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Abstract	This paper proposes a combination of the Analytic Hierarchy Process with Goal Programming for a better valuation of companies. The methodology includes the economic dimension of the company and another based on its social responsibility. A set of relative and absolute economic variables is proposed including concepts like leverage, liquidity or solvency. For the CSR dimension, we present a set of variables extracted from sustainability reports based on the Global Reporting Initiative. This way, the whole methodology relies on publicly available data and can be readily reproduced. We prove the methodology with a complex case study involving the estimation of a German real estate company that wants to foresee its market value. For that, we have analyzed four comparable companies plus the target one.

Keywords (separated by '-')	firm valuation - CSR - GRI reports - AHP - GP
Footnote Information	

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Methodology to assess the market value of companies according to their financial and social responsibility aspects: an AHP approach

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This paper proposes a combination of the Analytic Hierarchy Process with Goal Programming for a better valuation of companies. The methodology includes the economic dimension of the company and another based on its social responsibility. A set of relative and absolute economic variables is proposed including concepts like leverage, liquidity or solvency. For the CSR dimension, we present a set of variables extracted from sustainability reports based on the Global Reporting Initiative. This way, the whole methodology relies on publicly available data and can be readily reproduced. We prove the methodology with a complex case study involving the estimation of a German real estate company that wants to foresee its market value. For that, we have analyzed four comparable companies plus the target one.

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Keywords: firm valuation; CSR; GRI reports; AHP; GP

1. Introduction

In a global economy, knowing the value of a company and its parameters is crucial to establish a reference framework to provide a reasoned strategy toward the creation of shareholder value and it is key for successful management. Traditional financial theories focused on economic aspects in order to evaluate traded companies. However, in the stock market the delivered value estimations differ from their actual traded value due to nonstrictly financial issues (Du *et al*, 2010; García-Melón *et al*, 2016). Several authors have suggested that this difference is due to a series of social aspects that have scarcely been considered before in the evaluation of companies (Choi and Yu, 2014). Those nonfinancial features can be encompassed in a wider concept called corporate social responsibility (CSR henceforth).

Striving for CSR helps organizations to have a positive impact on development, business and society with a positive contribution to their bottom-line results (Choi and Yu, 2014; Du *et al*, 2010). In the last years, the number of organizations and agencies that evaluate and rank companies on their corporate social performance has increased (Chatterji *et al*, 2009). In parallel, an ever increasing number of companies are publishing self-assessments and sustainability reports based on guidelines of the Global Reporting Initiative (GRI), or Communication on Progress based on the United Nations Global Compact (UNGC).

The aim of this paper is to propose a methodology for assessing the market value of companies, based on their financial and social responsibility aspects. As it will be explained, for valuing a company including explicitly both dimensions, we need to process different data: direct and indirect, relative and absolute, quantitative and qualitative, etc. This complexity can be tackled with the combination of a multicriteria technique: Analytical Hierarchy Process (AHP) and Goal Programming (GP), both based on the public available information. To the knowledge of the authors, this is the first research that combines that way those financial and nonfinancial variables.

To prove it, the methodology is applied to four-listed German real estate companies in order to determine the stock value that an unlisted real estate company would have. Nevertheless, the methodology can also help making better decisions to managers of already traded companies.

The small difference obtained between actual and estimated stock market values demonstrates the accuracy of the proposed

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methodology, giving the largest importance to financial variables, whereas CSR aspects account for approximately the 20% of the firm value. Those results should not be understood as a statistical estimation of the contribution of the CSR performance to the market value of all companies, but as a methodology for estimating the contribution of the CSR performance of a particular company to its market value.

The rest of the paper is structured as follows. Section 2 introduces the concept of CSR and explains how to assess it. Section 3 presents the different methods for companies' valuation. Section 4 introduces AHP, and Section 5 explains the valuation methodology and discusses the main results. Finally, Section 6 includes the conclusions of the research.

2. Valuation of corporate social responsibility

According to the European Commission, "most definitions of CSR describe it as a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis. Being socially responsible means not only fulfilling legal expectations, but also going beyond compliance."

Despite the good intentions of that and other definitions, CSR has been contested in different ways. Some authors claim it is nothing but "green washing" (Walker and Wan, 2012). Some others argue companies should only focus on their business leaving all other aims to specific organizations like public offices, NGOs or business associations (Jahdi and Acikdilli, 2009). However, evidence is accumulating of CSR being actually significant and contributing to the firm's value (Arendt and Brettel, 2010; Choi and Yu, 2014; Du *et al*, 2010).

