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Multinational Corporations and climate adaptation - Are we asking the right questions? A review of current knowledge and a new research perspective

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ABSTRACT

Adapting to climate change requires the engagement of all actors in society. Until recently, predominant research focus has been on governments, communities and the third sector as key actors in the adaptation process. Yet, there is a growing emphasis internationally on understanding the role of and the need to engage businesses in adaptation given their potential to finance projects, develop and deploy technologies and innovative solutions, and enhance the scale and cost-effectiveness of certain adaptation measures. Already, many multinational corporations (MNCs) are purportedly beginning to take steps to adapt their operations to climate change. Some stated reasons for their engagement include minimising potential impacts on their supply chains, improving resource efficiency, enhancing the production and use of sustainable raw materials, and supporting customers', suppliers' and communities' efforts to adapt to climate change. However, there is a paucity of work analysing adaptation actions by MNCs, their motivations and contribution to broader adaptation and climate resilient development efforts, as well as possible instances of maladaptation. We apply a three-tier framework on drivers, responses and outcomes to examine the state of knowledge according to recent literature on private sector and MNC adaptation to climate change. Our review highlights that the literature on the impact and outcomes of MNC adaptation actions is considerably sparse and we consider the implications for future research. Our analysis concludes with a reflection on the relevance of MNC-led adaptation – for the companies themselves, for policy-makers at all scales, as well as for society at large.

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INTRODUCTION

Climate change is expected to lead to major impacts on human and natural systems and increase risks for individuals, businesses, infrastructure, assets and economies (IPCC, 2014a). No single intervention will deliver adaptation to climate change, as efforts cutting across various sectors and timescales will be required. Adding to this complexity is the uncertainty and long-term timescales of climate change impacts, which go beyond normal investment decision cycles in the private sector and policy planning cycles of governments (McKenzie Hedger et al., 2008).

The magnitude of the climate challenge has led to a growing recognition at international and national levels of the need to engage the private sector (Biesbroek et al., 2010; Cimato and Mullan, 2010; Partnership for Resilience and Environmental Preparedness (PREP), 2012; United Nations Framework Convention on Climate Change (UNFCCC), 2013; United Nations Framework Convention on Climate Change (UNFCCC), 2014; United Nations Global Compact, 2013; United Nations Global Compact et al., 2011). A recent survey of global decision makers ranks 'failure of adaptation measures' by business and governments as number five among the global risks with highest impact (World Economic Forum (WEF), 2015). Yet, the role and impact of the private sector in delivering adaptation and, more generally, climate-resilient development, is poorly understood—perhaps with the exception of certain sectors, such as insurance, tourism, energy and utilities or the food and beverage sector, that have been more visible in terms of their response to climate risks. There is also very little assessment of how private sector action can potentially increase risks and lead to maladaptation, i.e. actions that lead to inadvertent increases in vulnerability to climate change impacts (Barnett and O'Neill, 2010).

The private sector is very diverse. It encompasses all entities not owned or controlled by the public sector, incorporated under law and geared to making profits (Lienert, 2009). Private corporations differ in size, and in the location and economic sector they operate in. Some are single businesses operating locally while others, known as Multinational Corporations (MNCs) have a parent company that controls assets and equity capital of subsidiaries, associate enterprises or branches operating across various countries (United Nations Conference on Trade and Development (UNCTAD), 2014).

An important pre-requisite for MNC and private sector adaptation is a capacity to adapt. Adaptive capacity influences the extent a business is aware of its vulnerability, and can evaluate, make decisions about and implement adaptation measures, whether in anticipation or in response to climate change impacts (Berkhout et al., 2004). In this context, building adaptive capacity is important and involves creating the information and conditions (regulatory, institutional, and managerial) that are needed before adaptation actions can be undertaken. Not all corporations have adequate capacity to deliver adaptation to climate change for their operations or the communities in which they operate. This is why under the Climate Investment Fund over USD29 million has been set aside to "contribute to the financing of innovative programs and projects that engage the private sector in activities associated with reducing countries' exposure to climate risk and uncertainty"(Climate Investment Funds (CIF), 2014).

