consists of two parts: one portion is applied for reducing the principal (amount of the loan) and another portion is applied for paying the interest on the loan.

In our examples we will work with the loans where we will have only one lender (debtor) and only one borrower (creditor). Each of the periodical payments will be repaid at the end of the period. Timing of payment will be yearly. Payment which is used for repayment of the outstanding part of the loan at the end of the year t is called

principal (amortization) payment and is denoted Q_t. Total payment at the end of the year t (which is of course sum of principal payment and interest payment I_t at the end of the year) is denoted A_t.

There exist several ways how to calculate loan repayments (it depends on the needs of the lender and the borrower, and the characteristics of the loan). We will work with the following loan amortization (repayment) methods – Equal total payments per time period (year) method.

In what follows we denote the amount of the loan D, number of payment periods (years) n and interest rate compounded once a year i. When a loan is repaid by an annuity, then the periodical value of a yearly annuity payment (the amount of the loan is the present value of the immediate annuity and a portion of each payment is applied against the principal and the remainder against the interest) is

$$A = \frac{D \cdot i}{1 - (1+i)^{-n}} \qquad (1)$$

Interest payment (decreases as times goes on) at the end of the year t is

$$u_t = D_{t-1} \cdot i \qquad (2)$$

the amount of the loan repaid or principal payment (increases with each payment) at the end of year t is

$$Q_t = A - u_t \qquad (3)$$

and unpaid balance (outstanding principal) at the year t is

$$D_t = D_{t-1} - Q_t \qquad (4)$$

Making use of these results we can construct an amortization schedule, in which we can separate each instalment A into the interest u_t and principal component Q_t.

In our article we use the so called Annual Percentage Rate (APR) as the rate of interest. The annual rate that is charged by investing or borrowing, is used to express as a single (percentage) number representing the actual yearly cost of funds over the whole term of a loan. So this rate includes also any fees and additional costs which are associated with the transaction. The EU regulations are from directives 2008/48/EC and 2011/90/EU, and at this time are fully in force in all member states since 2013. A single method of calculating the APR was introduced in directive 98/7/EC and is required to be published for the major part of loans. In the EU is the basic formula for calculation of APR:

$$\sum_{l=1}^{M} S_l \left(1 + \frac{APR}{100}\right)^{-t_l} = \sum_{k=1}^{N} A_k \left(1 + \frac{APR}{100}\right)^{-t_k}, \qquad (5)$$

where: M is the number of cash flows paid by the lender,

l is the sequence number for the cash flows paid by the lender (draw down),

S_l is the cash flow (drawdown) in period l,

N is the total number of cash flows paid by the borrower,

k is the sequence number of the cash flows paid by the borrower (repayment),

A_k is the cash flow (repayment) of period k, and,

t_l and t_k is the interval, expressed in years and fractions of a year between the date of the first cash flow and the date of cash flow l or k.

The left side of the equation is the present value of the cash flows made by the lender and the right side is the present value of the cash flows made by the borrower (Mucha, 2010).

3. Profit testing as a method of product pricing in life insurance. Profit criteria

The main idea of this method is to determine such amount of the premium for the contract as to meet the company's profit requirement. Briefly proposed premium rates are tested by projecting possible levels of future business, claims, expenses, investment experience and profit. Pricing actuary will follow the steps on the Figure 1 (Dicsson, Hardy, & Waters, 2009; Sakálová, 2001; Krčová, 2005).
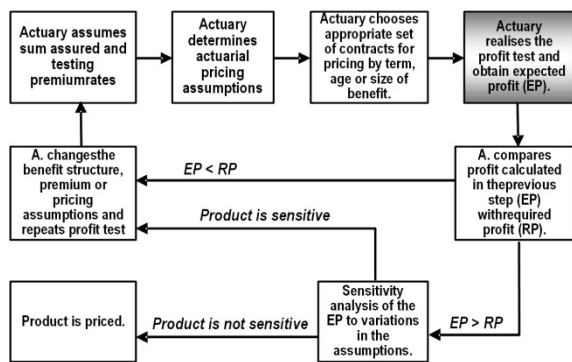
Figure 1 Profit testing scheme
Source: Authors

For measuring expected profit (Pinda, 2010) of the contract are used various profit criteria. Profit criterion is a single figure, which tries to summarise the relative efficiency of the contracts with different profit signature $\{\sigma_t\}_{t=1}^{n}$.

