THE RELATIONSHIP BETWEEN COMPANY SIZE AND CEO REMUNERATION: A SCALING PERSPECTIVE

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Abstract

The first objective of the study is to empirically test a number of company size determinants' significance as size proxies in benchmarking CEO remuneration for different sectors of Johannesburg Stock Exchange (JSE)-listed companies. The second objective is to investigate an issue that has not been examined in previous studies, namely the extent to which companies are able to linearly scale their CEO remuneration and company size without changing the remuneration-to-size ratio. To fulfil the first objective, data extracted from the McGregor BFA database were obtained for 2013, where 244 companies in four sectors, i.e. financial, manufacturing, minerals and services, are analysed using descriptive statistics and simple regression analysis. From the results obtained, to fulfil the second objective, a data envelopment analysis (DEA) model is built to estimate the technical and scale efficiencies of 231 companies. A hypothesis test was helpful to find that the following determinants can be used as proxies for company size: total assets (including intangible assets); market value of assets; total equity; market capitalisation; revenue; and total cost. The confidence level to which the null-hypothesis is rejected leads to the conclusion that those determinants are on their own suitable proxies that make further investigations into joint determinants unnecessary. Furthermore, the study concluded that the majority of companies are not able to linearly scale their CEO remuneration and company size without changing the remuneration-to-size ratio. Therefore, the conceptual theory of scaling is to a great extent rejected, since only nine of 231 companies in the sample investigated could achieve economies of scale. The paper is organised as follows: Section I provides the gap of missing knowledge in the literature as well as the conceptual framework of the study. The data and methodology are described in Section II, after which the results and a discussion thereof are provided in Section III. The study is finally concluded in Section IV.

Keywords: CEO Remuneration, Company Size, Data Envelopment Analysis, Return to Scale, Scaling Theory

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1. Introduction

This is an empirical study modelling the relationship between CEO remuneration and company size determinants. The issue of CEO remuneration is part of a company's corporate social responsibility towards investors, employees and other stakeholders (Theunissen, 2012; SAPA, 201; Hurtt et al., 2000). CEO remuneration recently received a great deal of negative media attention in South Africa and companies are accused of the fact that their CEOs are excessively remunerated (Lamprecht, 2014; Finweek, 2012; Joubert, 2011; Ensor, 2010; Financial Mail, 2008; Hindery, 2008). This media attention led to a number of studies investigating CEO remuneration of Johannesburg Stock Exchange (JSE)-listed companies (Nthoesane and Kruger, 2014; Bradley, 2011; Theunissen and Oberholzer, 2013; Scholtz and Smit, 2012; Oberholzer and Theunissen, 2012; Dommisse, 2011; Theunissen, 2010; Krugel and Kruger, 2006).

The literature agrees that there are many factors that drive or influence CEO remuneration, for example company size, performance, risk, leverage, ownership, age of CEO, tenure (i.e. number of years served as CEO), labour market influences and board size (Hearn, 2013; Sigler, 2011; Fulmer, 2009; Nwaeze et al., 2006; Gunasekaragea and Wilkenson, 2002). Some researchers reduced the number of factors to only company size and performance as the two most significant drivers of CEO remuneration (Nulla, 2012; Oberholzer and Theunissen, 2012; Cordeiro et al., 2006; Zhou, 2000). From all the factors, many authors agree that company size is the single most significant driver and the only factor that

has a constant and a positive correlation with CEO remuneration (Dan et al., 2013; Sigler, 2011; Vermeulen, 2008; Devers et al., 2007; Geiger and Cashen, 2007). Probable reasons for this positive relationship are that larger companies may employ better-qualified managers (Murphy, 1999), have more operations, subsidiaries and layers of management (Lippert and Moore, 1994), require a higher level of responsibility from their CEOs who have more complex tasks and therefore place greater value on decision-making (Janssen, 2009) and have more requirements by the board (Chhaochharia and Grinstein, 2009).

The importance of the study is that it attempts to better understand the concept of company size within the context of CEO remuneration and it will assist company board members in setting CEO remuneration. Many previous studies have investigated the relationship between company size determinants and CEO remuneration. Different determinants were used by the researchers to act as a proxy for company size, for example market capitalisation (Krugel and Kruger, 2006), turnover/sales/revenue (Chhaochharia and Grinstein, 2009; Fulmer, 2009; Nourayi and Daroca, 2008; Geiger and Cashen, 2007; Stanwick and Stanwick, 2001; Zhou, 2000), total assets (Griffith et al., 2011; Chourou et al., 2008; Grinstein and Hribar, 2004; Gunasekaragea and Wilkenson, 2002; Zhou, 2000), number of employees (Sigler, 2011; Nourayi and Daroca, 2008), market value of assets (Heaney et al., 2010) and total expenses (Chen et al., 2008). To emphasise some degree of uncertainty regarding to the appropriate choice for a size proxy, some authors apply multiple determinants of size, for example total assets and sales (Zhou, 2000), earnings and market capitalisation (Gabaix and Landier, 2008), total assets and number of employees (Nulla, 2012), market value of assets and market value of equity (Heany et al., 2010), company value, earnings before interest and taxes (EBIT), sales and equity (Gabaix et al., 2013), as well as total assets, total equity and turnover (Theunissen, 2010).

