Sustainable Corporate Performance Index for Manufacturing Industry

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ABSTRACT

The article presents a methodological approach consisting in the application of a discriminant analysis in evaluations using financial and non-financial ESG and economic indicators, including the establishment of the sustainable corporate performance index of Czech companies from the manufacturing industry. The proposed methodology for comprehensive performance evaluation is adjusted to allow for an assessment of financial and non-financial indicators and their weights. It is particularly necessary to focus on such financial and non-financial indicators that provide to some extent information about the potential risk to companies' sustainability. This will not only allow for an ex post evaluation of companies, but also of their sustainable development. The aim of this paper is to establish sustainable corporate performance index for Czech companies from the manufacturing industry based on defined financial and non-financial ESG and economic performance indicators. Environmental, social, corporate governance and economic indicators are often characterized by a large number of variables that are partly qualitative in nature and can only be evaluated on the basis of a subjective assessment, which inevitably includes various types of knowledge. The sustainable corporate performance index was determined by means of a discriminant analysis. The use of discriminant analysis to measure the comprehensive performance of the company can also improve the accuracy of qualitative aspects captured in a non-deterministic manner. Indicators selected for discriminatory analysis included those relevant financial indicators that relate to sustainability and non-financial indicators that also meet these conditions for Czech company from the manufacturing industry. The result of discriminant analysis is the sustainable corporate performance index, which should reflect the sustainability of companies from the manufacturing industry.

Keywords: environmental, social, corporate governance, economic performance, sustainable corporate performance index, discriminant analysis

1. INTRODUCTION

Corporate Sustainability can be considered a corporate response to sustainable development represented by strategies and procedures that focus on key issues associated with the global sustainable development. Sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality and social equity. Companies aiming for sustainability need to perform not against a single, financial bottom line but against the triple bottom line [1].

Currently, corporate sustainability can be defined as the integration of environmental, social, corporate governance as well as economic performance. Corporate sustainability is one of the facets in the demand for companies that publish sustainability results in areas such as environmental, social and corporate governance. Sustainability results are required from stakeholders such as investors wishing to know whether to engage in sustainable business practices [2], [3]. In addition, environmental and social performance is an important part of many companies' business strategy for the control of processes (Ferreira et al 2009), and a sufficient incentive to monitor financial and non-financial, environmental, social and corporate governace (ESG) and economic indicators. Sustainability assessment using financial and non-financial, ESG and economic performance indicators leads to the establishment of sustainable corporate performance (SCP) in many companies. And this also relates to the determination of the sustainable corporate performance index (SCPI).

At the research institute of the Faculty of Business and Management of BUT, sustainable corporate performance has been studied in the grant project "Development of Methods for Multi-factor Performance Measurement of Companies in a Selected Industry", and an SCP model has been proposed which includes financial and non-financial ESG and economic performance indicators for companies in the manufacturing industry. These financial and non-financial ESG and economic performance indicators were designed using multi-dimensional statistical methods of cluster and principal

component analysis (PCA) and factor analysis (FA). Research results were published both in journals and in books [4], [5], [6], [7], [8], [9]. In a follow-up grant project entitled "Measuring Corporate Sustainability in Selected Sectors", research efforts focus on determining the SCPI and sustainable value.

The aim of this paper is to establish the SCPI for Czech companies in the manufacturing industry. The SCPI could then be defined as a composite indicator that includes financial and non-financial, ESG and economic performance indicators and their weights. The inclusion of the corporate governance indicator together with environmental, social and economic performance indicators into the SCPI can globally characterize the problems and risks which investors consider in the context of corporate behaviour.

2. SUSTAINABLE CORPORATE PERFORMANCE INDEX: CONCEPTUAL AND THEORETICAL ANALYSIS

Companies seek to achieve long-term benefits by integrating sustainability-related activities into their core business strategy [10], [11]. In general, we can say that companies integrate sustainability methods, tools and practices because they feel obliged to do so, because they themselves want to it, or are forced to do so [12]. In the context of sustainable development concept, it is apparent that there is a need for performance indicators that are able to express the interdependence between ESG and economic performance. Composite indicators have recently become more widespread and popular for that purpose. This is primarily due to their ability to accumulate larger amounts of information in a single indicator.

A comprehensive method of evaluating performance of companies by means of financial and non-financial indicators may certainly become a specific set of instruments for assessing corporate sustainability. This is particularly true about multi-dimensional models employing several indicators that are assigned specific weights. The company's comprehensive performance is then expressed by a composite indicator, which can assess the company's sustainability. There are essentially two approaches to the evaluation of companies, namely evaluation using a set of indicators which includes the so-called key indicators, and evaluation using a single indicator (a composite indicator), which is a synthesis of partial indicators.