Net present value. Discounting the profit signature at the risk discount rate r we obtain the accumulated present value of expected future profits PR_t or the first criterion - net present value (NPV). So

$$NPV = \sum_{t=1}^{n}(1+r)^{-t} \cdot {}_{t-1}p_x \cdot PR_t = \sum_{t=1}^{n}(1+r)^{-t}\sigma_t \quad (6)$$

NPV is the best profit criterion to use, but there also exist some practical problems connected with it. It is subject to the law of diminishing returns and it says nothing about competition.

Net present value as a percentage of the initial commission. Because initial commission can partly reflect the work with selling the contract, it is usual to express NPV as a percentage of the initial commission, which the life insurance company intends to pay. Obviously in practice NPV as a percentage of the initial commission need not be less than 50 %.

Profit margin – NPV as a percentage of the present value of the future premiums. Alternatively, the NPV can be expressed as a percentage of the present value of the future premiums, which of course will be paid under the policy. So the appropriate formula in the case of a regular premium is

$$\frac{\sum_{t=1}^{n}(1+r)^{-t} \cdot \sigma_t}{\sum_{t=1}^{n}P_t \cdot {}_{t-1}p_x \cdot (1+r)^{-(t-1)}} \quad (7)$$

Life insurance companies require profit margin to be about 5 to 10 %.

Discounted payback period. The discounted payback period is the policy duration at which the emerging profits first have a discounted value of at least zero. That means, it is the time it takes for the office to recover its initial investment interesting it at the risk discount rate. So it is the first time k for which $(PVFP_k)$ is non-negative

$$PVFK_k = \sum_{t=1}^{k}(1+r)^{-t} \cdot \sigma_t \quad (8)$$

4. Example

As an example we consider that a businessman aged 35 takes from a bank a loan of 100 000 € for 10 years to compensate the cost connected with his business. Bank offers him annual interest rate 4 %. The bank calculates with two types of administrative expenses with respect to this business. First are initial expenses at the amount of 2 % from the value of the loan and second are yearly 50 € regular administrative expenses. After calculations of these fees and additional costs we obtain the annual percentage rate 4,49 %.

Bank considers using equal total payments per time period (year) method. Amortization schedule for this loan is in the Table 1.

Table 1 Amortization schedule (in €)

Year	A	u_t	Q_t	D_{t-1}
1	12 329.09	4 000.00	8 329.09	100 000.00
2	12 329.09	3 666.84	8 662.26	91 670.91
3	12 329.09	3 320.35	9 008.75	83 008.65
4	12 329.09	2 960.00	9 369.10	73 999.90
5	12 329.09	2 585.23	9 743.86	64 630.80
6	12 329.09	2 195.48	10 133.62	54 886.94
7	12 329.09	1 790.13	10 538.96	44 753.32
8	12 329.09	1 368.57	10 960.52	34 214.36
9	12 329.09	930.15	11 398.94	23 253.84
10	12 329.09	474.20	11 854.90	11 854.90

Source: Authors

The bank offers borrower an additional product to the loan agreement – loan protection insurance. This product is priced using profit testing. Pricing actuary sets the appointed profit – profit margin would be 5 %. Time is measured in years from the date of issue. Sum assured is 100 000 €. The policy has the single premium 1 565 € (calculated from the features of the contract with the use of actuarial software by the unnamed insurance company) paid at the beginning of the contract.

Office calculates initial expenses 100 € per policy and initial commission 9 % of the single premium. Marketing expenses are 2 % of the premium, renewal expenses are each year beginning from the second year 10 € (subject to the inflation) and claim expenses are calculated as 50 % from the product of two factors – probability of death in the year and the sum assured. We will assume that experienced mortality follows the Statistical office unisex table from year 2012. Technical interest rate is 1.9 %, rate of return from company's assets is 3 %, risk discount rate is 2.5 % and rate of inflation is 1.4 %.

So we are going to realise profit test of term insurance with decreasing sum assured, where sum assured is sum of outstanding part of the loan, yearly interest and expenses 50 € for managing the loan account, i. e. in the first year: 100 000 + 4 000 + 50 = 104 050 €, in the second year 91 670.91 + 3 666,84 + 50 = 95 387.75 €. Clearly initial commission decreases the value of the loan, i. e. businessman obtains 98 000 €. Value of the sum assured in each year is in the following table (Table 2).