Except for number of employees, the above-mentioned determinants are in terms of monetary values provided both by companies' statements of comprehensive income and the statements of financial position. All these above-mentioned examples are probably logical choices to define company size. Furthermore, the expectation is also that they are highly correlated with each other. Therefore, the co-linearity problem should be taken into account when multiple size determinants are applied in a multiple regression analysis (Wegner, 2007). Nevertheless, the argument is that these variables are probably not equally effective to define company size within the context of CEO remuneration. The choice of a proxy for size may also differ between the different business sectors (Nourayi and Daroca, 2008). Therefore, what is needed is a framework that links the size aspect to the responsibility of the CEO. The question is what determinants of company size are most applicable when constructing CEO packages. The first objective of the study is to empirically test the above-mentioned examples' significance as size proxies in benchmarking CEO remuneration for the different sectors. Therefore, the null-hypothesis is that there is no relationship between CEO remuneration and the different company size determinants. The study also argues, according to the idea of Gabaix et al. (2013), that a combination of size determinants should be considered. That is to consider, for example, defining company size by using certain combinations of the statement of comprehensive income's data in conjunction with the statement of financial position's data.

The second objective of the study is to investigate an issue not examined in previous studies, namely the extent to which companies are able to linearly scale their CEO remuneration and size without changing the remuneration-to-size ratio. In other words, the question is whether the CEO remuneration-to-size ratio stays constant when the CEO's remuneration and/or company size changes. Therefore, the study makes it possible to determine the degree to which companies achieve economies of scale, within the context of CEO remuneration, as the input variable, relative to a certain level of company size, the output variable.

To fulfil the objectives, the epistemology dimension preferred is quantitative research. Secondary data extracted from the McGregor BFA (2014) database were obtained for 2013, where 244 companies in four sectors, i.e. financial, manufacturing, minerals and services, are analysed to reach the first objective, to estimate the relationship between CEO remuneration and different company size determinants, by using descriptive statistics and simple regression analysis. From the results obtained, a data envelopment analysis (DEA) model is built to estimate the efficiencies of 231 companies, where the efficiency estimate is relative to the other companies within the same sector. To reach the second objective, companies in each sector are divided into quadrants analysing the average technical and scale efficiency per sector.

Conceptual scope

The focus of this study is on the dependency of CEO remuneration in relation with different determinants of company size. To put these size variables into proper context, the scaling theory is borrowed to provide a conceptual framework, which includes both constant return to scale (CRS) and variable return to scale (VRS). The CRS implies a proportionate rise in CEO remuneration when company size is increased, or in other words, a company's CEO remuneration-to-size ratio is not influenced by the scale of its operations (Avkiran, 1999). Using CRS, a company's

CEO remuneration-to-size is automatically considered fully scale efficient, implying that the company always achieves economies of scale. This is a significant assumption, since CRS may only be valid over a limited range and its use should be justified (Anderson, 1996). Alternatively, is the less restricted VRS approach, which implies a disproportionate rise or fall in CEO remuneration when company size is increased; in other words, if a company grows in size, its CEO remuneration-to-size will not remain constant, but it will either rise or fall. Using the VRS approach, the degree of scale efficiency should be estimated; that is where a company is too small in its scale of CEO remuneration-to-size, which falls within the increasing return to scale (IRS) part of the production function, and a company is too large in its scale of CEO remuneration-to-size if it falls within the decreasing return to scale (DRS) part of the production function (Avkiran, 1999; Coelli et al., 2005).

2. Data and methodology

Method

This is an empirical study using existing data from the JSE-listed companies to model correlations between CEO remuneration and some company size determinants. As existing numerical data are used, there exists a medium to high degree of control regarding to the findings of the study (Mouton, 2011). Validity of the study is ensured by including variables in the descriptive statistics, regression and correlation analysis and the DEA model that can fulfil the two objectives of the study. To ensure reliability, an effort is made to describe the research process in such a way that a repetition thereof will lead to a similar conclusion.

Data

Data were obtained from the McGregor BFA database for 2013. From the database, analysts have a choice between published or standardised data. The former was selected for the study because this is the readily available format provided in companies' annual integrated reports, and this study did not attempt to compare data of different companies, which may require some sort of standardisation.

For this study, companies were grouped into four sectors, namely financial, manufacturing, mineral and service. (In an effort to refine the data, the industrial companies were divided into two groups, i.e. manufacturing and services). The three companies indicated in the oil and gas sector were included in the mineral sector and all the gold companies were excluded since their financial statements' disclosures differ from other companies in this sector. The health sector contains service companies, for example hospitals, which are included in the service sector, and medicine manufacturers, which are included in the manufacturing sector. A total of 304 companies were detected in the database, of which only 245 are operational and/or provided all the required data. After visual inspection of the plotted data, another company was excluded, since it is extremely large with the most extreme CEO remuneration, to avoid a leverage effect in the regression analysis. The remaining 244 companies consist of 68 financial, 78 manufacturing, 45 mineral and 53 service companies. In a few cases, the monetary values are not in terms of rand (ZAR), where the average exchange rate of 2013 was applied to convert the values.

