

The concept of corporate fundamental strength assessment model based on fuzzy logic

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Abstract

The main aim of the paper is to present a theoretical concept of corporate fundamental strength assessment model based on combination of fuzzy methodology and financial ratios, which can be an alternative to dominant in the literature solutions based on taxonomic methodology. Due to covering a wider range of performance dimensions proposed model should give a more complete assessment of enterprise's business condition. On the other hand the use of fuzzy logic allows for significant flexibility, in comparison to multivariate comparative analysis methodology, and relatively easier adaptation of proposed solution to a particular specificity of enterprises.

Key words: *corporate fundamental strength; financial ratios; fuzzy logic; management support tool*

1. Introduction

One of the key decisions in the equity investment process is to establish preliminary selection criteria of the most interesting companies from their larger collection. In theory and practice, different approaches can be found in this area (e.g. value companies, growth companies, dividend companies, socially responsible companies, innovative companies), but the most often used criterion is economic and financial situation of individual enterprises, which is usually associated with the determinant of their so-called fundamental strength. The genesis of the fundamental strength term is naturally connected with fundamental analysis (*J.C. Ritchie*¹; *B. Graham, D.L. Dodd*²; *M.C. Thomsett*³), although one can also find some features common to the concept of value management (*A. Rappaport*⁴). Statement, that enterprise is fundamentally strong, in the understanding of an investor or stock market analyst, is subconsciously identified with a well-run business, with good economic and financial standing and a favourable perception on the capital market, especially in the long term. However, the problem is to translate this understanding into a model.

In academic considerations can indeed be discerned some attempts in this regard (in both cases taxonomic methodology is used), but it is difficult to recognize these solutions as a complete and objective ones, due to either the lack of clear assessment criteria and empirical verification (*G. Mikołajewicz*⁵), or the use of fairly vague and superficial criteria (*M. Tarczyńska-Luniewska*⁶). Therefore, the main purpose of this paper is to present a theoretical concept of corporate fundamental strength assessment model using fuzzy logic.

The paper outlines a general structure of the model, which is a compilation of various financial indicators, and indicates the basic stages of fuzzy model construction, which in the course of partial evaluation criteria gradual aggregation enables the final evaluation of corporate fundamental strength.

2. General assumptions of corporate fundamental strength assessment model

In the proposed concept, a firm with a high fundamental strength should distinguish oneself with permanent (repeatable) ability to generate good quality financial results and cash flows, high efficiency and operating performance, good (i.e. safe) financial condition and high level of development potential, both material and intangible, including human capital.

Assessment criteria selection and division in proposed solution were carried out arbitrarily, taking into account their quality/information rather than popularity, on the basis of their specific characteristics (*J. Lan*⁷; *D. Wędzki*⁸) as well as author's knowledge and years of practical experience in the field of fundamental analysis and portfolio management. The selection of indicators was guided by avoiding the use of similar measures within specified modules to provide wide and possibly objective picture of the situation in a given area. At the same time in the considered model it has been dropped to assign different weights to each evaluation criteria, due to the difficulty of carrying out such a process in an objective manner. Unlike e.g. risk assessment models of enterprises' bankruptcy, where a hard division into entities that have declared bankruptcy and those that are still in operation, there is no such possibility in the discussed issue – this results from the criteria used.

The structure of proposed model, along with the most detailed assessment criteria within the particular modules, has been presented in Fig. 1. An assessment within the three main thematic areas – financial condition, results and business efficiency, development potential – is supposed to be realized on the basis of a number of criteria, mainly in the field of corporate financial analysis, which within the model structure are aggregated to more and more general modules, ending with the final one – assessing corporate fundamental strength.