Maintaining a dialogue with stakeholders is one of the pillars of CSR (Sheikh and Beise-Zee, 2011). According to Duran-Encalada and Paucar-Caceres (2012), sustainability reports are the preferred means for making public the organizations' CSR strategy and progress. Through sustainability reports, stakeholders can value the company's accountability and performance and assess the actions undertaken beyond their fulfillment of legal obligations (Arendt and Brettel, 2010; Baviera-Puig *et al*, 2015).

Based on the above written, a common reference framework for CSR reports is highly demanded. The most well known of these initiatives is the Global Reporting Initiative (Global Reporting Initiative, 2011), a worldwide recognized nonprofit organization which provides a free, public set of complete guidelines for all organizations wishing to produce sustainability reports covering all three dimensions of sustainability: economic, environmental and social.

Several authors assess the CSR performance of companies, see, for example, Chatterji *et al* (2009), and most of them rely on GRI sustainability reports or, less frequently, databases such as Vigeo® or KLD®. However, the latter are private and the aim of the research is to take advantage of the public available information. Hence, our methodology will rely on GRI sustainability reports as the literature proves it gives enough CSR information for business experts (Baviera-Puig *et al*, 2015; Chalmeta and Palomero, 2011; Duran-Encalada and Paucar-Caceres, 2012; Tsai *et al*, 2009).

In this paper, the firm CSR value is calculated by comparing GRI indicators with the multicriteria technique AHP. We assume that CSR evaluation is closely related to CSR valuation, thus enabling us to determine how CSR aspects are valued in monetary terms.

3. Economic valuation

The economic valuation of firms is usually carried out taking into consideration economic and financial information. Methodologies for firm valuation can be grouped in single-period comparative methods and multiperiod methods (Demirakos *et al*, 2004).

The first group includes valuation techniques that calculate the firm value by considering only one current account from balance sheet or income statement. The accounting information is used for comparative purposes in such a way that the value of the firm is supposed to be proportional to the selected financial account. Under the conventional simple multiple valuation approach, valuation experts select only one accounting performance measure as a value driver (Yoo, 2013) and then convert it into an equity value estimate through the multiplication of the corresponding stock price multiple of the other comparable firms (Palepu *et al*, 2000). Therefore, this approach involves applying a synthetic market multiple from the set of comparable firms to the corresponding value driver of the firm being valued (Bhojraj and Lee, 2002).

In the earnings multiples approach, the value is inferred based on the earnings: The greater the earnings are, the greater the value of the firm is. Different measures for the earnings can be adopted: earnings before interests and taxes; earnings before interest, taxes, depreciation and amortization; and net profit, among others. Practitioners can also use more simple financial variables by considering income accounts, and not the difference between incomes and expenses (i.e., sales comparison approach). Besides the techniques that use income statement variables, balance sheet accounts can also be considered: equity, current assets, total assets and debt, among others.

The main drawback of single-period comparative methods is the consideration of a single variable to infer the value of the firm. This implies that the estimated value for the company will be different according to the variable used by the valuation method. Moreover, differences in estimated values may be very large, precisely depending on which variable is used in the valuation. This problem can be faced by compounding several accounting variables in a proper way (Aznar *et al*, 2011) and eliciting the value relevance of each variable by using a multicriteria approach (e.g., AHP). Alternatively, the firm value estimation can be addressed by

