SELECTED METHODOLOGICAL APPROACHES TO THE PYRAMID DECOMPOSITION OF RETURN ON ASSETS FOR THE FINANCIAL NEEDS OF CORPORATE GOVERNANCE

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Abstract: The most important factor often determining the prosperity or bankruptcy is the ability of the firm to make correct decisions in financial management questions. Like every decision, the decisions on the level of financial management must be based on detailed financial analysis. Pyramid systems of financial and economic indicators are therefore inevitable and extremely important tools of the financial analysis. They are able to capture the different processes and relations in the enterprise. The main goal of this paper is to describe the methodological approaches to create a hierarchy of selected financial and economic indicators and their subsequent practical use in the pyramid systems.

Keywords: Return on assets, Du Pont equation, Pyramid decomposition

Introduction

An important prerequisite for pyramid decomposition is knowledge of the firm management how to interpret financial and economic links between various indicators. Most of the pyramid decompositions are based on Du Pont equations. Du Pont equations enable to progressively decompose the ratio on the top of the pyramid (primary indicator) in a logical and deductive way. Characteristic feature of the primary indicator is that it is highly integrated indicator and it can be gradually disintegrated into other analytical (less integrated or secondary) indicators. Pyramid system of financial indicators is characterized by the conditionality of individual indicators, which means that the indicator of a lower layer (less integrated indicator) presents the economic criterion for indicators of higher layers (higher integrated indicators). Integrity of the financial indicator expresses the weight of the ratio on an analyzed phenomenon. Primary indicators are being the most general indicators which peak the pyramid. Analytical (secondary) indicators are more detailed and have lower degree of integrity. These are placed at lower layers of the pyramid system (from the perspective of the pyramid, primary indicator is closer to the top and secondary indicators are further from the top). The method of decomposition of primary indicators is based on mathematical and logical links. Vertical ties among indicators are causal. Horizontal links among indicators of certain layer of the pyramid are complementary. The direction and intensity of different factors affecting the return on assets (ROA) may therefore be very different.

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Understanding the decomposition of indicators is essential to understand the pyramid systems. Decomposition of a ratio (in literature also called analytical model) is actually a mathematical expression that links the system of indicators and a "pyramid" is its clear graphical representation.

One of the most widely used decompositions of indicators, as already mentioned in the text above, is the Du Pont decomposition of return on assets. Return on assets belongs to the group of profitability ratios providing a picture of business performance. However it does not explain the reasons behind the firm performance. To understand these reasons it is necessary to pay attention to a deeper analysis of financial statements. Sources of growth in profitability for the analyst present a valuable lesson that can be used in the future. Decomposition of the return on assets to its individual components is made by extension (by multiplying or dividing the numerator and denominator) by a fraction of turnover variable. The form of decomposition is as follows:

$$ROA = \frac{NP}{Assets} = \frac{NP}{Assets} \cdot \frac{Sales}{Sales} = \frac{NP}{Sales} \cdot \frac{Sales}{Assets}$$

Return on Sales

Turnover

where ROA – Return on Assets
NP – Net Profit

This decomposition has gained big popularity for its simplicity but also for significant degree of explanatory ability. It expresses:

- close relationship (interdependence) between profitability and turnover,
- if the aim of the firm is to increase the profitability of assets (or profitability of the total capital used in the business) it is necessary to impact the turnover and/or the profitability to increase,
- if the return on assets is constant (for example inelastic because of strong competition in the sector), then the company has to decide between two variables - either the company wants to achieve higher turnover with lower profitability or the company prefers higher profitability and a slower turnover. In practice, there are for example hypermarkets and discount stores with food, which prefer a high turnover of goods with lower profits per a unit of goods, or there can be a goldsmith, which sells less goods but with higher unit margins.

The above relationship shows that the return on assets is dependent on the profitability of sales (return on sales) and on the turnover. In the case the company would use only own capital, then the value of total capital would be equal to the value of total assets:

$$\text{Own Capital} = \text{Total Capital} = \text{Total Assets}$$

In such a case we can also write:

$$ROE = ROA$$

However the case of using only own capital is relatively rare in business practice. Foreign sources of capital affect the final performance of the company and cause differences between the values of ROA and ROE (ROE ≠ ROA). Important factor here is the gearing ratio (the share of foreign capital on total capital), which determines the intensity of leverage effect. Therefore, in many cases we extend the basic Du Pont equation and get different forms of decomposition.

