585

Int. J Sup. Chain. Mgt   Vol. 9, No. 4, August 2020

Deterministic Factor Analysis of Supply Chain Management Characteristic for Oil Companies

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Abstract— **The subject area of the research work, which determined the key aspects of its meaningful content, was the algorithms for the analytical diagnosis of indicators of Supply Chain Management (SCM) characteristic for the companies operating in the oil sector of the world economy. A generalization of the terms of the methodological tools for conducting a retrospective assessment of the studied indicator formed the basis for the argumentation in favour of the benefits of using the deterministic factor analysis model. They are caused by the possibility of a substantive economic interpretation of the factorial features included in its structure and reflecting changes in the results of operating and financial activities of corporations, as well as the pronounced relationship of the formalized algorithm used in the work with the format for disclosing financial indicators in the public reporting of the economic entities. The composition of factorial features formalized in the content of the mathematical model included the indicator of sales profitability for operating activities, the indicator of total assets turnover, the amount of financial leverage, the effect of financial transactions, and the levels of credit and tax burden of a company. Analytical processing of the results implied the integration of the results obtained for the dynamic assessment of supply chain management in the context of economic diagnostics, as well as the study of the homogeneity of cause-effect relationships for the dynamics of the analysed indicator under the influence of eliminated factors of the model when companies of one type of economic activity belong to different national economic systems.**

Keywords— *supply chain management, deterministic modelling, oil company.*

1. Introduction

Supply Chain Management (SCM) is one of the key indicators reflecting the efficiency of the financial and economic activity of an economic entity, characterizing the results of economic activity and the management strategy chosen by the company.

SCM is used as an indicator of the effectiveness of investments in the financial market, as it reflects the potential growth of the company's assets value, as well as an increase in dividend income due to higher performance of the company. The studied indicator is of interest to users, primarily to investors, in terms of the fact that it affects the growth of the market value of equity securities of the company, which determines its capitalization. SCM is the result of a combination of factors, the magnitude of which is disclosed in accounting, and, therefore, allows external users to analyse the results of financial and economic activities. The purpose of this work is to study the factorial features that affect the Supply Chain Management, as well as to assess the dynamics of indicators provided by companies of one type of activity, but different by their national economic systems. We selected as an object of analysis the indicators of oil companies disclosed in the accounting (financial statements) for 2017-2018.

2. Methods

Initially, ideas on profitability analysis were formulated by Benjamin Franklin, and, in turn, the basic analytical tools were introduced by Jules Dupuis. In particular, the last formulated a method of measuring benefits and costs and developed a principle according to which an investment decision should meet the criterion of excess of benefits over costs. A formalized analysis model was developed by specialists of the company Du Pont de Nemours; the model is a determinate factor dependence of the main components of a company's financial statements. The merit of Du Pont is that they not only created a new theory, but applied it in practice [1-9]. Currently, in economic science there are several varieties of the Du Pont model, differing in a set of factorial features.

The two-factor Du Pont model is a system that includes factors of return on total capital, return on sales, and resource return [10]. Subsequently, the two-factor model was transformed into a three-factor one. Their main differences are that the resulting indicator is replaced by Supply Chain Management and factorial features are highlighted in more detail. At the same time, in our opinion, the main drawback of these models is the distortion of the profitability indicator of sales due

to accounting for financial activities. This factor must be considered separately, since each company has an individual structure of financial activity, and sales profitability should characterize the results of operating activities [4]. In this regard, the six-factor Du Pont model, which was modified from the traditional three-factor model by adding additional indicators, is the best option for SCM analysis (Figure 1).
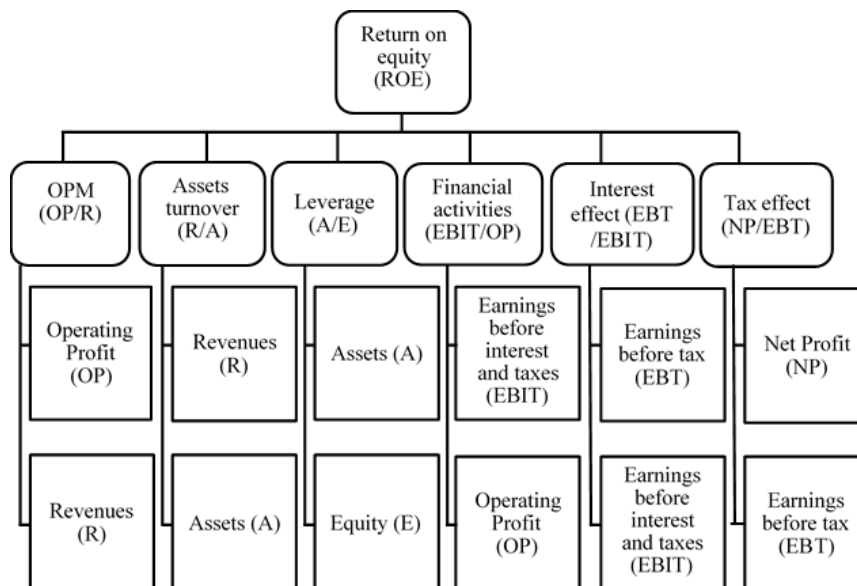