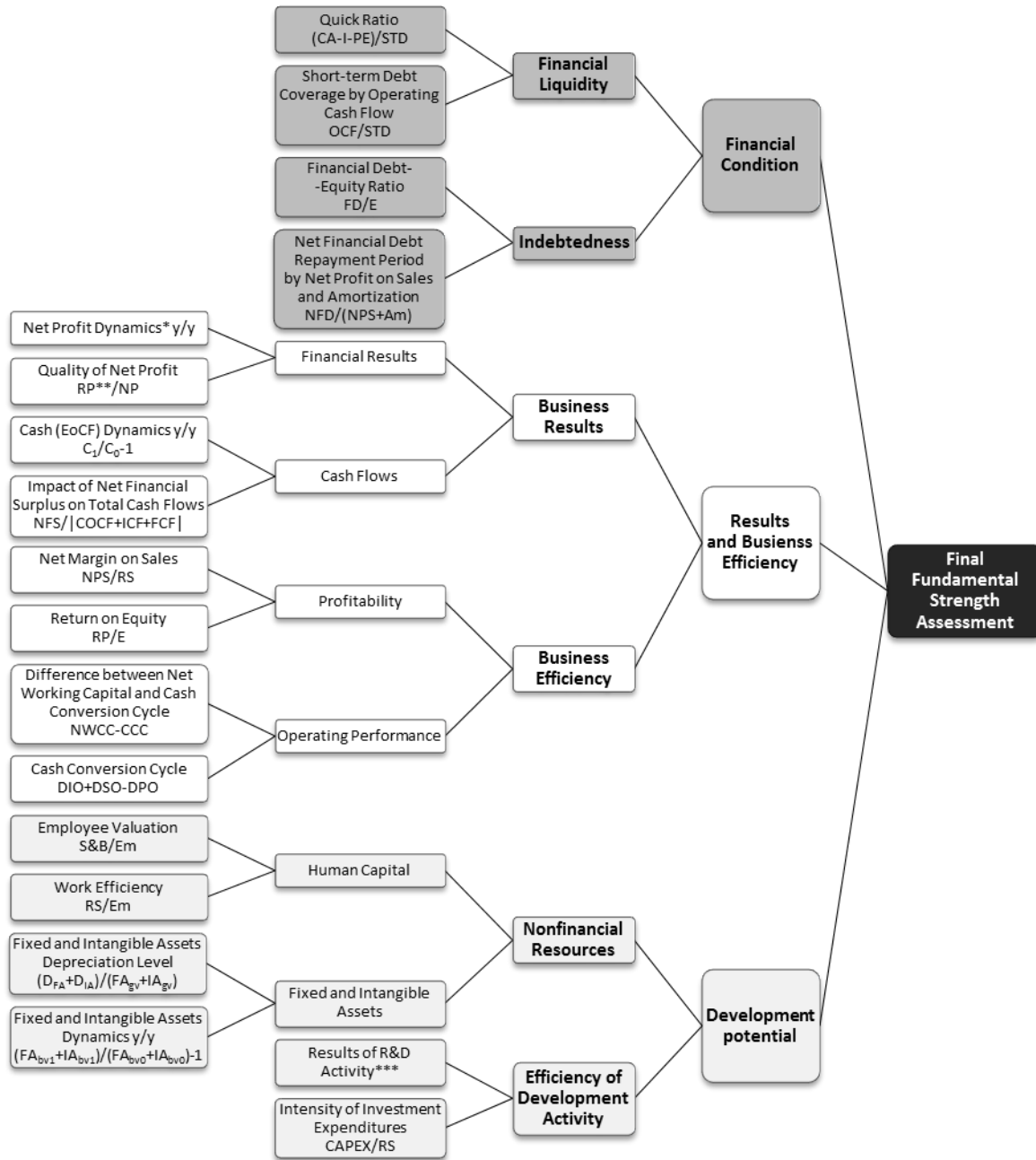


Fig. 1 – General structure of corporate fundamental strength assessment model

CA – current assets, I – Inventories, PE – prepaid expense, STD – short-term debt, OCF – operating cash flow, FD – financial debt, E – equity, NFD – net financial debt (FD – cash), NPS – net profit from sales, Am – amortization for the period, RP – repeatable profit/loss, NP – net profit/loss, EoCF – end of cash flows, C – cash and equivalents, NFS – net financial surplus (NP + Am), COCF – corrects of operating cash flow, ICF – investing cash flow, FCF – financial cash flow, RS – revenues from sales, NWCC – net working capital cycle (average current assets – average short-term liabilities) · 365 / revenues from sales, CCC – cash conversion cycle, DIO – days inventory outstanding (average inventories · 365 / revenues from sales), DSO – days sales outstanding (average accounts receivable · 365 / revenues from sales), DPO – days payable outstanding (average

accounts payable · 365 / revenues from sales), S&B – employees’ salaries and benefits, Em – employees, D – depreciation, FA – fixed assets (property, plant, equipment), IA – intangible assets (without goodwill), gv – gross value, bv – balance sheet value (net value).

