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Markus Groth and Annette Brunsmeier

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Abstract

Companies are increasingly concerned with current and future climate change risks that have the potential to generate a substantial change in their business operations, revenue and/or expenditure. Therefore, the paper focusses on the companies' perspective and aims to create a higher awareness of companies' risk drivers when it comes to specific challenges of different sectors as well as each company within its sector.

Based on companies' responses to the CDP's climate change information request 2013, including 125 companies from Germany, Austria and Switzerland, the paper presents a detailed companies´ perspective on climate-related risk-drivers, comprising i) changes in regulation, ii) changes in physical climate parameters and iii) changes in other climate-related developments. Hence, the paper provides insights into climate change and adaptation related risks for companies. Furthermore, the results also facilitate a comparison of risk drivers between and within sectors. This also enables companies to i) position themselves regarding the potential threat they might be facing now and in the future, ii) assess their competitive advantages and disadvantages as well as prioritize risk drivers they have to deal with by evaluating their own position within the sector-specific analysis. Regarding specific threats companies are facing, they furthermore have the possibility to take good practices and innovative ideas from companies out of different sectors into consideration, aiming for an efficient and effective adaptation to climate change. Thus, the study's findings can also serve as an innovative starting point for further research as well as the practical implementation of adaptation measures.

Keywords: business sectors, CDP climate change information request, climate change adaptation, climate change mitigation, climate reporting, risk drivers.

JEL-Classification: C83, D22, D81, L20, M20, M48, Q54.

[1] Leuphana University Lüneburg, Faculty of Sustainability, Sustainability Economics, Scharnhorststr. 1, 21335 Lüneburg, Germany.

[2] Climate Service Center Germany (GERICS), Climate Impacts and Economics Department, Fischertwiete 1 (Chilehaus), 20095 Hamburg, Germany.

Corresponding author: Dr. Markus Groth, Groth@leuphana.de, +49-(0)40-226338-409.

1. Introduction

Climate change challenges companies all over the world, forcing them to take action in climate change mitigation and adaptation. The need for action rises as risks already are noticeable today (CDP 2015; UN Global Compact 2015; Arent et al. 2014; IPCC 2014; Okereke et al. 2012; Agrawala et al. 2011; UKCIP 2010). Dealing with a multitude of consequences possibly affecting society in many different ways requires companies to engage with climate change issues and adapt to current and upcoming changes (UN Global Compact 2015; IPCC 2014). Besides climate change risks driven by changes in physical parameters (Arent et al. 2014), and risks driven by changes in regulation also risks driven by changes in other climate-related developments are main risk drivers with high importance for companies (BSR 2016; Brunsmeier and Groth 2015; CDP 2015; UN Global Compact 2015; CDP and Climate Service Center Germany 2014; CDP and Climate Service Center Germany 2013; Linnenluecke et al. 2013).

The IPCC (2014) defines adaptation as a process of adjustment to actual or expected climate and its effects. For companies, the principal purpose of adaptation is to build resilience to climate change for the continuity of service across the whole organization. However, climate change related risk drivers can differ heavily between and within business sectors with regard to the risk drivers‘ likelihood, kind of influence as well as magnitude of impact (BSR 2016; CDP 2015; CDP and Climate Service Center Germany 2014; CDP and Climate Service Center Germany 2013). Hence, every company is in need of a specific evaluation of relevant risk drivers.

The reasons for differences in the relevance and threat of specific risk drivers for each company are manifold. Climate change related impacts on companies are determined by the company‘s business, its location, its focus groups as well as its entire value-added chain characteristics (CDP 2015; UN Global Compact 2015; Linnenluecke et al. 2013; Agrawala et al. 2011). Climate change consequences can vary from an increase in the company’s operational cost or a decrease in demand to the destruction of production facilities and the inability to do business (IPCC 2014; Linnenluecke et al. 2013; Linnenluecke and Griffith 2010; Aragon-Correa and Sharma 2003). Hence, companies exhibit specific vulnerabilities and capacities which determine the necessity of adaptation activities. Furthermore, various organizational capabilities are required to deal with disruptions due to the natural environment – like climate knowledge absorption, climate-related operational flexibility, and strategic climate integration (Linnenluecke and Griffith 2012; Busch 2011). And sometimes even

surprises might be a way leading to the inclusion of climate change into business strategies, as shown by Haigh and Griffith (2012) for utility companies.

