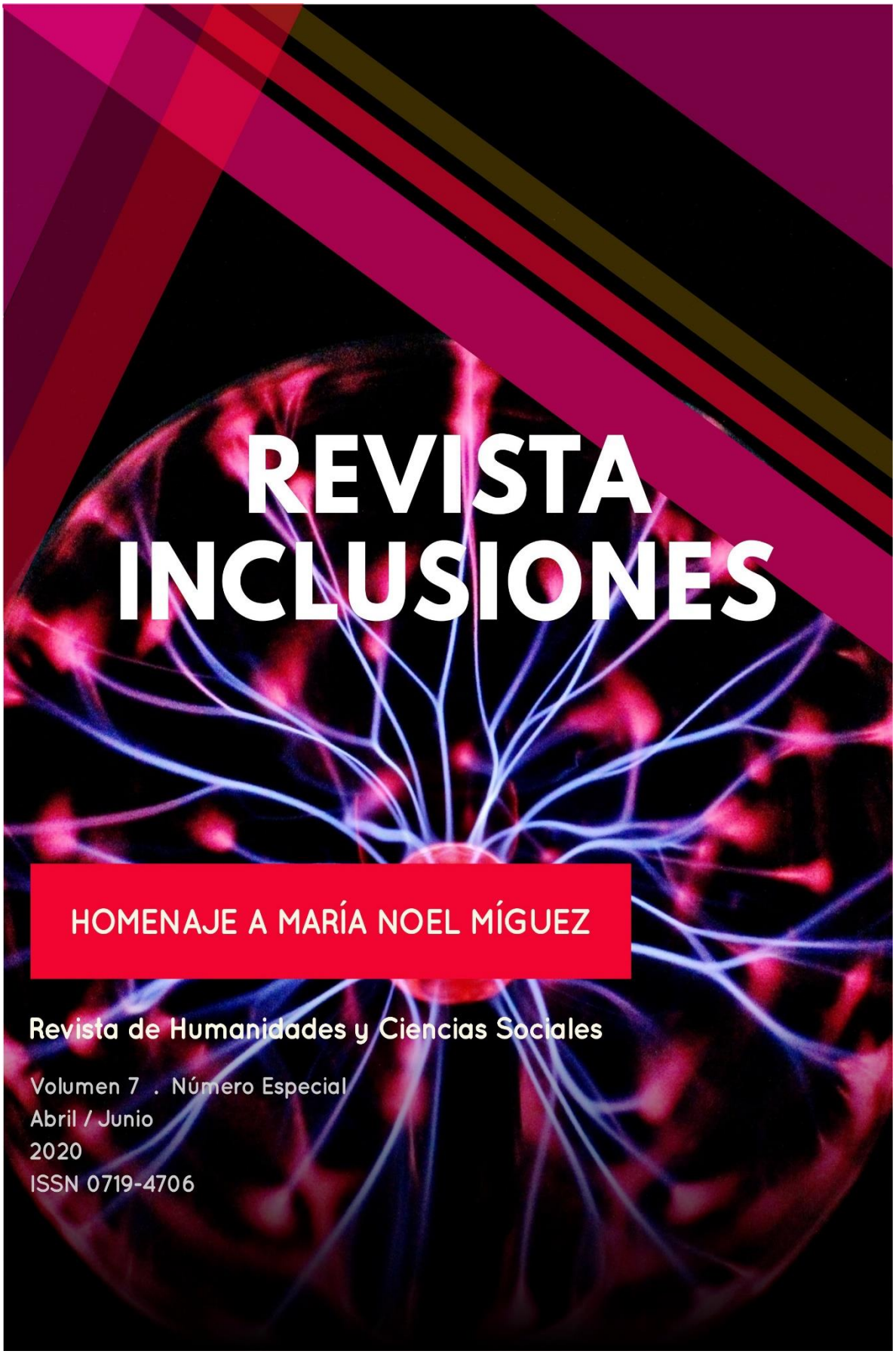

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# FORECASTING THE VALUE AND THE PRICE/EARNINGS RATIO OF THE INDUSTRIAL COMPANY WITH THE CONSTANT ANNUAL GROWTH OF ITS EARNINGS

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## Abstract

The growth of the company's value and the value of the monetary unit of its earnings depends on the growth of the company's earnings, and this interdependence is explored in this article. A method for calculating and analyzing the company's value and its Price/Earnings (P/E) ratio at a forecasted cash flow with a constant increase in the company's earnings over a certain number of periods (years) is proposed. An analysis of the value and dynamics of the company's P/E ratio is provided for the different but constant company's earnings growth over a given period, based on the company's value growth ratio formula or the company's P/E ratio and the company's constant annual earnings growth over several periods. The proposed formula and method for calculating the P/E ratio of a company with a forecasted cash flow and a constant annual growth of the company's earnings over several periods allow estimating its value and the P/E ratio for various values of the company's annual earnings growth over several periods, forecasting the company's position in the stock market, comparing it with the position of competing companies, comparing the dynamics of growth in the value and earnings of the company, and estimating the required annual earnings growth or the number of periods (years) required for maintaining a certain earnings growth for the company to occupy the desired position in the stock market.

## Keywords

Industrial economics – Input output analysis – Cost benefit analysis - Profits
Economic forecasting – Development planning

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## Introduction

The efficiency of the company development fully defines its value. The more actively the company develops and the higher share and wider sector of the market of it is, the higher its value is. If its value does not grow with an increase in market coverage or an increase in the company's performance, then the questions arise about appropriate actions, accuracy of the performance assessment, and the general economic policy of the company.

On the other hand, the growth of the company's value means the intensity of its development, the efficiency of the implemented economic policy of the company, and the relevance of the decisions made.

Identification and use of the quantitative and qualitative indicators reflecting the relationship between the efficiency and indicators of the company's development and growth of its value enable to make timely decisions required for maintaining the desired dynamics and development of the company.

The company's value is associated in the economic literature[1] with its earnings and presented as a ratio of value (or price) and earnings per share or the entire company–the P/E ratio of the company.

The P/E ratio can be defined at any particular point in time as an indicator of the number of monetary units of value attributable to one monetary unit of the company's earnings, or the unit cost of a company's earnings as estimated by the market, which is equal for both one share and for the entire company.

## Methods

The If a company expects the given annual earnings growth *(g),* then the value of the entire company ($P_1$) and the company's monetary unit of earnings $(P/E_1)$ will increase in comparison with the company's value at a constant earnings figure $(g = 0)$.