Fig. 1. Six-factor model for Supply Chain Management analysis

Operating profit margin on sales (OP / R) reflects the amount of profit a company receives from each rouble of revenue. In other words, this indicator characterizes the ability of the company to make a profit under the existing production mode in various business processes; therefore, it can be said that this indicator characterizes the profitability of a business and is one of the most important indicators of its potential.

Asset turnover (R / A) is an indicator of business activity and it characterizes the intensity of use of the company's assets. The slowdown in the turnover of assets of a company in the study period can be caused by the acquisition of non-current assets, an increase in inventories, and an increase in receivables. However, the slowdown does not always reflect the negative dynamics in the company, as it may be caused by carrying out investment activities of the company. The degree of turnover begins to slow down due to an increase in non-current assets, but this is typical for the short term, and in the medium and long term the company may begin to receive a return on investment in the form of revenue growth and an increase in the rate of turnover [11, 12].

Leverage (A / E) reflects the effect of borrowed funds on net income. The meaning of this indicator is that attracting additional borrowed funds allows a company to direct them to improve the production process. And this will lead to an increase in net profit and cash flow. The latter will increase the value of the company for investors, which is a strategically important task for any company. It is also worth noting that an increase in borrowed funds leads to a decrease in the financial independence of the company, but at the same time, financial risk grows, which, however, makes it possible to obtain greater profit [7].

The influence of the financial activities factor (EBIT / OP) shows the effectiveness of other operations, the optimal choice of their areas, as well as the degree of influence on the work of the company. The percentage effect (EBT / EBIT) reflects how the percentage load, which is formed under the influence of changes in the volume of borrowed funds, the choice of their source and terms of provision, can affect the amount of profit before tax, which is one of the resulting indicators of the functioning of any company. The tax effect (NP / EBT) demonstrates how the tax law and the tax policy chosen by the company affect its net profit.

When conducting a parametric assessment of the factors in the model, the method of chain substitutions is used. It reflects the idea of elimination, that is, a separate measurement of the influence caused by the factors. It should be noted that the order of replacement of factors is an object of discussion: the sequence of replacement does not have a single basis in economic science. Based on the directions of their activity, companies themselves choose one or another order of factorial features. Due to the fact that the factor being replaced by the latter is influenced by all other factors, it should be considered as an object of management influence in the current perspective [1, 5].

587

Int. J Sup. Chain. Mgt   Vol. 9, No. 4, August 2020

When conducting an analysis, the choice of a factor replacement algorithm is complicated by companies belonging to various national economic systems. In the study, the replacement procedure was determined by the nature of the companies. Due to the fact that companies operate in different financial systems, the effect of the tax effect is not put as a priority. In turn, the indicator of profitability of sales by operating profit for the oil industry plays a more significant role; therefore, its replacement in the model is carried out at the final stage [6].

Figure 2 shows the pattern of replacement of factorial features, which was used in this paper to analyse the Supply Chain Management of oil companies.
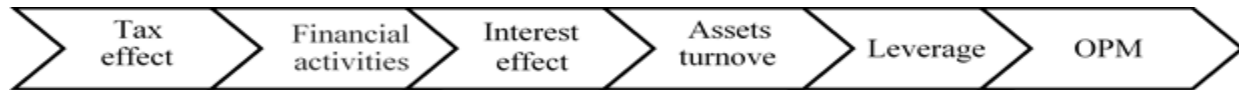

Fig. 2. The applied algorithm for replacing factorial features in the six-factor model

It should be noted that, indicators of asset turnover and financial leverage were found in the used analysis model based on the values of assets and capital at the beginning of the period. This allows us to consider SCM as an indicator reflecting the growth rate of our own sources.