Table 2 Sum assured (in €),

Year	Sum assured in €	Year	Sum assured in €
1	104 050,00	6	57 132,42
2	95 387,74	7	46 593,45
3	86 378,99	8	35 632,93
4	77 009,89	9	24 233,99
5	67 266,03	10	12 379,09

Source: Authors

First we calculate net cash flow CF_t for years t, pre t = 1, 2,…, 10 using the following formulae (Ondrejková Krčová & Sakálová, 2014) and results can be found in the Table 3:

$$CF_t = P_t - N_t + i \cdot (P_t - N_t) - (M_t + DC_t) \cdot q_{x+t-1}, \quad (9)$$

where P_t is the regular yearly premium received at the start of the year t (2nd column of Table 3),

N_t are the yearly expenses assumed to be incurred at the start of the year t (3rd column of Table 3),

$i \cdot (P_t - N_t)$ is the interest for the year t on the premium minus expenses (4th column of Table 3),

$M_t \cdot q_{x+t-1}$ is value of expected cost of the death benefit which happened during the year t and which is paid at the end of the year t, where M_t is

sum assured payable on death and q_{x+t-1} is probability of a person aged $(x+t-1)$ dying during the year (5th column of Table 3),

$DC_t \cdot q_{x+t-1}$ are the claim expenses in the case of death till the end of the year t (6. column of Table 3).

Table 3 Net cash flows

Year	Cash flows at the start of the year			Cash flows at the end of the year		Cash flows CF_t
	Premium	Expenses	Interest	Death claims (DC)	Claim expenses	
1	1 565.00	272.15	38.79	101.11	50.56	1 179,97
2	0.00	10.14	-0.30	105.76	52.88	-169,08
3	0.00	10.28	-0.31	110.72	55.36	-176,68
4	0.00	10.43	-0.31	107.76	53.88	-172,38
5	0.00	10.57	-0.32	100.92	50.46	-162,28
6	0.00	10.72	-0.32	91.98	45.99	-149,01
7	0.00	10.87	-0.33	84.41	42.21	-137,81
8	0.00	11.02	-0.33	76.64	38.32	-126,32
8	0.00	11.18	-0.34	58.77	29.38	-99,66
10	0.00	11.33	-0.34	33.25	16.63	-61,55

Source: Authors

The table above shows that net cash flow at the end of the first year is positive (the premium was single at the beginning of the contract), and in the other years the cash flows are negative.

The net cash-flow figures, however, are difference between the income and the outgo in each year, but they do not represent the profit, because they are without setting reserves. So policy values are calculated and the corresponding reserves are set up at the end of each year, immediately before the payment of any premium then due. So we calculate policy value $_{t-1}V$ at the beginning of the year t, for t = 1, 2,…, 10 (Sekerová & Bilíková, 2007; Gerber, 1988) using the following formulas (Dicsson, Hardy, & Waters, 2009):

for $t = 1$ $_{t-1}V = \dfrac{M_t \cdot q_{x+t-1} + p_{x+t-1} \cdot {}_t V}{1+i}$ – single net premium

$$(10)$$

and

for $t = 2, 3,…, 10$ $_{t-1}V = \dfrac{M_t \cdot q_{x+t-1} + p_{x+t-1} \cdot {}_t V}{1+i}$ (11)

The Table 4 shows the reserves:

Table 4   Net reserves

Year	1	2	3	4	5	6	7	8	9	10
Reserves	0.00	707.61	615.99	517.63	420.29	327.84	242.48	162.97	89.62	89.62

Source: Authors

The reserve will be invested and so there will be an additional income item representing the investment income earned on that reserve. Under this product (term assurance is a risky product) no surrender value will be payable (also in the case of a premature repayment of the loan), because sum assured is much higher than reserves.

So putting reserves and cash flows together, the profit emerging at the end of the each year is:

$$PR_t = CF_t + i \cdot {}_{t-1}V - \left(p_{x+t-1} \cdot {}_{t}V - {}_{t-1}V \right) \qquad (12)$$

Where $i \cdot {}_{t-1}V$ is interest on the reserve at the end of the year t (2nd column of Table 5),

$p_{x+t-1} \cdot {}_{t}V - {}_{t-1}V$ is the change (increase) in the reserve allowing for survivorship during the year t, that is, the reserve we expect to set up at the end of the year less the reserve we started with (3. column of Table 5).

The set $\{PR_t\}_{t=1}^{n}$ is called **the profit vector** for the contract.

Table 5   Profit vector

Year	Interest on the reserve	Change in the reserve	PR_t
1	0.00	706.93	473.04
2	21.23	-92.31	-55.54
3	18.48	-99.02	-59.18
4	15.53	-97.93	-58.93
5	12.61	-92.94	-56.73
6	9.84	-85.75	-53.43
7	7.27	-79.81	-50.73
8	4.89	-73.55	-47.88
9	2.69	-57.07	-39.91
10	0.98	-32.63	-27.94

Source: Authors

Finally we apply the survivorship factor ${}_{t-1}p_x$ to $\{PR_t\}_{t=1}^{n}$ and calculate value of the profit with respect to the original contract from the beginning. For $t = 1, 2,\dots,10$ we obtain then

$$\sigma_t = {}_{t-1}p_x \cdot PR_t \qquad (13)$$

or profit figures that are in the following Table 6 and are known as the profit signature of the contract.