The number of periods (years) during which this annual earnings growth is observed is the determining factor in this study for calculating and analyzing the value of the company and its monetary unit of earnings, apart from some constant annual earnings growth and the P/E value available at the beginning of the study.

The number of periods of constant annual growth in company's earnings could theoretically be infinite, but it is determined by the planning horizon in practice.

The value of a share or the entire company with a projected infinite (number of periods $n\rightarrow\infty$) earnings growth can be determined based on the Gordon growth model[2]:

[1] E. Brigham y L. Gapenski, Finansovy menedzhment (SPb.: Institute "Economic School", 2004); S. V. Valdaitsev, Otsenka biznesa: study book (Moscow: TK Velbi, 2008); A. Damodaran, Investitsionnaya otsenka. Instrumenty i metody otsenki lyubykh aktivov (Moscow: Alpina Publisher, 2018); W. F. Sharpe; G. J. Alexander y J. W. Bailey, Investments (Moscow: Infra-M. 2016), 317 y J. Van Horne y J. M. Wachowicz Jr, Fundamentals of Financial Management (Financial Times: Prentice Hall, 2008).

[2] S. V. Valdaitsev, Otsenka biznesa: study book (Moscow: TK Velbi, 2008); M. A. Fedotova; V. I. Busov y O. A. Zemlyanskiy, Otsenka stoimosti aktivov i biznesa (Moscow: Uright, 2018) y M. J.

$$P_1 = E\frac{(1+g)}{(i-g)},$$

where: *E* is the earnings obtained at the beginning of the period;
*g* is the constant annual earnings growth; and
*i* is the discount rate.

However, the constant earnings growth cannot be infinite, and the value is estimated not by the dividend value, as in the Gordon growth model, but by the entire earnings of the company.

For practical purposes and the efficient management of the company, the company's value and its position in the stock market by the P/E ratio were estimated and analyzed in this study with a certain finite number of forecasted periods of the company's steady earnings growth, revealing the interdependence of the company's value and earnings growth during these periods. Constant annual earnings are forecasted in subsequent periods.

The number of the growth periods is determined by the ability to project the constant or some averaged annual growth of the company's earnings during these periods with a sufficient degree of confidence.

In this case, the following is required for projecting the value and position of the company in the stock market in terms of the P/E ratio:

1. To formulate methods for studying the interdependence of the growth of earnings, value, and the P/E ratio. This requires the following:

– to determine the formulas and methods of estimating the value of the cash flow with a projected cash flow over several periods with a constant annual growth (change) in the company's earnings;

– to determine the formulas and methods of estimating the P/E ratio *($P/E_1$)* with the projected growth of the company's earnings *(g)* during the projected period *(n)* and compare it with the P/E ratio *(P/E)* at the constant earnings *($g = 0$)*; and

– to determine the interdependence *$v = f(g,n)$* between the growth in the value *(v)* of the monetary unit of earnings and the magnitude of the company's earnings growth *(g)* with some finite planning horizon, and investigate the inverse relationship: choose the required earnings growth *(g),* the required period *(n)* of this growth in order to achieve the desired growth in the value *(v)* of the monetary unit of earnings, which will lead to the achievement of a certain, desired or given value of the P/E ratio *($P/E_1$)*.

2. To conduct a study of the status of companies in accordance with the proposed methods for the indicators estimation and analysis, which allows to do the following:

– to determine the capabilities of the company at various values of its earnings growth;

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Gordon, The investment, financing, and valuation of the corporation Reprint (Homewood, Ill.: R.D. Irwin, 2010).

– to conduct a comparative analysis of the companies present in this market, in the industry, etc., to determine the opportunities and prospects of the company, to create its business plans, and to develop its economic policies.

## Determining the interdependence between the growth of earnings, value, and the P/E ratio of the company

### Definition and analysis of the value at the cash flow projected over several periods with a constant annual growth (change) in the company's earnings

The company's cash flows are determined based on the earnings forecast with some constant annual growth *(g)* over *n* forecast periods.
In other words, the company's earnings for each *k*-th period is[3]:

$$E_k = E(1+g)^k \quad (1)$$

In accordance with the appraisal theory, the company's value determined using the cash flow discounting method consists of discounted cash flows and discounted terminal value as the residual company's value beyond the forecast period, when cash flows were received. In this case, cash flows are formed at a constant annual earnings growth of the company.

The *cost of discounted cash flows ($P_{1CF}$)* at constant annual earnings of the company during the forecasted period is the following:

$$P_{1CF} = E\sum_{k=1}^{n}\left(\frac{1+g}{1+i}\right)^k = E\frac{1+g}{i-g}\left(1-\left(\frac{1+g}{1+i}\right)^n\right) \quad (2),$$

where: *g* is the constant annual earnings growth;

*k* is the number of the earnings period;

*n* is the number of the projected earnings periods;

*i* is the discount rate;

$\sum_{k=1}^{n}\left(\frac{1+g}{1+i}\right)^k$ is the sum of a geometric progression (S) at $a_1 = q = \frac{1+g}{1+i}$, hence:

$$S = \sum_{k=1}^{n}\left(\frac{1+g}{1+i}\right)^k = \frac{a_1(1-q^n)}{1-q} = \frac{\frac{1+g}{1+i}\left(1-\left(\frac{1+g}{1+i}\right)^n\right)}{\left(1-\frac{1+g}{1+i}\right)} = \frac{1+g}{i-g}\left(1-\left(\frac{1+g}{1+i}\right)^n\right)$$

(3),

which is represented in formula 2.

[3] R. Steiner, Mastering Financial Calculations: A step-by-step guide to the mathematics of financial market instruments (Pearson Education Limited: Financial Times, 2012).

If the constant annual earnings growth is *g = 0,* then $P_{1CF} = P$ and formula 2 will be reduced to the known formula of the current value of the constant cash flow obtained over several periods *n*[4]:

$$P = E\sum_{k=1}^{n}\left(\frac{1}{1+i}\right)^{k} = E\frac{1-(1+i)^{-n}}{i}$$

In accordance with the business appraisal theory, the *terminal value* of the company by the end of the planning horizon, after receiving cash flows, is defined as the residual value of net assets (cost approach), or the earnings capitalization method (income approach) in the year beyond the period when forecasted cash flows can be received.

