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Corporate Social Responsibility, Negative Externalities, and Financial Risk: The Case of Climate Change

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INTRODUCTION

Is there a business rational for firms to engage in corporate social responsibility (CSR) activities? Within the CSR-literature this remains a fiercely debated question. Some scholars champion the business case for CSR while others claim that doing well by doing good is an illusion (for a recent discussion see Karnani, 2011; Rivoli *et al.*, 2011). However, rather than merely viewing these two positions as opposing ends of the CSR-performance debate, the risk management hypothesis argues that "certain types of CSR activities can generate moral capital or goodwill [Godfrey, 2005] that tempers punitive sanctions by stakeholders" (Godfrey *et al.*, 2009: 426). Godfrey and colleagues find empirical support for such an 'insurance-like' benefit of CSR-activities: In case a firm is affected by a specific negative event, then prior CSR-activities can contribute to shareholder value by mitigating the losses.

We argue that an 'insurance-like' benefit of CSR-activities can be equally expected for long-term developments which threaten current business models. We develop our arguments for the incremental, long-term process of internalizing negative externalities. We test the risk management hypothesis for the example of negative externalities resulting from the emission of greenhouse gases (GHG). We investigate whether the corresponding internalization threat is already reflected in the risk of firms today and ask: Does reducing GHG-emissions affect financial risk?

We make two contributions to the CSR-performance literature: First, while Godfrey et al. (2009) empirically studied the risk management hypothesis in the context of firm-specific negative events, we propose and test the hypothesis for long-term developments that might or might not materialize. With regard to climate change, society and governments are increasingly concerned with the negative externalities GHG-emissions cause and have identified the private sector as the central actor responsible for them (Carbon Trust, 2006; Levy *et al.*, 2002b; PRI *et al.*, 2010). Once the private sector has to pay for the 'true' costs its

GHG-emissions cause, companies that have reduced their GHG-emissions will be less exposed to related costs. Such an internalization, however, is still subject to uncertainty. Our empirical analysis shows that investors have recognized this and incorporate the threat of GHG-emissions internalization as a risk factor: By reducing their GHG-emissions firms can lower their market-based risk, which is a measure reflecting the expectations of forward looking investors.

Second, while the risk management hypothesis was tested with market-based data, we also consider the effect of GHG-emissions reductions on balance sheet data, which reflect more backward looking accounting information. For accounting-based risk we propose an opposing relationship: As long as internalization measures have not been implemented and their future realization is subject to uncertainty, voluntary corporate GHG-emissions reductions that go beyond what is required by law and 'low hanging fruits' may require significant up-front investments (Ambec *et al.*, 2008; Darnall, 2009). These investments are displayed in a firm's balance sheet, which corresponds to an increased likelihood of bankruptcy. Thus we expect that firms that reduce their GHG-emissions incur increased accounting-based risk. We do, however, not find empirical support for this argument for the application to climate change.

This paper is organized as follows: We first summarize the literature on CSR, financial performance, and risk and derive our hypotheses. We then introduce our empirical research setting. Based on this we present our results and end with a conclusion summarizing our contribution and implications for management.

THEORY AND HYPOTHESIS DEVELOPMENT

The ongoing CSR-performance debate

CSR can be seen as an umbrella term for different concepts relating to corporate sustainability and business ethics (Matten *et al.*, 2008; Scherer *et al.*, 2007). The common denominator of the different concepts are corporate activities that have a positive impact on society (Carroll, 1979; Dawkins *et al.*, 2003). Within the CSR-literature, the profitability of CSR-activities is controversially discussed. One school of thought suggests that not all CSR-activities pay off and firms should focus on such activities that yield a positive financial benefit (e.g., Ambec *et al.*, 2008; Schreck, 2011). It is argued that there is no linear relationship between CSR-activities and financial performance, and managers should make use of cost-benefit analyses to determine the optimal amount of investment in CSR (McWilliams *et al.*, 2001). Management should adopt such activities only if they "complement the organization's business- and corporate-level strategies and ultimately enhance profitability or shareholder wealth" (Siegel, 2009: 5). Another school of thought goes beyond the purely economic requirements of the firm and also includes profit-sacrificing CSR-activities in their definition, provided such activities have a positive impact on society (e.g., Aguilera *et al.*, 2007; Davis, 1973). Management should care about environmental issues and CSR "regardless of whether it pays, [as] society expects" this (Marcus *et al.*, 2009: 24). According to this line of thought, firms benefit from such a strategy as their stakeholders value more socially acceptable business practices (Devinney, 2009), which in turn contributes to long-term business success (Jensen, 2002).