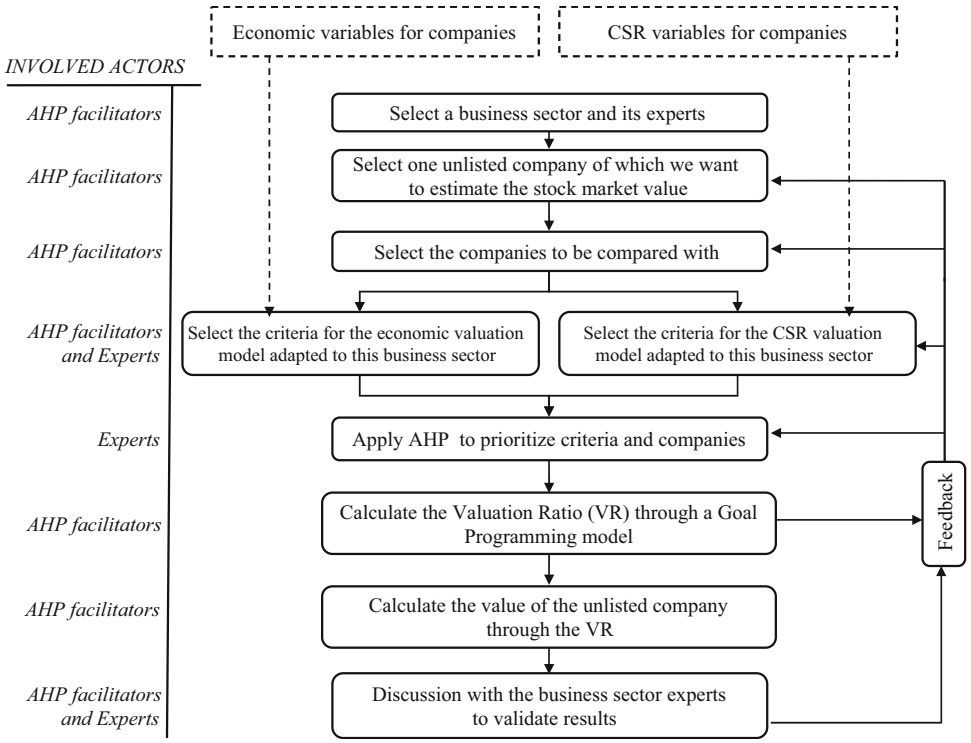

Figure 1 Proposed methodology.

Table 1 Economic criteria

Criteria	*Explanation*
Economic	
Equity	Total assets – total liabilities
Net rental income	Rental income – rental expenses
Net profit	Gross profit – overheads – interests
Current ratio	Current assets/current liabilities
Debt to worth	Total liabilities/equity
ROA	Return on assets: Net profit/total assets

weighting the valuation outcomes obtained from several simple multiple valuations (Yoo, 2013).

The most common multiperiod methods are the discounted cash flow and the residual income valuation. Both of them use future predicted cash flow and income, and the value of the firm is calculated by discounting these predictions to current date. Two important drawbacks are related to this approach: (1) The appraiser must infer the future value of cash flow (income), which is not a trivial question, and (2) the appraiser must also explicitly determine the discount rate. The final value of the firm will be closely affected by the discount rate, and a little change on this could suppose an important change in the value estimation. Kaplan and Ruback (1996) find that simple firm value to earnings before interest, taxes, depreciation and amortization (EV/EBITDA) multiples result in similar valuation accuracy to the discounted cash flow valuation method. The same conclusion is reported by Berkman *et al* (2000) for a sample of 45 IPOs (initial public offering) in New Zealand between 1989 and 1995.

For a more in-depth revision of classical firm valuation methodologies see Damodaran (2016), whereas a multicriteria approach of this issue can be found in Aznar *et al* (2011).

In this paper, the firm economic value is calculated by comparing accounting variables and considering a single-period framework. Instead of using only one financial variable, both balance sheet and income statement are considered. Ratios between accounting variables enable us to compare firms beyond size differences. Those ratios are related with liquidity, solvency or leverage.

4. Multicriteria valuation

The Analytic Hierarchy Process (Saaty, 1980) is a multicriteria evaluation technique that enables taking into account several variables in accordance with the multidimensional structure of the value that we have presented both in the CSR and in the economic valuation analysis.

AHP is based on the fact that the inherent complexity of a multiple criteria evaluation problem can be solved through the construction of hierarchic structures consisting of a goal, criteria and alternatives. In each hierarchical level, paired comparisons are made with judgments using numerical values taken from the AHP absolute fundamental scale of 1–9. These comparisons lead to dominance matrices from which ratio

Table 2 Starting CSR criteria and GRI performance indicators (for a better description of the criteria and GRI indicators see (Global Reporting Initiative, 2011)

CSR	
Social	
Labor practices and decent work	Employment conditions. LA1, LA2, LA15
	Labor/management relationships. LA4, LA5
	Occupational health and safety. LA7, LA8
	Training and education. LA10
	Diversity and equal opportunity. LA13
	Equal remuneration for women and men. LA14
Human rights	Investment and procurement HR practices. HR1, HR2, HR10
	Incidents of discrimination. HR4
	Freedom of association and collective bargaining. HR5
	Child labor. HR6
	Forced labor. HR7
	Remediation. HR11
Social performance	Impact on local communities. SO1, SO9, SO10
	Corruption. SO2, SO3, SO4
	Active participation in public policy. SO5
	Compliance (fines). SO8
Product responsibility	Customer health and safety. PR1
	Product and service labeling. PR3
	Marketing communication. PR6
Environmental	Materials. EN1, EN2
	Energy. EN3, EN4
	Water. EN8
	Biodiversity. EN11, EN12
	Emissions, effluents and waste. EN16, EN17, EN19, EN20, EN21
	Products and services. EN26, EN27
	Compliance. EN28
Economic	Economic performance EC1, EC2, EC3, EC4
	Market presence. EC5, EC6, EC7
	Indirect economic impacts. EC8, EC9

Table 3 General model with most important CSR criteria and their GRI performance indicators