If the earnings in this years are constantly growing (g > 0, at n→∞), then the Gordon growth model and the capitalization ratio *k = i-g* are used; if they grow during the year and then stabilize and do not change (g = 0), they are capitalized as constant earnings with a capitalization ratio *k=i*.

If further earnings growth is forecasted for a certain number of years (periods), then the number of forecasted periods for obtaining the company's cash flows with a constant annual earnings growth *(g)* should be increased until the period of stabilization of earnings in order to estimate the value.

The terminal value *(TV)* for the growth earning received during one year beyond the period when forecasted cash flows received, and without a forecast of its further growth, i.e., *g = 0* in the following periods is found using the capitalization ratio *k = i*:

$$TV = \frac{E_{n+1}}{i} = E(1+g)^{n}\frac{(1+g)}{i}$$ (4), where:

$E_n = E(1+g)^n$ is the amount of the company's earnings by the end of the forecasted period;

$E_{n+1}=E(1+g)^n(1+g)$ is the value of the company's earnings by the end of the year beyond the period when forecasted cash flows can be received;

$TV = E(1+g)^n(1+g)/I$ is the terminal value, a residual company's value by the end of the year beyond the period when forecasted cash flows received, estimated using the method of capitalization of the earnings in this period;

*i* is the capitalization ratio; and

*n* is the number of forecasted periods (years).

[4] S. V. Valdaitsev, Otsenka biznesa: study book (Moscow: TK Velbi, 2008); A. Damodaran, Investitsionnaya otsenka. Instrumenty i metody otsenki lyubykh aktivov (Moscow: Alpina Publisher, 2018); M. A. Fedotova; V. I. Busov y O. A. Zemlyanskiy, Otsenka stoimosti aktivov i biznesa (Moscow: Uright, 2018); M. J. Gordon, The investment, financing, and valuation of the corporation Reprint (Homewood, Ill.: R.D. Irwin, 2010); J. Fishman; Sh. Pratt; C. Griffith y K. Wilson, Guide to Business Valuations (Moscow: Kwinto-Consulting, 2000) y T. Copeland y T. Koller, Valuation: Measuring and Managing the Value of Companies (Moscow: Olympus-Business, 2005).

The terminal value ($P_{1TV}$) as a discounted residual company's value estimated using the company's earnings capitalization method ($E_{n+1}$) for one year of the forecasted period (there will be no growth in the company's earnings or no forecast after a year) is as follows:

$$P_{1TV} = \frac{R}{(1+i)^n} = \mathrm{E}\frac{(1+g)}{i} \times \frac{(1+g)^n}{(1+i)^n} \text{ (5), where}$$

$1/(1+i)^n$ is the coefficient (factor) of the terminal value discounting as the residual value of the company in the year beyond the period when forecasted cash flows can be received.

The company's value ($P_1$) determined by the cash flow discounting method with a constant annual growth in the company's earnings and the terminal value over a certain defined number of forecasted periods (years), taking formulas 3 and 5 into account, is as follows:

$$P_1 = P_{1CF} + P_{1TV} = \mathrm{E}\frac{1+g}{i-g}\left(1 - \left(\frac{1+g}{1+i}\right)^n\right) + E\frac{(1+g)}{i}\frac{(1+g)^n}{(1+i)^n} \text{ (6)}$$

or, after the transformation:

$$P_1 = \mathrm{E}\frac{(1+g)(i(1+i)^n - g(1+g)^n)}{i(i-g)(1+i)^n} \text{ (6.1), or}$$

$$P_1 = \mathrm{E}\frac{1+g}{i-g}\left(1 - \frac{g}{i}\left(\frac{1+g}{1+i}\right)^n\right) \text{ (6.2)}$$

Accordingly, there is a special case with a constant increase in earnings, i.e., the number of periods $n \to \infty$ at $g>0$, while formulas 6 – 6.2 correspond to the form of the Gordon growth model:

$$P = \mathrm{E}\frac{1+g}{i-g}$$

Therefore, the present value consisting of the discounted cash flow value with a constant annual growth of the company's earnings and the terminal value, as the discounted residual value of the company defined by capitalization of the forecasted company's earnings for one year beyond the period when forecasted cash flows received, is represented in general form by formulas 6– 6.2.

**Estimating the value of the P/E ratio ($P/E_1$) with the forecasted earnings growth during the forecast period and the interdependence for the growth of the value of the monetary unit of earnings**

Formulas 6 – 6.2 allow estimating the value of the P/E ratio with a cash flow predicted for several periods at the constant annual growth of the company's earnings as the following function $(P/E)_1 = f(g,i,n)$:

$$\left(\frac{P}{E_1}\right) = \frac{1+g}{i-g}\left(1 - \frac{g}{i}\left(\frac{1+g}{1+i}\right)^n\right) \text{ (7), or}$$

$$\left(\frac{P}{E_1}\right) = \frac{(1+g)}{(i-g)}\frac{(i(1+i)^n - g(1+g)^n)}{i(1+i)^n} \text{ (7.1)}$$

where $(P/E_1)$ is the expected value of the P/E ratio per share or the value of the monetary unit of earnings with a forecasted steady increase in earnings over several periods.

It can be seen from formulas 7 and 7.1 that if:

$g = 0$, then $\left(\frac{P}{E_1}\right) = \left(\frac{P}{E}\right) = \frac{1}{i}$ (7.2);

$n \to \infty$, then $\left(\frac{P}{E_1}\right) = \frac{(1+g)}{(i-g)}$, which corresponds to the Gordon growth model.

Formulas 7 and 7.1, i.e., the function $(P/E)_1 = f(g,i,n)$, reveal the interdependence between the P/E ratio at the cash flow forecasted for several periods and the constant annual growth (change) in the company's earnings, the discount rate, and the number of the cash flow forecasted periods.

Formulas 7 and 7.1 allow calculating and analyzing the position of the company and competing companies on the stock market in terms of the P/E ratio with a certain finite number of forecasted periods and various possible values of the permanent earnings growth.

**Determining the interdependence between changes in the value of the P/E ratio and the projected annual growth of the company's earnings**

*Estimating the growth in the value of the monetary unit of earnings (P/E ratio) or the company's value*

The function $(P/E_1) = f(P/E)$ can also be represented as $(P/E_1) = P/E(1+v)$, (8)

where $v$ is the growth (change) in the value of the monetary unit of earnings or the P/E ratio $(P/E_1)$ of the company with some growth (change) in earnings over several $(n)$ periods in comparison with the value of a monetary unit with constant earnings $(P/E)$.

