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# ASPECTS REGARDING INSURANCE COST MANAGEMENT

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**Abstract.** Cost management and financial risk evaluation are as important for insurance companies as for any other enterprise. Determining the turnover and the profitability threshold is of major importance for the evaluation of financial risks that insurance companies are exposed to. The present paper identifies the specific components of fixed and variable costs and establishes their dependence on the production volume for insurance companies. Graphs of the functions which model these costs and the graphical calculation method for the production level of the profitability threshold are presented.

**Keywords:** cost management, fixed costs, variable costs, total costs, profitability threshold

## 1. Introduction

Cost management as well as profitability threshold analysis are as important for insurance companies as for any other productive organization.

As defined in the specialized literature [3], cost management represents that management system which utilizes cost calculation with a double purpose: on one hand to collect, organize, analyze, and control the costs and, on the other hand to formulate and transmit information in the form of board reports and tables, necessary to enterprise management for the short and long term decision making process.

Insurance companies have fixed and variable costs, depending on the dependence on activity, just like any other productive organization.

The fixed costs [3] are those operational costs which remain relatively constant in value, being unaffected by the rhythm of the operations or by the production volume.

The variable costs [3] are those operational costs which vary with the production volume.

The profitability threshold (critical point, equilibrium point) represents the production volume for which the total costs are completely covered. When operating under the profitability threshold the enterprise is losing money; when operating over it, the enterprise is making a profit.

The profitability threshold can be determined using the algebraic or the graphical representation methods.

The algebraic method involves highlighting the elements which compose the costs and revenues of the enterprise. As already known, the fixed costs are the total expenses for a time period, independent of production volume, and the variable costs are the total expenses dependent on production volume.

To write the equations, the following established notation is used: $C_F$ – fixed costs; $C_V$ – variable costs; $C_A$ – turnover $Q$ – production volume (in the case of insurance companies this is the number of cashed policies); $p$ – average price of a policy, variable costs per unit of product (policy); $P$ – earned profits. The relationship between these elements is also known:

$$C_A = P + C_F + C_V\,, \tag{1}$$

where $C_A = p \cdot Q$ and $C_V = v \cdot Q$.

When the turnover equals the costs, the profit is zero and the system is at the profitability threshold (critical point). The production volume [1, 4, 5] corresponding to the critical point is:

$$Q_{CR} = \frac{C_F}{p - v}\,, \tag{2}$$

The graphical method [5, 6] involves representing on the same graph the turnover and the total costs corresponding to the production volume.

The turnover is:

$$C_A = p \cdot Q\,, \tag{1}$$

and the total costs:

$$C_T = C_F + v \cdot Q\,. \tag{2}$$

The relationships above are well known, thus the present paper will highlight the aspects specific to the insurance system.

The abscissa of their intersection point is $Q_{CR}$.

## 2. The determination of insurance total costs

As in all the other fields, in insurance too, the total costs include both fixed and variable costs.

The fixed costs category is comprised of the proper fixed costs and the relatively fixed costs.

The proper fixed costs ($C_{F0}$) are those operational costs which are constant in time or which vary only at long intervals [3]. In the insurance field [2, 8] these are made up of: maintenance and repair costs of computing systems ($C_{IR}$), the electricity costs ($C_{EE}$), the cost of the fuel used for heating and for hot water ($C_{GM}$), the turnover ($C_A$), the taxes and fees ($C_{IT}$), the rent ($C_{CH}$), the indirectly productive staff costs ($C_{PIP}$):

$$C_{F0} = C_{IR} + C_{EE} + C_{GM} + \\ + C_A + C_{IT} + C_{CH} + C_{PIP} \quad (5)$$

The relatively fixed costs ($C_{FR}$) or conventionally constant costs are those operational costs which manifest a higher sensitivity to the physical production volume and, respectively, to the production capacity [3]. In the case of insurance companies they are the salaries of insurance inspectors:

$$C_{RF} = 12 \times R_{IA} \times n_{IA}. \quad (3)$$

where: $R_{IA}$ - the wage of the insurance inspector; $n_{IA}$ - the number of insurance inspectors.

The total fixed costs are:

$$C_F = C_{F0} + C_{FR} = C_{F0} + 12 \cdot R_{IA} \cdot n_{IA}. \quad (4)$$

We note with $Q_1$ the maximum production level of all the hired inspectors, external collaborators, agents, and brokering agencies.

The number of insurance inspectors [8] who are needed to achieve the $Q_1$ production level is:

$$n_{1IA} = \left[ \frac{f_{IA} \cdot p \cdot Q_1}{T_{IA}} \right] + 1, \quad (5)$$

where: $p$ is the medium price of an insurance policy; $f_{IA}$ is the share of the total number of policies ($Q_1$) concluded by insurance inspectors; $T_{IA}$ is the yearly target for an insurance inspector, and $\left[ \frac{f_{IA} \cdot p \cdot Q_{Max}}{T_{IA}} \right]$ is the integer part of the expression.