CSR	
Social	
Labor practices and decent work	Occupational health and safety. LA7, LA8
	Diversity and equal opportunity. LA13
	Equal remuneration for women and men. LA14
Human rights	Child labor. HR6
	Forced labor. HR7
Social performance	Impact on local communities. SO1, SO9, SO10
	Corruption. SO2, SO3, SO4
Product responsibility	Customer health and safety. PR1
Environmental	Energy. EN3, EN4
	Emissions, effluents and waste. EN16, EN17, EN19, EN20, EN21
	Products and services. EN26, EN27
Economic	Economic performance EC1, EC2, EC3, EC4

scales are derived in the form of principal eigenvectors. These matrices are positive and reciprocal (aij = 1/aji). The synthesis of AHP combines multidimensional scales of measurement into a single one-dimensional scale of priorities. Hence, for each company analyzed, a one-dimensional AHP weight will be obtained, which will lead us to the stock market value of the companies.

The AHP method has the additional advantage of being easy to explain to the experts that have to assess the different valuation variables in a simple and systematic way. More details on the AHP can be found in Saaty (1980).

To the knowledge of the authors, seldom the AHP technique has been applied in firm valuation despite its strengths (Chen and Fan, 2011; García-Melón *et al*, 2016; Shen *et al*, 2015).

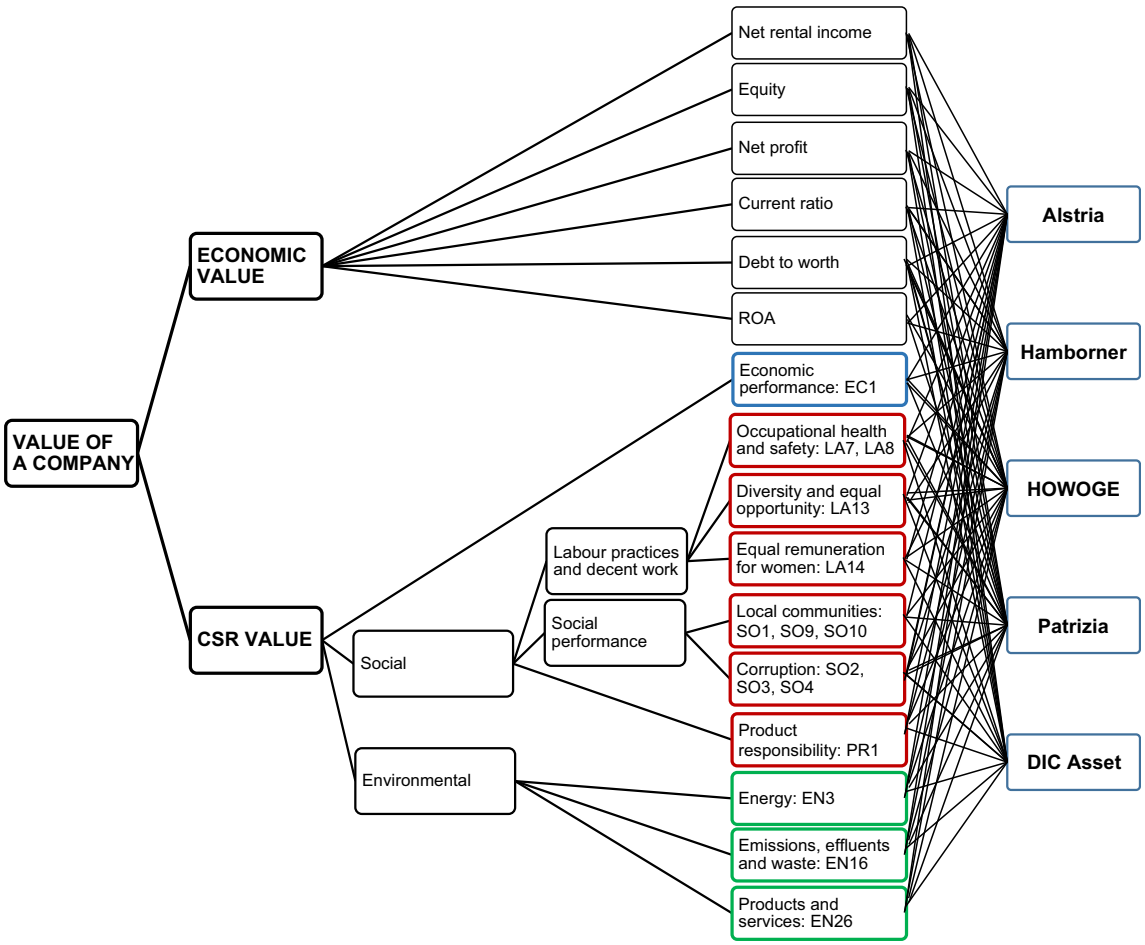

Figure 2 Final specific AHP model including the CSR and the economic dimensions. CSR criteria are together with their GRI performance indicators.