Accordingly, the growth of the value $(v)$ of the monetary unit of earnings or the P/E ratio of the company is as follows:

$v = (P/E_1)/P/E - 1$ (9).

Taking formulas 7 – 7.2 into account, the growth in the value of the monetary unit of earnings or the P/E ratio of the company $(v)$, formula 9 can be represented as follows:

$$v = \frac{(1+g)}{(i-g)} \frac{(i(1+i)^n - g(1+g)^n)}{(1+i)^n} - 1 \text{ (9.1) or, after transformation:}$$

$$v = g \frac{(1+i)}{(i-g)} \left(1 - \frac{(1+g)^{n+1}}{(1+i)^{n+1}}\right) = g \frac{(1+i)^{n+1} - (1+g)^{n+1}}{(i-g)(1+i)^n} \text{ (10)}$$

$$v = g \frac{1 - (\frac{1+g}{1+i})^{n+1}}{1 - \frac{1+g}{1+i}}, \text{ (10.1)}$$

in this case, $g<i$, in some cases there may be $g>i$, but always $g \neq i$.

Formulas 10 and 10.1 allow estimating and analyzing the growth (change) in the monetary unit of earnings or the P/E ratio of the company for various possible values of the constant growth of its earnings and a certain number of forecast periods (years).

In accordance with formulas 6 – 6.2, the value in terms of the P/E ratio in formulas 7 – 7.1 and 8 correlates with the amount of earnings *(E)* obtained in the initial period.

Therefore, in accordance with formula 8, after the conversion of formulas 6 – 7.1:

$P_1 = P(1+v)$ (6.3).

Formulas 10 and 10.1 allow estimating and analyzing not only the growth in the monetary unit of earnings, but also the growth in the entire company's value, its one stock share, any quantities of stock shares or controlling interest.

*Determining the rate of change in the growth of the value of a monetary unit of earnings*

Besides, when the growth of earnings *(g)* of the company is analized in a certain range of values, the rate of change in the growth of earnings can be determined *($r_g$)*:

$$r_g = \frac{g_{k+1}}{g_k}, \text{ (11) where:}$$

$g_{k+1}$ is the subsequent value of the growth of the company's earnings in a certain interval;

$g_k$ is the previous value of the growth of the company's earnings in that interval.

Formula 10 (10.1) allows determining the rate of change, increase or decrease, growth of the value of the monetary unit of earnings *($r_v$)*:

$$r_v = \frac{v_{k+1}}{v_k}, \text{ (12)} \quad \text{where:}$$

$v_{k+1}$ is the subsequent value of the growth of the monetary unit of earnings at the growth of the company's earnings $g_{k+1}$;

$v_k$ is the previous value of the growth of the monetary unit of earnings at the growth of the company's earnings ($g_k$).

Comparison of the growth rates of earnings ($r_g$) (formula 11) and the rate of change (increase or decrease) in the value of the monetary unit of earnings ($r_v$) (formula 12) allows the company's Management to determine the following:

– what rate of change in growth is higher: that of the earnings or of the value of the monetary unit of earnings; and

– at which values of the earnings growth interval the difference in growth rates is the highest.

These estimations allow determining and planning the achievement of the required earnings indicators in order to achieve the desired value of the monetary unit of earnings (P/E ratio).

*Chart of the interdependence between the growth in the value of a monetary unit of earnings and the company's earnings growth*

Chart of interdependencies $v = f(g,n,i)$ is that of the value growth $(v)$ of a monetary unit of earnings or of the entire company at various values of the company's earnings growth $(g)$ with finite planning horizon or a certain constant growth of the company's earnings $(g)$ with a different number of periods of this growth allows determining not only the direct, but also the inverse relationship:

– the required earnings growth $(g)$ for a certain specified number of periods of this growth $(n)$; and

– the required number of periods $(n)$ with a certain growth in earnings $(g)$

that allow achieving the desired growth in the value $(v)$ of the monetary unit of earnings, which, in turn, will lead to the achievement of a certain, desired, or given value of the P/E ratio ($(P/E_1)$.

Therefore, formulas 6 – 10.1 allow estimating the value and the P/E ratio, the growth rate of this ratio with a constant value of the company's earnings growth and a certain number of periods of this growth, or the growth of the company's earnings required for achieving the desired growth value for the monetary unit of earnings or the P/E ratio of the company.

*Determining the growth of the monetary value of the company's earnings for achieving the equality of the P/E ratios for companies*

Formulas 8–10.1 allow forecasting and analyzing the P/E-ratio position of companies.

If $P/E_A > P/E_B$ for companies A and B, then at the same rate of the earnings growth $(g)$ during equal periods of this growth in accordance with formula 10 (10.1), the growth in value $(v)$ of the monetary unit of earnings will also be the same. In accordance with formula 8, $P/E_{1A} > P/E_{1B}$ and the P/E ratios of the companies will not change:

$$\frac{P}{E_{1A}}/\frac{P}{E_{1B}} = \frac{P}{E_A}/\frac{P}{E_B} \text{ (13).}$$

If the earnings growth *(g)* of companies is different at equal periods of this growth, the growth *(v)* of the monetary unit of earnings will also differ, and the P/E ratio of the companies will change, i.e., formula 13 will not be correct.

The growth in the value *(v)* of the monetary unit of the company's earnings can be determined with a lower P/E ratio required to achieve the equality of the P/E values of the companies, $P/E_{1A} = P/E_{1B}$ (14),

or: $P/E_A(1+v_A) = P/E_B(1+v_B)$ (14.1).

In this case, the growth in the value *(v)* of the monetary unit of the company's earnings with a lower P/E ratio is as follows:

$$v_B = (\frac{P}{E_A}/\frac{P}{E_B}) \times (1 + v_A) - 1 \text{ (15).}$$

According to the chart of interdependencies $v = f(g,n,i)$, in accordance with formula 10 (10.1), the required value of the earnings growth *(g)* of company B can be determined, which allows to achieve the required (formula 15) growth in the value *(v)* of the monetary unit of company B, satisfying the condition of equality of the P/E values of the companies (formula 12).

In a general case, if companies have different P/E values and project different earnings growth and periods of this growth, then formulas 8 – 15 allow determining the expected P/E values of the companies, their ratio, and dynamics of the companies' position in the stock market.

