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SIMPLE METHOD OF SALES PROFITABILITY FORECASTING IN AN ENTERPRISE

Abstract: The return on sale (ROS) is one of the most common used indexes (ratios) to estimate the effectiveness of running an enterprise. This index – in general – is estimated "at point" having information about the sales income and financial results of the company. It does not, however, include the growing path of a company, which means that the results of a work done by an enterprise in time t are not influenced by the earlier results. So, to make up for that inconvenience, we propose to use the regression model with variable parameters, in which the explained variable are total operative costs and the explanatory variable are sales incomes. ROS can be estimated with the use of the following formula:

$$\text{ROS}_t = 1 - \left\{ \frac{a_{0t}}{PS_t} + a_{1t} \right\} \quad \text{for} \quad t = 1, 2, \ldots, n.$$

The empirical verification of the proposed model indicates that it has a lot of values and it brings into concrete existence the return of sale in an enterprise.

Key words: forecast, return of sale, regression model with variable parameters.

1. Introduction

Profitability calculation is one of the basic tools of finance management in an enterprise. Sales profitability is of great importance here, as it significantly influences assets and equity profitability, as well as shows sales revenues ability of profit generation.

Sales profitability may be calculated on different levels in a company. In this article we present a simple method of sales profitability forecasting on an operating level, i.e. level of basic activities being the principle activities of a company.

According to a classical understanding, sales profitability is calculated in a given point, i.e. in a period t, on the basis of data taken from this period only. So it takes into account "achievements" of a company in the given period. Please note, however, that the results achieved in the given period are also an effect of actions performed in the previous periods.

Moreover, sales profitability is also significantly influenced by operating costs structure – proportion of fixed and variable costs.

In the research described below we took into account both facts mentioned above. Therefore, in the process of sales profitability calculation, we suggest using the operating costs regression model with variable parameters.

Empirical verification of usefulness of this model was performed using available data derived from a real company, which – in our opinion – increases value of the proposed research.

2. Presentation of the research method

In the professional literature it is assumed that the main indicator of the sales profitability is operating sales profitability ratio which is defined as operating profit to sales revenues. It is presented by the equation:

$$\mathrm{ROS}_t = \frac{\mathrm{ZOP}_t}{PS_t}.$$

Operating profit can be calculated as follows:

$$\mathrm{ZOP}_t = PS_t - KC_t,$$

and further on we arrive at:

$$\mathrm{ROS}_t = \frac{PS_t - KC_t}{PS_t} = 1 - \frac{KC_t}{PS_t} = 1 - \frac{KS_t + KZ_t}{PS_t},$$

where: PS_t – sales revenues in the t period, KC_t – total operating costs in the t period, KZ_t – variable operating costs in the t period, KS_t – fixed operating costs in the t period, $t = 1, 2, \ldots, n$.

Where sales revenues are given, the sales profitability depends directly on costs – especially their split between fixed and variable. In order to use the fact in calculation of the sales profitability, we suggest presentation of the total operating costs as a function of the sales revenues:

$$\hat{KC} = \alpha_0 + \alpha_1 PS,$$

where: α_0 – fixed costs, α_1 – unit variable costs.

The disadvantage of this cost model is constancy of its parameters in interval of empirical verification. This problem can be avoided, however, using instead of the classical model – a cost model with variable parameters:

$$\hat{KC}_t = \alpha_{0t} + \alpha_{1t} PS_t. \tag{1}$$

In this model each period has different parameters α_{0t} and α_{1t} assigned to it. Because of this fact, fixed costs are treated as costs of the period, while variable costs are treated as dependent on the volume of activity in the period *t.* Taking the above into account we arrive at:

$$\text{ROS}_t = 1 - \left\{ \frac{\alpha_{0t}}{PS_t} + \alpha_{1t} \right\}. \quad (2)$$

As one can see, the sales profitability depends directly on fixed costs and variable unit costs and on sales revenues, whereas the higher the share of fixed costs in sales revenues, the lower ROS. The ROS changes in time and the ROS model takes into account that its value in the period *t* depends on the effects of the company's activities in the previous periods.

If you want to create a short term forecast of the ROS it is sufficient to prepare a prognosis of fixed costs and variable unit costs (presented by α_{0t} and α_{1t} in the cost model with variable parameters). We assume here that sales revenues in the projected period *T* are known (however, it would not be a problem if they were also subject of the forecasting process).

We suggest therefore using the following algorithm.