Design

Dependent variable

The dependent variable (y) represents the sum of components of CEO remuneration, which is in accordance with the terms and classification of the McGregor BFA database. The three components included are:

1. Base pay as measured by 'salary'
2. Prerequisites and pension as measured by the total of 'retirement and/or medical' contributions, 'allowances and benefits', 'motor and travel' allowances and 'fee/levy payment'
3. Annual bonus plans as measured by total of 'bonus paid in current year', 'performance bonus', 'other benefits' and "once-off payments'

The database also provides a fourth component, namely long-term incentives as measured by 'gains on shares'. Since these gains are only disclosed in the year that rights are exercised, it is extremely difficult to value them, especially when only one year's data are under consideration. The exclusion of long-term incentives was also practiced in studies such as Scholtz and Smit (2012), Bradley (2011) and Theunissen (2010).

Independent variables

A literature study was helpful to include independent variables for this study as possible proxies for company size. The variables are classified as data from the statement of financial position (SFP), statement of comprehensive income (SCI) and sundry items. These variables are indicated in parentheses [*] to indicate from which section, and the number in the section, they are extracted from the McGregor BFA database.

Firstly, two statements of financial position's line items were selected as proxies for company size, namely assets and equity, since the CEO is responsible for the investment (acquiring and utilisation assets) and, according to the agent theory, the representative of all shareholders. The total assets (at book value) were used frequently in the past (Nulla, 2012; Griffith et al., 2011; Theunissen, 2010;

Chourou et al., 2008; Grinstein and Hribar, 2004; Gunasekaragea and Wilkenson, 2002; Zhou, 2000). For this study, total assets, excluding intangible assets [SFP: 050], indicated as Total Assets (1) and total assets, including intangible assets [SFP: 051], indicated as Total Assets 2, were selected. Following Heany et al. (2010) the market value of assets was also used, which is represented by the book value of liabilities plus the market value of equity. The calculation is as follows: The average share price for the year [Sundry Items: 149] multiplied by the ordinary shares in issue at year-end [Sundry Items: 101] plus preference shares [SFP: 008] plus outside shareholders interest [SFP: 012] plus total liabilities [SFP: 022].

Gabaix and Landier (2008) and Krugel and Kruger (2006) calculated CEO remuneration relative to market capitalisation, which is the value of the investments by shareholders at a given time. This is calculated by the average share price for the year [Sundry Items: 149] multiplied by the ordinary shares in issue at year-end [Sundry items: 101] plus preference shares [SFP: 008] plus outside shareholders interest [SFP: 012]. Total equity (at book value) was applied by Theunissen (2010). This study also includes total equity [SFP: 013].

From the income statement data, following Chhaochharia and Grinstein (2009), Fulmer (2009), Nourayi and Daroca (2008), Geiger and Cashen (2007), Stanwick and Stanwick 2001 and Zhou (2000), revenue and turnover (sales) were both considered, but revenue is preferred because some companies, especially in the financial sector, do not indicate turnover. The revenue is calculated as turnover [SCI: 060] plus investment income [SCI: 062] plus interest received [SCI: 064]. Total expenses were applied by Chen et al. (2008). In this study, the calculation is as follows: The sum of cost of sales [IS: 053], total cost shown [SCI: 097] and interest and financial charges [SCI: 066]. Gabaix and Landier (2008) used earnings as a proxy for size. In this study, two items were selected, namely EBIT [IS: 098] and earnings before interest and taxes, depreciation and amortization (EBITDA) [SCI: 102]. As a variation of the number of employees, the salaries and wages from the income statement were also included, i.e. staff costs (excluding director's remuneration) [SCI General Supplementary: 345].

A non-financial item is also included, i.e. the total number of persons employed [Sundry Items: 131], which was previously used by Nulla (2012), Sigler (2011) and Nourayi and Daroca (2008).

Statistical analysis

Firstly, descriptive statistics are used to analyse the independent (x) and the dependent (y) variables. Secondly, to test the null hypothesis, simple linear regression analysis is used where the different determinants of company size are alternately the independent variables (x) and the CEO remuneration the dependent variable (y). Linear regression analysis has frequently been used in the past to analyse and benchmark CEO remuneration (Bradley, 2011; Dommisse, 2011; Theunissen, 2010; Chen et al., 2008; Nourayi and Daroca, 2008; Barber et al., 2006; Krugel & Kruger, 2006). Multiple linear regression analyses were not considered, because the expectation is that there should be a high level of correlation between the different size determinants. Furthermore, to avoid the effect of serial (auto)-correlation, analyses are done only for a single year, namely 2013. To control possible problems of heteroskedasticity and normality, the practice by many related studies was followed where the log (or ln) of variables is used (Chourou et al., 2008; Geiger and Cashen, 2007; Gabaix and Landier, 2008; Stanwick and Stanwick, 2001). If a controversial linear relationship between x and y exists, a linear relationship between log x and log y may be considered. Then, the power curve $\hat{y} = ax^b$ is a suitable curve to describe the relationship between x and y. The equation can be written in logarithmic form $log\ \hat{y} = log\ a + b\ log\ x$. If y', a' and x' are indicated by $log\ \hat{y}$, $log\ a$, $log\ x$, respectively, then this is the equation for linearity, namely $y' = a' + bx'$ with an intercept a' and the slope b (Steyn et al., 1999).

A hypothesis testing is also performed. The null-hypothesis, H_0, there is no relationship between CEO remuneration and the company size determinants, is an assertion about the value of the population measure. The value is the current value provisionally accepted as correct until it is proven wrong. The alternative hypothesis, H_a, specifies for the population parameter a range of values that are not specified by the null hypothesis (Swanepoel et al., 2010). A two-sided alternative hypothesis claims that the population parameter is not equal to the alleged value under H_0.