**Analysis of the practical situation of determining the value of the P/E ratio with the projected constant growth in the company's earnings**

The practical analysis of the state of companies by P/E ratios with the projected continuous growth of the company's earnings over several periods in accordance with formulas 6 – 15 can be carried out in the following directions:

– analysis of the state and capabilities of the company; and

– comparative analysis of the state and capabilities of companies.

**Analysis of the state and capabilities of the company**

The analysis of the practical situation can be carried out by the example of STL[5], which implemented an investment project, had reached its design capacity, and had achieved the P/E ratio of 13.07 and net profit of 535.23 thous. of monetary units as of early

[5] Quotes and charts in real time. Retrieved May 23, 2019 from: https://www.moneycontrol.com/stocks/marketinfo/pe/bse/homebody.php?indcode=%207&sortcode=0

2019. The company is considering development options where it predicts a possible steady annual earnings growth *(g)* when being engaged in various activities from 2 to 5.5 % in the period from 2019 to 2023, i.e., over four years.

The company's value at different projecting options for the growth of its earnings can be estimated using formulas 6 – 6.2.

The projected P/E ratio *($P/E_1$)* and the annual growth (change) in the value *(v)* of a monetary unit of earnings with different ranges of annual earnings growth *(g)* can be estimated using formulas 7 (7.1) and 10 (10.1).

The inverse problem can be solved and the required earnings growth required to achieve the desired P/E ratio of the company can be estimated based on the chart built in accordance with formula 10 (10.1) or the method of indicators selection in accordance with this formula.

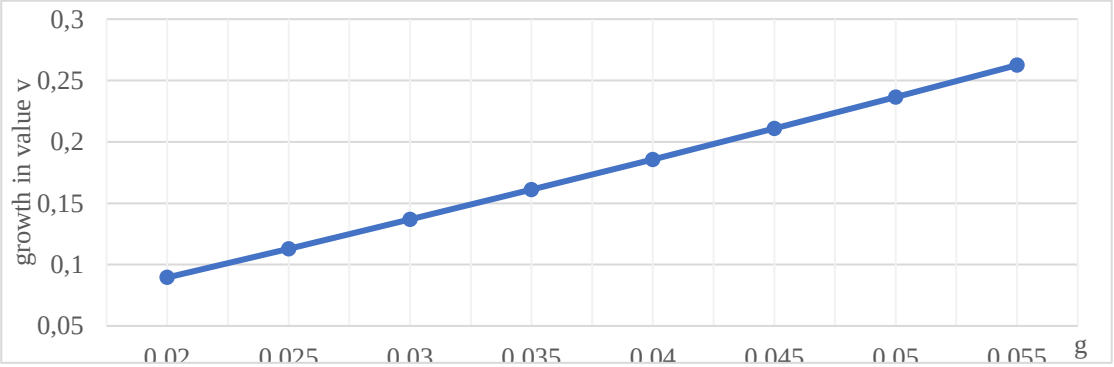
The results of estimating the projected value, the P/E ratio *($P/E_1$),* the expected annual growth in the value *(v)* of the monetary unit of earnings, and the company's value for various values of the annual earnings growth are presented in Table 1 and Figures 1, 2.

| # | *P/E* | *g* | $r_g$ | *i* | *n* | *v* | $r_v$ | $P/E_1$ | $P_1$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 13.07 | 0.02 | - | 0.08 | 4 | 0.089489 | - | 14.23962 | 7,289.091 |
| 2 | 13.07 | 0.025 | 1.25 | 0.08 | 4 | 0.112901 | 1.261611 | 14.54561 | 7,445.722 |
| 3 | 13.07 | 0.03 | 1.2 | 0.08 | 4 | 0.136739 | 1.211149 | 14.85718 | 7,605.213 |
| 4 | 13.07 | 0.035 | 1.166667 | 0.08 | 4 | 0.161012 | 1.177508 | 15.17442 | 7,767.604 |
| 5 | 13.07 | 0.04 | 1.142857 | 0.08 | 4 | 0.185724 | 1.15348 | 15.49741 | 7,932.937 |
| 6 | 13.07 | 0.045 | 1.125 | 0.08 | 4 | 0.210882 | 1.135459 | 15.82622 | 8,101.252 |
| 7 | 13.07 | 0.05 | 1.111111 | 0.08 | 4 | 0.236492 | 1.121442 | 16.16095 | 8,272.592 |
| 8 | 13.07 | 0.055 | 1.1 | 0.08 | 4 | 0.26256 | 1.110229 | 16.50166 | 8,446.999 |

Compiled by the authors using materials (Quotes and charts in real time, n.d.)

Table 1

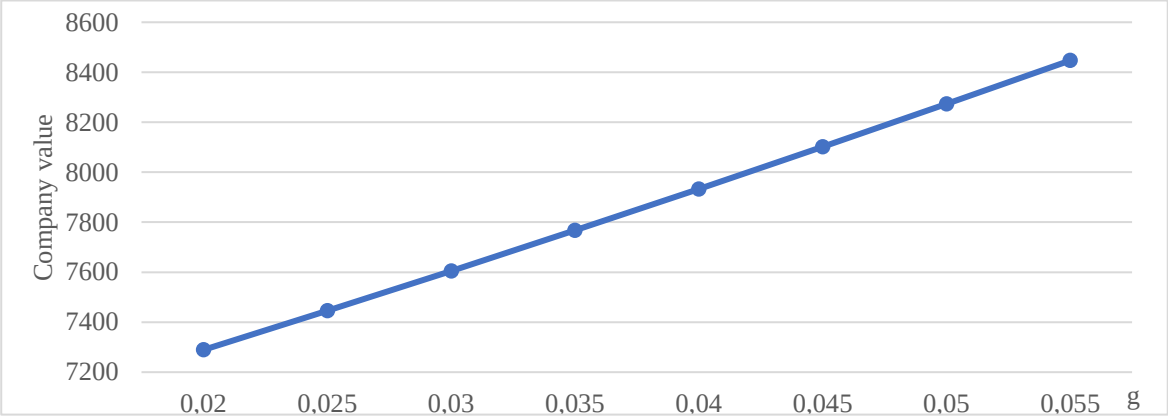
Forecasted values of the P/E ratio and the annual growth in the value of the monetary unit over four years




Compiled by the authors using materials (Quotes and charts in real time, n.d.)