To give consideration to differences when it comes to climate change related risk drivers and its consequences, a sector and company specific adaptation is indispensable (UN Global Compact 2015; Climate Service Center Germany 2014; IPCC 2014; CDP and CDP and Climate Service Center Germany 2013; Linnenluecke et al. 2013). However, there often is a lack of experience and innovative solutions – as well as other barriers like i) challenges of integrating long-term forecasts into business planning, ii) information gaps and risk uncertainty, iii) a lack of incentives to take adaptation action, or iv) missing access to financing – that hinder companies to develop and implement effective and sustainable adaptation strategies and adaptation actions (UN Global Compact 2015).

In this paper 125 companies' responses from the DACH-region (Germany, Austria and Switzerland) to the CDP's (formerly Carbon Disclosure Project) climate change information request 2013 have been analyzed. The paper therefore provides a detailed companies´ perspective on climate-related risk-drivers, comprising i) changes in regulation, ii) changes in physical climate parameters and iii) changes in other climate-related developments.

The aim is to facilitate a comparison of risk drivers between and within sectors, also enabling companies to i) position themselves regarding the potential threat they might be facing now and in the future, ii) assessing their competitive advantages and disadvantages as well as iii) prioritize risk drivers they have to deal with by evaluating their own position within the sector-specific analysis. Regarding specific threats companies are facing, they furthermore might get an inspiration to take good practices and innovative ideas from companies out of different sectors into consideration, aiming for an efficient and effective adaptation to climate change.

The paper is structured as follows. The second chapter explains the methodology and the data basis used. The third chapter presents main results regarding companies climate change related risk drivers for the three different overall categories of risk drivers. Chapter four concludes.

2. Methodology and data basis

The analysis presented in this paper is based on CDP-data, containing climate change related information from 125 companies.[3] Along with data on carbon emissions, reduction goals and activities as well as perceived climate change opportunities, the CDP-database provides a detailed companies‘ perspective on climate change related risk drivers, comprising i) changes in regulation, ii) changes in physical climate parameters, and iii) changes in other climate related developments. Our study is not only taking those risk drivers being named the most often by companies into consideration, but additionally measures the actual threat of specific risk drivers. The actual threat of a risk driver is measured by the simultaneous consideration of its magnitude of impact and its likelihood of impact for the company.

The likelihood of impact is defined as the likelihood of the impact occurring and refers to the probability of the impact to companies occurring within the timeframe provided, which in the case of an inherent risk might be similar to the probability of the climate event itself (CDP 2016). The terms used to describe likelihood are taken from the IPCC (2013). They are associated with probabilities, indicating the percentage likelihood of the event occurring.[4]

The magnitude of impact describes the extent to which the impact, if it occurred, would affect companies (CDP 2016). This considers the company as a whole and therefore the magnitude can reflect both the damage that can be caused and the exposure to potential damages. It is not possible to accurately define terms for magnitude as they will vary from company to company. Therefore companies have been asked by the CDP to determine the magnitude of impact on a qualitative scale of high, medium-high, medium, low-medium, low and unknown (CDP 2013).

The likelihood of impact and the magnitude of impact are the main components for identifying and prioritizing risks in this paper. By this kind of methodological approach it is possible to avoid distortion of results due to overestimation of above average frequently named risk drivers with low likelihoods and/or low magnitudes of impact, as well as distortion due to underestimation of below average frequently named risk drivers with high likelihoods and/or high magnitudes of impact.

