BENCHMARKING CEO COMPENSATION: DEVELOPING A MODEL FOR DIFFERENT BUSINESS STRATEGIES

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Abstract

Porter's generic business strategies of cost leadership and differentiation were adjusted to make them applicable to CEO compensation strategies. The cost leadership strategy equates to a firm that attempts to signal that their CEO is not over paid, not reaping off much of the profits, but is compensated according to best practices. The differentiation strategy relates to a firm that believes it is important to signal that their CEO is above average and therefore should earn an above average compensation. The purpose of the study was to develop a data envelopment analysis (DEA) model with two stages. The first provides a best practice frontier to benchmark segments of CEO compensation against determiners thereof, including firm-, CEO- and governance characteristics. Firms with different strategies will then position themselves differently to the best practice frontier. Irrespective of the strategy chosen at the first stage, the second stage estimates how efficient firms are to convert the above-mentioned determiners into multiple performance measures. The contribution of the study is that employing such a model may change the philosophy of how firms look at CEO compensation, for example firms whose CEOs are at the bottom half are not necessarily below average or underpaid, but signal that their CEOs are compensated according to best practices.

Keywords: Benchmarking; Best Practice; Business Strategy; CEO Compensation; Cost Leadership; Differentiation; Efficiency

1. INTRODUCTION

CEO compensation is a controversial study field where theory and practice do not always match (Edmans and Gabiax, 2009). Early studies (Jensen and Murphy, 1990) as well as recent studies (Hussain et al., 2014) all concluded that researching the pay-performance issue leads to a stream of inconsistent findings. These findings are not only inconsistent with theory, but also between the studies (Tosi et al., 2000).

In studying the CEO pay-performance sensitivity, Bussin (2015) identified three pay-performance theories. Firstly is the agency theory, which is the most prominent and the golden thread through previous studies (De Wet, 2012). This theory explains the shareholder (principle)-manager (agent) relationship and how shareholders delegate their power to management (Olivey, 2014). This theory was tested in studies such as Chourou et al. (2008), Gregory-Smith and Main (2014), Callan and Thomas (2012), Abraham et al. (2014) and Kuo et al. (2012). The second is the optimal contracting theory, which aligns managers and shareholders' interest by means of financial incentives (Jensen and Meckling, 1976). This theory was tested by, *inter alia,* Kuo et al. (2012). Edmans and Gabiax (2009) found that the practice shows that CEOs, rather than the boards, determine their pay. This is evident of the third, managerial power theory, i.e. where CEOs aim to control factors that are linked to their pay. This theory was tested, *inter alia,* by Farmer et al. (2010). To further complicate the pay-performance issue, other theories are also tested as part of CEO compensation studies. They are for example the human capital theory (Fulmer, 2009; Abraham et al. 2014), economic theory (Faleye et al., 2013), tournament theory (Faleye et al., 2013; Lee et al., 2008) and the relative performance theory (Farmer et al., 2013).

The complexity is further emphasised by the many determinants of CEO compensation. Tosi et al. (2000) did a meta-analytical study analysing 137 articles or unpublished manuscripts and identified 46 determinants of CEO compensation. Van Essen et al. (2012) analysed 219 US-based studies and identified 26 determinants. In a similar study, Doucouliagos et al. (2012) analysed 44 UK-based studies and identified 16 determinants. These many determinants make the sensitivity of CEO compensation a difficult topic to study and when linear regression analysis (LRA) is used, a number of control variables need to be embraced (Usman et al., 2015; Reddy et al., 2015).

Finally, another phenomenon found in CEO pay-performance studies is the emergence of the Lake Wobegon effect (which is jeering to a situation where everybody is above average). Since no firm will signal they have a below average CEO, they ensure that their CEO's compensation is above the average (or mean) CEO compensation in their peer group (Hayes and Schaefer, 2009), because a firm's status partly depends on its CEO's pay and status (Peetz, 2015). This results in an ever-increasing of CEO compensation, and subsequently if one CEO gets an

increase, all the others will follow, even if it is not substantiated by their (or the firm's) performance.