1. Based on the estimated cost regression model with variable parameters (MRP) we prepare costs prognosis for the period $n + 1$, considering agreed sales revenues level for the period PS_{n+1}. We use the interdependence:

$$KC^*_{n+1} = a^*_1 (PS_{n+1} - PS_n) + \hat{KC}_n,$$

where: $\hat{KC}_n$ – value of the approximant of costs in the last known period i.e. period n, PS_n – sales revenues in the period n, PS_{n+1} – sales revenues in the period $T = n + 1$, a^*_1 – average level of variable unit costs calculated according to the formula:

$$a^*_1 = \sum_{t=1}^{n} a_{1t} \cdot c_t,$$

where: a_{1t} – estimations of variable unit costs from the MRP model, c_t – harmonic wages for the successive verified periods.

2. We find evaluations of parameters $a_{0(n+1)}$ and $a_{1(n+1)}$ assuming that in the period $T = n + 1$ KC^*_{n+1} and PS_{n+1} will be realized. For this purpose we use costs regression model with variable parameters (MRP1). Its parameters were assessed by elimination of the observations KC_1 and PS_1 from the observations matrix, and by adding of the observations KC^*_{n+1} and PS_{n+1}.

3. ROS for the period $T = n + 1$ is calculated according to the following formula:

$$\text{ROS}_{n+1} = 1 - \left\{ \frac{a_{0(n+1)}}{PS_{n+1}} + a_{1(n+1)} \right\}.$$

4. Based on the estimated model MRP1 we project costs in the period $T = n + 2$ assuming that in this period sales revenues PS_{n+2} will be realized, according to the following formula:

$$KC^*_{n+2} = a_1^*(1) \cdot (PS_{n+2} - PS_{n+1}) + \hat{KC}_n(1),$$

where: $\hat{KC}_n(1)$ – value of approximant of costs derived from the MRP1 model in the last period, on the basis of which the MRP1 model was estimated, $a_1^*(1)$ – an averaged level of variable unit costs calculated according to the following formula:

$$a_1^*(1) = \sum_{t=1}^{n} a_{1t}(1) \cdot c_t ,$$

where: $a_{1t}(1)$ – estimations of variable unit costs derived from the MRP1 model.

5. We find evaluations of parameters $a_{0(n+2)}$ and $a_{1(n+2)}$ assuming that in the period $T = n + 2$ KC^*_{n+2} and PS_{n+2} will be realized. We use MRP2 model, which is created by elimination of the observations KC_2 and PS_2 from the model MRP1 observations matrix and by adding the observations KC^*_{n+2} and PS_{n+2}.

6. ROS for the period $T = n + 2$ is calculated according to the following formula:

$$ROS_{n+2} = 1 - \left\{ \frac{a_{0(n+2)}}{PS_{n+2}} + a_{1(n+2)} \right\}.$$

7. For the following periods we perform the same steps again. There should be however no more than three or four periods under consideration.

Prepared prognosis is – what is easy to notice – sequential, i.e. if you want to prepare it for the period $T = n + 2$ you need to know the prognosis for the period $T = n + 1$ and so on. To sum it up – if you want to prepare a prognosis for the period $T = n + k$ you need to have prognoses for the previous periods $T = n + 1, n + 2, \ldots, n + k - 1$. One builds it on the basis of n observations that should however be updated.

Unfortunately for the ROS prognosis prepared in this way it is impossible to assess the variation (error) of the prognosis, and due to that it is impossible to conclude how reliable the prognosis is. It can be done however indirectly – since it is possible to assess an average error of the prognosis for costs. If the costs prognosis happens to be acceptable, one may assume that the ROS prognosis is the same.

3. Presentation of the results of the research

The method described in section 2 was verified empirically, using source data coming from intentionally selected company. The data was included in the *F-01* statement and covered two variables:

– sales revenues – X,
– operating costs – Y.

The research period was 2006-2008 and time unit was a quarter.

The data was adequate, up-to-date and useful, so can be considered of a good quality [Kordos 1988, pp. 13-16]. The activities of the company were not subject to seasonal variations.

However, before we started estimation of the model parameters, we had found it useful to check, whether among all the observations relating to the verified variables (statistic data that characterize the chosen variables) there are or are not unusual observations, differing clearly from the others. Such observations are usually called “outliers”. This verification was performed in two different ways.

At first we assumed that the observations are one-dimensional and relate to single characteristics, i.e. separation of the total costs and sales revenues.

For the purpose of identification of the unusual observations we decided to apply the Grubbs test [Heilpern 2005, p. 51].

In this test two statistics are calculated:

$$G_{(n)} = \frac{x_{(n)} - \overline{x}}{s} \quad \text{and} \quad G_{(1)} = \frac{\overline{x} - x_{(1)}}{s},$$

where: $\overline{x}$ – arithmetic average, s – standard variation from the sample, $x_{(1)}$– minimum value of X, $x_{(n)}$ – maximum value of X.

If $G_{(i)} \geq G_{(\alpha)}$, then the i-th observation (so the first or the last one) may be considered as outlying. G_α is additionally a critical value of the Grubbs test for the assumed materiality level α.