So, is there empirical evidence of a business case for CSR or not? A large and ever-growing number of studies seek to answer this question. The results range from supporting evidence (e.g., Derwall *et al.*, 2005; Dowell *et al.*, 2000) to a negative relationship (e.g., Chong *et al.*, 2006; Shane *et al.*, 1983), or to inconclusive or mixed results (e.g., Aupperle *et* *al.*, 1985; Statman *et al.*, 2009). Meta-analyses illustrate that for the majority of studies there was at least no evidence for a negative relationship but at the same time highlight methodological concerns (Margolis *et al.*, 2009; Margolis *et al.*, 2003; Orlitzky *et al.*, 2003). In response to these concerns, researchers increasingly emphasize that the CSR-performance debate is too general in nature as to allow for one unequivocal, final answer (Barnett, 2007; Berchicci *et al.*, 2007; Peloza *et al.*, 2008; Rowley *et al.*, 2000). What is and what is not responsible corporate practice is time- and context-dependent; the same holds for the pay-off of CSR-activities (Bird *et al.*, 2007). We take these critiques into account and depart from there in two regards: First, as CSR is a multi-level construct reflecting a wide range of areas and different aspects (Carroll, 1999), we do not use CSR as a single, overarching variable (Griffin *et al.*, 1997) and instead investigate CSR in terms of corporate responses to a specific issue, climate change. Second, while most of the studies focus on financial returns when measuring firm performance, we investigate financial risk, an equally important but less studied measure in the CSR-performance context (Orlitzky *et al.*, 2001).

CSR, financial risk, and climate change

Within the CSR-literature, the notion that CSR-activities can affect financial risk is not new. Based on information about corporate reputation obtained from the Fortune magazine's annual survey, McGuire et al. (1988) find that risk is negatively related to CSR. Similarly, focusing on product recalls Minor and Morgan (2011) find that S&P 500 firms with better CSR ratings face less severe stock price variations, measured as abnormal changes in firm value. Using media accounts, Bansal and Clelland (2004) obtain a result that hints in the same direction for highly polluting US industries. They find that firms perceived as environmentally legitimate incur less unsystematic risk. Godfrey (2005) provides a theoretical foundation for these results by proposing the risk management hypothesis which argues that CSR can be seen as an insurance-like protection. Peloza (2006) suggests a similar approach.

Based on this hypothesis, Godfrey, Merrill, and Hansen (2009) empirically find that CSR-activities aimed at “secondary stakeholders” (Clarkson, 1995: 107) provide an insurance-like benefit should the firm face a negative event like the initiation of a lawsuit.

These studies all share a common focus on the effects of firm-specific negative events. However, when considering ecological and social issues, there are not always discrete negative events that can be attributed to individual companies. Instead, many environmental and social issues develop over time on a global scale and are the result of collective action. Efforts to internalize corresponding negative externalities usually represent incremental, long-term processes subject to uncertainty. To illustrate this, we focus on climate change as our empirical research context.

The external costs of GHG-emissions have been estimated to be about 7.5 percent of global GDP in 2008 and are expected to rise to about 12.9 percent in 2050 (PRI *et al.*, 2010) and the majority of GHG-emissions originate from the private sector (IPCC, 2007). Policy makers and other stakeholders are therefore exerting increasing pressure on the private sector to reduce GHG-emissions (Delmas *et al.*, 2010; Griffiths *et al.*, 2007; Hoffman, 2010; Kolk *et al.*, 2007a; Kolk *et al.*, 2007b; Levy *et al.*, 2002a; Reid *et al.*, 2009). However, the process of internalizing negative externalities resulting from GHG-emissions is subject to uncertainties: First, it is not clear how this process will continue to unfold. Related negative externalities have not been internalized to a major degree, yet, and the future development of this process is subject to regulatory uncertainty (Engau *et al.*, 2011). Second, agreed-upon changes will take time to be implemented. The transformation process of substituting fossil fuels is of a long-term nature and requires a fundamental reorientation of established business models. The rate and direction of this process is in many areas yet still uncertain. Should firms still begin to reduce their GHG-emissions? What does this entail in terms of financial risk?