H_0: regression intercept = 0
H_a: regression intercept $\neq$ 0
H_0: regression slope = 0
H_a: regression slope $\neq$ 0

DEA as a measure of technical and scale efficiency

A model is needed to reach the second objective, to investigate the extent to which companies can linearly scale their CEO remuneration and size without changing the ratio between them. For this purpose, DEA was selected, which is a non-parametric efficiency measurement technique, using linear programming to estimate a comparative ratio of weighted outputs to weighted inputs for each company by comparing the efficiency of how the same multiple inputs and the same multiple outputs are converted by a company, relative to other competing companies in the sample (Min et al., 2009; Coelli et al., 2005). DEA effectively estimates the frontier by finding a set of linear segments that

envelop the observed data. DEA can determine efficiencies from an input-orientated (input minimisation) or output-orientated (output maximisation) point of view (Coelli et al., 2005). Applying DEA, technical efficiency and scale efficiency can be estimated. Technical efficiency (TE) is an indication of how well inputs are converted into outputs, while scale efficiency (SE) estimates whether a company operates on a scale that maximises productivity (Murthy et al., 2009). Two approaches are available, i.e. constant return to scale (CRS) and variable return to scale (VRS). The CRS implies a proportionate rise in outputs when inputs are increased (Avkiran, 1999). Alternatively, VRS implies a disproportionate rise or fall in outputs when inputs are increased (Avkiran, 1999). Using CRS, a company is automatically considered fully scale efficient (that is companies are able to linearly scale their inputs and outputs without changing their efficiency), while using the VRS approach, the degree of scale efficiency should be estimated, that is where a scenario is too small in its scale operations, which falls within the increasing return to scale (IRS) part of the production function, and a scenario is too large if it falls within the decreasing return to scale (DRS) part of the production function (Coelli et al., 2005; Theunissen, 2012).

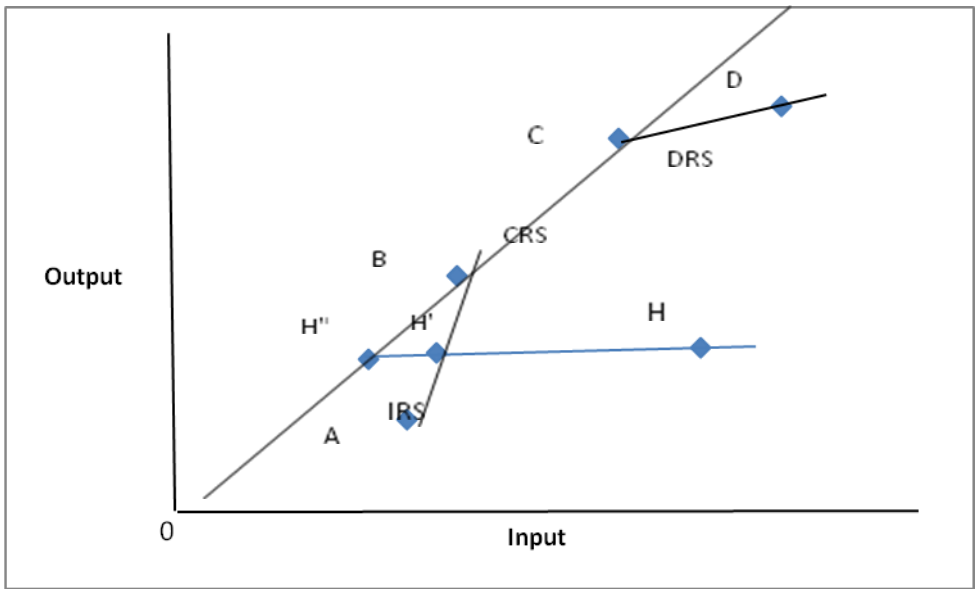

Figure 1. CRS and VRS efficiency frontiers (Source: Adapted from Zhu (2009))

To illustrate, Figure 1 assumes that the observed data consists of a single input, single output with five companies (indicated as decision-making units (DMUs), namely A, B, C, D and H. 0BC is the CRS frontier. A, D and H are not on the efficiency frontier and therefore they are considered non-efficient. H, for example, should move from an input-orientated view, horizontally, to point H" to become fully efficient. The less restricted VRC frontier is indicated by ABCD. Under this approach, H only needs to move horizontally to point H'. To summarise, TE_{VRS} implies that H'H is the technical inefficiency distance. TE_{CRS} indicates the overall improvement that is possible, namely H"H. SE = TE_{CRS}/TE_{VRS}, means that the distance H"H' represents the scale inefficiency, which should be improved upon by keeping the same input mix, but changing the size of operations (Zhu, 2009; Coelli et al., 2005). Suppose company H is 0.70 technically efficient according to the VRS approach – the remaining 0.30 represents the distance H'H. Suppose the CRS technical efficiency is 0.583', then the overall inefficiency of 1 – 0.583' = 0.416' (H'H) can be calculated. The scale efficiency 0.583'/0.70 = 0.83'indicates that the distance to achieve economies of scale is over and above the distance H'H (now 0.416' – 0.16' = 0.25), another 1 – 0.83' = 0.16', the distance H'H".

