THEORETICAL CONSIDERATIONS ON THE CALCULATION OF TURNOVER OF BREAK-EVEN IN INSURANCE COMPANIES

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Abstract: Risk management in the case of insurance companies involves two major aspects.
The first aspect refers to taking over the insurable risks of individuals and companies by signing an insurance contract instead of an insurance premium. The second aspect regards financial risks that insurance companies face. In order to evaluate the financial risks of an insurance company one of the major influence factors that has to be considered is: turnover of break-even. The paper's aims are to identify specific factors of insurance and their influence on the values of fixed and variable costs, essential parameters in determining the break-even point of any type of activity.

Keywords: *Risk management, insurances, costs, turnover of break-even*

1. INTRODUCTION

Profitability analysis of insurance companies is as important as with any productive organization.

As defined in the literature [1,4,6] profitability threshold (critical point, equilibrium point) is the volume of production to cover all expenses.

Under profitability threshold, the company works on loss. After overcoming the profitability threshold, the company gets profit again.

Profitability threshold can be determined by the algebraic method, or graphical representation of the relationships involved.

The algebraic method involves highlighting elements that make up company costs. As well known, fixed costs represent all costs over a period of time that are independent of production volume and variable costs represent costs are all costs dependent on the production volume.

To write the relations established notations are used C_F - fixed costs; C_V - variable cost; C_A - turnover, Q - production volume (in the case of insurance companies, the number of policies cashed), p - average price of a policy, v -variable costs per unit of product (policy), P - earned profits. The relationship between these elements is also known, also as that below:

$$CA = P + C_F + C_V,$$

where: $CA = p \times Q$ and $C_V = v \times Q$.

When turnover equals costs profit is zero, and the system is at the profitability threshold (critical point). Production volume corresponding to the critical point is

$$Q_{CR} = \frac{C_F}{p - v}. \qquad (1)$$

The graphical method involves representation on the same graphic the variation of turnover and total costs based on production volume. Total costs are given by the relationship:

$$C_T = C_F + v \times Q.$$

Abscissa of their intersection point represents Q_{CR}..

The above relations being known, on general level, this paper aims to highlight specific issues in insurance.

2. SPECIFIC OF COST CALCULATION IN GENERAL INSURANCES

General calculation relation [2] for any cost **C** is :

$C = C_u \times Q$ [um] (2),

where: C_u is the unit cost, expressed in adequate measuring units, and Q is the quantity (production volume). Relation (2) is valid also for the insurance field, so that Q signifies the number of cashed policies. In terms of direct relationship they have with insurance products, the insurance costs may be direct costs and indirect costs.

Similarly, in terms of volume dependency to insurance, costs can be fixed costs and variable costs.

2.1 Calculation of direct costs. Direct costs [2] include the following two components: material costs for the direct productive staff.

2.1.1 Costs of materials

Acquisition unit cost of materials needed for the materialization of an insurance contract: paper, toner, stickers, etc. will be:

$C_m = \sum n_{ck} \times p_k$ [units/pieces], where:

-n_{ck} represents consumption norm for material k;

-p_k represents unit price of material k.

For a total number of policies pro year –Q, material costs will be :

$C_{Mat/An} = C_{Mat} \times Q$ [um/year].

2.1.2 Costs with direct productive staff

Total number of policies Q may be provided by three ways:

-Q_{Ag} represents the number of insurances concluded during a year by insurance agents.

-Q_{Br} represents the number of insurances concluded during a year by brokerage companies.

-Q_{IA} represents the number of insurances concluded during a year by insurance inspectors

The commission for agents C_{Ag} represents a percent of the selling price for a policy -p.

Yearly costs for commissions of policies concluded by agents:

$$C_{Ag/An} = Q_{Ag} \times (C_{Ag} \times p) \quad (4)$$

The commission for brokerage companies C_{Br} represents procent of the selling price for a policy.