Looking at investors' expectations: Market-based risk

This paper takes a twofold perspective on financial risk: We propose that corporate GHG-reductions – our measure of CSR – may have different effects on risk, depending on whether market- or accounting-based risk is taken into account. Market-based risk reflects the assessment of one key stakeholder group, the investors, of the riskiness of a firm's activities (Orlitzky *et al.*, 2001). Investors aim to maximize returns while minimizing risk or, in other words, to optimize the risk/return ratio of their investments (Sharpe, 1970). For this, they evaluate firms with regard to their current and future financial performance. Market-based risk thereby includes an explicit forward-looking perspective on a firm's performance.

There is empirical evidence that investors' evaluations in general take CSR-issues into account: For example, Konar and Cohen (2001) find a positive relationship between environmental performance and the intangible asset value of publicly traded firms. Ioannou and Serafeim (2010) find that socially responsible firms have received more favorable security analysts' recommendations in recent years. We extend this argument to a risk perspective: If it becomes clear that "issues that are currently externalities will in time bear upon the firm's market transactions, […] a forward-looking firm will benefit from early perception of this" (Crouch, 2006: 1541). There is evidence that investors have started sharing such a perspective for the case of climate change. For example, the chief executive officer at Aviva Investors said in February 2012: "The external costs of greenhouse gas emissions will become internalized into company cash flows and profitability."[1] That this is not only an individual notion can be illustrated by the rapidly growing scope of the Carbon Disclosure Project (CDP, 2011) and the emergence of other investor-lead climate change initiatives (e.g., IIGCC *et al.*, 2011; UNEP FI, 2010). If investors expect climate change to become a threat to current business practices, they also expect firms that substantially reduce their GHG-

[1] http://www.bloomberg.com/news/2012-02-20/investors-managing-10-trillion-say-co2-emissions-hinder-profits.html

emissions to perform relatively better compared to firms that fail to do so. Nevertheless, the internalization process is subject to uncertainty. Uncertainty in investor expectations about future financial performance is expressed by market-based risk evaluations. Recent practitioner publications support the argument that climate change seems to be increasingly regarded by investors and shareholders as a risk factor for firms and their future performance (Carbon Trust, 2006; CERES, 2002; Innovest, 2002; Mercer, 2011; UNEP FI, 2010). We expect that these investor expectations are reflected in firms' risk evaluations:

H1: Reductions in GHG-emissions will lead to lower market-based risk.

Looking at the balance sheet: Accounting-based risk

Compared to market-based risk, accounting-based risk provides a more backward looking type of risk evaluation as it is not based on the expectations of market participants. It describes the likelihood of an organization's bankruptcy based on ex post data from the balance sheet (Miller *et al.*, 1990). In general, the firm can be viewed as a reservoir of liquid assets. Accounting-based predictors of bankruptcy can then illustrate the probability of failure in four dimensions: The larger firm's liquidity and the generated cash-flow, the smaller the probability of failure; the larger the amount of debt held and the required expenditures for operations, the greater the probability of failure (Beaver, 1966).

None of Beaver's four dimensions should be negatively affected in case firms limit their GHG-reduction efforts to areas where efficiency increases result in immediate cost savings (Barnett, 2007; King *et al.*, 2002; Klassen *et al.*, 1999) that offset the required investments. However, going beyond such 'low hanging fruits' and what is required by law may require organizations to make substantial upfront investments (Ambec *et al.*, 2008; Darnall, 2009). Such decisions are not primarily triggered by immediate pay-offs, but may instead reflect a response to anticipated long-term changes within the business environment

(Gladwin *et al.*, 1995). From a short-term perspective, these investments can be interpreted as a waste of resources (Filbeck *et al.*, 2004; Telle, 2006; Walley *et al.*, 1994) as they reduce its liquidity, result in new debts and/or additional operating expenditures. They can only be expected to pay off in the long-term. However, firms currently face a significant investment risk due to uncertain climate change policies (Blyth *et al.*, 2007). As Crouch (2006: 1534) puts it: “For a firm to reduce production of a negative externality […] requires it to take action that will cost it something, but for which it will not, *ceteris paribus*, receive payment.”