Table 4 Weights for the economic criteria

	Equity	*Net rental income*	*Net profit*	*Current ratio*	*Debt to worth*	*ROA*
Weights	0.096	0.293	0.167	0.055	0.096	0.293

5. The proposed methodology: case study discussion

The proposed methodology is structured as shown in Figure 1.

Following, we detail all the methodology steps adding the results of the case study for a better understanding.

5.1. Select a business sector and its experts

The developed methodology aims at being useful for any business sector. However, experts are necessary to adapt it to the characteristics of the studied companies. Furthermore, those experts ought to have some training in CSR and finance.

In the paper's case study, we have worked with two groups of experts:

- One expert on economic valuation of companies and 3 experts on CSR for the development of the general model (CSR and economic criteria, see Tables 1 and 2).
- Six experts on the business sector to, firstly, discuss and adapt the valuation model and, following, assess the companies according to their CSR performance (see Tables 1, 2 and 3, and Figure 2). They are experts on sustainability management, communication management and other disciplines related to German real estate firms. No one belonged to the companies analyzed in the case study.

Table 5 Weights for the CSR criteria

	Econom.	*Social*					*Environmental*		
	Economic performance	*Occupational H&S*	*Diversity and equal opportunity*	*Equal remuneration for M&W*	*Local communities*	*Corruption*	*Product responsibility*	*Energy*	*Emissions*	*Products and services*
Weights	0.12	0.12	0.08	0.07	0.04	0.16	0.04	0.16	0.05	0.16

5.2. Select the company to be valued

It ought to be a company of the chosen business sector whose value in the stock market is still unknown because the company is unlisted (and, for example, would consider to go public), or being known it cannot be fully explained with only economic data.

In our case study, we have chosen a German real estate company called HOWOGE, of which the value market is unknown.

5.3. Select the companies to be compared with

Once the unlisted company is selected, a group of comparable companies must be set up. The number of comparable companies must be large enough to be significant, but not too large if we want to compare them by means of AHP.

We have chosen listed German real estate companies that published a GRI report. Of the approximately 3.000 real estate German companies, 783 are listed and, of those, 14 had published CSR/sustainability reports.

We required the companies to have a full GRI report with the same year of completion. This ensures greater data reliability as the GRI parameters vary over time and parameters of different years might not be comparable. Only 7 out of the 14 were found to be consistently reporting. We assumed companies not reporting regularly were not reliable. From those 7 companies, 2 did not have appropriate GRI sustainability reports, and another one was found to be too large by comparison. It belonged to another economic scale, and therefore, we could not use it as AHP only allows the evaluation of comparable companies. In the end, 4 companies were analyzed based on their reports of 2013: Alstria (GRI report type B), Patrizia (GRI C), Hamborner (GRI C) and DIC Asset (GRI B). Type "A," "B" or "C" refers to the amount of GRI indicators, being type "A" the most complete. They have been our reference companies. The final list of the companies analyzed and their actual market value are presented, respectively, in the first and last columns in Table 6.

5.4. Select the criteria for the valuation model

In this step, an AHP valuation model is developed with two general dimensions: the economic, based on economic variables or criteria, and the social based on CSR features or criteria.

5.4.1. Criteria for the economic valuation model The economic valuation expert decided the variables related to the company's economic value for the AHP model. He considered important financial aspects as, on the one hand "Equity," "Current ratio" and "Debt to worth" from the balance sheet statements, and on the other hand, "Net rental income," "Net profit" and "Return on Assets" from the

Table 6 Companies' values for each economic criterion (year 2014)

	Balance sheet and income statement			*Liquidity*	*Leverage*	*Profitability*	*Market capitalization*
	Equity K€	*Net rental income K€*	*Net profit K€*	*Current ratio*	*Debt to worth*	*ROA*	*(M€)*
Alstria	846.693	88.960	36.953	2.602	1.090	0.021	813.9
DIC Asset	774.844	132.166	14.035	0.348	2.274	0.006	508.0
Hamborner	270.195	42.858	17.109	0.836	1.299	0.028	369.4
HOWOGE	664.738	104.071	29.470	0.251	0.475	0.030	To be valued
Patrizia	410.048	205.468	35.020	1.914	0.808	0.047	845.8

Table 7 Normalized companies' values for each economic criterion

	Balance and income statement			*Liquidity*	*Leverage*	*Profitability*	*Market capitalization*
Weights	0.096	0.293	0.167	0.055	0.096	0.293	
	Equity	*Net rental income*	*Net profit*	*Current ratio*	*Debt to worth*	*ROA*	*(M€)*
Alstria	0.29	0.16	0.28	0.44	0.18	0.16	813.9
DIC Asset	0.26	0.23	0.11	0.06	0.38	0.04	508.0
Hamborner	0.09	0.07	0.13	0.14	0.22	0.21	369.4
HOWOGE	0.22	0.18	0.22	0.04	0.08	0.23	To be valued
Patrizia	0.14	0.36	0.27	0.32	0.16	0.36	845.8

income statements. Thus, both absolute and relative variables were included in the economic model of the companies.