The currently most frequently used models in the Czech Republic are especially those that focus either on the determination corporate performance in terms of value creation, i.e. credit scoring indicators, or they assess the company based on its ability to pay its obligations, and these are bankruptcy indicators. These bankruptcy models are an example of composite indicators that focus primarily on financial indicators, such as the Altman Z_score, Credibility Index IN, Taffler Model, etc.

The first significant research was conducted by Altman and reported in an article published in 1968, where the author examined the determination of company credit scoring using a discriminant analysis and a single composite indicator. Thanks to its high prediction accuracy, the article met with great response and served as a basis for many articles that either extended the model or verified it on data from other markets or periods [13]. In 1978, Altman and Eisenbeis [14] came up with the final Z-score model, which took into account, among other things, new standards of financial reporting. The resulting model is called "Zeta Analysis".

In the Czech Republic, several prominent researchers studied the issue of corporate performance evaluation [15]. Their models were produced with the use of multiple discriminant analysis. The data in their studies, however, come exclusively from Czech enterprises and performance evaluations were made in Czech enterprises only. In their performance evaluations, financial indicators and their sets are predominant. Most financial indicators are associated with financial accounting based on the accounting standards; these are important indicators for measuring the financial performance of companies for tax purposes as well as for capital markets.

Performance evaluation based solely on the basis of financial indicators suffers from many shortcomings because of historical data, its exclusive focus on short-term goals, but its major problems are its apparent disconnectedness from strategy and its frequent lack of transparency and reliability. These deficiencies of financial indicators should be eliminated by non-financial indicators and models that are formed by such non-financial indicators, e.g. the Czech Benchmarking Index, Enterprises Evaluation Model created by H. Pollak, Argenti's Model, etc. The most common and most elaborate enterprise evaluation system is the Balanced Scorecard (BSC) system.

The theme of composite indicators has also been picked up by a number of other authors [16], [17]. For environmental sustainability, for instance, several composite indicators have been developed, e.g. the environmental sustainability index (ESI) compiled by the World Economic Forum for 142 countries, the wellbeing index (WI) aggregating 36 indicators, the FTSE4Good Index for social issues, the Natur-Aktien-Index or the Dow Jones Sustainability Indexes (DJSI), etc.

3. REASERCH METHODOLOGY

The proposed methodology of comprehensive assessment of sustainability of companies employs a method of new approach to the assessment of companies in the Czech context, in particular by means of examining the potential of Multiple Discriminant Analysis (MDA) which was also used by Altman for the design of bankruptcy models [18], [19], [20]. Altman applied the Multiple Discriminant Analysis to data from 66 bankrupt and non-bankrupt

companies listed at the New York Stock Exchange at the time. MDA was the dominant method for the design of models at that time, and was later replaced with less demanding statistical techniques, such as logit analysis (LA) which was applied by [21], [22], probit analysis (PA), which was used by [23], [24] for the assessment of companies.

Using the logit model and logistic regression in 2010, the latest version of the prediction model of E.I. Altman was published in 2010 - the Z-metrics model. Altman participated in its development with the RiskMetrics group in response to the economic crisis and the prediction capabilities of Z-models. The model is designed for both small and large companies from Canada and USA, and elsewhere. Further, models of linear probability (LPM) can also be used, Tamari's risk index - a scoring method, or the neuron network method, all of which have been researched since the early 1990s, can also be used.

The basis for empirical research for comprehensive assessment of companies, and potentially also the SCPI is comprised of a set of financial and non-financial ESG and economic performance indices for companies in the manufacturing industry. A questionnaire was developed in order to determine same, voluntary instruments for the environmental area, ISO 14 000 and EMAS, for the social area, CSR and ISO 26 000, for the corporate governance area, OECD Principles of Corporate Governance and the Green Paper - the EU corporate governance framework, serving as a basis therefor, together with other international and domestic resources (GRI, IFAC, ASSET, EFFAS-DVFA and Czech Statistical Office); for the economic area, annual reports of companies and data from AMADEUS was used. Of the database compiled, 79 companies in the manufacturing industry with the number of employees over 250 were investigated. The following manufacturing companies were involved: electrical engineering, engineering, medical products, metallurgy, textile and leather production, chemical production and food processing.

Sustainability of the company is also shown by the introduction of voluntary instruments in a company in the manufacturing industry, as such tools encourage considerate treatment of the environment, social responsibility and good corporate governance.