MNCs differ from other companies in the ability to operate and move resources across countries and sectors and in their role as suppliers of some of the credit required to fuel innovation and economic growth (Strange, 2003). They are seen as having the ability to supply resources and/or the know-how needed for adaptation (Berkhout, 2012; Biagini and Miller, 2013; Hart, 2013; IPCC, 2014c; Pauw

and Pegels, 2013; Pauw, 2014; SIDA et al., 2009; United Nations Framework Convention on Climate Change (UNFCCC), 2013; United Nations Global Compact and United Nations Environment Programme (UNEP), 2012). Moreover, MNCs also experience a high level of exposure to climate change in part from their role in coordinating close to 80 per cent of global trade (United Nations Conference on Trade and Development (UNCTAD), 2013) through their global value chains. As such, the following questions are highly relevant for today's adaptation discourse: Are MNCs responding to calls for action? If so, what motivates them to do so? And what are the consequences of their actions?

Applying a three-tier framework on drivers, responses and outcomes we examine the state of knowledge in the recent literature on private sector and MNC adaptation to climate change. Further, on the basis of our review we provide a critical conceptual narrative for the assessment of outcomes of MNC adaptation, which is largely absent from the burgeoning literature.

DEFINING MNC ADAPTATION TO CLIMATE CHANGE

Adaptation to climate change is defined in the 5th Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) as "the process of adjustment to actual or expected climate and its effects" (IPCC, 2014b). Yet, what does adaptation mean explicitly for businesses?

A key challenge for any study on adaptation and businesses is terminology: companies use a wide range of terms when describing their responses to climate risks: resilience, business continuity, enterprise risk management, or flood risk management, to name a few. Looking for 'adaptation' may not necessarily reveal any of those actions. As mentioned by Agrawala et al (2011) many actions undertaken by businesses to improve their resilience or manage environmental or climate risks may be part of their standard risk management processes and will not be explicitly labelled as adaptation.

The need for clarity on the definition of adaptation for MNCs is important as there is confusion amongst businesses of its meaning. In particular, the synergies and distinctions between adaptation and mitigation are far from clear in a corporate context (United Nations Global Compact and United Nations Environment Programme (UNEP), 2012). For example, a 2009 survey by Natural Resources Canada found that of the 40% of businesses claiming to be taking adaptation measures 73% of them were in fact describing mitigation actions and only 18% described adaptation actions, while the synergies between both sets of actions were largely overlooked (National Round Table on the Environment and the Economy (NRTEE), 2012).

In addition, it is important to consider whether and in what way adaptation to climate change means anything new or different for businesses. Anticipating and responding to risks is considered business-as-usual for many companies, alongside their efforts to respond to other external changes and stressors, such as industry structures and institutional conditions, suggesting that corporate adaptation is part of corporate risk management. For example, Berkhout et al (2006) and Weinhofer and Busch (2013) see adaptation as involving the generic risk management stages of identifying, assessing and responding to the risks. In fact, many companies appear to incorporate climate change risks into existing risk management or business continuity plans and processes. A 2012 CDP study of the UK FTSE 100 companies found that only 10% of companies surveyed have a specific climate change risk management process, whereas 88% have integrated risk management into their multi-

disciplinary company-wide risk management processes (Carbon Disclosure Project (CDP), 2012b). This trend does not appear to be UK specific as Crawford and Seidel's study of the S&P Global 100 companies found that a majority of companies reported including changes in extreme weather risks due to climate change into existing business continuity plans and processes (Crawford and Seidel, 2013).