Yearly costs for commissions of policies concluded by brokerage companies:

$$C_{Br/An} = Q_{Br} \times (C_{Br} \times p), \quad (5)$$

Expenses for the salaries of insurance inspectors:

$$C_{IA} = 12 \times n_{IA} \times R_{IA} \quad (6)$$

where:- n_{IA} is the number of insurance inspectors;

-R_{IA} is the average expense recorded by an organization (monthly gross salary plus the employer's contribution to the state budget), for an insurance inspector.

Costs associated to direct productive staff will be:

$$C_{PDP/An} = C_{Ag/An} + C_{Br/An} + C_{IA}$$

Direct costs pro year:

$$C_{DAn} = C_{MatAn} + C_{PDPAn}$$

$$C_{DAn} = C_{Mat} \times Q + Q_{Ag} \times C_{Ag} \times p + Q_{Br} \times$$
$$\times C_{Br} \times p + +12 \times n_{IA} \times R_{IA}$$

2.2 Calculation of indirect costs. Indirect costs [2] include the following components:

2.2.1 Expenditure on maintenance and repairs of computer equipment (C_{IR}).

2.2.2 Electricity charges

$$C_{EE} = N_T \times T_{ef} \times p_{UE}$$

where: - N_T [KW] is the total power used;

-T_{ef} [ore] is the effective operating time;

-p_{UE} [um/kwh] is the unit price of electricity.

2.2.3 Charges for fuel used for heating and hot water

$$C_{GM} = (N_{GMI} + N_{GMA}) \times p_{UG}$$

where: -N_{GMI} [m^3] is the volume of gas used for heating;

-N_{GMA} [m^3] is the volume of gas used for hot water;

-p_{UG} [um/m^3] ist he unit price of gas.

2.2.4 Fixed assets depreciation expenses C_A:

$$C_A = \sum_{i=1}^{q} \frac{C_{MFi}}{T_{Ai}}$$

where: - q ist he number of the company's fixed assets;

- C_{MFi} [um] is the expense recorded for the asset acquisition, including freight, installation, commissioning, etc.;

- T_{Ai} [ani] is the normal service life of the fixed asset ***i.***

2.2.5 Taxes and fees expense, C_{IT} [um/year].

2.2.6 Rent expenses:

$$C_{CH} = \sum C_{Chi}$$

where: C_{Chi} is the yearly rent expense for the location „i''

2.2.7 Indirect productive staff costs: managers, accountants, etc., C_{PIP};

$$C_{PIP} = 12 \times n_{PIP} \times R_{PIP}$$

where: - n_{PIP} is the number of indirect productive staff;

- R_{PIP} is the average expense recorded by the organization (monthly gross salary plus the employer's contribution to the state budget), for a indirect productive employee.

2.2.8 Annual damage costs (**C_{Daune}**), represent the total value of compensation paid in a year.

$$C_{Daune} = Q \times R_D \times p \qquad (7)$$

where: - R_D – loss ratio.

Total indirect costs are:

$$C_{IND/An} = C_{IR} + C_{EE} + C_{GM} + C_A + C_{IT} + C_{CH} + C_{PIP} + C_{Daune}$$

Direct and indirect costs calculation serves to highlight aspects of business efficiency, since only directly productive activities are related to the activity of the company. Indirect activities provide the conditions to achieve directly productive activities.

2.3 Fixed costs. C_F – fixed costs, represent the total expenditure over a period of time, which are independent of production volume.

$$C_F = C_{IR} + C_{EE} + C_{GM} + C_A + C_{IT} + C_{CH} + +C_{PIP} + C_{IA} \qquad (8)$$

2.4 Variable costs. C_V – variable costs, represent the total expenditure increased with increasing production volume.

The category of variable insurance costs includes: material costs, annual costs for policies concluded by agents and annual costs for commissions on policies concluded by brokerage companies as well as damage costs.

$$C_V = C_{Mat/An} + C_{Ag/An} + C_{Br/An} + C_{Daune} \qquad (9)$$

Yearly damage costs - **C_{Daune}** are considered as variable costs, because they depend on the yearly concluded policies (**Q**).