The results of the Grubbs test are included in Table 1.

Table 1. Results of the Grubbs test for “outliers” in the empirical research

Item	Value of the examination H_0		Decision $G_{0.05}$=2.29
	$G_{(1)}$	$G_{(n)}$	
Sales revenues Total operating costs	1.53 1.59	1.52 1.47	No basis to reject H_0

Source: own calculations.

H_0 indicates here that the observations come from homogeneous sample.

As $G_{(1)}$ and $G_{(n)}$ are smaller than G_α, the boundary observations do not violate uniformity of the observations class.

The second method assumes treatment of the observations as multidimensional. The main item of our interest is regression model presenting the dependence between total costs and sales revenues.

In this case, for the purpose of identification of the unusual observations we used leverage values h_t, being diagonal elements of the matrix **H** as follows [Ostasiewicz (ed.) 1998, pp. 255-259]:

$$\mathbf{H} = \mathbf{X}(\mathbf{X}^T\mathbf{X})^{-1}\mathbf{X}^T$$

called projection matrix, where **X** is the observation matrix on explanatory variables of the regression model.

The observation number t we find unusual, if:

$$h_t > h_{kr},$$

where: h_{kr} – critical value of the projection ratio, calculated according to the formula:

$$h_{kr} = \frac{2 \cdot (k+1)}{n},$$

where: k – number of explanatory variables in the model, n – number of observations.

Values of ratios h_t are presented in Table 2.

Table 2. Projection ratios h_t for the data, on the basis of which costs regression model in the company was estimated

t	h_t	t	h_t
1	0.278	7	0,084
2	0.203	8	0,116
3	0.140	9	0,088
4	0.086	10	0,205
5	0.178	11	0,243
6	0.102	12	0,276
h_{kr} = 0,333			

Source: own calculations.

Table 3. Results of the estimation of parameters of the costs model (type 1) in the analyzed company

t	a_{0t}	a_{1t}
1	119.7	0.726
2	137.5	0.746
3	215.0	0.745
4	275.7	0.744
5	299.2	0.751
6	472.2	0.733
7	586.2	0.719
8	566.1	0.726
9	593.1	0.722
10	659.8	0.704
11	497.3	0.737
12	269.5	0.780
X	S_u = 151.2 V_u = 4.9% φ^2 = 3.4%	

Source: own calculations.

As it clearly results from the data included in Table 2, none of the twelve figures, on the basis of which we will be estimating the regression model with variable parameters, can be treated as "outlier".

Due to the above, we estimated the parameters of the model (1) on the basis of all observations, using the procedure described by S. Bartosiewicz [Bartosiewicz 1976, pp. 116-121].

The results of the estimation are presented in Table 3.

On the basis of the figures presented in Table 3 one may conclude that:

- the model is of a good quality, what is proven by:
  - standard deviation of the residual error and the relative estimation error,
  - coefficient of indetermination;
- evaluations of the model parameters vary in time (quarter to quarter).

We concluded therefore that the model can be used for the purpose of estimation of the sales profitability in the analyzed company. The results of the estimation, on the basis of the formula (2), are presented in Table 4 and on Figure 1.

Table 4. Sales profitability in the company, estimated according to the formula (2) in quarters of the years 2006-2008

t	ROS_t	t	ROS_t
1	0.189	7	0.120
2	0.181	8	0.152
3	0.168	9	0.131
4	0.187	10	0.177
5	0.107	11	0.177
6	0.109	12	0.175
$\overline{ROS} = 0.156$; $\sigma_{ROS} = 0.030$; $V_{ROS} = 19.0\%$; $Me = 0.172$; $Ws = -0.665$			

Source: own calculations.

Observation of the ROS indicators presented in Table 4 shows that the sales profitability was variable in quarterly review. It means that the ability of sales revenues to generate operating profit was changing in time. In the first quarter of 2007 (t = 5) 1 złoty of sales revenues generated 10.7 groszy of profit, whilst in the first quarter of 2006 it was 18.9 groszy (t = 1).

The dispersion of sales profitability in the quarterly review was not high, which is proven by calculated variability ratio.

In the 50% of quarters that have been subject to the research the profitability did not exceed 17.2%, and its pattern was left-sided asymmetrical with high intensity. Prevailing were therefore quarters, in which ROS was higher than the average that amounted to 15.6%.

In the light of the conducted empirical research it is rather undisputable that use of the regression model with variable parameters for the purpose of assessment of the sales profitability helped to make it more reliable. Therefore we think that the model can be well used for preparation of the short term prognosis of sales profitability, according to algorithm described in section 2 of this study.