[3] The CDP is a global non-for-profit organization, providing a global natural capital disclosure system, including an annual questionnaire for the private sector. In this context 4.500 companies worldwide, representing over 50% of the world’s market capitalization, report, share and take action on vital environmental information. All data from the CDP is available free of charge for research (non-commercial purposes).

[4] The likelihood terms are: virtually certain (greater than 99% probability); very likely (greater than 90% probability); likely (greater than 66% probability); more likely than not (greater than 50% probability); about as likely as not (between 33% and 66% probability); unlikely (less than 33% probability); very unlikely (less than 10%); exceptionally unlikely (less than 1% probability); unknown.

However, risk drivers differ between and within business sectors. The reasons for differences in the relevance and threat of specific risk drivers for each company are manifold. Climate change related impacts on companies are determined by the company‘s business, its location, its focus groups as well as its entire value-added chain characteristics. Climate change consequences can vary from an increase in the company’s operational cost or a decrease in demand to the destruction of production facilities and the inability to do business (Arent et al. 2014; IPCC 2014). Further, companies exhibit specific vulnerabilities and capacities which determine the necessity of adaptation activities (IPCC 2014).

To give consideration to these differences when it comes to climate change related risk drivers and its consequences, a sector specific analysis is indispensable. That for, the 125 responding companies from the DACH-region were grouped into nine business sectors according to their own specifications, as follows: i) consumer staples, ii) consumer discretionary, iii) energy and utilities, iv) financials, v) health care, vi) materials, vii) industrials, viii) telecommunication services, and ix) information technology. The classification of business sectors is based on the Industry Classification Benchmark (ICB)[5], whereas companies from the energy sector and companies from the utility sector were grouped together due to their similar structure and vulnerabilities.

[5] http://www.icbenchmark.com/ICBDocs/Structure_Defs_English.pdf.

3. Results

Based on the individual companies' responses main results will be presented on the companies´ perspective on climate-related risk-drivers, comprising i) changes in regulation, ii) changes in physical climate parameters and iii) changes in other climate-related developments. First of all it becomes clear that companies in all sectors are concerned with current and future climate change risks that have the potential to generate a substantive change in their business operations, revenue and/or expenditure. While changes in physical climate parameters have been the focus of plenty of studies (Arent et al. 2014; Linnenluecke et al. 2013), also changes in regulation, and changes in other climate-related developments are of high relevance as climate change related risk divers for companies (figure 1), even though they are often still overlooked risk drives within the scientific community regarding climate change adaptation (Brunsmeier and Groth 2015).

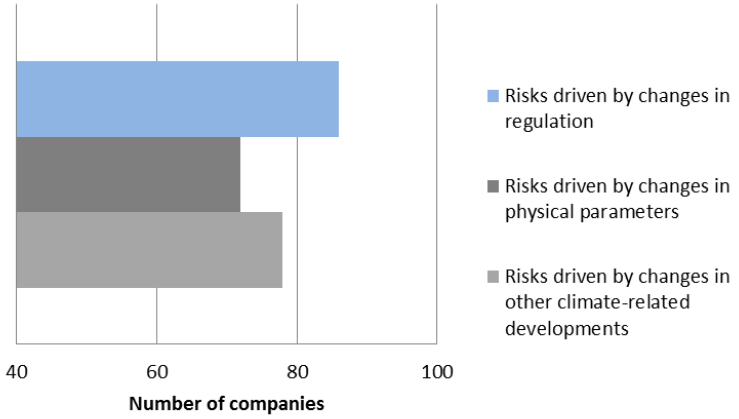


Figure 1: Climate related risk drivers from a companies' perspective

Within the following subchapters the results are presented for the three different overall categories of risks drivers. For the different risk drivers the results show the magnitude of impact and the likelihood of impact for each sector. In addition, the size of the bubbles reflects the relative importance of each risk driver for the companies within the specific sector – the bigger the bubble, the greater the importance. Within this paper the most relevant risk drivers are presented and discussed in order to learn about the general approach as well as to get insights on how specific sectors compare to other sectors in Germany, Austria and Switzerland reading these different climate change risk drivers.