Aim and method

Pyramid system based on Du Pont equations was designed to analyze the profitability of assets (ROA) of an enterprise. The aim of our analysis is to evaluate the profitability of business assets through special pyramid system and to quantify the influence of the increase or decrease of analytical indicators on the development of ROA in the observed period (for these purposes a fictitious business name FAT, Inc. has been created). Various methods of scientific investigation, such as the comparative method (comparison), method of analysis and synthesis were used to achieve our objective. Furthermore, standard mathematical relations and procedures were used to quantify the impact of the change of various analytical indicators on the change of the primary indicator. These methods are generally known and used, when multiplicative and additive ties are binding the indicators inside the pyramid system. Economic software SOFINA_standard was used to make the computations. Outputs of this software are mathematically rounded; therefore the results of our computations may vary slightly when calculating by hand.

Results

Pyramid Decomposition of Return on Assets (ROA)

The first step in the pyramid decomposition process is the creation of the pyramid system of indicators. Logical relations among indicators are described by simple mathematical operations (addition, subtraction, multiplication and division). These mathematical relationships among variables can be divided into two main groups; **additive relations** (addition, subtraction); **multiplicative relations** (multiplication, division).

In case there is a multiplicative relation among analytical indicators, we may use variety of methods to quantify the impact of their change on the development of the primary indicator. Selection of the method depends on concrete variables

and their values. The most accurate method is logarithmic method. Its use, however, fails if the index of the indicator is a negative number. In this case we must resort to one of the three other methods, which are not interfered with a negative index. These methods differ mainly in way of calculation and in the precision of calculated results. Functional method is believed to be relatively precise, but algorithmically the most difficult. Less accurate is the chain substitution method, it is not interfered with negative index problem and it represents a simple way of computation. However it is a less precise method, as the outcome of the computation is dependent on the order in which variables are calculated. This problem is eliminated by the next method of decomposition with residuum; however this method is more complicated to compute and to interpret the obtained residuum.

Following pyramid system was designed to decompose the return on assets (ROA) indicator into its analytical components.

$$ROA = \frac{NP}{TA} = \frac{TR - TC}{FA + CA + OA}$$

Where: ROA – Return on Assets, TA – Total Assets, NP – Net Profit, TR – Total Revenues, TC – Total Costs, FA – Fixed Assets, CA – Current Assets, OA – other Assets.

Impact Analysis of Changes in Analytical Indicators on the Development of ROA

Pyramid decomposition of ROA is shown in Figure 1. Selected input and output data to the given pyramid system are clearly listed in the Table 1. A detailed procedure for calculating the pyramid decomposition is shown in Table 2.

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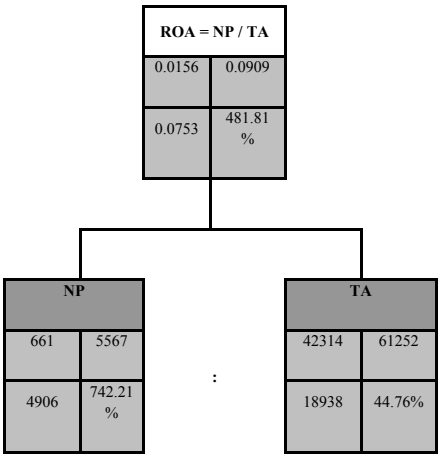