5.4.2. Criteria for the CSR valuation model For building the AHP model of the CSR dimension, we require first the collaboration of the CSR experts and, later, the experts on the business sector. The general AHP model is built first, and then a specific one is developed, adapted to the business sector characteristics.

As introduced in Section 2, based on the literature review and the proposal of the GRI v3.1 (the one used by the selected companies), the following list of starting criteria was put forward to the experts, together with the GRI indicators to assess their performance. As it can be seen in Table 2, 28 of the 81 GRI performance indicators were left out because they were not applicable.

This starting model was too complex to handle, because real estate experts would have to find the information for all 53 indicators (29 AHP criteria) in the sustainability reports and then compare the data, usually not communicated in the same terms. Hence, CSR experts were asked to apply AHP to assess the importance of the criteria. For that, pairwise comparisons were conducted by the experts judging two criteria at a time with regard to a superior criterion in the hierarchy (or cluster). Then, for each cluster an AHP matrix was arranged and the eigenvector calculated obtaining the criteria weights or importance. Whenever the experts' judgments could not be agreed upon, the geometric mean was applied and an average criterion weight was calculated (Saaty, 1980).

Afterward, those criteria accumulating 80% of the weights were selected and the other discarded (see Table 3).

AHP comparisons were made considering any kind of big company in a country similar to Germany, not particularly real estate of Germany. Therefore, this new model could be applied to most companies of countries similar to Germany. Nevertheless, according to our methodology, yet a specific AHP model must be deployed with the eligible criteria for the specific business sector: German real estate. For that, the main publications about CSR in the German real estate were reviewed (Apanavičienė *et al*, 2015; Azasu, 2012; Cervelló-Royo *et al*, 2015; EPRA, 2014; GdW and AGW, 2014; Regierungskommission, 2015; Stibbe and Voigtländer, 2010). Afterward, we asked the 6 experts of the German real estate sector to assess the model, both based on our findings and their experience. They decided some of the indicators, and AHP criteria ought not to be applied to that specific business sector. They would not contribute to make differences among the alternatives. Hence, we decided those criteria were eliminated in the final AHP model (see Figure 2). Note that this specific model for German real estate companies has 10 criteria and 15 GRI indicators, instead of the 12 criteria and 26 indicators of the general one.

5.5. Apply AHP to prioritize valuation criteria and the companies

Applying the AHP procedure to the valuation model in Figure 2, a weight or priority for each criterion is obtained,

Table 8 Companies' values for each CSR criterion

Weights	*0.12 Economic Performance*	*0.12 Occupational health and safety*	*0.08 Diversity and equal opportunity*	*0.07 Equal remuneration for women*	*0.04 Local communities*	*0.16 Corruption*	*0.04 Product responsibility*	*0.16 Energy*	*0.05 Emissions*	*0.16 Products and services*
Alstria	0.16	0.19	0.16	0.22	0.31	0.25	0.22	0.19	0.21	0.46
DIC Asset	0.17	0.17	0.22	0.17	0.18	0.28	0.20	0.20	0.15	0.14
Hamborner	0.27	0.18	0.18	0.18	0.14	0.12	0.24	0.13	0.10	0.14
HOWOGE	0.32	0.28	0.23	0.21	0.14	0.24	0.25	0.32	0.15	0.11
Patricia	0.07	0.19	0.20	0.22	0.23	0.10	0.09	0.16	0.40	0.15

and then similarly for each of the companies compared. In the AHP hierarchy, both listed and unlisted companies must be considered.

5.5.1. Prioritization of the economic criteria After applying AHP, the weights obtained for the economic criteria are presented in Table 4.

The net rental income and ROA parameters are the most important ones according to the experts, followed by the net profit, equity and debt to worth values, and finally the current ratio.

5.5.2. Prioritization of the economic criteria Similarly, weights for the CSR criteria are obtained (see Table 5), but this time we needed to compare criteria within clusters first and then clusters among themselves.

The most important criteria are those regarding the company social aspects, with 51% of the total weight, followed by the environmental criteria with 37%, and the economic criteria with 12%.