3.1 Risks driven by changes in regulation

Regulatory risk drivers for companies include i) carbon taxes, ii) cap and trade schemes, iii) renewable energy regulations, iv) fuel/energy taxes and regulations, v) product efficiency

regulations and standards, vi) international agreements, vii) general environmental regulations (including planning), and viii) uncertainty surrounding new regulation (figures 2 to 9).

Figures 2-9: The relevance of regulatory risk drivers for different sectors

Focusing on a few regulatory risk drivers for companies, it becomes clear that current or possible future carbon taxes are of high relevance in different sectors (figure 2). Carbon taxes are a type of regulation that imposes specific economic incentives for polluters in order to internalize external environmental cost. Compared to other sectors, the sector energy and utilities is for example affected by this specific risk driver with the highest magnitude of impact, an average likelihood as well as a relatively low importance within the sector.

Also cap and trade schemes play a very important role to the private sector, as shown in figure 3. Cap and trade schemes are also known as emissions trading schemes and cap the amounts of release of a product/pollutant. Especially the sector materials as well as the sector energy and utilities with a medium-high likelihood combined with a medium – for energy and utilities an above medium – magnitude of impact, perceive cap and trade schemes as threatening to their business. However, also sectors with a very high likelihood have to react immediately to potential risks driven by cap and trade schemes.

Risks driven by renewable energy regulation – like national and regional renewable energy policy targets or renewable energy support policies – are one of those risk drivers not being named the most often by companies, but one that harbors danger for a great many of companies although it is perceived as threatening to very few sectors. As shown in figure 4, particularly the sector energy and utilities such as the sector materials fear possible national and/or regional policy targets or support policies concerning the use of renewable energy.

The most often named risk driver, which also exhibits an above average likelihood and magnitude of impact, is fuel/energy taxes and regulations, whereby the regulations mainly aim at the consumption of fuel and/or other energy types but not specifically greenhouse gas emissions. All nine sectors are aware of the risks fuel/energy taxes and regulation involve. Further, eight of nine agree on an above average threat that is generated by current or expected regulations concerning fuel/energy consumption and use (figure 5).

Another issue threatening all nine sectors is the case of risks driven by product efficiency regulations and standards, such as requirements on buildings energy efficiency. However, these regulations and standards – targeting the efficient production or commercialization of a product – affect sectors on a different level regarding the variables likelihood and magnitude of impact. The different perceptions of product efficiency regulations and standards as climate-related risk drivers and how they vary between sectors is shown in figure 6.

However not only expected policy on climate change issues, but also the uncertainty surrounding new regulations can involve a threat for the private sectors. New products or

cooperation can for example be incompatible to future regulations and standards, which could lead to high losses taking research and development cost into consideration (figure 9).

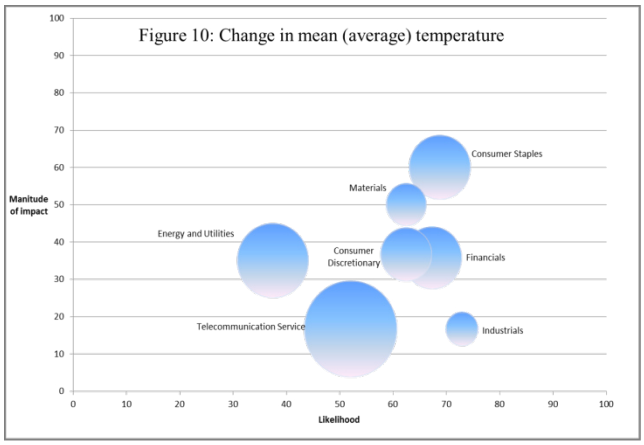
3.2 Risks driven by changes in physical climate parameters