Figure 1

Chart of the growth of the P/E value of the company for various values of its earnings growth *v = f(g)*




Compiled by the authors using materials[6]

Figure 2

Chart of the company's value at different growth of its earnings

Table 1 and Figures 1 and 2 reveal that with an increase in earnings from 2 to 5.5 %:

– increase in the value *(v)* of the monetary unit of earnings grows from 8.9 % to 26.256 %;

– rate of change in the earnings growth and the value of the monetary unit of earnings (formulas 11 and 12) are reduced. At the beginning of the earnings growth interval, the rate of change: $r_g$ = 1.25 and $r_v$ = 1.2616, i.e., the growth in the value of the monetary unit of earnings is 1.00928 times higher than the earnings growth; by the end of the earnings growth interval, the rate of change $r_g$ = 1.1 and $r_v$ = 1.11, i.e., the growth increases 1.009 times. If the earnings growth interval continues to grow, the rate of change in the earnings growth ($r_g$) and the rate of change in the growth of the monetary unit of earnings ($r_v$) will be almost the same, but at the same time, g≠i=0.08:

– value of the P/E ratio *($P/E_1$)* increases from 14.24 to 16.5; and

– company's value is in the range of 7,289.09 – 8,447.0 thous. monetary units.

The company managment analyzed their capabilities and the state of competing companies and determined, for example, that, other conditions being equal, the company should achieve the value of the P/E ratio *$P/E_1$* = 15 instead of the current *P/E* = 13.07. In this case, the economic, production policy and other company actions should contribute to the constant growth in the company's earnings in the range of 3 – 3.5 % (more precisely, 3.28 %) over four years. In this case, the company's value will be in the range of 7,605–7,767 thous. monetary units.

If the company wants to achieve the P/E ratio *$P/E_1$ = 15* over three years, then the required constant growth of the company's earning, in accordance with formula 10 (10.1), determined by the selection method, is presented in Table 2.

[6] Quotes and charts in real time. Retrieved May 23, 2019 from: https://www.moneycontrol.com/stocks/marketinfo/pe/bse/homebody.php?indcode=%207&sortcode=0

| # | ***P/E*** | ***g*** | ***i*** | ***n*** | ***v*** | ***P/E₁*** | ***P₁*** |
|---|---|---|---|---|---|---|---|
| 1 | 13.07 | 0.039 | 0.08 | 3 | 0.147339 | 14.99573 | 7,676.131 |
| 2 | 13.07 | 0.040 | 0.08 | 3 | 0.151329 | 15.04786 | 7,702.82 |

Compiled by the authors using materials[7]

Table 2

Forecasted values of the P/E ratio and annual growth in the value of the monetary unit over three years

The value of the company's constant earnings growth (Table 2) in this case should be in the range of 3.9 – 4 % (more precisely, 3.9082 %), the company's value interval will narrow and amount to 7,676 – 7,703 thous. monetary units.

The required earnings growth that should be achieved for the desired P/E ratio *(P/E₁)* of the company, taking formula 10 (10.1) into account, can be determined for periods of any other duration during which the company is able to provide the required earnings growth.

Besides, if the company has successfully implemented its investment projects, the market situation changes for the better, or other positive conditions arise under which the company expects annual earnings growth of more than 8 %, then the growth in the value of the monetary unit of earnings (*P/E₁*) of companies will be greater. STL expects annual earnings growth in the range from 8.5 to 12.5 % (Table 3, Figure 3).

| # | ***P/E*** | ***g*** | ***$r_g$*** | ***i*** | ***n*** | ***v*** | ***$r_v$*** | ***P/E₁*** | ***P₁*** |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 13.07 | 0.085 | - | 0.08 | 4 | 0.428953446 | - | 18.67642 | 9,560.234 |
| 2 | 13.07 | 0.095 | 1.117647 | 0.08 | 4 | 0.488378977 | 1.138536 | 19.45311 | 9,957.813 |
| 3 | 13.07 | 0.105 | 1.105263 | 0.08 | 4 | 0.549874726 | 1.125918 | 20.25686 | 10,369.24 |
| 4 | 13.07 | 0.115 | 1.095238 | 0.08 | 4 | 0.613495992 | 1.115701 | 21.08839 | 10,794.89 |
| 5 | 13.07 | 0.125 | 1.086957 | 0.08 | 4 | 0.67929906 | 1.107259 | 21.94844 | 11,235.14 |

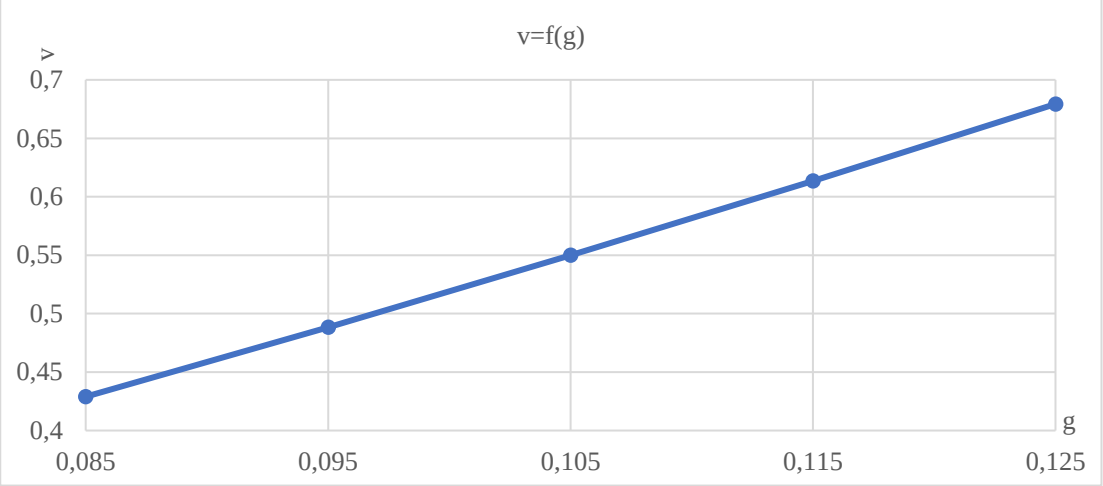
Compiled by the authors using materials[8]

Table 3

Expected values of the P/E ratio and annual growth in the value of a monetary unit over four years

[7] Quotes and charts in real time. Retrieved May 23, 2019 from: https://www.moneycontrol.com/stocks/marketinfo/pe/bse/homebody.php?indcode=%207&sortcode=0

[8] Quotes and charts in real time. Retrieved May 23, 2019 from: https://www.moneycontrol.com/stocks/marketinfo/pe/bse/homebody.php?indcode=%207&sortcode=0




Compiled by the authors using materials[9]

Figure 3

Chart of the growth in the P/E ratio of the company with different values of its earnings growth v = f (g)

Table 3 and Figure 3 reveal that with an increase in the growth interval of earnings, g>i = 0.08, the company's P/E ratio ($P/E_1$) and the growth in the value of its monetary unit of earnings will be significantly higher, and the rate of change of the earnings growth and rates of change in the growth of the monetary value of earnings will be in commensurate limits with the values in Table 1 and Figure 1, i.e., with g<i = 0.08.

