BUSINESS, MANAGEMENT AND EDUCATION
ISSN 2029-7491 / eISSN 2029-6169
2015, 13(2): 220–233
doi:10.3846/bme.2015.300

COMPLEX ANALYSIS OF FINANCIAL STATE AND PERFORMANCE OF CONSTRUCTION ENTERPRISES

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Received 18 October 2015; accepted 21 November 2015

Abstract. The paper analyses the financial state and performance of large constructions enterprises by applying financial indicators. As there is no one single decisive financial indicator enabling to objectively assess enterprise performance, the multi-criteria decision making (MCDM) methods are applied with four groups of financial ratios (profitability, liquidity, solvency and asset turnover) acting as evaluation criteria, while the alternatives assessed are two enterprises compared throughout the reference period of three years, also with the average indicator values of the whole construction sector. The weights of the criteria have been estimated by involving competent experts with chi-square test employed to check the degree of agreement of expert estimates. The research methodology contributes to the issue of complex evaluation of enterprise financial state and performance, while the result of the multi-criteria assessment – the ranking of enterprises and sector average with respect to financial state and performance – could be considered worth attention from business owners, potential investors, customers or other possible stakeholders.

Keywords: enterprise performance, financial analysis, financial ratios, profitability, liquidity, solvency, MCDM, SAW, complex analysis.

JEL Classification: C44, C61, D24, G11, G30, G33, M41.

1. Introduction

In the light of complicated highly competitive modern business environment, disposing comprehensive information on enterprise financial state and performance, enabling to objectively assess the position of an enterprise in the market and its competitive capabilities, becomes the question of vital importance. Although modern scientific research on the issue of enterprise performance evaluation propose a variety of methods based on financial and non-financial, both quantitative and qualitative criteria, it is still the pure financial approach (with the values of quantitative indicators, or financial ratios, calculated) being applied most commonly.

However, a significant drawback concerning financial ratios application has to be recognized – a comprehensive and sustainable study on enterprise financial state and performance should involve a balanced set of financial ratios, which could seem to be equally important, but very different in their nature, while there is no single financial indicator reflecting the ultimate result. Moreover, this problem becomes even more important in case of comparative analysis of financial performance in a reference period or among the group of enterprises. Suppose, a part of indicators (e.g. profitability and turnover) reflect improved enterprise performance comparing to the previous year, while the others (e.g. liquidity and solvency) take a turn for the worse, thus making the results of such research quite controversial and tricky to interpret.

The *problem* of this paper is complex quantitative evaluation of financial state and performance of construction enterprises. The *aim* of the research is to complexly assess the financial state and performance of construction enterprises on the basis of quantitative financial criteria. Facing the issue of multiple financial ratios reflecting enterprise performance, multi-criteria decision making (MCDM) methods are applied in order to calculate the value of the integrated criterion for each alternative, i.e. financial state and performance of a particular construction enterprise in a particular year. The assessment criteria are composed of the balanced set of financial ratios, with their weights being estimated by the competent experts.

The structure of the paper is as follows: we start with an overview of previous research on enterprise performance analysis concentrating on the role of financial indicators and MCDM; then the methodology of the research is presented including criteria selection and their weight estimation, normalization of criteria values, and MCDM methods application; the paper is finished with the discussion of the results and conclusions.

2. Previous research

Traditional, and probably, most popular approach to enterprise performance analysis, is based on financial results, usually being expressed with the values of financial ratios which are commonly classified into the following groups: profitability, liquidity, solvency, activity (turnover), and market value (Bansal 2011; Erdogan 2013; Hofmann, Lampe 2012; Kotane, Kuzmina-Merlino 2012; Mackevičius, Valkauskas 2010; Seay 2014; Zelgalve, Zaharcenko 2012). The certain advantages of the following approach include the quantitative analysis, possibility to compare performance in a number of periods, between different enterprises without limitations to company size (as the calculated indicators are ratios with no dimension); besides, it is always profit and market value being the ultimate results the business owners are interested in. However, there is no one single decisive indicator enabling to objectively assess the enterprise financial state and performance. Rather, enterprise financial analysis could provide quite controversial results if a part of indicators is showing good results, while this is not the case for the others; especially, taking into account possible reverse dependence between some ratios.