2.5 Total costs. Total costs (**C_T**) – represent the sum of fixed costs and variable costs

$$C_T = C_F + C_V \qquad (10)$$

3. PROFITABILITY ANALYSIS

3.1 Calculation of fixed costs. In the relation (8) we are noting

$$C_{IR} + C_{EE} + C_{GM} + C_A + C_{IT} + C_{CH} + + C_{PIP} = C_0,$$

resulting:

$$C_F = C_{F0} + 12 \times R_{IA} \times n_{IA} \qquad (11)$$

3.2 Calculation of variable costs. In the relation (9), we replace (3), (4), (5), and (7). We obtain:

$$C_V = C_{Mat} \times Q + Q \times R_D \times p + + Q_{Ag} \times C_{Ag} \times p + Q_{Br} \times C_{Br} \times p \qquad (12)$$

We note: f_{Ag} - share of the number of policies concluded by agents from the total number of policies and

f_{Br} – share of the number of policies concluded by the brokerage companies from the total number of policies.

Then: $Q_{Ag} = f_{Ag} \times Q$ and $Q_{Br} = f_{Br} \times Q$, The relation of variable costs calculation (12) becomes:

$$C_V = Q\times[C_{Mat} + p\times R_D + p\times(f_{Ag}\times C_{Ag} + f_{Br}\times C_{Br})] \quad (13)$$

The unitary variable costs are:

$$v = C_{Mat} + p\times R_D + p\times(f_{Ag}\times C_{Ag} + f_{Br}\times C_{Br}) \quad (14)$$

The slope of variable costs is:

$$Tg\alpha_1 = C_{Mat} + p\times(R_D + f_{Ag}\times C_{Ag} + f_{Br}\times C_{Br}) \quad (15)$$

3.3 Determination of profitability threshold

We use the most common method that applies linear model of costs and revenue growth with increases in output.

3.3.1 Analytical method

Replacing (11) and (14) in relation (1) we obtain:

$$Q_{CR} = \frac{C_{F0} + 12\times R_{IA}\times n_{IA}}{p\times[1-(R_D + f_{Ag}\times C_{Ag} + f_{Br}\times C_{Br}) - C_{Mat}]} \quad (16)$$

Turnover of the profitability threshold (breakeven) is calculated with relation:

$$CA_{CR} = p\times Q_{CR}$$

3.3.2 Graphic method

Functions chart is plotted

Turnover: $CA = p\times Q$ and of total costs

$$C_T = C_{FO} + 12\times R\times n_{IA} + [C_{Mat} + p\times R_D + p\times(f_{Ag}\times C_{Ag} + f_{Br}\times C_{Br})]\times Q$$

At the intersection of the two graphs Q_{CR} is obtained.

3.4 Dependency of fixed costs to a production level. Maximum turnover achieved by a number „n_{IA}'' of inspectors is:

$$C_{MaxIA} = n_{IA}\times T_{IA} \quad (17)$$

where:- T_{IA} is the target imposed to an insurance inspector, ie. total of insurance premiums cashed during a year.

We note f_{IA}- weight of turnover achived by insurance inspectors from the total turnover CA_{Max} of the insurance company.

We have $CA_{MaxIA} = f_{IA}\times CA_{Max}$

$$CA_{Max} = \frac{n_{IA}\times T_{IA}}{f_{IA}} \quad (18)$$

$$CA_{Max} = p\times Q_{Max}$$

where :Q_{Max} – is the maximum number of policies.

From relation (18), we obtain the number of insurance inspectors who could achieve Q_{Max}

$$n_{IA} = \left[\frac{f_{IA}\times p\times Q_{Max}}{T_{IA}}\right] + 1 \quad (19)$$

where; $\left[\frac{f_{IA}\times p\times Q_{Max}}{T_{IA}}\right]$ represents the full part of the respective expression.

Replacing relation (19) into the relation of fixed costs (11) we obtain the dependency between fixed costs and Q_{Max}:

$$C_F = C_{FO} + 12\times R_{IA}\times\left\{\left[\frac{f_{IA}\times p\times Q_{Max}}{T_{IA}}\right] + 1\right\} \quad (20)$$

where Q_{Max} is the maximum number of policies which may be concluded by this level of fixed costs.