Instead, the arguments above could be seen as a reason for firms to take a ‘wait and see’-position (Hoffmann *et al.*, 2009). A strategy that postpones substantial investments in GHG-reductions may bear two advantages: First, as long as only initial internalization pressures exist, lagging firms may retain a cost advantage over their competitors. They have the option of investing into reducing their GHG-emissions once the uncertainty has been resolved. Until then they face no effect on liquidity, cash-flows, debt, or operating expenditures. Second, by delaying investments into GHG-reductions, lagging organizations might even benefit from knowledge spillovers from more proactive organizations and decrease adoption costs due to learning effects (Jaffé *et al.*, 2004). Such a strategy not only saves costs in the present, but may also generate higher cash-flows at a later stage. Thus, we propose that GHG-emissions reductions will have a reverse effect on accounting-based risk as compared to market-based risk:

H2: Reductions in GHG-emissions will lead to increased accounting-based risk.

METHOD

Sample and Data

We obtained a global data base of corporate GHG-emission across industries from Trucost and derived all financial data from Bloomberg. Trucost is an independent data provider which covers major globally listed firms and uses an input-output model to calculate corporate emissions (Trucost, 2008). This model is based on 464 sectors[2] and allocates the amount of resources required (the inputs) to produce goods and services (the outputs) and calculates the resulting GHG-emissions. Based on several consistency checks, we crosschecked the reliability of the data provided with further independent sources (e.g., company reports and web pages, responses to the Carbon Disclosure Project). We discussed subsequent questions concerning individual data points directly with Trucost analysts and adjustments were made where necessary. We excluded companies belonging to the financial industry as the emissions from their own operations listed in our data base do not reflect the principal GHG-related risks of their business models. For instance, the principal GHG-related risks of banks are not based on their own physical operations, but rather on the GHG-emission levels of their financial assets under management.

In employing a global sample of firms, we had to take into account that the geographic location of corporate facilities may affect the absolute level as well as the trend over time of corporate GHG-emissions. We were only able to control for country-specific differences which are constant over time with our model. As far as GHG-emission trends are concerned, markets and technology characteristics relevant in the context of corporate GHG-emission mitigation can be expected to differ most significantly between developed and developing countries. This was something we found evidence for in our data. We therefore excluded

[2] The sectors are classified according to the North American Industrial Classification System.

firms headquartered in developing countries[3] from the sample. The resulting data base allowed us to perform a panel analysis for 1699 firms with a total of 8089 observations over a period of seven years.

Dependent variables

For market-based risk we calculate three models. In Model 1, total market-based risk is measured as the volatility of a firm's stock price, which we calculate as its annualized volatility. This total market-based risk is composed of a systematic and an unsystematic risk component (e.g., Elton *et al.*, 2003). A firm's unsystematic risk is measured through the residual of the volatility of its stock price once the systematic risk component has been accounted for. In Model 2, we calculate it as the unsystematic risk component of the annualized volatility of a firm's stock price. In Model 3, we calculate the systematic component of a firm's risk via its beta coefficient.[4]

Accounting-based risk can be measured via debt- and liquidity-ratios (Brealey *et al.*, 2000). In Model 4, we use the total-debt-to-total-assets ratio as a debt measure. For a liquidity measure, we use the cash flow-to-total-assets ratio in Model 5. We chose these ratios according to their relatively high power to predict bankruptcy (Beaver, 1966).

Independent variable

We measure a firm's GHG-emissions[5] in terms of the GHG-emission intensity of its operations. We define a firm's GHG-emission intensity as the ratio of the GHG-emissions caused by sources that are owned or controlled by the firm to the sales it generates during a given year (Hoffmann *et al.*, 2008). These GHG-emissions correspond to the so-called scope 1 emissions as defined in the Greenhouse Gas Protocol (WBCSD *et al.*, 2004). When measuring whether a firm has reduced its GHG-emissions we are not interested in marginal

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[3] Developing countries are defined according to the UN Development Index.

[4] The beta coefficient relates the returns of a stock or portfolio to the returns of the overall market. We calculate a firm's beta with respect to the MSCI-world index.