Financial indicators could also be assessed on economic sector or industry level in the empiric research based on the structure-conduct-performance (see Bain 1959), i.e. the SCP paradigm (e.g. Bhardwaj *et al*. 2013; Garza-Garcia 2012); moreover, the financial analysis approach in industry research (i.e. investigating industry-average values of common financial ratios) gained additional importance under the conditions of the recent economic crisis: e.g. furniture industry (Li *et al*. 2011), logistics (Hofmann, Lampe 2012), textile (Abbas *et al*. 2012), agriculture (Li *et al*. 2011), inter-industry complex analysis (Krivka 2014).

Other common approaches to enterprise performance analysis integrate financial indicators with other non-financial criteria. The combination of thereof is commonly supported by managerial needs, as, in deed, financial criteria are considered to be lagging, clearly reflecting the past, but not saying much about the future. The balanced scorecard, or the BSC (see Kaplan, Norton 1992), offers the assessment of performance from four interrelated perspectives (financial, customer, internal business processes, learning and growth), in empiric research each represented by a set of performance evaluation criteria (Ardekani *et al*. 2013; Lee 2014; Panicker, Seshadri 2014; Tavana *et al*. 2015). Key performance indicators (KPI) also integrate financial and non-financial dimensions providing feedback from enterprise strategy implementation, as they usually represent the detail quantitative criteria enabling to assess the achievement of the objectives, laid down in company's strategy as the desired values of the indicators, or to compare enterprise performance with industry best or best practices using benchmarking technique (Milichovsky, Hornungová 2013; Pavláková Dočekalová *et al*. 2015).

As it was mentioned earlier, there is no one single indicator, enabling to make the ultimate conclusion on enterprise financial state and performance, therefore modern empiric research address this problem in at least two different ways: determining the indicators having the most significant influence on enterprise financial state and performance (Bhunia, Sarkar 2011; Erdogan 2013; Hsu 2013; Pavláková Dočekalová *et al*. 2015) or calculating the integrated criterion characterizing enterprise performance by applying MCDM methods. The latter methods are applied involving financial indicators only (e.g. Ginevičius, Podviezko 2013; Hosseini *et al*. 2013; Krivka 2014; Liao, Ni 2014) or combining both financial and non-financial indicators in the context of the BSC (e.g. Ardekani *et al*. 2013; Tavana *et al*. 2015) or other approach, e.g. financial performance and risk analysis (Hsu 2014).

Although some researchers as one of the main features, distinguishing construction industry from other kinds of economic activity, indicate large scale projects with high risk of delay, growing costs and the subsequent need to manage the associated risks (González *et al*. 2014; Gündüz *et al*. 2013; Rosenfeld 2014; Zhao *et al*. 2013), a considerable part of construction sector studies is devoted to enterprise performance assessment, while the analysis methodology is common with those applied to other industries. The paragraph below presents a brief overview of a number of recent empiric studies devoted to enterprise financial state and performance analysis in construction.