To summarise, there are many studies investigating various CEO compensation theories, and the large number of CEO compensation determinants and the Lake Wobegon effect, which is evident in some studies, widen the gap between pay and performance. In my opinion, it is not the duty of the academe to prescribe to the practice how they should operate their businesses and remunerate their CEOs. It will be much more helpful to provide the support that they need, i.e. a model to benchmark CEO compensation, which fits the subjacent strategy of a firm. Therefore, this study is approached from a different angle, namely to diverge from pay-performance theories and rather focus on different business strategies. Consequently, this study applies two of Porter's generic strategies, i.e. cost leadership and differentiation (Porter, 1980).

1.1. Problem statement and purpose of the study

Cost leadership is where a firm's strategy is to minimise costs continuously to offer lower prices to their customers, which leads to an increase in its market share. The differentiation strategy is where a firm distinguishes itself from rivals by providing goods or services that are of a higher quality (Griffin, 2014). Applicable to CEO compensation, the cost leadership strategy equates to a firm that attempts to signal that their CEO (and other executives) is not over paid, not excessively reaping off much of the profits, but is compensated according best practices. The differentiation strategy relates to a firm that believes it is important to signal that their CEO is above average and therefore should be compensated accordingly (above average pay). These two strategies can also be combined.

With the focus on the two above-mentioned strategies, cost leadership and differentiation, the problem is that there is no single model that can accommodate both these opposing strategies. What is needed is a model that simultaneously provides a best practice benchmarking frontier – where the cost leadership type of firm would strive to operate on the benchmark frontier and the differentiation type of firm would strive not to operate on. Furthermore, whatever the strategy of the firm, it still needs to align to some extent CEO compensation with performance.

The purpose of the study is to develop a model with two stages. The first is where the segments of CEO compensation are evaluated relative to various determinants thereof. The aim is to assist firms with different CEO compensation strategies to position themselves relative to their peers. The second is where the firms' performances are evaluated relative to the same determinants. The link between CEO compensation and performance measures is that the selected determinants are simultaneously drivers for CEO compensation and firm performance.

The contribution of the study is that employing such a model may change the philosophy of how firms look at CEO pay. The argument is that firms probably do not want to articulate that their CEO is at the bottom half, implying the CEO is either relatively underpaid or relatively below average. This is a negative signal to the market. Applying this study's model will signal that this hypothetical firm is not part of the bottom half or underpaid, but it is rather relatively efficient and operating close to or on the efficiency frontier, and also compensating their CEO according to best practices. Furthermore, CEO compensation and firm performance are linked by evaluating both of them relative to the same determinants.

1.2. Method

This study involves model-building and is all about questioning existing practices of studying CEO compensation. Science needs theories and models to make progress. "A model is a set of statements that aims to represent a phenomenon or set of phenomena as accurate as possible." (Mouton, 2011:177). The model-building process is part of conceptual types of studies, which is largely based on the critical engagement and the understanding of concepts, given secondary sources (Nieuwenhuis, 2013). To fulfil the purpose of the study, a two-stage data envelopment analysis (DEA) model is built. DEA is a useful tool to evaluate performance and benchmarking against best practice (Cook et al., 2014). It is a non-parametric linear programming technique that aggregates the efficiency of each stage into a single estimate of a comparative ratio of weighted multiple inputs to weighted multiple outputs for each firm, known as a decision-making unit (DMU) (Avkiran, 2011). In this model, the first stage provides a best practice frontier to benchmark multiple components of CEO compensation as input variable against multiple outputs, which are a variety of determinants of CEO compensation. The second stage, where the outputs of the first stage automatically form the input of the second stage, provides an estimate to indicate how efficient DMUs (firms) are to convert the mentioned determinants into multiple performance measures.

The layout of the study is as follows: The next section provides the conceptual scope, i.e. the parameters wherein the study is accomplished, the explanation of DEA, a literature review and finally the statement of two research questions. This is followed by the theory section, including the summary of the argument, model formulation, a detailed justification of the model, and explaining the model by means of a case study. This is followed by a discussion, including the conclusion of the study.

2. BACKGROUND

2.1. Conceptual scope

This study is performed within the conceptual scope of logic; firstly, to evaluate CEO compensation levels relative to determinants thereof, namely firm-, CEO- and governance characteristics. The determinants are explained as follows:

- Firm characteristic, e.g. firm size: A large firm's CEO should be relatively higher paid than a small firm's CEO, since a larger firm is probably more complex, for example it has more assets and employees for which the CEO is responsible.
- CEO characteristics, e.g. CEO skills and capabilities: A higher skilled and capable CEO should be relatively higher compensated than a CEO with fewer skills and capabilities.
- Governance characteristics, e.g. level of board involvement/control: A more controlling board requires more responsibilities from the CEO, for example the board requires probably more frequent, more accurate and more detailed feedback from its

CEO. Therefore, a relatively higher quality of work is expected from the CEO, which should lead to a relatively higher compensation.