The objects of research selected to conduct our factor analysis were the largest world companies representing Asia, Europe, North America (Saudi Aramco, Exxon Mobil, Shell, PetroChina, BP, Total), as well as the sector leaders in the Russian Federation (Lukoil, Rosneft, Tatneft, Gazpromneft). Saudi Aramco is the oil and gas company of the Kingdom of Saudi Arabia; it is the most expensive company in the world (as of December 12, 2019). Exxon Mobil Corporation is an American international oil corporation, one of the world's largest oil and gas producers. Royal Dutch Shell is a Dutch-British energy company, one of the largest in the world, with operations in more than 70 countries. PetroChina is China's largest national oil and gas corporation; it has become the first trillion-dollar company in the world. BP is a UK-based multinational oil and gas company, with most of its revenue coming from US operations. Total is a French petrochemical concern, which, in addition to traditional types of energy, is actively developing the use of alternative ones (solar and biomass). Lukoil is a Russian vertically integrated oil and gas company with a leading position in the world in oil reserves. Rosneft is one of the largest oil and gas companies in the world with a majority stake in the state (Rosneftegaz). Tatneft is a Russian oil company and it mainly develops hard-to-recover heavy sour crude, which is expensive at its cost of production. Gazpromneft, one of the leaders in the Russian oil industry, is a subsidiary of Gazprom. In terms of hydrocarbon production, it is one of the three largest companies in Russian Federation.

3. RESULTS

Supply Chain Management and its change in the analysed companies are presented in table 1.

Table 1 Supply Chain Management in oil companies in 2017-2018, %

Name	2017	2018	Change
Lukoil	13,0256	17,7946	4,7690
Rosneft	7,8530	15,5152	7,6622
Tatneft	17,4766	29,4336	11,9571
Gazprom neft	18,6736	24,1688	5,4952
Saudi Aramco	38,7055	50,4067	11,7013
Exxon Mobil	11,3387	10,7147	-0,6240
Shell	7,1269	12,0852	4,9583
PetroChina	2,6793	5,2410	2,5617
BP	3,5811	9,5566	5,9755
Total	8,1704	10,1283	1,9579

Thus, according to the results of a factor analysis concerning the Supply Chain Management of the companies under study, it is impossible to state a single stable dynamics of economic development. The highest SCM growth was observed in Tatneft and Saudi Aramco companies (11.96% and 11.7%, respectively). PetroChina and Total (2.56% and 1.96%) are characterized by minimal growth; it should also be noted a slight negative change in the profitability index of Exxon Mobil.

It is advisable to summarize the results obtained during the factor analysis devoted to Supply Chain Management in the context of changes in the level of profitability under the influence of factorial features, which is reflected in Figure 3.
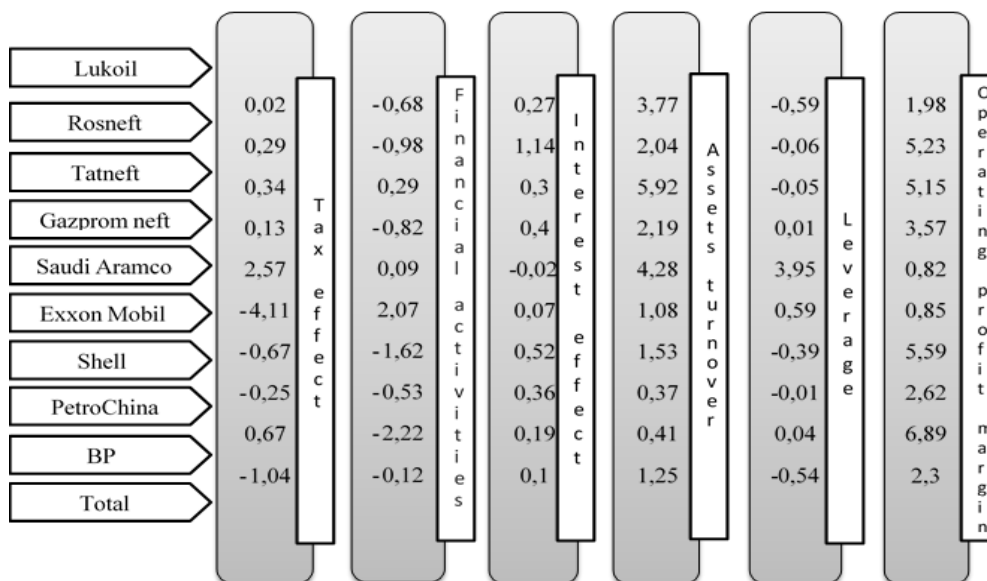