H. Al-Malkawi and R. Pillai (2013) investigate the impact of the financial crisis on UAE real estate and construction sectors by applying liquidity, profitability, financial leverage, and turnover ratios. M. Hegazy and S. Hegazy (2012) develop a benchmarking model to evaluate UK construction companies' performance by outlining the set of financial KPI (including the indicators representing liquidity, leverage, activity management, profitability, and shareholder value), together with the minimum standard values of the mentioned indicators (benchmarking technique). T. Adeleye *et al*. (2013) apply binary logistic regression, with financial ratios (e.g. operating expense divided by sales, cost of revenue divided by sales, long-term debt divided by total assets) coupled by non-financial indicators (e.g. age of a company, type of trade) acting as parameters, to distinguish the factors having the strongest influence on probable loss of large construction companies. I. E. Tsolas (2013) in the first step of his research employs data envelopment analysis (DEA) to model the performance of listed construction enterprises in two dimensions: profitability efficiency and efficiency in the market value-generating process; the second step is devoted to identifying the drivers of performance with the help of the regression model. F. Deng and H. Smyth (2013) present a comprehensive overview of studies by other researches on the topic of measuring performance of constructions companies and distinguish 36 financial and non-financial indicators, reflecting enterprise performance, whereas the profitability indicators are considered to be used most often. In other empiric research, headed by F. Deng, factor analysis is applied in order to find out the indicators having the strongest influence on construction companies' competitiveness in China (Deng *et al*. 2013), and the main performance drivers for construction enterprises in the UK focusing on three groups of indicators: profitability measures, employee measures, and growth measures (Deng, Smyth 2014). Jin *et al*. (2013) apply the BSC approach for evaluating international construction companies' performance within six dimensions of indicators: financial performance, market performance, customer perspective, stakeholders, internal business processes, learning and growth. Y. S. Liu *et al*. (2013) investigate the relationship between market structure, ownership structure and performance in Chinese construction industry under the SCP approach based on multiple regression analysis. H.-J. Kim and K. F. Reinschmidt (2012) present a study investigating market structure of US construction industry and the organizational performance of large contractors and design firms, focusing on size, growth rate, business stability, and market diversification. Y. Tan *et al*. (2012) analyse the impact of competition environment on performance, examining the relationship between competitive strategy and performance, and indicating four main generic strategies applied by contractors classified into four groups according to their different strategic orientations: prospectors, analysers, defenders, and reactors. Tamošaitienė *et al*. (2011) offer a Du Point pyramid-based methodology for profitability analysis of construction projects with MCDM methods applied for estimating the best contractor.

With regards to the accomplished literature review, it has to be emphasized that both financial and non-financial indicators could be applied for enterprise performance

analysis in the scope of different approaches; however, the decision upon relying on financial indicators only or combining them with non-financial criteria, and the choice of particular indicators depend on the aim of the research. The research presented in this paper employs financial indicators only, while such approach is based on the following arguments:

- the aim of the research considers the assessment of enterprise financial state and performance in the past reference period, with no managerial implications to ongoing performance monitoring;
- financial indicators are quantitative criteria, which is usually more reliable than qualitative;
- MCDM methods are to be employed for evaluation, thus avoiding the problem of no single ultimate indicator to reflect enterprise performance.

The following section of the paper explains the methodology of the research, including the alternatives to be assessed, the choice of financial indicators (evaluation criteria), weight estimation and an overview of MCDM methods to be applied.

3. Methods and theoretical framework

The financial data of the constructions enterprises analysed in this paper is obtained from financial reports of companies listed in Nasdaq Baltic; moreover, the analysis is supplemented by the average construction industry data obtained from Statistics Lithuania (official national authority in the sphere of statistics). With regards to experience of other authors (Bansal 2011; Erdogan 2013; Kotane, Kuzmina-Merlino 2012; Mackevičius, Valkauskas 2010; Seay 2014; Zelgalve, Zaharcenko 2012) the system of financial state and performance indicators is composed of four main groups of enterprise financial ratios: profitability, liquidity, solvency and asset turnover. On the authors' opinion, financial ratios are the most convenient way to compare financial state and performance of a specific company to its competitors and average industry data. The indicators selected for the research and their formulas are presented in Table 1.

Financial state and performance of an enterprise cannot be evaluated on one financial ratio (or even group of ratios); rather, it has to be assessed from various perspectives (different ratios and their groups). All these indicators might be contrary to each other, maximizing or minimizing, so it is necessary to find the single integrated criterion enabling to judge upon enterprise financial state and performance. In such a case MCDM methods, currently widely applied in construction (e.g. Kalibatas *et al.* 2012; Šaparauskas *et al.* 2011; Zavadskas *et al.* 2008), economics and management (e.g. Ginevičius *et al.* 2012, 2013; Ginevičius, Podviezko 2011, 2013; Hsu 2013), seem to be an appropriate tool.