Yet, adaptation to climate change may represent an additional challenge for business beyond adapting to economic, policy or legislative changes, as it involves adapting to complex, non-linear and potentially irreversible environmental changes with uncertain impacts (Linnenluecke and Griffiths, 2010; Linnenluecke et al., 2012; Winn et al., 2011). Traditional risk management approaches can be applied to the impacts and changes that can be anticipated and quantified but new approaches may be needed to deal with the discontinuous change that climate change represents (Sur, 2012; Winn et al., 2011). Climate change can also be seen as a 'risk multiplier' and businesses have yet to understand its full meaning and impact on all aspects of their business and in particular their supply chains (Gledhill et al., 2013). To date little research on sustainability management has looked at how to create innovative, robust and resilient organisations (Winn et al., 2011).

Through the application of a three-tier framework on drivers, responses and outcomes the following section investigates the state of knowledge according to recent literature on private sector and MNC adaptation to climate change.

AN ANALYTICAL FRAMEWORK FOR TAKING STOCK OF THE STATE OF KNOWLEDGE

A tripartite division is proposed based on a distinction between drivers of MNC adaptation, responses by MNCs and outcomes of MNC actions (see Figure 1). This is a simple framework, which can be applied at company level (MNC), for a certain sector or to geographical boundaries such as a country, region or city. At a given point in time an MNC may experience multiple drivers and these may vary not only by industry but also by the country where it is domiciled or where it operates. Similarly, a company may pursue multiple responses with various outcomes. The result is a dynamic setting characterised by continuous feedback loops that both shape and are shaped by MNC adaptation actions.

The analytical framework proposed is useful for three main reasons. First, it allows for the collation of a very diverse set of studies according to consistent categories to enable us to summarise the state of knowledge. As each dimension is understood and clarified it becomes useful for the relevant actors in each domain, in particular for policymakers who are interested in promoting MNC-led adaptation while ensuring that it adds to broader societal adaptation. Second, the approach enables identification of questions that remain unanswered and to outline a way forward to address the main gaps. Third, it is a tool to help deal with the considerable diversity of MNCs across sectors and jurisdictions.