The relative compensation established by the three above-mentioned determinants will further be influenced depending on a firm's strategy, cost leadership, differentiation or a combination of the strategies. A cost leadership type of firm will compensate the CEO according to best practices; for example, if two firms of a similar size remunerate their CEOs at different levels, the best practice is to compensate the CEO closely at the lower level of the two. In the contrary, the differentiation type of firm will prefer to compensate their CEO closely to the higher level of the two.

The second logic is that the determinants of CEO compensation are also determinants of the firm's performance. The links between them are as follows:

- Firm characteristic, e.g. firm size: A large firm's performance should be relatively higher in monetary value than a small firm; for example, its profits and market value will be relatively higher, and *vice versa*.
- CEO characteristics, e.g. CEO skills and capabilities: A higher skilled and capable CEO should have a relatively higher positive impact on firm performance (profits and market value), and *vice versa*.
- Governance characteristics, e.g. level of board involvement/control: A more controlling board improves the quality of the work of the CEO and other executives. Therefore, relatively better management should lead to a relatively higher performance, and *vice versa*.

To summarise, the determinants such as firm size, CEO skills and board control are positively related to monetary performance in terms of profits and market value of a firm. Nevertheless, to bring these multiple determinants within the context of efficiency, it should be determined how efficient firms are to convert them into multiple monetary performance measures. For example, if two firms of a similar size (e.g. total assets) have different profit levels, the relative efficient firm is the one with the higher profit and the inefficient firm the one with the lower profit.

2.2. Data envelopment analysis

DEA provides a single aggregated answer that compares the efficiency of how multiple inputs are converted into multiple outputs by a DMU, relative to other DMUs in the sample (Liu and Wang, 2009). Therefore, the relative efficiency of DMUs not laying on the frontier can be estimated, relative to those who are operating on the frontier, which is also known as the best practice frontier. Consequently, targets for inefficient DMUs can be estimated to improve their performance, in other words to determine how much inputs should decrease and/or outputs should increase to allow them to operate on the best practice frontier.

DEA assumes that if a DMU is capable of producing a certain output by a given set of inputs, then other DMUs should also be capable of doing the same to be operated on the efficiency frontier (Anderson, 1996). Care must be taken if DEA is applied when a real production function does not exist. That is, for example, when there is no clear link of how resources (inputs) are directly converted into outputs. In such a case, "the meaning of efficiency as a distance to the frontier may no longer be valid. However, DEA still yields information on relative distance to the best-practices" (Cook et al., 2014).

Farrel (1957) was the first to establish the concept of a satisfactory measure for productive efficiency that takes account of multiple inputs. Charnes et al. (1978) built on this idea and developed the CCR (Charnes, Cooper and Rhodes) model, which was based on the assumption of constant return to scale (CRS), implying a DMU is automatically considered to be fully scale efficient (Coelli et al., 2005; Alvandi et al., 2013). This is because CRS assumes a proportionate rise in outputs when inputs are increased (Avkiran, 1999). Banker et al. (1984) developed the BCC (Banker, Charnes and Cooper) model, which is an extension of the CCR model (Alvandi et al., 2013), which accommodates variable return to scale (VRS), which implies a disproportionate rise or fall in outputs when inputs are increased, or in other words, if a DMU grows in size, its efficiency will not remain constant, but will either rise or fall (Avkiran, 1999).

The researcher has to choose among the model options of input minimisation and output maximisation with the DEA. Input minimisation (input-orientated approach) examines the extent to which inputs can be reduced while maintaining output levels. Alternatively, output maximisation (output-orientated approach) investigates the extent to which outputs can be raised given current input levels (Cook et al., 2014).