From an input-orientated view, the following DEA equation is used to create the model (Zhu, 2009):

$$\min \theta - \varepsilon(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+)$$

subject to

$$\sum_{j=1}^{n} \lambda_j \chi_{ij} + s_i^- = \theta \chi_{io} \qquad i = 1,2,....,m;$$

$$\sum_{j=1}^{n} \lambda_j \gamma_{ri} - s_r^+ = \gamma_{ro} \qquad r = 1,2,....,s;$$

$$CRS \qquad \lambda_j \geq 0 \qquad j = 1,2,....,n.$$

$$VRS : Add \sum_{j=1}^{n} \lambda_j = 1$$

The above input-orientated formula calculates input minimisation (where θ indicates the efficiency score). Each observation, DMU_j (j = 1, ..., n), uses m inputs X_{ij} (i = 1, 2, ...,m) to produce s outputs Y_{rj} (r = 1, 2, ...,s), where DMU_o represents one of the n DMUs under evaluation, and X_{io} and Y_{ro} are the ith input and rth output for DMU_o, respectively. In order to take any slack into consideration, the inclusion of the non-Archimedean ε effectively allows the minimisation over θ to pre-empt the optimisation involving the slacks, s_i^- and s_r^+ (Zhu, 2009). Firstly, the technical efficiencies are calculated according to both the CRS and VRS approaches to arrive at a scale efficiency estimate. Technical and scale efficiencies can take on values between zero and one, where zero signals total inefficiency and one total efficiency.

3. Results and discussion

Descriptive statistics and linear regression analysis (first objective)

After the data was plotted, the heteroskedasticity of the variances was clear where the spread of the larger values of company size is much larger than those of the smaller company size values, which requires a log transformation to stabilise the data. Power curves seemed to be the best transformation for both heteroskedasticity and the residuals of the fit. An exception was made regarding to the two profit determinants of company size, EBIT and EBITDA, because these data contain some negative values where conventional linear regression analysis was applied.

Table 1 exhibits the descriptive statistics of the data. The average values are in all cases much higher than the mean, implying there are a few companies with appreciably higher variable values than the rest of the companies; the frequency distribution is positively skewed. The huge differences between the minimum and maximum values explain the relatively high standard deviation, indicating a wide spread of data. These descriptive statistics, together with the above-mentioned visual inspection of the data, are a clear identification that the effect of non-normality of the dependent variable and the heteroskedasticity of the variances will make a power curve a much more sensible analysis.

Table 1. Descriptive statistics of dependent and independent variables (R million)

	Average	Median	Standard deviation	Minimum	Maximum
Dependent variable					
CEO compensation	7.62	5.15	8.37	0.20	70.15
Independent variables					
Total assets 1	54168	4060	209425	5.812	1823796
Total assets 2	57319	4537	215332	9.215	1861401
Market value of assets	68464	5396	227854	1.359	1909039
Total equity	13705	1829	42914	3.172	444278
Market capitalisation	24850	2714	67792	-0.085	636229
Revenue	23573	2099	128439	0.044	1948725
Total costs	21730	1996	131109	-5061	2007607
EBIT	946	226	6910	-54677	40628
EBITDA	2073	297	7941	-15599	59788
Staff costs	2664	394	5960	0.000	43927
Personnel (actual number)	10372	3321	18703	0.471	111338

Table 2 exhibits that, in total, 244 companies were analysed. Only 231 companies (95 per cent) reported staff cost and only 194 (80 per cent) reported the number of personnel.

Table 2 exhibits a summary of the regression analysis. R^2 is important to indicate to what extent a change in CEO remuneration is explained by a change in the company size determinants. Guidelines supplied by Ellis and Steyn (2003) are applied to interpret the R^2 values. The regression for EBIT in the group All Companies was not sensible, since only 13% of the change in CEO remuneration is explained by the change in EBIT. The regression for EBIT (Financial, Mineral and Service) and EBITDA (All Companies and Financial) is significant and there is a deviation from zero ($0.13 < R^2 > 0.25$), but in the rest of the analyses, the regression is practically important and large enough that a linear relationship between the different company size determinants and CEO remuneration exists ($R^2 > 0.25$).

Table 2. Regression and correlation analysis between CEO remuneration and company size determinants