The research, presented in this paper, is based on financial data of calendar years 2011–2013 (since the research was conducted in 2014, the data for 2014 had not been published yet). The alternatives under evaluation are two large construction companies

Table 1. Enterprise financial state and performance indicators, applied in the research (source: Erdogan 2013; Mackevičius, Valkauskas 2010; Zelgalve, Zaharcenko 2012)

No	Indicator	Formula
Profitability ratios		
1	Gross margin ratio	Gross profit / Sales revenues
2	Return on sales (ROS)	Net profit / Sales revenues
3	Return on assets (ROA)	Net profit / Total assets
4	Return on equity (ROE)	Net profit / Equity
Liquidity ratios		
5	Current ratio	Current assets / Current liabilities
6	Quick ratio	(Current assets – Inventory) / Current liabilities
Solvency ratios		
7	Equity-to-debt ratio	Equity / Total liabilities
8	Debt ratio	Total liabilities / Total assets
Asset turnover ratios		
9	Total asset turnover	Sales revenues / Average total assets
10	Accounts receivable turnover	Sales revenues / Average accounts receivable

and construction industry average (see Table 2) – each of them is assessed with regards to 10 financial state and performance indicators (the scheme of evaluation is presented in Table 3). The evaluation is performed on yearly basis, so the calculations are repeated for every year from 2011 to 2013. The value r_{ij} of the particular evaluation criterion (financial indicator) i ($i = 1,...,10$) for the assessed alternative (construction enterprise / industry average) j ($j = 1,...,3$) is calculated on the basis of officially published companies' financial statements, while the industry average values of financial ratios are obtained from Statistics Lithuania. To estimate weights ω_i of the financial indicators, the method of expert evaluation is applied with respect to condition $\sum_{i=1}^{10} \omega_i = 1$.

Table 2. The assessed alternatives (source: authors)

No	Description
1	AS "Merko Ehitus"
2	AS "Nordekon"
3	Construction industry average

Table 3. The scheme of multi-criteria assessment of construction enterprises with regards to financial state and performance indicators (source: authors)

Criteria				Criteria values for assessed alternatives		
No	Description	Max (+) / Min (–)	Weight	1	2	3
1	Gross margin ratio	+	ω_1	$r_{1,1}$	$r_{1,2}$	$r_{1,3}$
2	Return on sales (ROS)	+	…	…	…	…
3	Return on assets (ROA)	+	…	…	…	…
4	Return on equity (ROE)	+	…	…	…	…
5	Current ratio	+	ω_1	$r_{i,1}$	$r_{i,2}$	$r_{i,3}$
6	Quick ratio	+	…	…	…	…
7	Equity-to-debt ratio	+	…	…	…	…
8	Debt ratio	–	…	…	…	…
9	Total asset turnover	+	…	…	…	…
10	Accounts receivable turnover	+	ω_{10}	$r_{10,1}$	$r_{10,2}$	$r_{10,3}$

The result of multi-criteria evaluation is the ranking of enterprises for every year of the period from 2011 to 2013. Three MCDM methods, i.e. Sum of Ranks, Geometric Mean and SAW (Simple Additive Weighting), have been applied in the research. These methods have been chosen for several reasons: because of their popularity, simple calculation algorithm, which can be easily performed without a help of special software, and clear interpretation of the results obtained.

Sum of Ranks calculates the sum of criteria value ranks r_{ij} of all criteria for each j-th alternative (Ginevičius 2007):

$$V_j = \sum_{i=1}^{m} r_{ij} , \tag{1}$$

where the best alternative has the lowest sum of ranks V_j.