The analysis of the company's capabilities allows Management to determine the necessary development actions and project their results.

## Comparative analysis of the state and capabilities of companies

VST Tillers Tractors Ltd., Escorts Ltd, and Swaraj Automotives Ltd.[10] (Quotes and charts in real time, n.d.) are present in the market and predict a possible steady growth in annual earnings (g) in the range from 2 % to 5.5 % in the period from 2019 to 2023, i.e., over four years. The current and projected values of the P/E ratio of companies are presented in Table 4 and in Figure 4.

| | | | | | ***VTS TTL*** | | ***Escorts*** | | ***Sw auto*** | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***#*** | ***g*** | ***i*** | ***n*** | ***v*** | ***P/E*** | ***P/E₁*** | ***P/E*** | ***P/E₁*** | ***P/E*** | ***P/E₁*** |
| 1 | 0.02 | 0.08 | 4 | 0.089489 | 21.01 | 22.89017 | 15.34 | 16.71276 | 14.14 | 15.40538 |
| 2 | 0.025 | 0.08 | 4 | 0.112901 | 21.01 | 23.38204 | 15.34 | 17.07189 | 14.14 | 15.73641 |
| 3 | 0.03 | 0.08 | 4 | 0.136739 | 21.01 | 23.88289 | 15.34 | 17.43758 | 14.14 | 16.07349 |
| 4 | 0.035 | 0.08 | 4 | 0.161012 | 21.01 | 24.39286 | 15.34 | 17.80992 | 14.14 | 16.41671 |

[9] Quotes and charts in real time. Retrieved May 23, 2019 from: https://www.moneycontrol.com/stocks/marketinfo/pe/bse/homebody.php?indcode=%207&sortcode=0

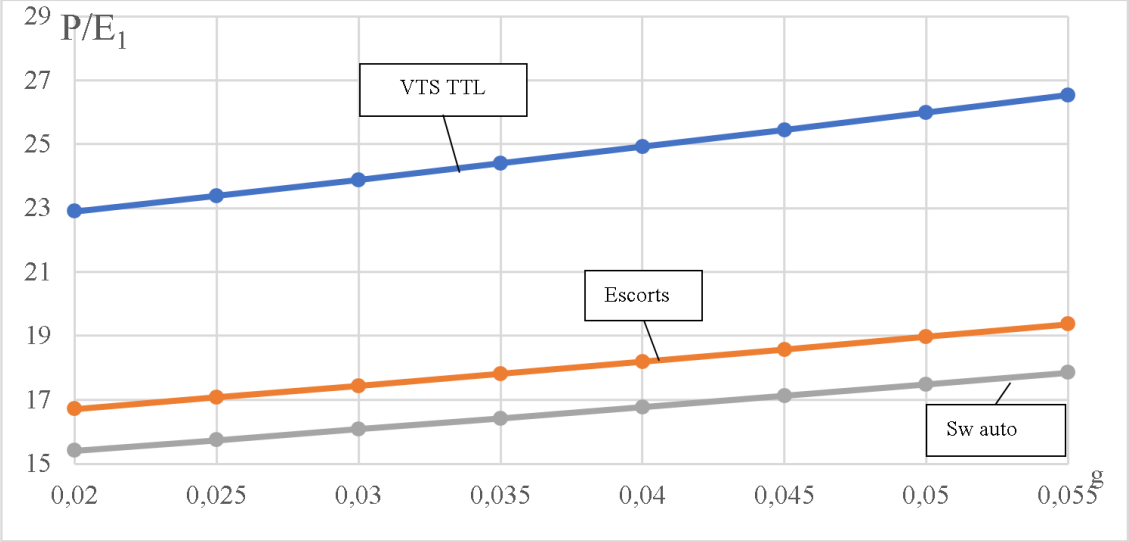
[10] Quotes and charts in real time. Retrieved May 23, 2019 from: https://www.moneycontrol.com/stocks/marketinfo/pe/bse/homebody.php?indcode=%207&sortcode=0

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 0.04 | 0.08 | 4 | 0.185724 | 21.01 | 24.91206 | 15.34 | 18.189 | 14.14 | 16.76613 |
| 6 | 0.045 | 0.08 | 4 | 0.210882 | 21.01 | 25.44062 | 15.34 | 18.57492 | 14.14 | 17.12187 |
| 7 | 0.05 | 0.08 | 4 | 0.236492 | 21.01 | 25.97869 | 15.34 | 18.96778 | 14.14 | 17.48399 |
| 8 | 0.055 | 0.08 | 4 | 0.26256 | 21.01 | 26.52638 | 15.34 | 19.36767 | 14.14 | 17.8526 |

Compiled by the authors using materials[11]

Table 4

Current and projected P/E ratios of companies over four years




Compiled by the authors using materials[12]

Figure 4

Chart of growth in the P/E ratio of companies
at different values of their earnings growth

Analysis of Table 4 and Figure 4 reveals the following:

1) Escorts Ltd and Swaraj Automotives Ltd. will not be able to achieve indicators *(P/E₁)* of VST Tillers Tractors Ltd. in the projected range of constant annual earnings growth *g*=2–5.5 % over four years.

2) If Escorts Ltd and Swaraj Automotives Ltd. are going to achieve the value of the P/E ratio $P/E_{1E} = P/E_{1S} = 17$, then the constant annual earnings growth should be $g = 2.4$ % for Escorts Ltd and $g = 4.33$ % for Swaraj Automotives Ltd.

In this case, the expected annual growth of the value *(v)* of the monetary unit of earnings and the company's value will be in accordance with formula 10 (10.1) (Table 5):

[11] J. Van Horne y J. M. Wachowicz jr, Fundamentals of Financial Management (Financial Times: Prentice Hall, 2008).