Table 1 Voluntary instruments in companies in the manufacturing industry (in %)

Use	ISO 9000	MRP	ISO 14000	EMAS	OHSAS 18000	EMA	CSR	Codex Corporate governace	Cleaner production	LCA	Enviro-mental labelling of products
No	10,1	51,9	44,3	84,8	51,9	91,1	74,7	88,6	69,6	78,5	69,6
Yes	89,9	48,1	55,7	15,2	48,1	8,9	25,3	11,4	30,4	21,5	30,4

The selection of non-financial indices is related to the company's objective - sustainability. There is a causal nexus between these non-financial indicators and financial indicators. They are structured in such a way so as to make it possible to assess whether any change therein occurred or not, and if so, whether desirable or undesirable. Environmental performance indicators tend to be quantitative, i.e., tangible indicators, and are expressed in various units. Social and corporate indicators are mainly qualitative, i.e., intangible indicators. There was an effort to replace such intangible indicators with a hard indicator, a change in which reflected a change in the soft indicator as a substitute indicator.

Indexes ESG and economic performance indicators were set using the Principal Component Analysis (PCA) and Factor Analysis (FA) for companies in the manufacturing industry [25], [26]. indexes (I_{ENVI}) for environmental performance indicators (EN) were set for three areas capable of measurement: *Emissions, Consumption of resources, Waste,* which contain 7 environmental indicators (EN1 - costs of environmental investments, EN2 - total atmospheric emissions, EN3 - total greenhouse gas emissions, EN4 - total consumption of renewable energy, EN5- total annual consumption of water, E6 - total annual production of waste, EN7 - total annual production of hazardous waste), and their metrics.

Index (I_{SOC}) for social performance indicators (SOC) were also set for four areas capable of measurement: *Society, Human rights, Labor relations, Product liability*, which contain 8 social factors (SOC1 - Community, SOC2 - Funding for municipalities, SOC3 - Discrimination, SOC4 - Equal opportunities, SOC5 - Employment fluctuation level, SOC6 - Mortality rate, SOC7- Marketing communication, SOC8 - Customer health and safety), and their metrics.

Index (I_{CG}) for corporate governance indicators (CG) were also set for two areas capable of measurement: *Monitoring, Efficiency of CG*, which contain 6 corporate governance indicators (CG1- Corporate information for aim, CG2- Accountability, CG3 - Remuneration, CG4 - Composition, CG5 - Equal opportunities, CG6 - Legal compliance), and their metrics.

The methodological approach to comprehensive assessment of company performance using financial indicators follows, just like one based on non-financial indicators, the same objective: sustainability. The financial indicators were designed in line with ESG performance indicators, with GRI 2006, 2011, 2013 and annual reports of companies serving as a basis.

Index (I_{ECO}) economic indicators (ECO) were set for three areas capable of measurement: *Profitability, Economic results, Cash flow*, which contain 8 economic indicators (ECO1 – ROE, ECO2 – ROA, ECO3- ROI, ECO4 – ROCE, ECO5 - Profit (EAT), ECO6 - Turnover size, ECO7 - Asset turnover, ECO8- Cash-flow), and their metrics.

Empirical research of integrated (comprehensive) performance of companies in the manufacturing sector using financial and non-financial ESG and economic indicators will mean that such aggregated indicators will be able to provide the most comprehensive picture of sustainability in the companies concerned. The assessment is based on a multi-criteria evaluation aggregating various indicators, whereby it is subsequently possible to determine the SCPI using those results.

4. RESULTS AND DISCUSSION

The aim of the sustainable corporate performance index is to assess the sustainability of companies from the manufacturing industry.

The sustainable corporate performance index is based on a set of Indexes I_i , $i = \{ENVI, SOC, CG, ECO\}$, which are produced by aggregating financial and non-financial, ESG and financial performance indicators.

The performance Indexes I_{ENVI}, I_{SOC}, I_{CG} and I_{ECO} do not act independently but, rather, are interacting with each other, which means that the effect of some indicators may be cancelled out by action of some other indicators. To determine how the indicators act together, the Multiple Disciminant Analysis was applied.

The general equation of discriminant analysis:
$$Z = a_1 X_1 + a_2 X_2 + \ldots + a_p X_p$$
where $a_1, \ldots a_p$ are discrimination coefficients and $X_1, \ldots X_p$ are selected independent variables that best explain the classification into groups.

The most common statistical method for predicting the financial failure is the multi-dimensional discriminant analysis (MDA) based on the categorization of individual quantities into several characteristic groups.