2.3. Literature review

The aim of this literature review is primarily to investigate the variables (determinants) and methods used by previous researchers to establish a basis to build a new model. Although Tosi et al. (2006) found that cash compensation is an excellent proxy for total CEO compensation, researchers prefer to break it up into different components. Researchers argue, for example, that cash compensations such as salaries are a function of firm size, while bonuses are a function of performance (Griffith et al., 2011; Stanwick and Stanwick, 2001). Therefore, Bussin (2015) segmented the financial reward system suggested by 21st Century Solutions, namely that fixed (or guaranteed) pay consists of a base salary plus benefits. The variable pay consists of short- and long-term incentives. The guaranteed pay plus the short-term incentives is the total cost of employment and if the long-term incentives are added hereto, then the total cost to company is determined. The latter segmentation of CEO compensation forms the multiple inputs of the first stage of the DEA model; that is to be compared to the determinants of CEO compensation that form the multiple outputs of the first stage of the DEA model.

Many independent variables as determinants of CEO pay have been identified, e.g. Van Essen et al. (2012) identified 26, Doucouliagos et al. (2012) 16 and Tosi et al. (2000) 46 of which 16 are measures of size and 30 are measures of performance. This number can be reduced; for example, the study of Tosi et al. reports similar determinants such as net income before extraordinary items, net income for previous year, net income for two years, etc. Nevertheless, it makes sense that researchers group determinants together, for example firm, CEO and governance characteristics (Brick et al., 2005), or size, performance and governance (Nulla, 2013), or

performance, risk, size, leverage and ownership (Gunasekaragea and Wilkenson, 2002), or performance and size (Tosi et al., 2000), or ownership, board, size and performance (Reddy et al., 2015). It is evident from prior literature that firm size is the most significant determinant of CEO compensation and proved to be constant with a positive relationship (Sigler, 2011). Maybe the most sensible categorisation is presented by Alves et al. (2014) with CEO pay as the dependent variable and the following five categories the independent variables: performance, firm characteristics, CEO characteristics, board and director characteristics, and shareholder and ownership characteristics. To simplify the model to be developed, determinants are grouped into three categories, namely firm-, CEO- and governance characteristics.

Each of these determinants can be broken up into more detailed components. For example, Usman et al. (2015) identified six governance components, namely board size, percentage of non-executive directors on the board, duality, independence of the chairman, CEO shareholding, and board shareholding. These governance components are primarily an indication of the level of controlling the firm. A variety of firm characteristics were identified. For firm size, the monetary value of sales, total assets, profits and the book- and market value of equity and the number of employees have previously been used as proxies for firm size (Oberholzer and Barnard, 2015). Other firm characteristics, except size and performance measures, include the ratios of research and development expenditure relative to assets, tangible assets to total assets and capital expenditure to total assets and some risk measurements such as cashflow risk, stock volatility and the debt-to-asset ratio (leverage) (Brick et al., 2005). CEO characteristics consist of items such as CEO age, tenure, education and shareholding (Alves et al., 2014).

Firm performance measures are not treated as part of firm characteristics, since they form the outputs of the second stage of the DEA model, which are compared to the inputs of the second stage (the outputs of the first stage), i.e. the determinants of CEO pay. Many different performance measures have previously been used, and are divided into accounting-based measures such as return on equity and return on assets, and market-based measures such as return to shares and variations of the market-to-book ratio (Oberholzer and Barnard, 2015).

Previous studies primarily used regression analysis where the CEO compensation is the dependant variable; the independent variables are those that investigated having a relationship with the dependent variable and control variables are also included to ensure validity (Usman et al., 2015; Shin, 2013; Chhaochharia and Grinstein, 2009). Thanassoulis (1993) listed some advantages that LRA has over DEA, but also the advantages of DEA over LRA. To justify the preference of DEA in this study, the following three advantages are important:

- "DEA is a non-parametric method not requiring the user to hypothesize a mathematical form for the production function.
- DEA measures performance against efficient rather than average performance.
- DEA can cope more readily with multiple inputs and multiple outputs."

Therefore, DEA is suitable to set a best practice frontier instead of a regression line that represents the average performance and the multiple component of CEO compensation (salary plus benefits, short-term and long-term incentives) can be included separately in a single model together with multiple determinants of CEO compensation. DEA is a widely used technique, but has not received much attention in CEO or executive compensation studies. There are only a limited number of studies that have previously employed DEA. Other authors who employed DEA in studying CEO remuneration are Cordeiro et al. (2006), Chen et al. (2008) Oberholzer and Theunissen (2012), and Theunissen (2012), who investigated DEA models to benchmark CEO remuneration as an alternative for regression analysis.