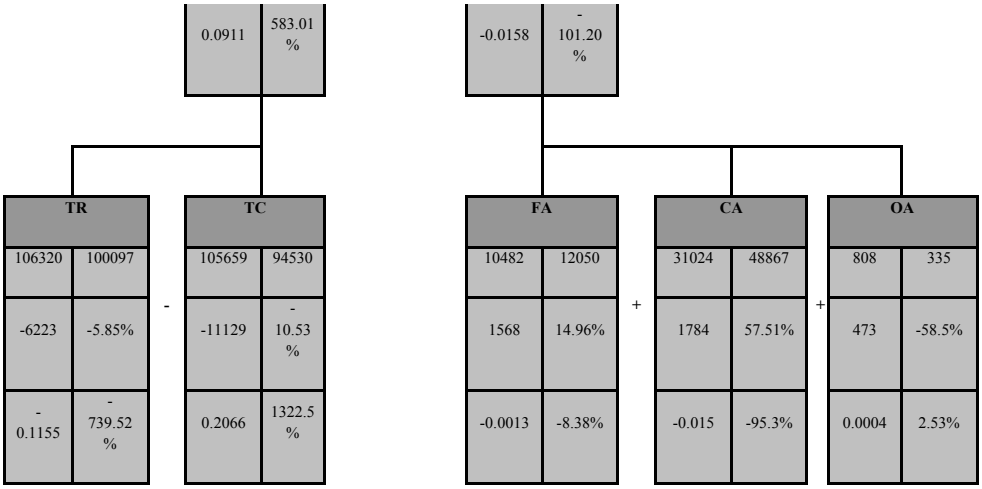

Figure 1. Pyramid Decomposition of Return on Assets (ROA)
Source: Kotulič, Király, Rajčániová, (2010).

Interpretation of numerical information under an analytical indicator is explained in Figure 2.

indicator	NP		
value of indicator in 2009	661	5567	value of indicator in 2010
difference (annual change)	4906	742.21 %	(Index -1) in %; growth rate
absolute impact	0.0911	583.01 %	relative impact

Figure 2. Interpretation of the Results in the Pyramid Decomposition
Source: Kotulič, Király, Rajčániová, (2010).

Layer	Indicator		Year 2009	Year 2010	Change	Index 05/03	Growth rate	Abs. impact	Rel. impact
0	**NP / TA**	*Return on Assets (ROA)*	0.0156	0.0909	0.0753	5.8181	481.81%	-	-
1.1	**NP**	*Net Profit*	661	5567	4906	8.4221	742.21%	0.0911	583.01%
1.2	**TA**	*Total Assets*	42314	61252	18938	1.4476	44.76%	-0.0158	-101.20%
2.1	**TR**	*Total Revenues*	106320	100097	-6223	0.9415	-5.85%	-0.1155	-739.52%

Layer	Indicator		Year 2009	Year 2010	Change	Index 05/03	Growth rate	Abs. impact	Rel. impact
2.2	**TC**	*Total Costs*	105659	94530	-11129	0.8947	-10.53%	0.2066	1322.54%
3.1	**FA**	*Fixed Assets*	10482	12050	1568	1.1496	14.96%	-0.0013	-8.38%
3.2	**CA**	*Current Assets*	31024	48867	1784	1.5751	57.51%	-0.0149	-95.35%
3.3	**OA**	*Other Assets*	808	335	-473	0.4146	-58.54%	0.0004	2.53%

Table 1. Input and Output Data for ROA Decomposition

Source: Kotulič, Király, Rajčániová, (2010)

Indicator	COMPUTATION		RESULT
Return on Assets (ROA) (0. layer)	*Change*	$\Delta_{ROA} = ROA_B - ROA_A =$	0.0753
	Index	$I_{ROA} = \frac{ROA_B}{ROA_A} =$	5.8181
	Growth rate	$= (I_{ROA} - 1) \cdot 100\% =$	481.81 %
	Absolute impact	Not computed because it is primary indicator	-
	Relative impact	Not computed because it is primary indicator	-
Net Profit (NP) (1. layer)	*Change*	$\Delta_{NP} = NP_B - NP_A =$	4906
	Index	$I_{NP} = \frac{NP_B}{NP_A} =$	8.4221

Indicator	COMPUTATION		RESULT
	Growth rate	$= (I_{NP} - 1) \cdot 100\% =$	742.21%
	Absolute impact	$(\Delta_{NP} \rightarrow \Delta_{ROA})_{ABS} = \frac{\log I_{NP}}{\log I_{ROA}} \cdot \Delta_{ROA} =$	0.0911
	Relative impact	$(\Delta_{NP} \rightarrow \Delta_{ROA})_{REL} = \frac{\log I_{NP}}{\log I_{ROA}} \cdot (I_{ROA} - 1) \cdot 100\% =$	583.01%
Total Assets (TA) (1. layer)	*Change*	$\Delta_{TA} = TA_B - TA_A =$	18938
	Index	$I_{TA} = \frac{TA_B}{TA_A} =$	1.4476
	Growth rate	$= (I_{TA} - 1) \cdot 100\% =$	44.76%
	Absolute impact	$(\Delta_{TA} \rightarrow \Delta_{ROA})_{ABS} = - \frac{\log I_{TA}}{\log I_{ROA}} \cdot \Delta_{ROA} =$	-0.0158
	Relative impact	$(\Delta_{TA} \rightarrow \Delta_{ROA})_{REL} = \frac{\log I_{TA}}{\log I_{ROA}} \cdot (I_{ROA} - 1) \cdot 100\% =$	-101.20%