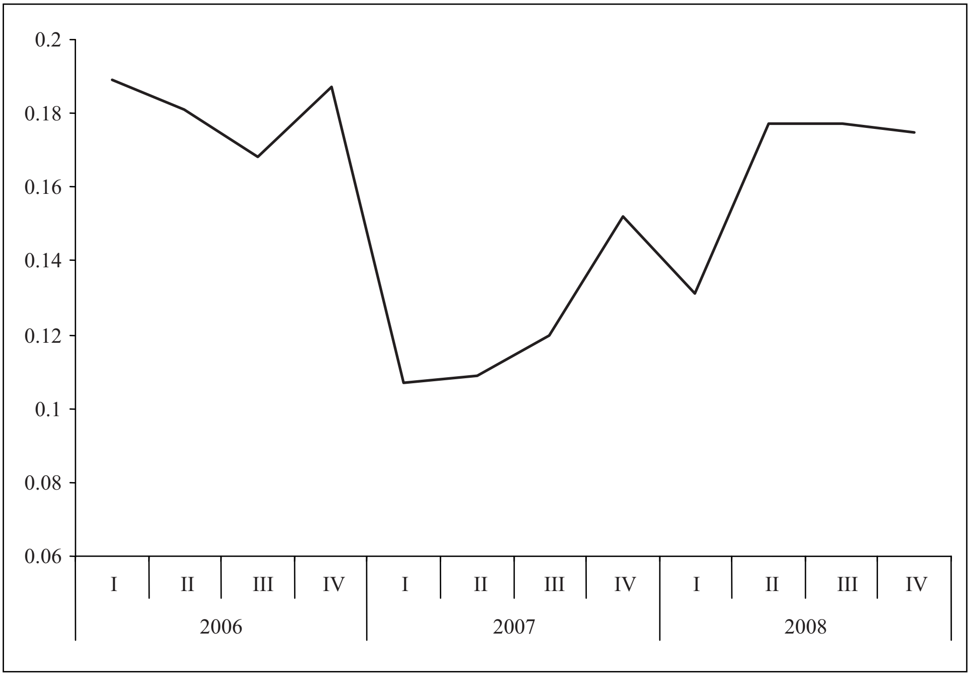

Figure 1. Sales profitability in the company in quarters of the years 2006-2008

Source: see Table 4.

The results of the prognosis are presented in Table 5.

Table 5. Short term prognosis of sales profitability in the analyzed company

Prognosis period T	Sales revenues PS_T [mln zł]	An average prognosis error ex ante total costs [tys. zł]	Relative prognosis error ex ante total costs – V_p [%]	Sales profitability prognosis ROS_T [%]
$n + 1$	4500	154.0	4.01	14.7
$n + 2$	5750	168.0	3.57	18.2
$n + 3$	6000	173.8	3.55	18.3

Source: own calculations.

The quality of the prognosis cannot be – as we stressed earlier – assessed directly. One may conclude about it on the basis of quality of total costs prognosis, which appeared to be good. The relative error of the prognoses happened to be very small and did not exceed 5%. It is a reason to state that also sales profitability prognoses can be found reliable.

4. Conclusions

The study's procedure presented above has, very likely, two advantages:

– it allows including in the profitability calculation the company's history and its previous development path,
– it clearly shows that sales profitability depends on the share of fixed and variable costs in total operating costs.

To be able to apply the above mentioned procedure, however, we should have relatively long time series of the analyzed variables, and the prognosis can be only short term one.

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PROSTA METODA PROGNOZOWANIA RENTOWNOŚCI SPRZEDAŻY W PRZEDSIĘBIORSTWIE

Streszczenie: rentowność sprzedaży (ROS) jest jednym z najważniejszym wskaźników stosowanych do oceny efektywności gospodarowania w przedsiębiorstwie. Wskaźnik ten z reguły oblicza się „w punkcie", mając dane o wyniku finansowym i przychodach ze sprzedaży. Tym samym nie uwzględnia on ścieżki rozwojowej firmy, a więc tego, że na rezultaty pracy podmiotu gospodarczego w okresie *t* mają wpływ rezultaty jego pracy w okresach wcześniejszych. W pracy proponujemy, by niedogodności tej zaradzić, wykorzystując do oszacowania ROS model regresji ze zmiennymi parametrami, w którym zmienną objaśnianą są całkowite koszty operacyjne, a zmienną objaśniającą przychody ze sprzedaży. Okazuje się wówczas, że ROS można obliczyć, korzystając ze wzoru:

$$ROS_t = 1 - \left\{ \frac{a_{0t}}{PS_t} + a_{1t} \right\} \qquad \text{dla } t = 1, 2, \ldots, n.$$

Weryfikacja empiryczna proponowanego modelu wykazała, że ma on stosunkowo duże walory poznawcze, przyczynia się bowiem, jak sądzimy, do urealnienia rachunku rentowności sprzedaży w przedsiębiorstwie.