2.4. Research questions

A two-stage DEA model is the choice for this study. Within the conceptual scope with the two opposed generic strategies of cost leadership and differentiation, adapted for this study, the first research question is:

How is CEO compensation, broken-up into multiple segments, given the multiple determinants thereof, namely firm-, CEO- and government characteristics, benchmarked?

The first stage of the DEA model deals with this question. Answering this question indicates to the firm with a cost leadership strategy by how much their CEO's pay should be decreased to reach the best practice frontier. In other words, given factors such as firm size, firm risk, CEO age, CEO tenure and the level of control, best practice compensation can be determined. A firm with a differentiation strategy can also determine a CEO compensation that is distant from the best practice frontier.

The second stage of the DEA model deals with the second research question, namely:

How to estimate the efficiency of firms to convert multiple firm-, CEO- and governance resource inputs into multiple performance outputs?

Answering this question, irrespective of the firm's choice of generic strategy, how efficient resources such as firm assets, number of employees, the CEO's age, experience and qualification, and the involvement of the board and shareholders controlling the firm, etc. are converted into performance outputs such as profits and market value gains.

3. THEORY

3.1. Summary of argument

The first argument is that the strategy of cost leadership and differentiation in conjunction with firm-, CEO- and governance characteristics influence CEO pay. The second is that the CEO is not solely responsible for the firm's performance. The performance is a function of the CEO, firm- and governance characteristics of a firm. Against this backdrop, a model should be developed.

3.2. Model formulation

To answer the two research questions, a two-stage DEA model is needed. The first stage of the DEA model relates to the first question. The first question (How to estimate the optimal CEO pay, based on the best practice, given the firm-, CEO- and government characteristics of a firm) falls outside the definition of a real production function. The link is not clear to determine how efficient firms are to convert the input of CEO compensation into firm-, CEO- and governance

characteristics. Therefore, the DEA model can still provide an answer on the relative distance to the best practice. An input-oriented model reveals the distance, that can be converted to a monetary value to determine by how much CEO compensation should be reduced to enable firms to operate on the best practice frontier. Furthermore, an input-oriented approach is preferred because it will probably be more meaningful to indicate by how much CEO compensation should be reduced than to determine by how much firm-, CEO- and governance characteristics should be increased in the case of an output-oriented approach.

The following equation (Zhu, 2009) is based on the input-oriented DEA model:

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

$$Subject\ to$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \theta x_{i0} \quad i = 1, 2, \dots, m;$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{r0} \quad r = 1, 2, \dots, s;$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

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

The value of θ^* represents the input-oriented efficiency score of DMU_0. If $\theta^* = 1$, DMU_0 lies on the (best practice) frontier. If $\theta < 1$, DMU_0 does not lie on the frontier and should decrease its input levels. DMU_0 represents one of the n DMUs under review and x_{i0} and y_{r0} are the ith input and rth output for DMU_0, respectively. Each observation, DMU_j ($j = 1,...n$), uses m inputs x_{ij} ($i = 1,2,...,m$) to produce s outputs y_{rj} ($r = 1,2,...,s$). The efficiency frontier will be determined by these n observations.

It is possible for the DEA to indicate an individual input reduction or output increase for a specific DMU in order to move it onto the frontier. These input reductions or output increases are called input or output slacks and are represented by s_i^- and s_r^+, respectively. The presence of ε in the input-oriented model allows the minimisation over θ to pre-empt the optimisation involving the slacks, s_i^- and s_r^+. The maximal reduction of inputs is firstly achieved by optimising θ. Then, secondly, the movement onto the frontier is achieved by optimising the slack variables.

The second research question is how to estimate the efficiency to convert firm-, CEO- and government characteristic inputs of firms into multiple performance outputs. It is clearly a real production function where the efficiency can estimate how the input resources (the firms, the CEO and the level of board involvement) can be converted into performance outputs such as profit and/or market value gains. An output-oriented approach is preferred for the second stage to answer the question by how much the outputs should be increased, given the set of input variables. The following equation (Zhu, 2009) is based on the output-oriented DEA model:

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

$$Subject\ to$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = x_{i0} \qquad i = 1, 2, \dots, m;$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = \phi y_{r0} \qquad r = 1, 2, \dots, s;$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