The dependency between fixed costs and the production level $Q_1$ is [8]:

$$C_{F1} = C_{FO} + 12 \cdot R_{IA} \cdot \left( \frac{f_{IA} \cdot p \cdot Q_1}{T_{IA}} + 1 \right). \quad (9)$$

In the case of insurance companies the safest way to increase the production volume is to hire bigger number of insurance inspectors.

When going from the $Q_1$ to $Q$ yearly production levels, the hiring of the following number of additional insurance inspectors [8] is required:

$$n_{2IA} = \left[ \frac{(Q - Q_{1Max}) \cdot p}{T_{IA}} \right] + 1. \quad (6)$$

The fixed costs corresponding to the new situation ($C_{F2}$) are:

$$C_{F2} = C_{F1} + 12 \cdot R_{IA} \cdot n_{2IA}$$

or

$$C_F = C_{F1} + 12 \cdot R_{IA} \cdot \left\{ \left[ \frac{p \cdot (Q - Q_1)}{T_{IA}} \right] + 1 \right\}. \quad (11)$$

When going from a production level of $Q_{i-1}$ to a $Q_i$ one, the fixed costs for the $Q_i$ level are:

$$C_{Fi} = C_{F(i-1)} + 12 \cdot R_{IA} \cdot \left\{ \left[ \frac{p \cdot \left(Q_i - Q_{(i-1)}\right)}{T_{IA}} \right] + 1 \right\}. \quad (12)$$

The variation of the thresholds of the fixed costs for various levels of the maximum production volume to be achieved is represented in figure 1.

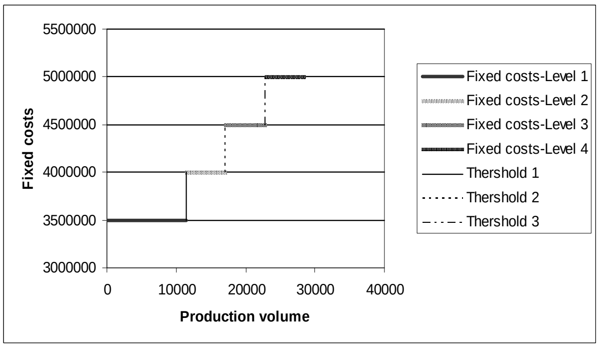


Figure 1. The variation of fixed costs for various levels of the maximum production volume

The variable costs in insurance [8] are comprised of: material costs ($C_{Mat}$), agents' commissions costs ($C_{Ag}$), brokering companies' commissions costs ($C_{Br}$), and the costs related to solving damages ($C_{Daune}$):

$$C_V = C_{Mat} + C_{Ag} + C_{Br} + C_{Daune}$$

or

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

where: $Q$ is the number of policies; $R_D$ is the rate of the damages; $f_{Ag}$ is the share of policies closed by agents from the total number of policies; $f_{Br}$ is the share of policies closed by brokering agencies from the total number of policies; $C_{Ag}$ is the medium commission of insurance agents; $C_{Br}$ is the commission of the insurance brokers.

The unitary variable costs are:

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

The slope of the variable costs is:

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

In the situation where the production level $Q$ exceeds the $Q_1$ level, the variable costs [8] are:

$$C_V = C_{V1} + (C_{Mat} + p \cdot R_D) \cdot \Delta Q , \quad (7)$$

where

$$C_{V1} = Q_1 \cdot [C_{Mat} + p \cdot R_D + p \cdot (f_{Ag} \cdot C_{Ag} + f_{Br} \cdot C_{Br})]$$

is the variable cost of the $Q_1$ production level, or

$$C_V = Q_1 \cdot p \cdot \left(f_{Ag} \cdot C_{Ag} + f_{Br} \cdot C_{Br}\right) + +\left(C_{Mat} + p \cdot R_D\right) \cdot Q . \quad (17)$$

The new slope of the variable costs is:

$$Tg\alpha_2 = (C_{Mat} + p \cdot R_D) . \quad (8)$$

By comparing the relations (15) and (18) a decrease in the slope of the variable costs can be observed.

The dependence of the variable costs on the production volume is:

$$C_V(Q) = \begin{cases} Q \cdot \left[ \begin{array}{l} C_{Mat} + p \cdot R_D + \\ + p \cdot \left(f_{Ag} \cdot C_{Ag} + f_{Br} \cdot C_{Br}\right) \end{array} \right], & \\ \qquad if \quad Q \le Q_1 & \\ Q_1 \cdot p \cdot \left(f_{Ag} \cdot C_{Ag} + f_{Br} \cdot C_{Br}\right) + & \\ \quad + \left(C_{Mat} + p \cdot R_D\right) \cdot Q , & \\ \qquad if \quad Q > Q_1 & \end{cases} \quad (19)$$

This function is represented in figure 2.