Indicator	COMPUTATION		RESULT
Total Revenues (TR) (2. layer)	*Change*	$\Delta_{TR} = TR_B - TR_A =$	-6223
	Index	$I_{TR} = \frac{TR_B}{TR_A} =$	0.9415
	Growth rate	$= (I_{TR} - 1) \cdot 100\% =$	-5.85%
	Absolute impact	$(\Delta_{TR} \rightarrow \Delta_{ROA})_{ABS} = (\Delta_{NP} \rightarrow \Delta_{ROA})_{ABS} = \frac{\Delta_{TR}}{\Delta_{NP}} \cdot$	-0.1155
	Relative impact	$(\Delta_{TR} \rightarrow \Delta_{ROA})_{REL} = (\Delta_{NP} \rightarrow \Delta_{ROA})_{REL} = \frac{\Delta_{TR}}{\Delta_{NP}} \cdot$	-739.52%
Total Costs (TC) (2. layer)	*Change*	$\Delta_{TC} = TC_B - TC_A =$	-11129
	Index	$I_{TC} = \frac{TC_B}{TC_A} =$	0.8947
	Growth rate	$= (I_{TC} - 1) \cdot 100\% =$	-10.53%
	Absolute impact	$(\Delta_{TC} \rightarrow \Delta_{ROA})_{ABS} = - \frac{\Delta_{TC}}{} \cdot$	0.2066

Indicator	COMPUTATION		RESULT
		$(\Delta_{NP} \rightarrow \Delta_{ROA})_{ABS} = \frac{\Delta_{TC}}{\Delta_{NP}}$	
	Relative impact	$(\Delta_{TC} \rightarrow \Delta_{ROA})_{REL} = -\frac{\Delta_{TC}}{\Delta_{NP}} \cdot (\Delta_{NP} \rightarrow \Delta_{ROA})_{REL} =$	1322.54%
Fixed Assets (FA) (2. layer)	*Change*	$\Delta_{FA} = FA_B - FA_A =$	1568
	Index	$I_{FA} = \frac{FA_B}{FA_A} =$	1.1496
	Growth rate	$= (I_{FA} - 1) \cdot 100\% =$	14.96%
	Absolute impact	$(\Delta_{FA} \rightarrow \Delta_{ROA})_{ABS} = \frac{\Delta_{FA}}{\Delta_{TA}} \cdot (\Delta_{TA} \rightarrow \Delta_{ROA})_{ABS} =$	-0.0013
	Relative impact	$(\Delta_{FA} \rightarrow \Delta_{ROA})_{REL} = \frac{\Delta_{FA}}{\Delta_{TA}} \cdot (\Delta_{TA} \rightarrow \Delta_{ROA})_{REL} =$	-8.38%
Current Assets (CA)	*Change*	$\Delta_{CA} = CA_B - CA_A =$	1784
	Index	CA_B	1.5751

Indicator	COMPUTATION		RESULT
(2. layer)		$I_{CA} = \frac{}{CA_A} =$	
	Growth rate	$= (I_{CA} - 1) \cdot 100\% =$	57.51%
	Absolute impact	$(\Delta_{CA} \rightarrow \Delta_{ROA})_{ABS} = \frac{\Delta_{CA}}{\Delta_{TA}} \cdot$ $(\Delta_{TA} \rightarrow \Delta_{ROA})_{ABS} =$	-0.0149
	Relative impact	$(\Delta_{CA} \rightarrow \Delta_{ROA})_{REL} = \frac{\Delta_{CA}}{\Delta_{TA}} \cdot$ $(\Delta_{TA} \rightarrow \Delta_{ROA})_{REL} =$	-95.35%
Other Assets (OA) (2. layer)	*Change*	$\Delta_{OA} = OA_B - OA_A =$	-473
	Index	$I_{OA} = \frac{OA_B}{OA_A} =$	0.4146
	Growth rate	$= (I_{OA} - 1) \cdot 100\% =$	-58.54%
	Absolute impact	$(\Delta_{OA} \rightarrow \Delta_{ROA})_{ABS} = \frac{\Delta_{OA}}{\Delta_{TA}} \cdot$ $(\Delta_{TA} \rightarrow \Delta_{ROA})_{ABS} =$	0.0004