* If $NP_0 > 0$ Then $(NP_1 / NP_0 - 1) \cdot 100\%$; If $NP_0 < 0$ Then $-(NP_1 / NP_0 - 1) \cdot 100\%$.

** $RP = (NPS - FD \cdot r) \cdot (1 - t)$, where: r – interest rate, t – CIT rate.

*** Qualitative criterion based on info from company’s interim reports and applications to the patent office.

The calculation tool in the suggested solution is based on the fuzzy set theory, which is one of the approximate reasoning methods (L. Zadeh⁹; A. Piegat¹⁰; P. Dworniczak¹¹; A. Rutkowska¹²).

It was assumed, that the financial data for calculation purposes will be obtained from financial reports of analyzed companies. In all cases of variables based on balance sheet it is also assumed to use their average values from two-year period. Additionally, to take into account within the individual input variables of the model both their current level and values from earlier periods, the following formula of their calculation was proposed:

$$w_i^* = 0,5 \cdot w_{i_t} + 0,33 \cdot w_{i_{t-1}} + 0,17 \cdot w_{i_{t-2}}, \quad (1)$$

where:

w_i^* – corrected value of i -th indicator (partial evaluation criterion) at the end of the given period, taking also into account its values in two earlier periods,

$w_{i_t}, w_{i_{t-1}}, w_{i_{t-2}}$ – the value of the i -th indicator (partial evaluation criterion) respectively at the end of the given period (t), at the end of one period back ($t-1$) and at the end of two periods ago ($t-2$).

This type of an approach makes, that the final corporate fundamental strength assessment is less susceptible to fluctuations caused by changes in the value of partial evaluation criteria. It is also, in a sense, a way to appreciate companies, which develop less chaotic and more regular. It was decided to include two periods backwards because in such a situation there is a balance of influence on the input variable final value of given partial evaluation criterion current reading and its readings from earlier periods. At one retrograde time, it would be a prevalence of current reading, and at three or more back periods – earlier readings.

Application of fuzzy logic for detailed calculations of corporate fundamental strength assessment entails the construction of the so-called fuzzy model, based on expert knowledge. Information necessary to achieve this goal should be acquire through the interview

questionnaire, or, if a model developer has a good knowledge in the scope of analyzed category, it is also possible to develop an original model.

3. Main guidelines of fuzzy model construction

In proposed solution it was assumed, that fuzzy model will be developed along with Mamdani approach (A. Piegat¹⁰) which in general form is presented in Fig. 2.

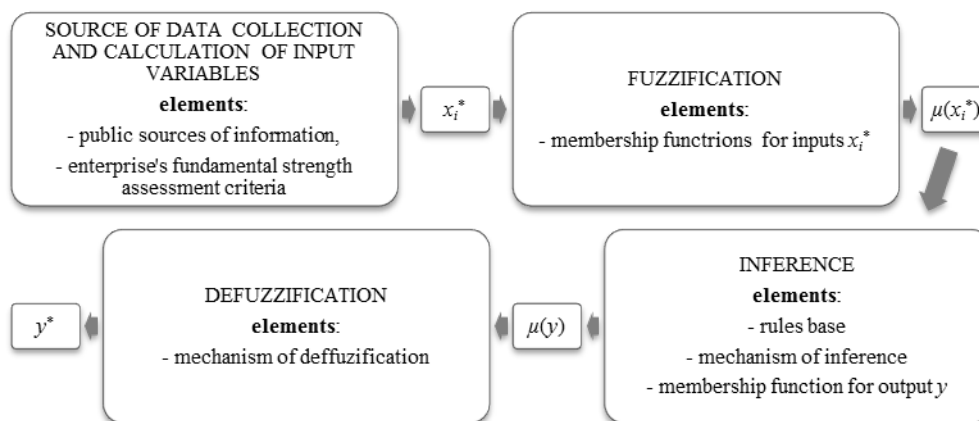


Fig. 2 – Construction scheme of corporate fundamental strength assessment fuzzy model

Basing on the experiences from developing other fuzzy models (T. Nawrocki¹³; T. Nawrocki, I. Jonek-Kowalska¹⁴), following procedure of corporate fundamental strength assessment fuzzy model building process has been proposed:

Step 1: Gathering input variables x_i^* for the model: company's interim reports and website analysis as well as patent office website database analysis.