[5] The data features the six main greenhouse gases regulated by the Kyoto protocol calculated as CO_2-equivalent emissions.

efficiency improvements that just correspond to 'low hanging fruits' and reflect the typical performance improvements within an industry. Instead, the underlying logic of our hypotheses requires firms to substantially reduce their emissions beyond what is business as usual. For this reason, we measure the GHG-emission level as the ratio of the firm's GHG-emission intensity to the industry's median GHG-emission intensity of a given year:

$$GHG\text{-}emission\ level_{f,t} = \frac{GHG\text{-}emission\ intensity_{f,t}}{median\ (GHG\text{-}emission\ intensity_{i(f),t})}$$

where *f* denotes the firm, *t* denotes the year, and *i(f)* denotes the industry to which a given firm belongs. This provides a robust measure of a firm's relative performance as compared to the industry benchmark.

Control variables

We control for financial factors of influence for which an effect on a firm's risk level has been shown in the literature (e.g., Amit *et al.*, 1988; Lubatkin *et al.*, 1994; Miller *et al.*, 1990). We use the following controls for our risk models: the logarithm of total assets to control for firm size; the ratio of total assets-to-sales for capital intensity; the total debt-to-total equity ratio to control for leverage; the research expenditure-to-sales ratio to control for research intensity. We furthermore include year dummies for the observed period of time to control for any additional macro-economic factors of influence such as the financial crisis.

Model

To account for the direction of causality between the independent variable and the dependent variables, we lag the financial data (2003 - 2009) by one year with respect to the GHG-emission data (2002 - 2008) for our market-based risk models. For the accounting-based models, we used both data from the same year as we assumed that for a given investment, GHG-emissions reductions and required investments are reported concurrently.

Two technical reasons suggest a fixed effects model (e.g., Wooldridge, 2005). First, the results we obtained from performing Haussman tests support the choice of a fixed effects model over an alternative random effects model. Second, one requirement for using a random effects model is that possible unobserved time-independent effects such as management quality are uncorrelated with all time-dependent explanatory variables. This cannot be ruled out for our model-specification, even if one controls for observable time-independent effects such as region or industry.

We detected heteroscedasticity in our data using the modified Wald test and addressed this effect by grouping our data by firm, a standard procedure in panel analysis (e.g., Cameron *et al.*, 2010). We took the logarithm of unsystematic risk, total volatility, and GHG-emission level as tests showed this transformation made the relationship closer to linear kind while at the same time making the error term behave better in terms of the normality assumption of ordinary least square regression (Wooldridge, 2005). This furthermore reduced the influence of outliers in the sample.

RESULTS

Table I reports the means, standard deviations, and correlations for the variables used for our three market-based and two accounting-based risk models.

Table II reports the results obtained for the five models. We obtain a significant positive coefficient for GHG-emission level ($p < 0.05$) for Model 1 featuring total market-based risk as the dependent variable, supporting Hypothesis 1. The significant positive coefficient for GHG-emission level ($p < 0.05$) for Model 2 using unsystematic market-based risk again provides support for Hypothesis 1. The very low R^2-value of 0.014 for Model 3 featuring systematic market-based risk as the dependent variable indicates that the model is not well specified. The high correlation between the dependent variables of Models 1 and 2

Table I

	Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1	Total market-based risk	3.562	0.427	1									
2	Unsystematic risk	3.452	0.408	0.966	1								
3	Systematic risk	0.923	0.546	0.374	0.227	1							
4	Debt-to-assets ratio	22.100	15.792	-0.005	-0.020	-0.008	1						
5	Cash flow-to-assets ratio	0.101	0.084	-0.080	-0.086	-0.024	-0.262	1					
6	GHG-emissions level	0.098	1.403	0.032	0.043	0.005	0.145	-0.083	1				
7	Firm size	8.424	1.501	-0.185	-0.258	0.091	0.236	-0.094	0.027	1			
8	Capital intensity	2.342	27.240	0.038	0.044	-0.012	-0.013	-0.021	0.003	-0.030	1		
9	Leverage	113.993	1,628.095	0.012	0.009	0.000	0.086	-0.003	0.012	0.007	-0.001	1	
10	R&D intensity	6.243	63.353	0.037	0.047	-0.023	-0.066	-0.137	-0.009	-0.094	0.170	-0.004	1