5.5.3. Valorization of the companies: economic dimension As explained, before prioritizing the companies, their values for each criterion must be gathered or calculated by pairwise comparisons. It is compulsory that German companies make publicly available their balance sheet and income statement, besides the market capitalization value for the four companies could be obtained from the Frankfurt Stock Exchange. Therefore, direct data were used for the economic valorization, as shown in Tables 6 and 7.

After normalization of the values by the sum (consistent with AHP normalization), companies' economic values are given in Table 7.

As it can be seen, Patrizia obtains the better values in the majority of criteria, while DIC Asset, Hamborner and HOWOGE get the worst values.

5.5.4. Valorization of the companies: CSR dimension For the valorization of the 5 companies regarding the CSR criteria, pairwise comparisons were conducted by the experts on the business sector. They reviewed the companies' GRI reports, mainly the selected indicators for each criterion and then compared the companies two at a time with regard to each CSR criterion. Then, for each criterion an AHP matrix was arranged and the eigenvector calculated obtaining the companies' valorization. The geometric mean was applied, and an average value was calculated. According to those experts, the CSR performance of the companies is shown in Table 8.

Different from the economic dimension, in the CSR dimension Patrizia obtains several times the worst results, while HOWOGE obtains the majority of good results. Alstria is the other company with good results per criterion (columns in Table 8).

Table 9 Normalized companies' values for each economic criterion and their weights, excluding HOWOGE and normalizing again

	Balance and income statement			*Liquidity*	*Leverage*	*Profitability*	
Weights	0.096	0.293	0.167	0.055	0.096	0.293	
Economic criteria	*Equity*	*Net rental income*	*Net profit*	*Current ratio*	*Debt to worth*	*ROA*	z_{econ_i}
Alstria	0.37	0.19	0.36	0.46	0.20	0.21	0.26
DIC Asset	0.34	0.28	0.14	0.06	0.42	0.05	0.20
Hamborner	0.12	0.09	0.17	0.15	0.24	0.27	0.18
Patrizia	0.18	0.44	0.34	0.34	0.15	0.47	0.37

5.5.5. Prioritization of the companies For the prioritization of the companies, i.e., the total value of each company, still some information is missing: the distribution of weight between economic and CSR dimensions. To estimate those weights, we could not compare them with regard to the top level of the AHP hierarchy, although several studies have predicted that the CSR value of a company could represent up to the 20% of its weight, for example Guijarro and Guijarro (2010). Hence, we assigned a weight $(100 - y)\%$ to the economic dimension, while assigning a weight of $y\%$ to the CSR dimension.

We arranged the calculation of the stock market value of the unlisted company by means of the Valuation Ratio as explained in the following Section 5.6. A Goal Programming (GP) model was implemented in the optimization modeling tool LINGO® for our case study. GP is a multicriteria technique that allows the incorporation of soft constraints (as opposed to the hard constraints) and the adherence to the philosophy of "satisficing" as opposed to optimization (Ignizio and Romero, 2003).

The weight for each value dimension was calculated (1) by normalizing by the sum the information from Tables 7 and 8 (see Tables 9 and 10) and the market capitalization (Table 11), but excluding the information regarding the firm we want to value: HOWOGE; (2) solving the following GP model for the values obtained in the previous step:

$$\text{Min} \sum_{i=1}^{n-1} (n_i + p_i)$$

$$\text{s.t. } w_A z_{\text{econ}_i} + w_B z_{\text{csr}_i} + n_i - p_i = z_{mvi}.$$

$$w_A + w_B = 1$$

where:

- w_A and w_B are the estimated weights we want to calculate for the economic dimension and the CSR dimension, respectively.
- z_{econ_i} and z_{csr_i} are the normalized values for the economic dimension and the CSR dimension in firm i.
- n_i and p_i represent the negative and positive deviations, respectively, to compute the difference between the normalized market capitalization and its estimated value.

By using this method, the optimal values were obtained when the CSR dimension weight is fixed to $y = 23.8\%$ and therefore, the economic dimension weight is fixed to 76.2%.

5.6. Calculate the stock market value of the unlisted company with the Valuation Ratio

Aznar *et al* (2010) propose to calculate the Valuation Ratio (VR) through Goal Programming model the following way

$$\text{Min} \sum_{i=1}^{n-1} \left(d_i^- + d_i^+\right)$$

$$\text{s.t. } \text{AHPW}_i \times \text{VR} + d_i^- - d_i^+ = MV_i \quad \forall i = 1, \ldots, n-1$$

being:

- MV_i the stock market value of each of the ith comparable and listed company.
- AHPW_i the weight (value) obtained with the AHP model for the ith company.
- n the number of companies, considering $n - 1$ listed or comparable companies and the unique unlisted company.
- d_i^- and d_i^+ the negative and positive deviations, respectively, which compute the differences between the current market value of the ith company and the estimated value of the ith company through the GP model.