			Intercept			x-variable		
All companies	R^2	n	Coefficient R'000 #	p-value	*H0*	Coefficient R'000	p-value	H0
Total assets (1)	0.33	244	6.14	0.003***	Reject	3.5750	<0.001***	Reject
Total assets (2)	0.37	244	97.48	<0.001***	Reject	0.2575	<0.001***	Reject
Market value of assets	0.39	244	107.67	<0.001***	Reject	0.2477	<0.001***	Reject
Total equity	0.37	244	97.51	<0.001***	Reject	0.2731	<0.001***	Reject
Market capitalisation	0.36	241	137.80	<0.001***	Reject	0.2431	<0.001***	Reject
Revenue	0.45	244	174.16	<0.001***	Reject	0.2318	<0.001***	Reject
Total costs	0.51	230	86.30	<0.001***	Reject	0.2813	<0.001***	Reject
EBIT*	0.13	244	7198.90	<0.001***	Reject	0.0004	<0.001***	Reject
EBITDA**	0.24	244	6543.58	<0.001***	Reject	0.0005	<0.001***	Reject
Staff costs	0.57	231	130.16	<0.001***	Reject	0.2883	<0.001***	Reject
Number of personnel	0.46	194	690.92	<0.001***	Reject	0.2797	<0.001***	Reject
Financial								
Total assets (1)	0.39	68	0.21	0.301***	Not reject	5.0532	<0.001***	Reject
Total assets (2)	0.42	68	21.82	<0.001***	Reject	0.3184	<0.001***	Reject
Market value of assets	0.40	68	31.58	<0.001***	Reject	0.2942	<0.001***	Reject
Total equity	0.27	68	75.79	<0.001***	Reject	0.2644	<0.001***	Reject
Market capitalisation	0.31	68	61.41	<0.001***	Reject	0.2713	<0.001***	Reject
Revenue	0.46	68	49.49	<0.001***	Reject	0.3130	<0.001***	Reject
Total costs	0.49	54	69.41	<0.001***	Reject	0.3003	<0.001***	Reject
EBIT**	0.24	68	5707.51	<0.001***	Reject	-0.007	<0.001***	Reject
EBITDA**	0.20	68	5944.66	<0.001***	Reject	-0.008	<0.001***	Reject
Staff costs	0.66	56	128.64	<0.001***	Reject	0.2968	<0.001***	Reject
Number of personnel	0.45	42	923.28	<0.001***	Reject	0.2650	<0.001***	Reject
Manufacturing								
Total assets (1)	0.54	78	1.19	0.845	Not reject	4.5488	<0.001***	Reject
Total assets (2)	0.58	78	58.03	<0.001***	Reject	0.3046	<0.001***	Reject
Market value of assets	0.58	78	81.86	<0.001***	Reject	0.2783	<0.001***	Reject
Total equity	0.55	78	69.03	<0.001***	Reject	0.3079	<0.001***	Reject
Market capitalisation	0.54	78	147.55	<0.001***	Reject	0.2503	<0.001***	Reject
Revenue	0.62	78	34.87	<0.001***	Reject	0.3358	<0.001***	Reject
Total costs	0.61	78	34.86	<0.001***	Reject	0.3378	<0.001***	Reject
EBIT	0.59	78	5476.66	<0.001***	Reject	0.0014	<0.001***	Reject
EBITDA	0.56	78	5481.41	<0.001***	Reject	0.0010	<0.001***	Reject
Staff costs	0.64	78	56.27	<0.001***	Reject	0.3460	<0.001***	Reject
Number of personnel	0.52	73	504.79	<0.001***	Reject	0.3075	<0.001***	Reject
Mineral								
Total assets (1)	0.45	45	19.96	0.003***	Reject	3.0476	<0.001***	Reject
Total assets (2)	0.49	45	149.46	<0.001***	Reject	0.2402	<0.001***	Reject
Market value of assets	0.46	45	184.21	<0.001***	Reject	0.2257	<0.001***	Reject
Total equity	0.51	45	138.77	<0.001***	Reject	0.2541	<0.001***	Reject
Market capitalisation	0.42	42	227.59	<0.001***	Reject	0.2213	<0.001***	Reject
Revenue	0.45	45	728.05	<0.001***	Reject	0.1491	<0.001***	Reject
Total costs	0.45	45	222.35	<0.001***	Reject	0.2228	<0.001***	Reject
EBIT*	0.15	45	8323.90	<0.001***	Reject	0.0003	<0.001***	Reject
EBITDA	0.37	45	6400.61	<0.001***	Reject	0.0005	<0.001***	Reject
Staff costs	0.47	44	244.40	<0.001***	Reject	0.2467	<0.001***	Reject
Number of personnel	0.49	33	625.63	<0.001***	Reject	0.3007	<0.001***	Reject
Service								
Total assets (1)	0.52	53	0.93	0.954	Not reject	4.7130	<0.001***	Reject
Total assets (2)	0.53	53	42.31	<0.001***	Reject	0.3288	<0.001***	Reject
Market value of assets	0.55	53	59.41	<0.001***	Reject	0.2953	<0.001***	Reject
Total equity	0.52	53	43.20	<0.001***	Reject	0.3440	<0.001***	Reject
Market capitalisation	0.48	53	128.43	<0.001***	Reject	0.2540	<0.001***	Reject
Revenue	0.60	53	38.10	<0.001***	Reject	0.3294	<0.001***	Reject
Total costs	0.58	53	39.99	<0.001***	Reject	0.3285	<0.001***	Reject
EBIT*	0.25	53	7004.27	<0.001***	Reject	0.0007	<0.001***	Reject
EBITDA	0.26	53	6896.06	<0.001***	Reject	0.0005	<0.001***	Reject
Staff costs	0.52	53	59.01	<0.001***	Reject	0.3412	<0.001***	Reject
Number of personnel	0.49	46	336.73	<0.001***	Reject	0.3568	<0.001***	Reject

 # Transformed intercept (except for EBIT and EBITDA where actual numbers are used).

** Regression was not sensible, only 13% of the variance is explained.*

*** Regression is significant and there is a deviation from zero.*

**** Significant at 1% (two-sided).*

The coefficients of the intercept (transformed values, except for EBIT and EBITDA) and the x-variables are provided as well as the applicable p values, which indicate with how much confidence H_0 is rejected or not rejected. Regarding Total Assets (1) for financial, manufacturing and service companies, H_0 is not rejected, implying that the indicated intercept is not significant and could be zero. In the rest of the analyses, H_0 will be rejected at a significance level of one per cent, implying the intercepts are significant. In the two cases where a log transformation was not performed, i.e. EBIT and EBITDA, the coefficients of the intercept are for all the company groups higher than the average and the median CEO remuneration, implying that a CEO's fixed remuneration, regardless of the company size, should be higher than the average and/or median remuneration. These high intercept values lead to extremely low x-variable coefficients, implying a very flat regression line. For the financial companies, the x coefficients are even negative, implying a negative slope. H_0 will be rejected at a significance level of one per cent in all of the analyses regarding to the x variable.