Fig. 3. The influence of factorial features on the change in the Supply Chain Management ratio of oil companies in 2018, %

A generalization of the digital data obtained in the factor model allows us to conclude that the factors of asset turnover (+ 4.28%) and financial leverage (+ 3.95%) had the greatest influence on the Supply Chain Management ratio of Saudi Aramco. At the same time, unlike other companies in the oil sector, the factor of profitability of sales by operating profit did not play a significant role and contributed to a change in profitability of only 0.82%. A similar situation with the sales profitability factor is also observed in Exxon Mobil, which influence was 0.85%. In addition, a strong negative impact on the company's SCM was due to a tax effect. Among the group of Russian companies, Tatneft has the largest increase in SCM, which is achieved by the positive influence of asset turnover and return on sales.

For the purpose of a parametric assessment of the homogeneity demonstrated in the factorial feature dynamics, it is possible to analyse the variation coefficient values in the context of all the studied companies in the oil industry, as well as research objects that are residents of the Russian Federation (table 2, table 3).

Table 2 Indicators of variation coefficients shown in the study of SCM factorial features for the companies under analysis.

Indicator	Tax effect	Financial activities	Interest effect	Assets turnover	Leverage	Operating profit margin
Variation coefficient	7,8269	2,4488	0,9298	0,7547	7,2383	0,5734

The data in the table indicate the conditional homogeneity of the percentage effect, asset turnover and return on sales indicators compared with the rest of the presented indicators. However, the values of the variation coefficients as a whole characterize the general heterogeneity of the factorial features. Therefore, we can conclude that there is no communality between the studied companies in the oil industry.

Turning to a group of Russian companies, one can note the following indicators of variation (table 3).

Table 3 Indicators of variation coefficients shown in the study of SCM factorial features in the studied oil companies of the Russian Federation.

Indicator	Tax effect	Financial activities	Interest effect	Assets turnover	Leverage	Operating profit margin
Variation coefficient	0,6466	0,9049	0,6772	0,4483	1,4228	0,3340

589

Int. J Sup. Chain. Mgt   Vol. 9, No. 4, August 2020

Russian companies have a more pronounced communality of factors, in particular, within the framework of profitability of sales by operating profit and asset turnover. Despite this, the studied parameters cannot be characterized as absolutely homogeneous.

4. SUMMARY

It should be noted that the overall dynamics as a whole is formed under the influence of an industry-wide favourable market environment: increasing energy demand, rising world prices, increasing oil production, developing the global economy, which generally has a positive effect on the activities of oil companies. According to the results of factor analysis, we can see the unity in the influence of the operating profit margin earned from sales on the change in the Supply Chain Management ratio for almost all the companies under consideration, with the exception of Exxon Mobil and Saudi Aramco.

It is validly to state that the studied economic entities that are residents of the Russian Federation demonstrate the greatest unity of factors influencing the SCM indicator. This situation is largely due to a single economic space, the cost of financial resources, and the parameters of tax regulation.

The results of the study indicate that in most cases, the analysed companies are characterized by differences in the values of factorial features that affect the rate of Supply Chain Management. The lack of unity in the directions and power of the parametric assessment of model factors is due to the generalizing nature of the resulting indicator, which is formed under the influence of a full range of individual characteristics of the economic situation and financial regulation, differences in technological potential and asset structure, organisation of business process management, and company development strategies.

5. CONCLUSIONS

Implementation of supply-chain management in the oil industry can help to reduce costs, increase the company's profits in managing supply, and manage the planning of deliveries. Thus, it is obvious that the analytical assessment of companies in the context of comparability of the factor analysis results is accompanied by significant difficulties. At the same time, the ideas of the comparative approach do not lose their fundamental relevance and can be successfully implemented in conjunction with the

study of factorial features of changes in the profitability index of individual companies in dynamics and in comparison with global average indicators.

6. ACKNOWLEDGEMENTS

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