3.5 The case of the company turnover growth over CA_{Max}. We note: n_{1IA} – initial number of insurance inspectors;

CA_{1Max} - maximum turnover reached by the company with n_{1IA} – insurance inspectors;

Q_{1Max}- maximal number of policies due to this turnover;

The due fixed costs are:

$$C_{F1} = C_{F0} + 12\times R_{IA}\times n_{1IA} \quad (21)$$

The new turnover imposed by the insurance company is CA_{2Max}

$$CA_{2Max} = CA_{1Max} + \Delta CA,$$

where - ΔCA represents the turnover growth.

The number of policies is:

$$Q_{2Max} = Q_{1Max} + \Delta Q$$

This turnover growth is achieved only

by employing a certain number of insurance inspectors, namely „ $\mathbf{n_{2IA}}$ ‘’ calculated by the relation**:**

$$n_{2IA} = \left[\frac{\Delta Q \times p}{T_{IA}}\right] + 1$$

$$n_{2IA} = \left[\frac{(Q_{2Max} - Q_{1Max}) \times p}{T_{IA}}\right] + 1$$

Fixed costs $\mathbf{C_{F2}}$ corresponding to the new situation will be**:**

$$C_{F2} = C_{F1} + 12 \times R_{IA} \times n_{2IA} \quad (22)$$

By operating the accordingly replaces, we obtain:

$$C_{F2} = C_{FO} + 12 \times R_{IA} \times n_{1IA} + 12 \times R_{IA} \times n_{2IA} \quad (23)$$

Variable costs:

For Q= Q_{1Max}, variable cost will be:

$$C_{V1} = Q_{1Max} \times [C_{Mat} + p \times R_D + p \times (f_{Ag} \times C_{Ag} + f_{Br} \times C_{Br})], \quad (24)$$

If Q exceeds Q_{1Max} variable costs will be:

$$C_V = C_{V1} + (C_{Mat} + p \times R_D) \times \Delta Q, \quad (25)$$

The new slope of variable costs will be:

$$Tg\alpha_2 = (C_{Mat} + p \times R_D) \quad (26)$$

By comparing relations (26) and (15) we found the variable costs lowering.

In relation (25) we replace: $\Delta Q = Q - Q_{1Max}$, and (24) obtaining:

$$C_V = Q_{1Max} \times p \times (f_{Ag} \times C_{Ag} + f_{Br} \times C_{Br}) + (C_{Mat} + p \times R_D) \times Q, \quad (27)$$

Variable costs as per product unit are:

$$v = [Q_{1Max} \times p \times (f_{Ag} \times C_{Ag} + f_{Br} \times C_{Br})]/Q + (C_{Mat} + p \times R_D), \quad (28)$$

To obtain analytic profitability threshold (breakeven) we replace (28) and (22) into the relation (1). We obtain:

$$Q_{CR} = \frac{C_{F2} + (f_{Ag} \times C_{Ag} + f_{Br} \times C_{Br}) \times Q_{1Max}}{p \times (1 - R_D) - C_{Mat}} \quad (29)$$

To obtain graphically profitability threshold function graphs will be plotted

Turnover: $CA = p \times Q$, and of total costs:

$$C_T = C_{F2} + Q_{Max} \times p \times (f_{Ag} \times C_{Ag} + f_{Br} \times C_{Br}) + (C_{Mat} + p \times R_D) \times Q,$$

At the intersection of the two graphs we obtain Q_{CR}

4. NUMERICAL RESULTS

Data are coming from the **„X’’** insurance company

- Yearly turnover :

CA=16,800,000 [RON] ;

- Number of ywarly cashed policies:

Q_{AN}=12,000 [buc}] ;

- Average price of a policy:

p=1,400 [RON];

- Number of indirect productive employees: n_{PIP}=42;

-Average expenditure for an indirect productive employee

R_{PIP}=2,000 [RON/month] ;