According to the findings in this section, it is clear that the following company determinants may be applied as proxies for size, namely statement of financial position-based items, total assets (including intangible assets), market value of assets, total equity and market capitalisation; and statement of comprehensive income-based items, revenue and total cost. The profitability measures, EBIT and EBITDA, and the total assets (excluding intangible assets) are not recommended to use, because their relationship with CEO remuneration is practically not important. Furthermore, staff costs and the number of personnel seem to be excellent proxies for company size, but not all the companies disclose these items.

Technical and scale efficiency (second objective)

To reach the second objective of the study, an input-output DEA model is required to calculate the efficiencies, where the input variable is CEO remuneration and the output variables are multiple determinants of company size. From the above-mentioned recommended size proxies, it was decided to apply two items each from the statement of financial position and statement of comprehensive income. To ensure a variety in the data market values of assets and total equity, the largest and the smallest components in the statement of financial position, respectively, were selected. The two recommended size proxies from the statement of comprehensive income, revenue and total costs, are also included. To summarise, in the DEA model, the input and output variables are:

Input: x_1 = *CEO remuneration*
Output: y_1 = *Market value of assets*
y_2 = *Total equity*
y_3 = *Revenue*
y_4 = *Total cost*

For a company to be technically efficient, it should use as little as possible input (CEO remuneration) relative to as high as possible multiple outputs (company size). Normally, an item such as total costs will not be selected for an output variable, since companies aim to lower costs, but within this context, total costs (and the other three output variables) represent the company size, with the assumption that companies are aiming to expand their size. After the data were cleaned up by eliminating outliers, especially from the financial sector, descriptive statistics were calculated to present the following summary of the data per sector (Table 3).

Table 3. Descriptive statistics of input and output variables in DEA model (rand million) (n = 231)

Sector	Average	Median	Standard deviation	Minimum	Maximum
Financial (n= 56)					
CEO pay	7.01	4.34	7.12	0.20	31.69
Asset MV	166785	13783	396342	113.08	1909039
Equity	16183	2965	30358	3.60	152648
Revenue	14289	1102	35826	3.00	225425
Total cost	2511	103	5736	0.51	25255
Manufacturing (n = 78)					
CEO pay	7.77	6.08	9.02	1.73	70.15
Asset MV	30308	3318	106519	125.08	877256
Equity	9385	1524	29782	70.02	229541
Revenue	15287	4537	34020	38.02	199741
Total cost	2312	668	4704	10.00	22444
Mineral (n = 44)					
CEO pay	8.61	5.54	9.41	0.52	53.67
Asset MV	44750	3475	109599	1.36	629728
Equity	19790	2474	51922	7.77	312330
Revenue	20905	2088	46876	0.04	247538
Total cost	3552	662	7843	5.18	43927
Service (n = 53)					
CEO pay	8.20	5.78	8.18	1.08	50.00
Asset MV	31442	5093	73598	75.40	446218
Equity	6758	1208	17906	53.26	119771
Revenue	16605	5288	27755	13.95	147917
Total cost	2127	792	2969	2.01	10369

Software, purposefully developed by Zhu (2009), was used to calculate the input-orientated technical efficiency estimates to determine how efficiently each company is relative to the other

companies in its sector. Using both the TE_{VRS} and TE_{CRS}, the model is capable to also provide the relative scale efficiency of each company, since SE = TE_{CRS}/TE_{VRS}. Table 4 exhibits a summary of the three efficiency estimates. For a more detailed analysis, each sector has been broken up into quadrants according to the ranking of CEO remuneration. To explain, the average TE_{VRS} of 0.261, 0.516, 0.236 and 0.443 for financial, manufacturing, mineral and service companies, respectively, implies that the input, CEO remuneration, should on average decrease by 73.9, 48.4, 76.4 and 55.7% for this group of companies, respectively, to operate on the less restricted VRS efficiency frontier. Table 4 provides clear evidence that companies with lower levels of CEO remuneration tend to have higher TE_{VRS} values, implying that they will find it easier than larger companies to move to the VRS frontier.

The average TE_{CRS} of 0.175, 0.190, 0.102, and 0.246 for financial, manufacturing, mineral and service companies, respectively, indicates the overall possible improvement, implying that, on average, companies in those groups should reduce CEO remuneration by 82.5, 81.0, 89.8 and 75.4%, respectively, to operate on the CRS frontier. In other words, from an input-oriented approach, CEO remuneration should on average be reduced by these latter percentages to enable the companies to linearly scale their CEO remuneration and size without changing the remuneration-to-size ratio. Manufacturing companies, and to a lesser extent service companies, show a trend suggesting that it is easier for larger companies to operate on the CRS frontier than it is for smaller companies.