The discriminant analysis is used to identify the Indexes I_{ENVI}, I_{SOC}, I_{CG} and I_{ECO} that help enhance sustainability, or otherwise. An analysis of variance showed that the Indexes I_{soc} *Labour relations*, I_{soc} *Product labelling*, I_{CG} *Monitoring* , I_{ECO} *Economic result* and I_{ECO} *Profitability* were statistically insignificant. These Indexes were dropped and the discriminant analysis was performed again. Tab. 2 below shows that when the five statistically insignificant were left out, the others were statistically significant.

Table 2 ANOVA - reduced discriminant analysis

Indexes	Wilks' Lambda	F	df1	df2	Sig.
I_{ENVI} EMISSIONS	0.874	11.150	1	77	0.001
I_{ENVI} CONSUMPTION OF RESOURCES	0.943	4.661	1	77	0.034
I_{ENVI} WASTE	0.897	8.853	1	77	0.004
I_{SOC} SOCIETY	0.904	8.213	1	77	0.005
I_{SOC} HUMAN RIGHTS	0.899	8.649	1	77	0.004
I_{CG} EFFICIENCY OF CG	0.872	11.317	1	77	0.001
I_{ECO} CASH-FLOW	0.934	5.404	1	77	0.023

Box's M conformity of covariance matrices indicated to us that the null hypothesis of covariance matrices conformity must be rejected. That assumption can, nevertheless, be usually circumvented by comparing the natural logarithms of the determinants of the covariance matrices. The value of Wilks' lambda is an analogue to R2 in the regression analysis. In our case, too much variance is left unexplained, the value of 1-lambda is the proportion of variance explained with the help of discriminated groups. In our case, too much variance remained unexplained (31.8%), and it can therefore be assumed that we failed to find all relevant indicators (see Tab. 3).

Table 3 Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	0.682	28.148	7	0.000

Using the 7 listed sub-indices, we nevertheless managed to correctly classify almost 76.3% of the cases, which is quite a good result. It can therefore be assumed that we did not find all the relevant cases (19.5%), see Tab. 4.

The SCPI discriminant equation employs Standardized Canonical Discriminant Function Coefficients:
$$
\begin{aligned}
SCPI &= 0.432\, I_{SOC} HUMAN\ RIGHTS \\
&+ 0.426\, I_{CG} EFFICIENCY\ OF\ CG + 0.386\, I_{ENVI} WASTE \\
&+ 0.280\, I_{ECO} CASH\ FLOW + 0.263\, I_{ENVI} EMISSIONS \\
&- 0.30\, I_{ENVI} CONSUMPTION\ OF\ RESOURCES
\end{aligned}
$$

SCPI values of < -0.041 indicate an unsustainable company, SCPI values of > 0.070 indicate the company's sustainability and SCPI values in the <-0.041; 0.049> interval do not give clear information in relationship to sustainability.

Table 4 Classification Results[a,c]

		Sustainability	Predicted Group Membership		Total
			no	yes	
Original	Count	no	33	8	41
		yes	9	29	38
	%	no	80.5	19.5	100.0
		yes	23.7	76.3	100.0
Cross-validated[b]	Count	no	26	15	41
		yes	12	26	38
	%	no	63.4	36.6	100.0
		yes	31.6	68.4	100.0

a. 78.5% of original grouped cases correctly classified.

b. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.

c. 65.8% of cross-validated grouped cases correctly classified

The sustainable corporate performance index is a composite indicator that makes it possible to assess sustainability development of companies from the manufacturing industry. The sustainable corporate performance index may be important for decision making of managers, investors, etc., as well as an initial composite indicator for *Integrated Reporting*. An accurate selection of appropriate indicators is, however, difficult, and it is therefore necessary to identify suitable financial and non-financial performance indicators for each of the sectors in the Classification of Economic Activities (CZ-NACE) so that they fulfilled, and were grouped into, a single *Sustainable corporate performance index.*

5. CONCLUSIONS

A comprehensive corporate performance measurement using financial and non-financial indicators consisted of three stages: identification of financial and non-financial ESG and economic indicators affecting the company's performance and their transformation into measurable indicators, the measurement of the indicators, the use of the indicators in practice. The basis for the design of the SCPI were financial and non-financial performance indicators that were determined by factor analysis (including indices I_{ENVI}, I_{SOC}, I_{CG} and I_{EKO}). SCPI was produced using discriminant analysis. All calculations were analysed by the SPSS program, version 22, for Windows.

The aim of the article was therefore to test the discriminant analysis method for creating the SCPI. For the creation of the sustainable corporate performance index and its subsequent improvements, data obtained in questionnaire surveys of companies in the manufacturing industry were used.

The designing of a SCPI is one of the ways how to create a necessary tool for sustainability evaluation of companies in the manufacturing industry.

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