Geometric Mean calculates the geometric mean of normalized criteria values $\tilde{r}_{ij}$, and the best alternative is indicated by the highest value of the integrated criterion Π_j. Initial criteria values r_{ij} are normalized using the formula (Ginevičius *et al.* 2008a, 2008b, 2012; Podvezko 2011):

$$\tilde{r}_{ij} = \frac{r_{ij}}{\sum_{j=1}^{n} r_{ij}} , \tag{2}$$

and the integrated criterion values are calculated as follows:

$$\Pi_j = \sqrt[m]{\prod_{i=1}^{m} \tilde{r}_{ij}} . \tag{3}$$

SAW method calculates the sum of normalized (see formula 2) weighted values $\tilde{r}_{ij}$ of all criteria ($i = 1,...,m$) for each *j*-th alternative (Ginevičius *et al.* 2008a, 2008b, 2012, 2013; Podvezko 2011):

$$S_j = \sum_{i=1}^{m} \omega_i \tilde{r}_{ij} , \quad (4)$$

while the best alternative gains the highest value of the integrated criterion S_j .

4. Research procedure and results

The questionnaires for estimating the weights of the selected financial state and performance indicators were submitted to a number of construction enterprises, and 7 fully filled-in forms have been received. The experts (construction enterprises' finance department managers) were asked to evaluate the weights of the financial indicators in two steps: first to estimate the weights of the indicators inside every particular group (profitability, liquidity, solvency and asset turnover – see Table 1) and then the weights of four groups: the ultimate weight ω_i of the *i*-th indicator was calculated by multiplying its weight ω_i^g inside the group by the weight ω_g of the group in the integrated criterion:

$$\omega_i = \omega_i^g \cdot \omega_g , \quad (5)$$

with respect to conditions: $\sum \omega_i^g = 1$ (for every group of indicators) and $\sum \omega_g = 1$ (for the integrated criterion). Table 4 displays the ultimate weights of the evaluation criteria.

Table 4. Evaluation criteria weights based on expert estimates (source: authors)

Evaluation criteria		Experts and criteria weights							
No	Description	1	2	3	4	5	6	7	Average
1	Gross margin ratio	0.09	0.09	0.06	0.09	0.06	0.09	0.09	0.081
2	Return on sales (ROS)	0.09	0.15	0.15	0.09	0.12	0.06	0.15	0.116
3	Return on assets (ROA)	0.06	0.03	0.03	0.06	0.09	0.06	0.03	0.051
4	Return on equity (ROE)	0.06	0.03	0.06	0.06	0.03	0.09	0.03	0.051
5	Current ratio	0.15	0.09	0.12	0.15	0.12	0.15	0.15	0.133
6	Quick ratio	0.15	0.21	0.18	0.15	0.18	0.15	0.15	0.167
7	Equity-to-debt ratio	0.21	0.18	0.18	0.18	0.21	0.18	0.18	0.189
8	Debt ratio	0.09	0.12	0.12	0.12	0.09	0.12	0.12	0.111
9	Total asset turnover	0.06	0.06	0.04	0.06	0.06	0.06	0.04	0.054
10	Accounts receivable turnover	0.04	0.04	0.06	0.04	0.04	0.04	0.06	0.046
	Totals	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

The agreement of experts' responses has been tested by applying χ^2 criterion with $v = m - 1$ degrees of freedom (Ginevičius *et al.* 2008a, 2008b):

$$\chi^2 = \frac{12S}{rm(m+1)}, \tag{6}$$

where m is the number of evaluation criteria, r is the number of experts, and S is the dispersion calculated by the formula:

$$S = \sum_{i=1}^{m} \left(c_i - \overline{c}\right)^2, \tag{7}$$

with c_i being the sum of ranks of all r experts' criterion i estimates, and $\overline{c}$ is the mean value of sums of all criteria ranks.

Seeing that the calculated value of $\chi^2 = 49.53$ is larger than the critical value of $\chi^2_{cr} = 16.92$ (with the significance level of $\alpha = 0.05$ and 9 degrees of freedom), the experts' responses are considered to be in agreement. This allows us to use the average weights of the indicators in our calculations.

First, the alternatives have been evaluated for every year of the reference period of 2011–2013 (Table 5).