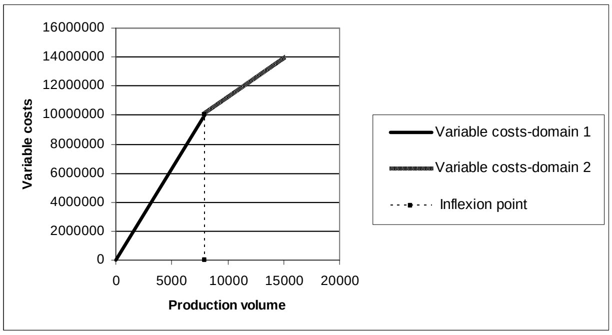


Figure 2. The graph of the variable costs

The total costs are:

$$C_T = C_F + C_V . \quad (20)$$

## 3. The determination of the profitability threshold

The method used for determining the production volume corresponding to the profitability threshold is the most common one and it uses the linear model of cost and income increase as the production volume increases.

Graphically, the production volume corresponding to the critical point, [5] both for $Q \le Q_1$ and $Q \ge Q_1$ can be obtained in the following manner:

- the graphs of the $C_A = p \cdot Q$ functions are drawn, where $C_A$ is the turnover and total costs (20).
- the critical production level ($Q_{CR}$) is at the intersection of the two graphs.

## 3. Numerical results

The data used in the numerical applications come from a county office of a general insurance company. They are: yearly turnover $C_A$ = 16,800,000 [RON], medium policy price $p$ = 1,400 [RON], the number of insurance inspectors $n_{IA}$ = 12, medium wage for an insurance inspector $R_{IA}$ = 2,000 [RON/month], the turnover share achieved by the insurance inspectors from the total turnover $f_{IA}$ = 30% = 0.3, the agents' commissions (% from the selling price of a policy) $C_{Ag}$ = 10% = 0.1, the turnover share achieved by the insurance agents from the total turnover $f_{Ag}$ = 40% = 0.4, the brokering agencies' commissions $C_{Br}$ = 15% = 0.15, the turnover share achieved by insurance brokers from the total turnover $f_{Br}$ = 30% = 0.3, damages rate (% of the medium price of a policy) $R_D$ = 48% = 0.48, material costs for a policy $C_{Mat}$ = 10 [RON/policy], yearly target for an insurance inspector $T_{IA}$ = 400,000 [RON/year].

Using the relations from this paper we get: $C_F$ = 3,500,000 [RON/year], $C_V = 801 \times Q$ [RON], $Tg\alpha_1$ **=** 801**,** $Q_{CR}$ = 5,843 [policies].

A more complete and suggestive image of the dependencies previously presented can be obtained through graphical representation. This is even more important as the functions involved are discontinuous and the equations are difficult to solve analytically.

Aiming to create graphical representations of the functions on sub-domains where they are continuous and operating the corresponding replacements, is obtaining:

$$C_T = 3{,}500{,}000 + 801 \cdot Q ; \; C_A = 1{,}400 \cdot Q .$$

The graphical calculation of the production volume corresponding to the profitability point is presented in figure 3.

The graph shows that the profitability point (found at the intersection of the two functions) is obtained at a value of 5,850 [Policies] and the maximum turnover achievable with the 12 inspectors initially hired is 16,000,000 [RON].

The graph also shows that the maximum achievable number of policies is $Q_1$ **=** 11,430

[Policies]. This production is contributed to by the 12 inspectors, the agents and the brokering agencies.

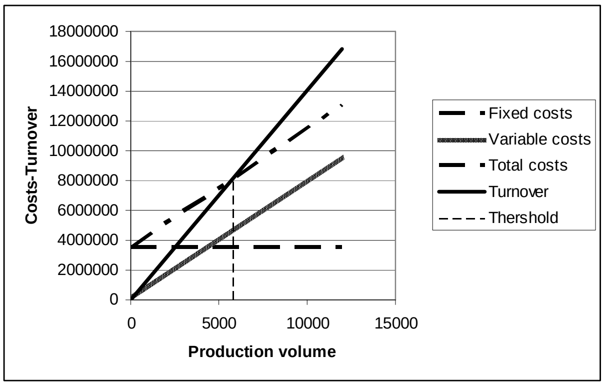


Figure 3. Graphical determination of the profitability point

The studied firm wishes to increase its turnover, in a first phase to 24,000,000 [RON], corresponding to a production volume $Q$ = 17,150 [Policies], but is also interested by the marginal evolutions of the costs. The problem of using fixed data for calculations can be solved as in the previous pages, resulting that the desired increase in turnover can be achieved by hiring 21 more inspectors. This number was calculated using the relation (10), dependency of fixed costs on the production volume is given by the following expression:

$$C_F = 3500000 + 24,000([0.0035(Q - 11430)] + 1).$$

Going from the fixed costs level for a maximum production volume $Q_1$ to the level corresponding to a maximum production volume $Q$, results in the graph in the figure 4.