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

The value ϕ represents the output-oriented efficiency score of DMU_0. If $\phi = 1$, DMU_0 lies on the frontier. If $\phi > 1$, DMU_0 is inefficient and should increase its output levels. Similar to the input-oriented model, the output-oriented model is also calculated in a two-stage process by firstly calculating ϕ and then optimising the slacks by fixing ϕ. Suppose that in a particular application $\phi^* = 1.30$ is obtained. This means that all the outputs should be increased by 30% for the DMU to become fully efficient. Now suppose that $s_1^{+*} = 15$. This implies that output$_1$ can be further increased by 15 units. Moreover, if any one of the input slacks is strictly positive, the previous expansion of the outputs can be achieved while reducing individual inputs at the same time.

3.3. Detail justification

It is the prerogative of the researcher to decide which input and output variables should be included in the model. Nevertheless, they should be sensible, i.e. inputs should be minimised and outputs should be maximised to improve the efficiency rate. Consider for example a single input, CEO pay, and a single output, firm size in terms of total assets ($). This is not a real production function, because CEO pay cannot directly create total assets. This input-output exercise can indicate the distance how far a firm lies from the benchmark frontier. Consider two similar firms with both containing assets of $10. The only difference is that the CEO of Firm A receives pay of say $1 and the CEO of Firm B $2. In this example, Firm A is more efficient than Firm B. Firm A sets the benchmark, because its CEO is willing to work for $1 and if B want also to lie on the frontier, it should reduce its CEO pay from $2 to $1. The $1 pay, indicating where the frontier is, is also the best practice pay for this size of firm. Table 1 indicates the suggested input and output variables for the DEA model. The first stage focuses on the first research question of the study and the second stage on the second question.

Table 1. Two-stage DEA model

Input stage 1	*Output stage 1*	*Output stage 2*
• CEO salary & benefits • CEO short-term incentives • CEO long-term incentives	• Firm characteristics • CEO characteristics • Governance characteristics	• Market-based performance • Accounting-based performance

The aim of Stage 1 of the model is to set a benchmark pay (as input variable) where the determinants of CEO compensation are the output variables. It is unpractical to include all the

determinants of CEO pay as the output variables of Stage 1. For example, the 26 mentioned by Van Essen et al. (2012) or the 16 mentioned by Doucouliagos et al. (2012). The researcher can do a combination of two things; one, only select the most logical and sensible determinants, for example firm size, which is, according to several authors, the most significant determinant of CEO compensation; or two, combine as many as possible factors in a group (firm, CEO and governance) using indices or techniques such as the analytical hierarchy process (AHP) as suggested by Chen (2002). Wensley's (2013) example explains the selection of a CEO where there are three candidates, each with a different 1) age, 2) experience, 3) qualification and 4) charisma. Weights have to be directed to each of the four categories and each candidate obtains a single aggregated relative score. (See the literature review under section 2 for lists of examples of firm-, CEO- and governance characteristics that can be combined in a single measure.)

As stated, the selected variables should be sensible, i.e. inputs should to be minimised and outputs should to be maximised to improve the efficiency rate. This is applicable for both Stage 1 and Stage 2, where the outputs of Stage 1 are automatically the inputs for Stage 2. The following is an example of a detailed model (Table 2).

Table 2. Two-stage detailed DEA model

Input stage 1	*Output stage 1*	*Output stage 2*
• CEO salary & benefits • CEO short-term incentives • CEO long-term incentives	• Firm characteristics (Firm size) • CEO characteristics (Combined: age, tenure and qualification) • Governance characteristics (Combined: board size, board independence ratio, board shareholding)	• Market-based performance (total return to shares) • Accounting-based performance (net income)

The logic of this model is as follows: Stage 1:
Firstly, the larger the firm, the more complex and difficult it is for the CEO to manage the firm. Therefore, a positive relationship between CEO pay and firm size is hypothesised. The CEO age, tenure and qualifications (the higher the better) will positively influence pay. Thirdly, board size, board independence ratio and board shareholding indicated the degree of control. The argument is that the higher these scores, the higher the control is that increases the responsibility of the CEO and he/she should be remunerated accordingly. Although positive relationships are hypothesised, the best practice is found where the input-output differences are the largest. (See above example of Firm A and Firm B).