Indicator	COMPUTATION		RESULT
	Relative impact	$(\Delta_{OA} \rightarrow \Delta_{ROA})_{REL} = \frac{\Delta_{OA}}{\Delta_{TA}} \cdot$ $(\Delta_{TA} \rightarrow \Delta_{ROA})_{REL} =$	2.53%

Table 2. Detailed Methodology of Pyramid Decomposition of ROA
Source: Kotulič, Király, Rajčániová, (2010)

Impact Analysis of the Changes in NP and TA on the Development of ROA

In this section of the decomposition we calculate the impact of changes in analytical indicators NP (Net Profit for the observed year) and TA (Total Assets) on the change in primary indicator NP / TA (Return on Assets, ROA) for the observed period. The analysis is based on data already listed in the above tables (Table 1 and Table 2).

Quantification

The basis for the decomposition is expressed by equation:

$$NP/TA = NP : TA$$

Where: ***ROA*** *is a primary indicator (top indicator, with the highest integrity and 0. decomposition layer),* ***NP, TA*** *are analytical indicators (1.decomposition layer).*

Logarithmic method was used to compute the impacts. First, indexes of selected indicators were computed:

$$Ix = (NP/TA)_{2010} \ / \ (NP/TA)_{2009} = 0.0909 / 0.0156 = 5.8181$$

$$Ia = NP_{2010} / NP_{2009} = 5567 / 661 = 8.4221$$

$$Ib = TA_{2010} / TA_{2009} = 61252 / 42314 = 1.4476$$

The impact of the development of net profit on the development of ROA (multiplicative relation – division) computed as follows:

$$\textit{Absolute impact} = \frac{\log I\,(NP)}{\log I\,(NP/TA)} \times \Delta\,(NP/TA) = \frac{\log 8.4221}{\log 5.8181} \times 0.0753 = 0.0911$$

$$\textit{Relative impact} = \frac{\log I\,(NP/TA)}{\log I\,(NP/TA)} \times [I\,(NP/TA) - 1] \times 100 = \frac{\log 5.8181}{\log 5.8181} \times 481.81\% = 583.01\%$$

Impact of the development of total assets used in the firm on the development of ROA (multiplicative relation – division) computed as follows:

$$\textit{Absolute impact} = -\frac{\log I\,(TA)}{\log I\,(NP/TA)} \times \Delta\,(NP/TA) = -\frac{\log 1.4476}{\log 5.8181} \times 0.0753 = -0.0158$$

$$\textit{Relative impact} = -\frac{\log I\,(TA)}{\log I\,(NP/TA)} \times [I\,(NP/TA) - 1] \times 100 = -\frac{\log 1.4476}{\log 5.8181} \times 481.81\% = -101.20\ \%$$

Verification for ROA decomposition, (1. decomposition layer – impact analysis of the changes in NP and TA on the change in ROA)

The sum of impacts of all analytical indicators in the first decomposition layer on the change in primary indicator must be equal to change in the primary indicator.

In absolute terms:

$(\Delta_{NP} \rightarrow \Delta_{ROA})_{ABS} + (\Delta_{TA} \rightarrow \Delta_{ROA})_{ABS} = \Delta\,(ROA)$

$0.0911 + (-0.0158) = 0.0753$

In relative terms:

$(\Delta_{NP} \rightarrow \Delta_{ROA})_{REL} + (\Delta_{TA} \rightarrow \Delta_{ROA})_{REL} = [I\,(ROA) - 1] \times 100$

$583.01\ \% + (-101.20\ \%) = 481.81\ \%$

Equality is maintained; the sum of the impacts of the changes in NP and TA on the change in the profitability of assets (ROA) is equal to the change of ROA. (The results may differ only due to rounding.)

A similar computation procedure is used when analyzing the effect of changes in TR, TC, FA, CA and OA to change in the ROA.

Conclusion

Pyramid system of financial-economic indicators allows optimizing financial processes, particularly in regard to the evaluation of financial goals of the enterprise. Therefore, creating hierarchical systems of financial and economic

indicators in financial management will always play an important role in financial decision-making of enterprise.