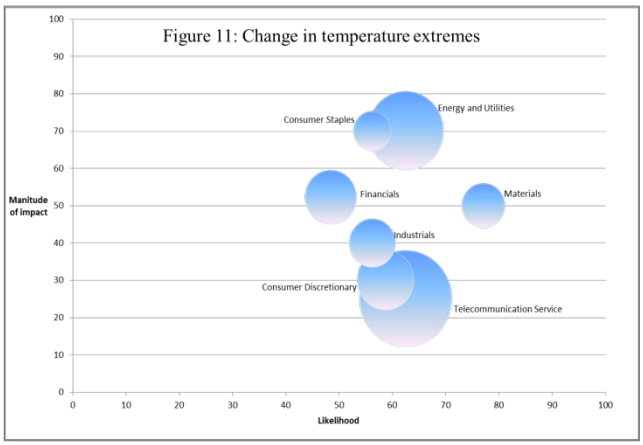
Physical risk drivers for companies taken into account are i) changes in mean (average) temperature, ii) changes in temperature extremes, iii) changes in precipitation extremes and droughts, iv) induced changes in natural resources, v) changes in precipitation pattern, vi) sea level rise, vii) snow and ice, and viii) changes in mean (average) precipitation (figures 10 to 17).

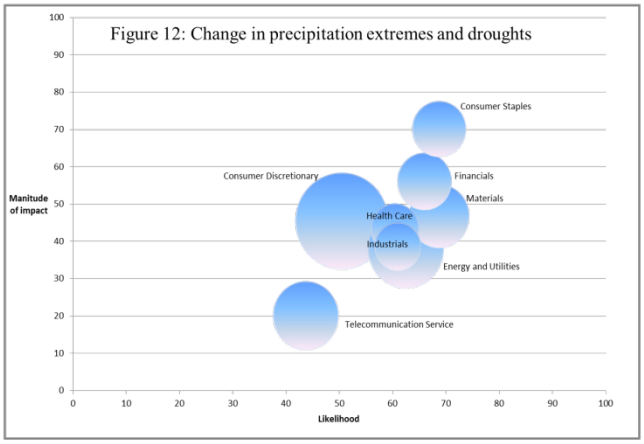
Regarding risks driven by changes in physical climate parameters some key parameters will be focused in more detail. It becomes clear that companies in many economic sectors are affected by risks driven by changes in physical climate parameters like temperature, precipitation, sea level rise, and extreme events (Arent et al. 2014). Climate change-related risks and its widespread impacts on people, economies and ecosystems are increasing steadily, as also the IPCC (2014) points out. For Europe climate projections (Jacob et al. 2014) show a marked increase in high temperature extremes, meteorological droughts, heavy precipitation events with variations across Europe and small or no changes in wind speed extremes except increases in winter wind speed extremes over Central and Northern Europe. Climate change will increase the likelihood of systemic failures across European countries caused by extreme climate events affecting multiple sectors and critical infrastructures, like the energy sector (Cortekar and Groth 2015). Extreme weather events currently have significant impacts in Europe in multiple economic sectors as well as adverse social and health effects. There is limited evidence that resilience to heat waves and fires has improved in Europe (Kovats et al. 2014). The general capacity to adapt in Europe, however, is high compared to other world regions, but there are important differences in impacts and in the capacity to respond between and within the European sub-regions (IPCC 2014; EEA 2012).

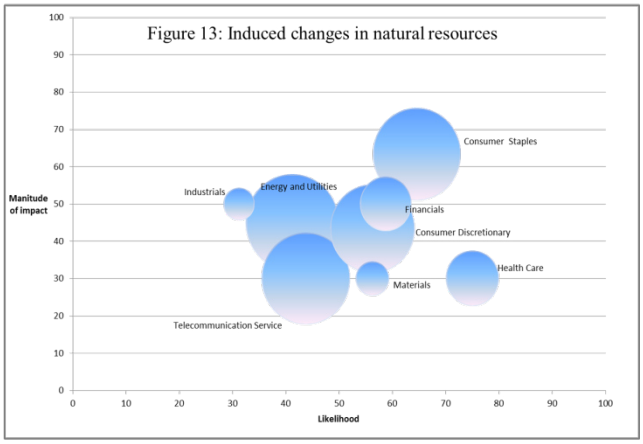
Like figure 10 points out, changes in mean (average) temperature are of relatively low relevance for the sector energy and utilities compared to other sectors, since the companies responses indicate the relatively lowest likelihood as well as a medium magnitude of impact.