Table 6   Profit signature

Year	Survivorship factor	Profit signature
1	1,000 000	473,04
2	0,999 028	-55,48
3	0,997 921	-59,05
4	0,996 641	-58,73
5	0,995 247	-56,46
6	0,993 754	-53,09
7	0,992 154	-50,34
8	0,990 356	-47,42
9	0,988 226	-39,44
10	0,985 830	-27,54

Source: Authors

From the profit signature of the contract, where values are discounted back to time 0 using the rate of return required by the shareholders (so called risk discount rate – 2.5 %) we obtain discounted profit signature (Table 7).

Table 7   Discounted profit signature

Year	1	2	3	4	5	6	7	8	9	10
Disc. profit signature	461,50	-52,81	-54,84	-53,20	-49,90	-45,78	-42,35	-38,92	-31,58	-21,52

Source: Authors

We calculate first profit criterion – net present value. From the final table it can be seen that the total expected discounted profit is 70,60 € and the company would need to consider whether this was an appropriate profit.

NPV = 461.50 + (–52.81) + (–54.84) + (–53.20) + (–49.90) + (–45.78) +
+ (–42.35) + (–38.92) + (–31.58) + (–21.52) = 70.60 €.

In the preceding part of the article are formulas for other criteria, so we can easy present values of them in the following Table 8. The most important for us is profit margin.

Table 8   Selected profit criteria

Net present value	70,60
NPV as a percentage of initial commission	50,13 %
Profit margin	4,51 %
Discounted payback period	1 year

Profit margin is 4.51 %, which is appropriate value for company needs. It is not necessary to carry out the profit test again.

Question is how would be the effect of changing elements of the pricing basis on the profit criteria used above, especially on the profit margin. So we carry out sensitivity analysis for profit margin varying only one element of the pricing basis in each analysis. That means for example, that if we change only amount of the premium 1 545 €, 1 555 €, 1 575 € and 1 585 €, then the resulting values of profit margin are in Table 9. Other changes in the assumptions with resulting figures of the profit margin are also given in Table 9 below.

Table 9   Sensitivity of profit margin of changing some assumptions

Premium in €	Profit margin
1 545	3.41 %
1 555	3.97 %
1 565	4.51 %
1 575	5.05 %
1 585	5.58 %

Rate of investment return in %	Profit margin
2.50	3.24 %
2.75	3.88 %
3.00	4.51 %
3.25	5.15 %
3.50	5.78 %

Risk discount rate in %	Profit margin
2.00	3.98 %
2.25	4.25 %
2.50	4.51 %
2.75	4.77 %
3.00	5.02 %

Age	Profit margin
33	21.03 %
34	13.63 %
35	4.51 %
36	-4.04 %
37	-13.24 %

For better illustration of our results from Table 9 we display particular figures on the Figure2.

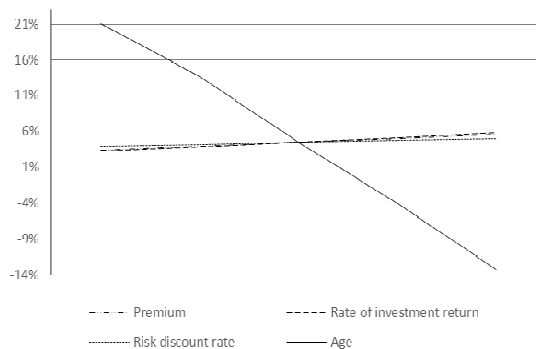**Figure 2**   Sensitivity of profit margin of changing some assumptions

As we see from Table 9 and also Graph 1, change in only one factor, i. e. rate of investment return and risk discount rate (rate of returns) and also change in the premium has a small effect on the profit margin. On the other side the effect of mortality (age) on the profit margin is most important. When changing age, it is caused by type of insurance product – term insurance product.

Conclusion

However, despite the fact that the profit is quite sensitive to the change in mortality on the one side and on the other side not very sensitive to the change of interest rates (risk discount and investment return), we can say that product is properly priced. It is also interesting that if the insurance company insured entrepreneur aged 34 years, then sufficient premium amount to have a minimal profit of 4,52 % is of 1 398 €. However, if the yield on assets and the risk discount rate decreased by 0,5 % then the 34 year old entrepreneur needs to pay single premium 1 428 €. It is therefore interesting to observe the changes of profit when changing more than one assumption. SM

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