In the case of a modified decomposition of firm's profitability of assets we can conclude that the increase in ROA was due to a positive impact of growth net profit (NP) in the observed period. Net Profit recorded a 8.4-fold increase in 2010 in comparison to 2009. The value of firm's profit increased from 661 EUR to 5 567 EUR, i.e. by about 4 906 EUR in absolute terms, or by 742.21% in relative terms. This growth had a positive impact on the development of ROA and caused a growth of ROA by 0.0911 in absolute terms, or by 583.01% in relative terms.

Growth in property values had on the contrary a negative impact on the development of ROA. Change in value of total assets by 44.76% resulted in a reduction of ROA by 0.0158 i.e. by 101.20%. It is positive to see that the growth of company profits has required only modest increase in individual items of assets, compared with profit growth and therefore the positive impact of the net profit exceeded the negative effect of the total business assets.

As is apparent from the preceding section, the increase in profitability of assets ROA was caused mainly by positive effects of the increase in net profit and to a lesser extent by the negative impact of growth in the value business assets. Results of the second decomposition layer provide us with answers to the question, what factors were behind the already mentioned increase in profits and business assets.

Net Profit in 2010 increased in comparison to 2009 due to cost savings by 11129 EUR or by 10.53%. Thanks to the cost saving, the return on assets increased by 0.2066 or by 1322.54%.

The fact that the overall increase in profitability of assets was lower and reached 481.81% growth rate was due to the cost savings were reflected also in lower revenues. The decrease in total company revenues by 106 320 EUR in 2009 to the value of 100 097 EUR in 2010 had a negative impact on ROA and lowered its value by 0.1155 in absolute terms, or by 739.52% in relative terms.

The remaining effect on the growth of ROA was caused by the development of business assets. The value of total assets grew and so the profit per unit was lower (ceteris paribus) and therefore the development of growth in total assets had a negative impact on ROA. What was the real development of concrete items of firm's property and what was their impact on the profitability of assets development?

The value of fixed assets has increased from 10 482 EUR in 2009 to 12 050 EUR in 2010, which stood behind the reduction the profitability of assets by 0.0013 in absolute terms or by 8.38% in relative terms.

Even more significant was the impact of the change in current assets on the development of ROA. It was caused by the growth of current assets, which was stronger and reached to 57.51%. This growth stood behind the reduction of ROA by 0.0149 in absolute terms, or by 95.35% in relative terms.

Other items of assets have decreased by 473 EUR, from 808 EUR in 2009 to

the value of 335 EUR in 2010. Therefore these are the only part of the firm's property, whose development had a positive impact on growth of ROA by 2.53%.

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WYBRANE PODEJŚCIA METODOLOGICZNEGO DO ROZKŁADU PYRAMID ZWROTU Z AKTYWÓW DLA POTRZEBY FINANSOWE ŁADU KORPORACYJNEGO

Abstrakt: Najważniejszym czynnikiem często określenia dobrobytu lub upadłości jest zdolność przedsiębiorstwa do podejmowania właściwych decyzji w kwestii finansowych zarządzania. Jak każda decyzja, decyzje na poziomie zarządzania finansami musi opierać się na szczegółowej analizie finansowej. Systemów Piramida wskaźników finansowych i ekonomicznych są więc nieuniknione i bardzo ważne narzędzia analizy finansowej. Są one w stanie uchwycić różnych procesów i stosunków w przedsiębiorstwie. Głównym celem tego artykułu jest opisanie podejścia metodologicznego do tworzenia hierarchii wybrane dane finansowe i wskaźniki ekonomiczne, a następnie ich praktyczne zastosowanie w systemach piramidy.

選擇公司治理的財務需要對資產的方法學辦法來回報金字塔分解

决定公司繁荣或破产的最重要的因素是公司在财务管理问题上能否做出正确决策的能力。如同每一项决策，财务管理水平的决定必须基于详细的财务分析。金字塔式的财务系统和经济指标的是财务分析不可避免的、极其重要的工具。它们都能够确定企业中不同的进程

和关系。本文的主要目的是描述一种方法，这种方法能创建一个具有选定的财务和经济指 标的系统制度，并在随后介绍这种方法在金字塔财务系统的实际用处。