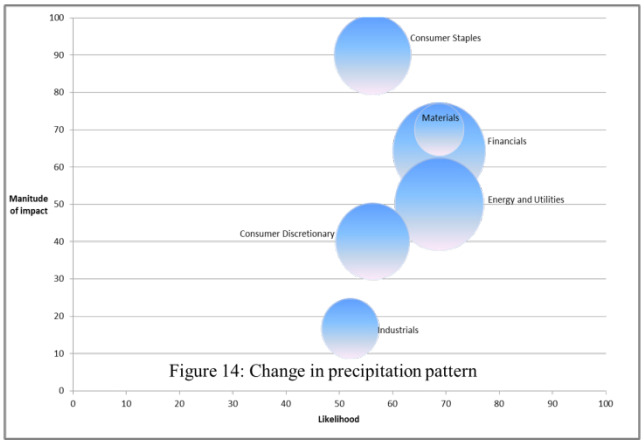
In contrast to changes in mean (average) temperature, changes in temperature extremes are an important risk for companies in various sectors, especially for companies within the sector energy and utilities.

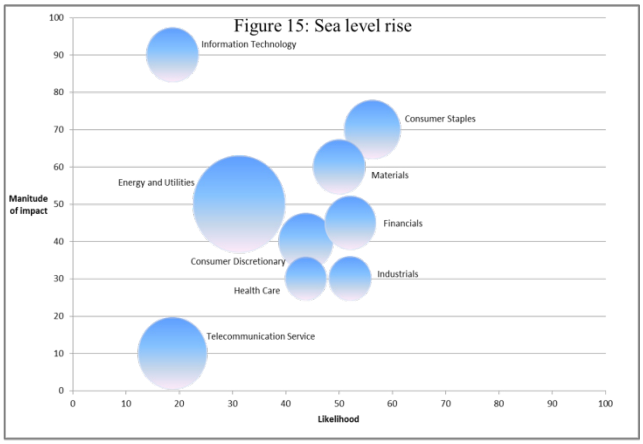


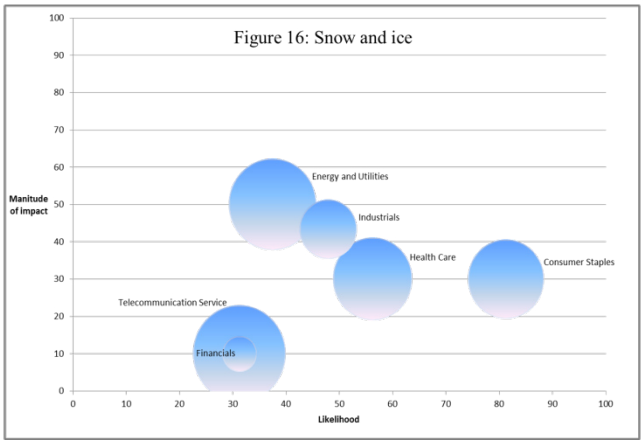


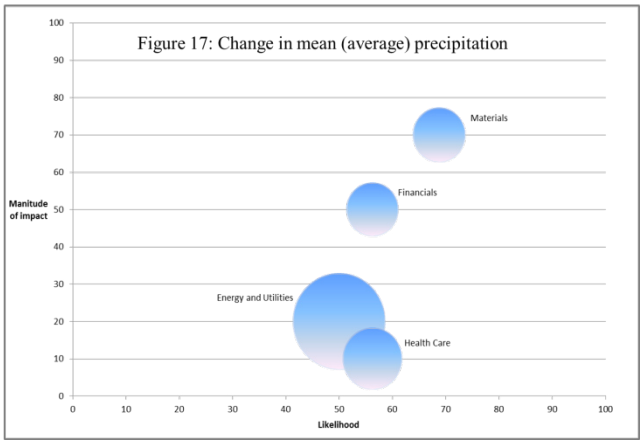