- Number of insurance inspectors:

n_{IA}= 12;

- Average expenditure for an insurance inspector:

R_{IA}=2,000 [RON/month] ;

- Turnover share achieved by the insurance inspectors form the total turnover: f_{IA}=30%=0.3 ;

- Commission for agents as percent of the selling price of a policy:

C_{Ag}=10%=0.1 ;

- Turnover share achieved by the insurance agents from the total turnover:

f_{Ag}=40%=0.4 ;

Calculation of fixed costs

$\mathbf{C_{PIP}}$=1,008,000 [RON /YEAR];

$\mathbf{C_{F0}}$ =3,200,000 [RON/YEAR]

$\mathbf{C_{IA}}$=288,000 [RON /YEAR];

$\mathbf{C_{F1}}$=3,488,000; We consider:

$\mathbf{C_{F1}}$=3,500,000 [RON /YEAR];

Calculation of variable costs

$C_V = 801 \times Q$ [RON]

$Tg\alpha_1$=801

Profitability threshold will be:

Q_{PR1}=5,850 [policies]

Calculation of total costs

$$C_T = 3{,}500{,}000 + 801 \times Q \quad (30)$$

$$CA = 1{,}400 \times Q \quad (31)$$

Equaling the relations (31) and (31) we obtain Q_{CR}=5,850 [policies]

Maximum turnover to be obtained with the n_{1IA}=12, is

CA_{Max1}=16,000,000 [RON];

Maximum number of policies to be obtained:

Q_{1Max}=11,430 [policies]

To this production, both the n_{1IA}=12 inspectors and the agents and brokerage companies are contributing.

The company wishes the turnover growth to: CA_{Max2}=24,000,000 [RON];

This growth can be achieved only by increasing the number of inspectors.

ΔCA_{Max}=8,000,000 [RON];

Additional number of inspectors will be:

n_{2IA}=21 inspectors

In this situation fixed costs will be: C_{F2}=4,000,000 [RON];

By operating replacements, relations (21) and (22), become:

$$C_{F1} = 3{,}500{,}000 + 24{,}000 \times \times ([0{,}00105 \times Q_{1Max}] + 1)$$

$$C_{F2} = 3{,}500{,}000 + 24{,}000 \times \times ([0{,}00105 \times Q_{1Max}] + 1) + + 24{,}000 \times ([0{,}0035 \times (Q_{2Max} - Q_{1Max})] + 1)$$

Variable costs:

For $Q \leq Q_{1Max}$, we have:

$$C_V = 801 \times Q$$

Total costs:

$$C_T = 3{,}500{,}000 + 801 \times Q$$

For $Q \geq Q_{1Max}$, we have:

C_{V1}=9,160,000 [RON]

$$C_V = 9{,}160{,}000 + 682 \times \Delta Q ,$$

By replacing $\Delta Q = Q - Q_{1Max}$, we have:

$$C_V = 1{,}360{,}000 + 682 \times Q$$

The slope for variable costs in the new situation:

$Tg\alpha_2$=682;

The slope of variable costs decreased from $tg\alpha_1$= 801 to $tg\,\alpha_2$= 682

Total costs will be:

$$C_T = 5{,}360{,}000 + 682 \times Q \quad (32)$$

The business turnover will be:

$$CA = 1{,}400 \times Q \quad (33)$$

Equaling the relations (33) and (34) we obtain:

Q_{PR} =7,465 (policies)

Profitability threshold may be determined also analytically, as per relation (29) Q_{PR}= 7,465 (policies).

5. CONCLUSIONS

The paper deals with specific issues in insurance cost calculation of the profitability threshold (breakeven).

By determining the computing relations we found two fundamental features. The first concerns the dependence of the *threshold function* depending on the fixed costs. The second concerns the change of the straight lines slope that shapes variable costs once with the appearance of fixed costs thresholds.

This makes the total cost depending on the number of insurances to be a fairly complex function, so that profitability threshold (breakeven) is difficult to be determined by solving an algebraic equation. Therefore, the graphical representation allows much easier to determine the profitability threshold.

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