Results for year dummies not shown

Table II

	Market-based risk			Accounting-based risk	
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Variable	**Total market-based risk**	**Unsystematic risk**	**Systematic risk**	**Debt-to-assets ratio**	**Cash flow-to-assets ratio**
GHG-emissions level	0.053 **	0.051 **	3.97 E-4	-4.15 E-4	-3.39 E-6
	(0.023)	(0.023)	(0.001)	(0.005)	(2.95 E-6)
Firm size	-0.058	-0.075	0.002	0.124 ***	-3.07 E-5 ***
	(0.068)	(0.069)	(0.002)	(0.014)	(1.14 E-5)
Capital intensity	2.956 *	3.512 **	-0.077 **	-1.485	-0.025 ***
	(1.543)	(1.363)	(0.037)	(0.903)	(0.009)
Leverage	0.002	0.004	-4.71 E-5	0.004 *	2.97 E-7
	(0.005)	(0.004)	(7.90 E-5)	(0.003)	(5.14 E-7)
R&D intensity	-0.335 ***	-0.438 ***	-0.004	0.010	1.97 E-4 *
	(0.097)	(0.060)	(0.003)	(0.010)	(1.09 E-4)
Constant	-0.536 ***	-0.451 ***	0.007 ***	-0.014 **	-0.011 ***
	(0.018)	(0.018)	(4.70 E-4)	(0.006)	(5.23 E-5)
R-sq. within	0.681	0.579	0.014	0.081	0.100

*** p<0.01, ** p<0.05, *p<0.1
Coef. (std. err.)
Results for year dummies not shown

(0.966) suggests that the result for total market-based risk is primarily driven by the unsystematic risk component.

The coefficients for GHG-emission level for Model 4 featuring the debt-to-assets ratio and Model 5 featuring the cash flow-to-assets ratio as dependent variable are insignificant. We therefore do not find support for Hypothesis 2.

We performed a large set of robustness tests. We varied the time-lag between independent and dependent variables from zero to two years for the accounting-based models, however, without obtaining significant results. We furthermore tested alternative debt and liquidity ratios, again without obtaining significant results. Additionally, we varied the operationalizations of the independent variable and controls, the sample size, and the years of data considered. For the market-based models, the results showed a high level of robustness to these variations in terms of the sign of the regression coefficients as well as their significance.

DISCUSSION & CONCLUSION

We find empirical support that the risk management hypothesis not only holds for firm-specific negative events, it is also applicable to long-term developments which threaten existing business models. Considering the threat that negative externalities in the climate change context are internalized we illustrate: Firms can reduce their market-based risk by curbing their GHG-emissions. We have thereby found empirical support for a strategic risk rational for firms to engage in certain long-term oriented CSR-activities, even though they may not yet be profitable. This result adds a new dimension to our understanding of the business rational for firms to engage in CSR: In the CSR-performance literature, reaping ‘low-hanging fruits’ is considered as a natural component of a short-term profit-maximizing strategy (Aguilera *et al.*, 2007; Aguinis *et al.*, 2012; Ambec *et al.*, 2008; Carroll *et al.*, 2010; Schreck, 2011) and it has been proposed that there is an ‘ideal’ level of CSR (McWilliams *et* *al.*, 2001). It is, however, of key importance to also go beyond such considerations and understand if and how long-term efforts towards addressing ecological and social issue materialize. For embarking on such a strategy, management needs to anticipate which negative externalities within the ecological and social sphere are likely to be internalized and thus threaten current business models.

We did not find support for the opposing effect of emissions reductions on accounting-based risk. One may speculate that in firms there are still plenty of unused potentials for reductions. Companies are still able to substantially reduce their emissions without incurring significant expenses. This may explain why we do not find significant support for our second hypothesis. Future research may investigate whether the hypothesis holds in times when (further) GHG-emission reductions require more significant upfront investments.

This paper refers to the concept of negative externalities. While the economics literature has discussed the phenomena of market failure and negative externalities extensively, the CSR-literature puts less explicit emphasis on these concepts (Daudigeos *et al.*, 2011). Our example climate change is one prominent case for investigating CSR in the context of the threat of internalization. There are many other research phenomena which are of similar importance, for example the loss of biodiversity (TEEB, 2010). Future research could therefore empirically investigate the benefits of strategic CSR-activities aimed at reducing corporate contributions to negative externalities for other research contexts.

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