[12] Quotes and charts in real time. Retrieved May 23, 2019 from: https://www.moneycontrol.com/stocks/marketinfo/pe/bse/homebody.php?indcode=%207&sortcode=0

| ***company*** | ***g*** | ***i*** | ***n*** | ***v*** | ***P/E*** | ***P/E₁*** |
|---|---|---|---|---|---|---|
| *Escorts Ltd* | 0.024 | 0.08 | 4 | 0.108184 | 15.34 | 17 |
| *Swaraj auto* | 0.0433 | 0.08 | 4 | 0.202278 | 14.14 | 17 |

Compiled by the authors using materials[13]

Table 5

Annual growth in the value (v) of the monetary unit of earnings (P/E ratio) of companies over four years

Table 5 reveals that in order to achieve the required $P/E_{1E} = P/E_{1S} = 17$, the annual growth in the value *(v)* of the monetary unit of earnings for Swaraj Automotives Ltd. ($v_S$ = *20.228 %)* should be 1.870 times higher than the value growth for Escorts Ltd *($v_E$ = 10.818 %)*.

The ratio of the indicators presented in Table 5 corresponds to formula 15.

Formula 15 allows determining the required amount of growth in the value of the monetary unit of earnings of one company with the same indicator known for another one. Escorts Ltd predicts the value of the growth of the value of the monetary unit of earnings in the range of 12 – 13.5 %; in this case, in order to obtain equality of the P/E ratio ($P/E_{1E} = P/E_{1S}$), Swaraj Automotives Ltd should have a range of growth in the value of monetary units of earnings as 21.5 **–** 23.13 % (Table 6).

| $v_E$ | $P/E_E$ | $P/E_S$ | $v_S$ | $v_E/v_S$ |
|---|---|---|---|---|
| 0.12 | 15.34 | 14.14 | 0.2150 | 1.792079 |
| 0.125 | 15.34 | 14.14 | 0.2205 | 1.763791 |
| 0.13 | 15.34 | 14.14 | 0.2259 | 1.737678 |
| 0.135 | 15.34 | 14.14 | 0.2313 | 1.7135 |

Compiled by the authors using materials[14]

Table 6

Growth values (v) of the monetary unit of earnings for Escorts Ltd and Swaraj Automotives Ltd

Table 6 reveals not just the correspondence between the growth values of the monetary value of earnings for Escorts Ltd and Swaraj Automotives Ltd, but also a slight decrease in the ratio of these values ($v_E/v_S$) from 1.792 to 1.7135, which suggests that the higher the increase in the value of monetary units of earnings and the very earnings of companies is, the less it depends on the difference in the initial P/E ratio of the companies.

Formula 15 allows estimating the required growth in the value of the monetary unit of earnings for any company.

[13] Quotes and charts in real time. Retrieved May 23, 2019 from: https://www.moneycontrol.com/stocks/marketinfo/pe/bse/homebody.php?indcode=%207&sortcode=0

[14] Quotes and charts in real time. Retrieved May 23, 2019 from: https://www.moneycontrol.com/stocks/marketinfo/pe/bse/homebody.php?indcode=%207&sortcode=0

If Escorts Ltd is required to determine the conditions under which it can achieve the equality of the P/E ratio with VST Tillers Tractors Ltd ($P/E_{1E} = P/E_{1V}$), then with the growth in the value of the monetary unit of earnings for VST Tillers Tractors Ltd $v_V$ = 0.089489 (Table 3), a growth in the P/E ratio of Escorts Ltd should be the following:

$$v_E = (\frac{P}{E_V}/\frac{P}{E_E}) \times (1 + v_V) - 1 = \frac{21,01}{15,34} * 1,089489 - 1 = 0,4922,$$

which in accordance with formula 10 (10.1) means that with the annual growth of VST Tillers Tractors Ltd $g_V$ = 0.02 and the growth in the value of its monetary unit of earnings $v_V$ = 0.089489 (Table 4), Escorts Ltd should have a growth in the value of the monetary unit of earnings (P/E ratio) $v_E$ = 49.22 % at the annual earnings growth of $g_E$ = 9.57 % over four years, or $g_E$ = 11.7 % over three years, which satisfies the condition of formula 10 (10.1) $g>i = 0.08$. If the Management of Escorts Ltd are able to satisfy this condition and stock market analysts agree with this, then VST Tillers Tractors Ltd and Escorts Ltd will have the same P/E ratio ($P/E_{1E} = P/E_{1V} = 22.89$), i.e., the market will value the monetary unit of the earnings of companies equally.

The ratio of these indicators can be estimated and implemented for any companies.

## Conclusions

The interdependence between the growth of earnings, value, and the P/E ratio of the company was explored with a cash flow forecasted for several periods with a constant annual growth (change) in the company's earnings based on the proposed methods of calculation, analysis, and determination methods:

– company’s value (P1) with cash flows at the constant value of growth in the company's earnings during a certain number of periods of this growth (formulas 6 – 6.2);

– value of the monetary unit of its earnings (P/E ratio) (formulas 7 – 7.1);

– interdependence and dynamics of the value of the monetary unit of the company's earnings and changes in the earnings at finite planning horizon (formulas 10 – 10.1); and

– inverse relationship: selection of the required earnings growth, the number of periods of this growth required for achieving the desired growth in the value of the monetary unit of earnings, which will lead to the achievement of a certain, desired, or given value of the P/E ratio (formulas 10 – 15).

The studies of the state of companies in accordance with the proposed methods for calculating and analyzing their indicators, as well as the identified relationship between these indicators will allow Management to:

– determine the cost and magnitude of the growth in the P/E ratio for various values of the company's constant growth in earnings for a certain number of periods of this growth or the growth in the company's earnings required for achieving the desired company’s value and its monetary unit value (P/E ratio);

– conduct a comparative analysis of the state, capabilities and prospects of companies present in the market, industry, etc., and determine the ratio of P/E ratio of companies, the possibility of mergers or acquisitions;

– adjust or develop production, marketing, and general economic policy of the company aimed at achieving the required performance and the desired result, the

possibility of obtaining it being estimated in accordance with the proposed methods for determining the indicators of the company's value and earnings.

The proposed methods for determining the value, P/E ratio of the company, a comparative analysis of the state, opportunities and prospects may be applicable for companies in any industries and markets.

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