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

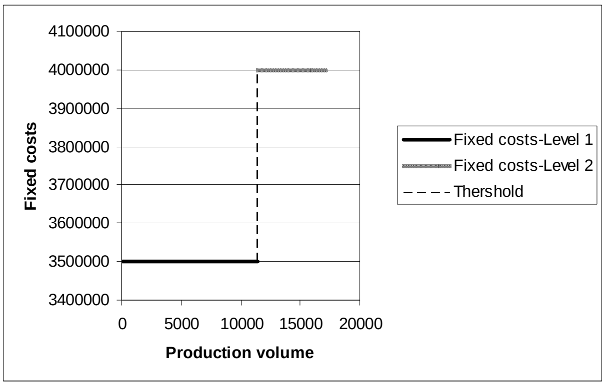


Figure 4. The dependence of the fixed costs on the production volume

In the new situation, where $Q > Q_1$, the variable costs are calculated with:

$$C_V = 9,160,000 + 682 \cdot \Delta Q,$$

or

$$C_V = 1,360,000 + 682 \cdot Q.$$

The slope for the new variable costs is $Tg\alpha_2 = 682$.

The slope of the variable costs has decreased from 801 to 682.

Figure 5 shows the fixed costs, the variable costs and total costs both for $Q \leq Q_1$ and for $Q > Q_1$.

The thresholds for the fixed costs and for the total costs corresponding to the maximum production volume $Q_1$ are highlighted.

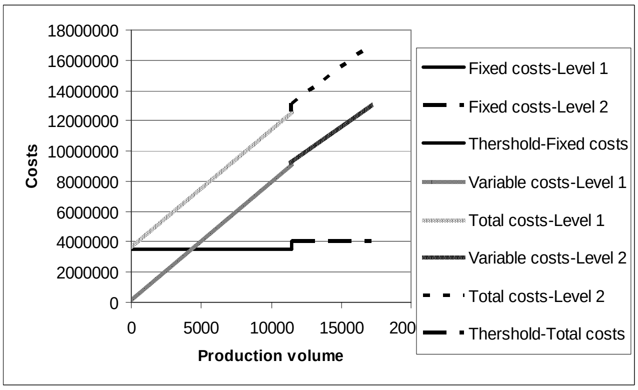


Figure 5. Total costs

The total costs are: $C_T$ = 5,360,000$\cdot Q$, and the turnover is: $C_A$ = 1,400$\cdot Q$.

At the intersection of the functions' graphs (figure 6) we find the new production volume corresponding to the profitability threshold: $Q_{CR}$ = 7,465 [Policies].

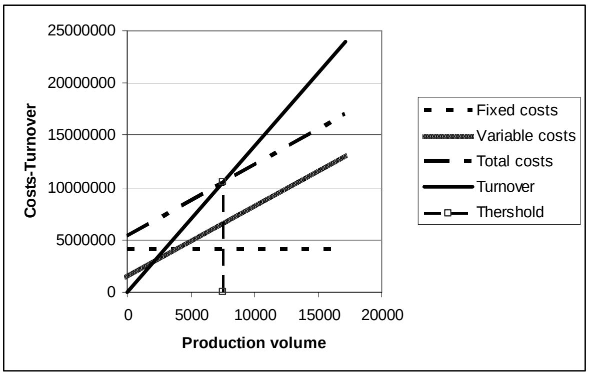


Figure 6. Determining the profitability threshold for the maximum production level $Q$

## 4. Conclusions

The paper highlights specific aspects regarding cost calculation in insurances and determining the production volume corresponding to the profitability threshold.

In the case of fixed costs, two main components stand out: the proper fixed costs (constant over time) and the relatively fixed costs (these manifest a high susceptibility to the production volume). The latter make a discontinuous, *step function* of the function which models the dependency of fixed costs on production levels.

The function which models the variable costs is a continuous function with a discontinuous derivative, its right line changing its slope as maximum production volume changes.

Because of these functions cost dependency on the total number of insurance policies is a discontinuous function which, in its turn, presents a step where the maximum production level changes.

That is why the production volume corresponding to the profitability threshold is hard to determine analytically, the graphical method being easier to use.

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