Stage 2 is an example of a production function where the estimation is how efficient a firm is to convert its assets (firm size), CEO skills and capabilities and the role of the involvement of the board in the management of the firm into performance outputs such as profits. For example, consider two firms: Firm A has assets of $5 and Firm B has assets of $10. Both yield a net income of $2. Firm A is efficient and a benchmark for Firm B. If B possesses double the amount of assets, then it should yield double the current net income ($4). Both a market-based and an accounting-based performance measure are recommended. For market-based, the total return to share included all the dividends paid plus the market value gains. For accounting-based, the net income represents the amount attributable to its shareholders, also known as the bottom-line.

3.4. Case study

To illustrate the two stages of the model, a simple case study that can be exhibited on a two-dimensional graph is used. Therefore, a single-input-two-output model is employed for Stage 1 and a single-output-two-input model for Stage 2. Consequently, not all the variables as indicated in Table 2 are employed. Nevertheless, this case study attempts to explain the consecutive links of the model, from CEO compensation to determinants thereof, and from these determinants to performance yields.

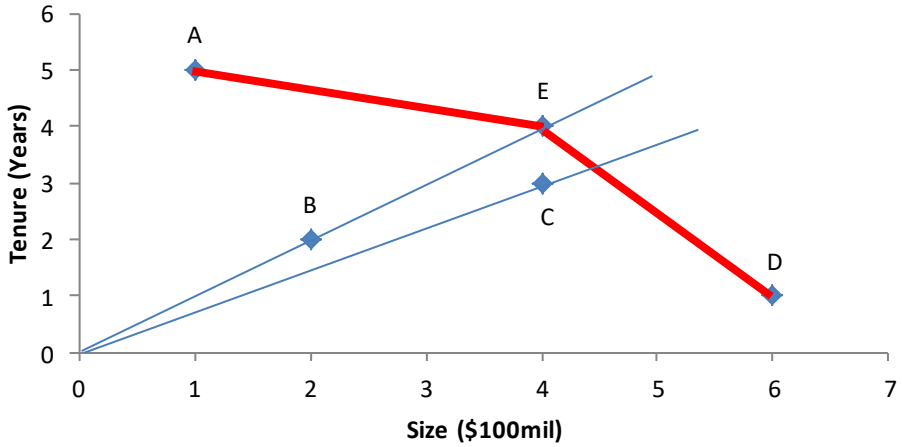
To ensure the validity of the study, the software provided by Zhu (2009) was used to calculate the efficiency scores. Assume five firms (A-E) and for the first stage only a single input, CEO pay, which is exactly the same for each firm. Assume two outputs, firm size (total assets) and CEO tenure (years) that are different for the five firms. Table 3 exhibits the data for Stage 1 and Stage 2. The two outputs for Stage 1 are the two inputs for Stage 2, which has a single output, namely profit, which is the same for all five firms.

Table 3. Case study example of a two-stage DEA model

Firm	*Stage 1*			*Stage 2*
	Input	*Output 1*	*Output 2*	*Output*
	CEO pay ($mil)	*Size ($100mil)*	*Tenure (years)*	*Profit ($10mil)*
A	1	1	5	2
B	1	2	2	2
C	1	4	1	2
D	1	6	1	2
E	1	4	4	2

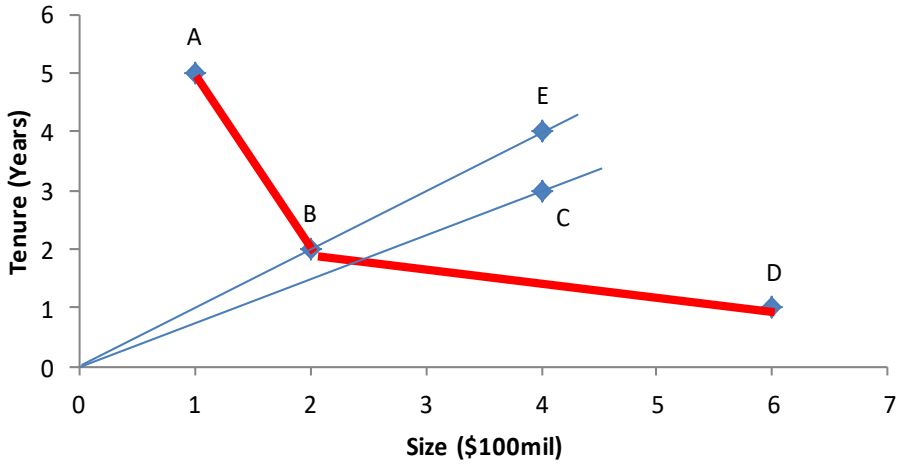
The graph below indicates the data for Stage 1, with AED representing the benchmark line (efficiency frontier). Firms B and C are not on the frontier, and the distance to it is important to them. Since an input-oriented approach is followed here, the question is by how much the input (CEO pay) of B and C should be decreased to enable them to also be on the efficiency frontier. Firm E presents the benchmarks for Firm B with θ = 0.5, implying that B should reduce its CEO compensation to 50% of its current level to be on the frontier. For Firm C, θ = 0.9, implying that it should reduce its CEO compensation to 90% of its current level to be on the frontier. Firm C's benchmark is a virtual Firm where 0C-extended intersects with the benchmark line AED, which represents 78% of Firm E and 22% of Firm D.