Table 5. The results of multi-criteria assessment on yearly basis (source: authors)

Alternative	Sum of ranks		Geometric mean		SAW		Ultimate results	
	Value	Rank	Value	Rank	Value	Rank	Sum of Ranks	Ultimate Rank
	2011							
AS "Merko Ehitus"	19	2	0.22	3	0.33	2	7	2
AS "Nordecon"	23	3	0.23	2	0.27	3	8	3
Construction industry average	18	1	0.4	1	0.4	1	3	1
	2012							
AS "Merko Ehitus"	13	1	0.42	1	0.44	1	3	1
AS "Nordecon"	23	2	0.27	2	0.26	3	7	2
Construction industry average	24	3	0.26	3	0.3	2	8	3
	2013							
AS "Merko Ehitus"	16	1	0.37	1	0.4	1	3	1
AS "Nordecon"	21	2	0.31	2	0.28	3	7	2
Construction industry average	23	3	0.28	3	0.32	2	8	3

The yearly results indicate that AS "Merko Ehitus" was the best alternative in 2012 and 2013, while in 2011 both enterprises performed worse than construction sector average. Though all the chosen MCDM methods have provided the same result concerning the best alternative (ranked 1st), for the 2nd and 3rd ranks the results have deviated. This supports the approach of applying several MCDM methods with the ultimate ranking coming from the average results.

Then the whole period of 2011–2013 was taken into account – the ultimate results of assessment of financial state and performance during the entire reference period, based on the sum of the ultimate yearly ranks, are presented in Table 6.

Table 6. The final ranking of the alternatives throughout the research period of 2011–2013 (source: authors)

Alternative	Sum of the ultimate yearly ranks	Final rank
AS "Merko Ehitus"	4	1
AS "Nordekon"	7	2–3
Construction industry average	7	2–3

It has been determined that for the whole reference period the best alternative is AS "Merko Ehitus", which means that this enterprise can be characterized by the strongest financial state and performance in 2011–2013, compared to other alternatives, whereas AS "Nordecon" performed similar to the construction sector average.

5. Conclusions

The research on complex evaluation of construction enterprises' financial state and performance presented in this paper is summarized by the conclusions and a glance at possible further research.

Having accomplished the comprehensive literature study, it can be presumed that although modern scientific research propose a wide range of methodology for enterprise financial state and performance analysis, most of the recent studies on the topic rely on financial indicators completely or at least partially (combining them with non-financial criteria). This fact, coupled by extra arguments related to the aim of this research and reasonable preferences towards the purely quantitative approach, encouraged the authors of this paper to assess enterprise financial state and performance on the basis of financial indicators.

Since it has been presumed in the paper that there is no single financial indicator enabling to reflect the ultimate result of enterprise financial state and performance, the balanced set of financial indicators (including profitability, liquidity, solvency and asset turnover ratios) has been applied for assessment, with the integrated criterion values being estimated with the help of MCDM methods. In the scheme of multi-criteria evalu-

ation financial state and performance of two enterprises along with the average construction industry results in a three-year reference period are considered to be the alternatives assessed, while the criteria for evaluation are represented by the set of financial ratios with their weights being estimated by the competent experts.

The results of multi-criteria assessment enable to rank the alternatives, i.e. it has been determined that taking into account the whole reference period of 2011–2013, AS "Merko Ehitus" had supreme financial state and performance results compared to their rival AS "Nordekon" and to industry average. It has to be stated though that on the basis of multi-criteria assessment it cannot be determined to what extent AS "Merko Ehitus" has outperformed the other alternatives, because MCDM methods are limited to providing rankings only. However, the results of the assessment can be considered worth attention from business owners, potential investors, customers or other possible stakeholders, as they have clearly shown that 1) AS "Merko Ehitus" is performing better than the construction industry in general; 2) AS "Merko Ehitus" is performing better than its main competitor AS "Nordekon".

The further research could be related to wider application of MCDM for enterprise financial state and performance analysis in the context of choosing the best alternative for investment from publicly listed enterprises.

Disclosure statement

Authors do not have any competing financial, professional, or personal interests from other parties.

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