5.6.1. Application to the case study Applying the GP model for estimating the optimum weight for the CSR dimension ($y = 0.238$), the values in Table 12 are obtained. Table 12 shows the market value of the companies, the estimated value according to the methodology and the differences in absolute values. As it can be seen, the estimated market value for HOWOGE would be 618.0 M€. For whatever other value of the weight of the CSR dimension, the model deviation was higher.

5.7. Discussion with the business sector experts and validation of results

After applying the methodology and obtaining the results, all experts were asked to review the general results. With some

Table 10 Normalized companies' values for each CSR criterion and their weights, excluding HOWOGE and normalizing again

Weights	*0.12*	*0.12*	*0.08*	*0.07*	*0.04*	*0.16*	*0.04*	*0.16*	*0.05*	*0.16*	z_{csr_i}
CSR criteria	*Economic performance*	*Occupational health and safety*	*Diversity and equal opportunity*	*Equal remuneration for women*	*Local communities*	*Corruption*	*Product responsibility*	*Energy*	*Emissions*	*Products and services*	
Alstria	0.23	0.26	0.21	0.27	0.36	0.34	0.29	0.28	0.25	0.52	0.31
DIC Asset	0.25	0.23	0.29	0.22	0.21	0.37	0.27	0.30	0.17	0.16	0.26
Hamborner	0.40	0.25	0.24	0.23	0.16	0.16	0.32	0.19	0.11	0.15	0.22
Patrizia	0.11	0.26	0.26	0.28	0.27	0.14	0.12	0.23	0.47	0.17	0.21

Table 11 Market capitalization, normalization by the sum, excluding HOWOGE

Company	*Market capitalization (M€)*	z_{mv_i}
Alstria	813.9	0.32
DIC Asset	508.0	0.20
Hamborner	369.4	0.15
Patrizia	845.8	0.33

Frankfurt stock market in year 2014.

criticism that has been considered in the final version of the methodology hereby presented, there was a consensus about the utility of the procedure and the accuracy of the market value estimation.

6. Conclusions and directions for future developments

The research carried out proves the value market of a company can be better explained when combining financial and social criteria. For such a valuation, within the economic dimension, we have proposed a set of relative and absolute variables including concepts like leverage, liquidity or solvency. Moreover, the paper also shows CSR provides a complete set of criteria for assessing the nonfinancial company's performance. With the help of CSR experts, we were able to trim the initial model selecting the most important CSR variables to be assessed.

The methodology allows estimating the market value of a nonlisted company. For that, besides the variables, we also put forward a methodology merging the multicriteria decision aid methods AHP and Goal Programming. With the German real estate business sector, CSR has proven to be significantly influential, with approximately a 20% of the contribution to the estimated company's market value. Although that contribution is consistent with the findings of other authors for other business sectors, it cannot be assumed a priori and should be calculated in each case study.

Valuing a company involves direct and indirect data, relative and absolute data, and criteria that can be measured and others that can only be compared based on the qualitative information available. AHP and Goal Programming allow working with such different variables in an explicit, traceable and feasible way. Experts commented the procedure was somewhat laborious but proportional to the complexity of the goal, and the results justified the devoted resources.

Finally, the hereby presented methodology could be applied to a wide range of business sectors and companies. Some minor adaptations would be needed and always a panel of experts should be arranged for that adaptation and the companies CSR valuation.

Another important finding of the research is GRI reports provide enough information for an expert on the specific business to assess the CSR performance of the company. Indeed experts' assessments reached a good degree of consensus showing they

Table 12 Market value according to the methodology for HOWOGE

Company	*AHP economic valuation (%)*	*AHP CSR valuation (%)*	*AHP global valuation (%)*	*Market capitalization (M€)*	*Estimated market value (M€)*	*Difference in absolute value (M€)*
Alstria	20.7	24.5	21.8	813.9	668.3	145.6
DIC Asset	16.3	19.3	16.9	508.0	525.2	17.2
Hamborner	14.2	16.2	14.7	369.4	454.7	85.3
Patrizia	29.8	16.3	26.9	845.8	843.8	2.0
HOWOGE	18.9	23.7	19.9	–	618.0	–
Model deviation						250.1

Weight of CSR dimension set to 0.238.

obtained similar conclusions from the reports. Therefore, this work has confirmed the utility of the public, available and free GRI databases, providing companies are reporting in the researched business sector. Other similar guidelines can be used as sustainability reports like those of the Dow Jones Sustainability Index and the Global Compact. The procedure here presented could be carried out similarly. However, new performance indicators available in those guidelines should be suggested for gathering the needed information.

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