Step 2: Fuzzification of input variables – conversion of input variables x_i^* into fuzzy form $\mu(x_i^*)$: determination the form of fuzzy sets for respective input variables, determination for these variables so-called basic terms set and the division of their values space; expert knowledge is needed.

Step 3: Inference – transformation input variables in the fuzzy form $\mu(x_i^*)$ to output membership function $\mu(y)$ of the model: creation of relevant rules bases in the form of IF-THAN sentences, determination of inference mechanism and defining output membership function of the model; regarding rules bases creation expert knowledge is needed.

Step 4: Defuzzification – determining a method of conversion model outputs y from fuzzy form $\mu(y)$ into accurate (non-fuzzy) figures y^* .

As a result of realization abovementioned four steps, it should be received a ready to use fuzzy model of corporate fundamental strength assessment. The intermediate and final assessments generated by the model take values in the range between 0 and 1, where from the viewpoint of analysed issue, values closer to 1 mean a very favourable result, while values closer to 0 indicate a result less favourable.

4. Conclusions

Proposed model of corporate fundamental strength assessment is characterized by the following advantages, that partially enable reducing the defects of methods previously applied: (i) the use of full range, and not just view selected, financial indicators to provide greater objectivity of final results and less susceptible to falsify them on the grounds of industry; (ii) combination of analytic and synthetic assessment, achieved through the use of sub-criteria, that are next aggregated into a more general assessments; (iii) combination of quantitative and qualitative approach to the fundamental strength assessment, manifested mostly in a qualitative dimension of ratios used for its measurement and qualitative method of its diversification determination, but also in the use of qualitative criterion – effects of R&D activity; (iv) using for the assessment process data included in generally accessible companies' interim reports.

Proposed model can be a useful tool supporting investment process in the stock market, as well as a tool supporting managerial decision making in enterprises. It should be also noted that presented in the paper concept of corporate fundamental strength assessment model has by now a preliminary character, which during further research will be developed.

Acknowledgements

This research was financed from BK212/ROZ1/2017 (13/010/BK_17/0026).

References

1. *J.C. Ritchie*, Fundamental Analysis: A Back-to-the-basics. Investment Guide to Selecting Quality Stocks, McGraw-Hill, New York, 1995.
2. *B. Graham, D.L. Dodd*, Securities Analysis, McGraw-Hill Education Ltd., New York, 2008.
3. *M.C. Thomsett*, Buy, Sell or Hold: Manage Your Portfolio for the Maximum Gain, Jon Wiley & Sons Inc., New York, 2002.

4. *A. Rappaport*, Creating shareholder value. A guide for Managers and Investors. Free Press, New York, 1998.
5. *G. Mikołajewicz*, The Determinants of the Fundamental Strength of the Company, *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu: Zarządzanie finansami firm – teoria i praktyka*, 365 (2014) 173-185.
6. *M. Tarczyńska-Łuniewska*, Definition and nature of fundamental strengths, *Actual Problems of Economics*. 2 (2013) 15-23.
7. *J. Lan*, 16 Financial Ratios for Analyzing a Company's Strengths and Weaknesses, URL: <http://www.aaii.com/journal/article/16-financial-ratios-for-analyzing-a-companys-strengths-and-weaknesses.touch> (19.08.2017).
8. *D. Wędzki*, Analiza wskaźnikowa sprawozdania finansowego t.2. Wolters Kluwer, Kraków, 2009.
9. *L.A. Zadeh*, Fuzzy sets, *Information and Control*, 8 (1965) 338-353.
10. *A. Piegat*, Fuzzy Modeling and Control, Springer-Verlag Berlin Heidelberg, 2001.
11. *P. Dworniczak*, Zbiory rozmyte dla początkujących, URL: <http://www.smp.uph.edu.pl/msn/31/dworn.pdf> (18.09.2017).
12. *A. Rutkowska*, Fuzzy return rate estimation based on historical data, *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Poznaniu*, 222 (2012) 198-207.
13. *T. Nawrocki*, The use of fuzzy logic in the enterprises business efficiency assessment [in:] *The essence and measurement of organizational efficiency*. Eds. Tadeusz Dudycz, Grażyna Osbert-Pociecha, Bogumiła Brycz. Springer, 2016, pp. 229-248.
14. *T. Nawrocki, I. Jonek-Kowalska*, Assessing operational risk in coal mining enterprises – internal, industrial and international perspectives, *Resources Policy*, 48 (2016) 50-67.