The average scale efficiency of 0.574, 0.353, 0.371 and 0.524 for financial, manufacturing, mineral and service companies, respectively, indicates that those groups of companies should reduce CEO remuneration by another 42.6, 64.7, 62.9 and 47.6% to move from the VRS frontier to the CRS frontier to achieve economies of scale. The results regarding scale efficiency of all four sectors are similar, namely the scale efficiencies are the highest in quadrant 1, second highest in quadrant 2, followed by quadrants 3 and 4. Table 4 also exhibits that only two, three, two and two companies in the financial, manufacturing, mineral and service sectors, respectively, achieved CRS, implying that only those nine companies are fully scale efficient. Although the CRS approach is based on the assumption that companies are able to linearly scale their inputs and outputs without changing their efficiency, its value is that it has helped to arrive at the conclusion that 54, 75, 42 and 51 companies in the financial, manufacturing, minerals and service sector, respectively, did not achieve economies of scale. A few of these companies fall in the DRS part of the operation function, implying that they are too large in their scale of operations. The majority of the companies fall in the IRS part of operation, implying that they are too small in their scale of operations.

Table 4. Average CEO Remuneration, average SE and return to scale per sector per quadrant

		Efficiencies			Return to scale		
n	CEO pay	TE CRS	TE VRS	SE	CRS	IRS	DRS
Financials n = 56							
Q1	17384	0.204	0.262	0.794	0	12	2
Q2	5765	0.223	0.252	0.621	2	12	0
Q3	3382	0.145	0.198	0.540	0	14	0
Q4	1501	0.129	0.332	0.342	0	14	0
ALL	7008	0.175	0.261	0.574	2	52	2
Manufacturing n = 78							
Q1	16711	0.374	0.470	0.684	3	15	2
Q2	6817	0.163	0.388	0.356	0	20	0
Q3	4437	0.130	0.491	0.243	0	19	0
Q4	2681	0.083	0.724	0.114	0	19	0
ALL	7767	0.190	0.516	0.353	3	73	2
Mineral n = 44							
Q1	20828	0.160	0.194	0.713	1	6	4
Q2	7365	0.116	0.179	0.470	0	9	2
Q3	4317	0.035	0.151	0.191	0	11	0
Q4	1935	0.096	0.419	0.110	1	10	0
ALL	8611	0.102	0.236	0.371	2	36	6
Service n = 53							
Q1	18254	0.317	0.363	0.837	0	11	3
Q2	7247	0.430	0.510	0.730	2	10	1
Q3	4436	0.086	0.286	0.288	0	13	0
Q4	2105	0.144	0.618	0.218	0	13	0
ALL	8204	0.246	0.443	0.524	2	47	4

4. Conclusion

The first objective of the study was to empirically test a number of company size determinants' significance as size proxies in benchmarking CEO remuneration for the different sectors. The hypothesis test was helpful to find that the following determinants can be used as proxies for company size, namely from the statement of financial position, total assets (including intangible assets), market value of assets, total equity and market capitalisation; and determinants from the statement of comprehensive income, revenue and total cost. The high determination coefficients ($R^2 > 0.25$) and the confidence level of rejecting the null-hypothesis ($p < 0.01$) regarding to all these determinants in all sectors, led to the conclusion that they are on their own suitable proxies for company size and no further combinations, for example joint determinants from the statement of financial position and statement of comprehensive income, are necessary.

What makes this study unique is that it also investigated the extent to which companies are able to linearly scale their CEO remuneration and size without changing the remuneration-to-size ratio. An analysis of technical efficiencies according to the CRS and VRS approaches and scale efficiency has been done. The low average TE_{VRS} efficiency estimates of 0.261, 0.516, 0.236 and 0.443 for financial, manufacturing, mineral and service companies, respectively, led to the conclusion that most companies are not able to operate on the VRS frontier. The even lower average TE_{CRS} efficiency estimates of 0.175, 0.190, 0.102, and 0.246 for financial, manufacturing, mineral and service companies, respectively, led to the conclusion that all the companies in the sample, except the nine that achieved economies of scale (SE = 100%), are not able to keep the remuneration-to-size ratio constant when changing the CEO remuneration and/or the company size. Only nine companies are operating on the CRS frontier, implying that they achieved economies of scale. The majority of the companies fall in the increasing return to scale part and few in the decreasing return to scale part of the production function. To explain, say, for example, that the CEO remuneration is dependent on the company size as measured by total assets and the company can achieve economies of scale by paying its CEO 100 monetary units within a specific period; if it is operating on an increasing return to scale, it may, for example, require 50 per cent of the total assets to pay ten per cent of CEO pay, namely ten monetary units. On the opposite side, if it is producing on a decreasing return to scale, it may require, for example, three times as many total assets only to double the CEO pay. The value of this study is that it contributes to the literature because it indicates suitable proxies for company size when benchmarking CEO remuneration. Furthermore, the study concluded that the majority of companies are not able to linearly scale their CEO remuneration and company size without changing the remuneration-to-size ratio. The value of the study lies in the practical implication that many company size determinants are identified that can be used by board members to benchmark their CEO's package. Furthermore, the conceptual theory of scaling is to a great extent rejected, since only nine of 231 companies in the sample investigated could achieve economies of scale. Since most of the companies operate on the increasing return to scale part of the production function, analysts investigating CEO remuneration must keep this phenomenon in mind, i.e. that the remuneration-to-size ratio mostly favours CEOs. Further research that is recommended is to also investigate the scaling issue when other determinants of CEO remuneration, especially company performance, are included.

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