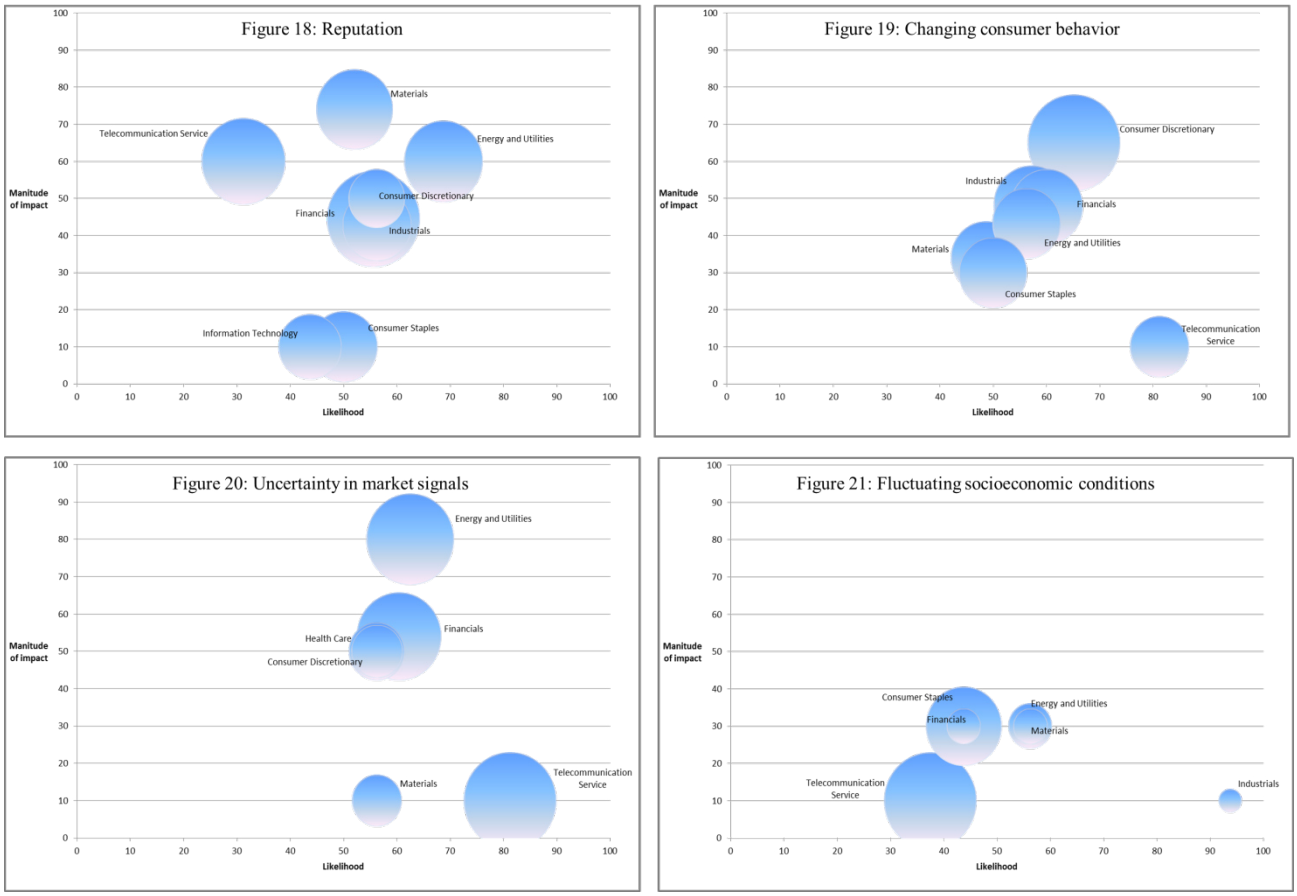
Figures 10-17: The relevance of physical risk drivers for different sectors

The results shown in figure 11 point out, that for the sector energy and utilities this risk driver leads to impacts marked by a very high magnitude of impact, a medium likelihood as well as a high importance within the sector.