Figure 1. Stage 1: Input-oriented graph



The graph below illustrates the data for Stage 2. ABD is the efficiency frontier and Firms C and E are currently inefficient with ∅ = 1.6 and 2, respectively. That implies that Firms C and E should increase their outputs (profits) to 160% and 200%, respectively, of its current level to become fully efficient, operating on the benchmark line. Firm B is the benchmark for Firm E and Firm C's benchmark is a virtual firm where line 0C intersects with the benchmark line ABD, which represents 87.5% of Firm B and 12.5% of firm D.

Figure 2. Stage 2: Output-orientated graph



4. DISCUSSION

The study has reached its purpose to develop a model, employing DEA firstly to accommodate a cost leadership and a differentiation type of strategy applicable to benchmark CEO compensation. The cost leadership type of strategy represents in this study where a firm signals that its CEO is not overpaid, but paid according to best practices. A differentiation type of strategy represents where firms signal that their CEO is above average and paid accordingly.

Referring to the Stage 1 input-oriented graph, Firms A, D and E lie on the efficiency frontier, implying they either prefer a cost leadership strategy, paying their CEOs according to best practices, or they prefer a differentiation strategy, which then urges them to move from its current position to a point lower than the benchmark line. Firms B and C either prefer a differentiation strategy that wants to lie a distance from the benchmark line, or a cost leadership strategy that urges them to move from their current position towards the benchmark line.

No matter which strategy is preferred by a firm, the second part of the model is where the efficiency is estimated to convert those same determinants of CEO compensation (which are resources of the firm) into various performance measures, either accounting-based or market-based. The second graph representing Stage 2 applies an output-oriented approach.

Assume the positions in Stage 1 are where all the firms prefer to lie. Therefore, Firms A, E and D apply a cost leaders strategy and Firms B and C apply a differentiation strategy. Moving to the Stage 2 graph, Firms A and D appear on both benchmark frontiers and are examples of cost leaders who are also efficient to convert firm resources into yields. Firm B is an example of a differentiation strategy that is also efficient in converting firm resources into yields. Firm C is an example of a differentiation strategy that is inefficient to convert firm resources into yields.

Finally, Firm E is an example of a cost leadership strategy that is inefficient to convert firm resources into yields.

The main contribution of this study is that a model is developed where the relative efficiency to convert firm resources is link, but independent of the strategy that a firm prefers to compensate its CEO. Firms that currently prefer a differentiation strategy endeavour to signal a positive message to the market, namely that their CEO is better than the average and should be remunerated accordingly. Applying this model is an aid to look differently at this signalling issue. Opposed to the differentiation strategy, is the cost leadership – applying this model as cost leadership strategy also signals a positive message to the market, namely that the CEO is not overpaid, but is remunerated according to best practices. The limitation of the study is that only a selected number of CEO pay determinants are included in the model. Future studies can refine this model and include more determinants.

The final conclusion is that CEO pay-performance studies should not be dominated using the linear regression analysis approach. This gives an impression that CEOs under the regression line are probably below average or underpaid, while those above the regression line are above average and should be remunerated accordingly. This fuels the Lake Wobegon effect! This model, applying DEA, will assist firms whose CEOs are currently at the bottom half of their peer groups also to signal a positive message and limit the effect of ever continuous up-spiralling of CEO compensation without the support of applicable performance yields.

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