Regarding risks by changes in precipitation extremes and droughts in Germany, Austria and Switzerland – as another example for physical risk drivers – the results show a rather average relevance for the sector energy and utilities, compared to other sectors (figure 12).

3.3 Risks driven by changes in other climate-related developments

Other climate-related risks taken into account are i) reputation, ii) changing consumer behavior, iii) uncertainty in market signals, and iv) fluctuating socio-economic conditions (figures 18 to 21).



Figures 18-21: The relevance of other risk drivers for different sectors

Finally, potential impacts by risk drivers due to changes in other climate-related developments will be highlighted. Reputation deals with negative perceptions experienced by the public (including lobby groups) as well as suppliers and customers (Brunsmeier and Groth 2015). Looking at figure 18, it becomes obvious, that from a companies' perspective reputation as a

strong part of a company‘s capital is very vulnerable to negative perceptions by focus groups when it comes to the evaluation of companies’ climate change adaptation and mitigation activities. For the energy and utility sector, reputation is – for example – a risk driver characterized by a high magnitude of impact, a high likelihood as well as a high importance within the sector.

Also changing consumer behavior within the energy and utility sector is already visible. As shown in the figure 19, the likelihood of a changing consumer behavior due to climate change for the private sector varies from medium to high. Especially with regard to the magnitude of impact there are major differences between sectors. However, it becomes clear that changing consumer behavior is a very important factor when it comes to the perception of climate change related risk drivers from a companies’ perspective.

As markets respond to climate change impacts and predictions, volatility can be induced. That for, uncertainty in market signals have also to be taken into consideration, when it comes to the evaluation of climate-related risk drivers. The potential threat of uncertainty of market signals regarding climate change issues is presented in the figure 20. In contrast to reputation and changing consumer behavior, all sectors stated a high likelihood.

4. Conclusion

Europe is already affected by impacts related to climate change – and will be even stronger in the future (Jacob et al. 2014; Kovats et al. 2014; EEA 2012). Thus, adaptation action is important for preventing further damage and, together with mitigation, is a powerful, resource-efficient means to address climate change (CDP 2015; UN Global Compact 2015; Arent et al. 2014; IPCC 2014; UKCIP 2010).

While the main consequence of risk drivers due to changes in physical climate parameters as well as the consequence of risk drivers due to changes in regulation is an increase of operational and capital cost, the main consequences of other climate-related risk drivers are a reduced demand for products and services (Brunsmeier and Groth 2015).

This paper provides first of all detailed insights into climate change and adaptation related risks for companies. Furthermore, the cross-sectoral analysis offers companies a basis to position them within their own sector. By doing so, companies are given the opportunity to become aware of risk drivers they might be facing now or in the future as well as to evaluate their current risk management regarding climate change risks. Hence, the results facilitate a comparison of risk drivers between and within sectors. Further, the results might foster knowledge exchange between sectors. Regarding specific threats companies are facing, they can profit from other companies‘ experiences, good practices and innovative solutions from different sectors – most probably companies they would have not taken into consideration before, aiming for an efficient and effective adaptation to climate change. Thus, the study’s findings can also serve as an innovative starting point for further research as well as the practical implementation of adaptation measures.

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Leuphana Universität Lüneburg
Institut für Volkswirtschaftslehre
Postfach 2440
D-21314 Lüneburg
Tel.: ++49 4131 677 2321
email: brodt@leuphana.de

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