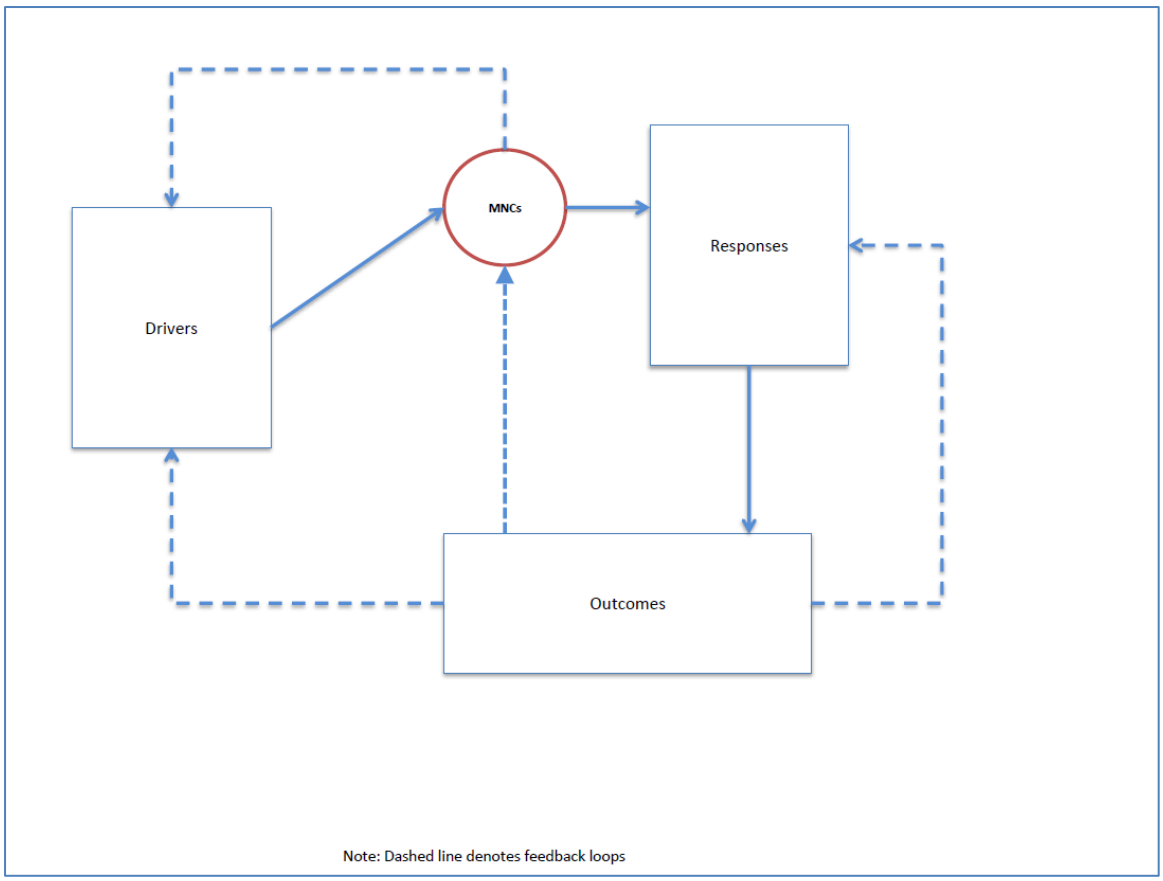

Figure 1. Analytical framework for understanding MNC adaptation

A few important points regarding the application of our analytical framework to the literature need to be mentioned. First, assessing MNC climate change adaptation actions is complicated by several factors. For instance, as highlighted above, companies may not classify their actions as adaptation per se, and may use other terms, such as resilience or risk management. In light of this lack of conceptual clarity we have opted to be inclusive in reviewing a broad array of papers with a different understanding of adaptation. Our approach responds to the cross-disciplinary treatment required to understand actions by MNCs in response to climate change and its impacts.

A second related point is the use of the term 'private sector' which is often applied interchangeably and unevenly across academic and policy literature often with little clarification whether referring to MNCs or other types of corporations. Our review suggests large companies have received more attention than small and medium sized businesses but findings are far from representative of the population of MNCs that in 2009 amounted to 82,000, with approximately 810,000 foreign affiliates worldwide (United Nations Conference on Trade and Development (UNCTAD), 2009).

Our review of MNC adaptation to climate change was based on two main sources: i) relevant peer-reviewed academic papers through searches in Web of Science and Google Scholar; and ii) relevant grey literature, as this literature reflects some of the latest thinking in the field (Wilby and Vaughan, 2011). The search for academic papers had two main purposes, which were to firstly identify specific case studies or sector studies of adaptation by the private sector, and in particular MNCs, and secondly to review the more theoretical literature on private sector and organisation-centred adaptation to climate change. For the academic papers we did extensive searches using the terms CLIMAT and ADAPT as well as CLIMAT and RESILIENCE, EVALUAT and ADAPT, OUTCOME and ADAPT,

EFFECTIVENESS and ADAPT with a variety of terms to denote the private sector, including: PRIVATE SECTOR, BUSINESS, ORGANISATION, CORPORATION, FIRM. This search highlighted that the literature on MNC adaptation is still emerging and contains mainly a small number of sectoral case studies, in particular focusing on the construction, energy, food/beverage, insurance, winter tourism, and water sectors (Arnell and Delaney, 2006; Beermann, 2011; Haigh and Griffiths, 2012; Hertin et al., 2003; Hoffmann et al., 2009; Scott and McBoyle, 2007; Weinhofer and Busch, 2013; Wilby and Vaughan, 2011) as well as a few overview (Tompkins et al., 2010) and theoretical papers on business and organisational adaptation (Berkhout, 2012; Linnenluecke and Griffiths, 2010; Linnenluecke et al., 2013). Given the nascent nature of this literature our review is also underpinned by selected readings from other bodies of related literature including business management and organisational studies, risk management, corporate social responsibility and multi-sectoral partnerships. The search of the grey literature enabled us to access reports from international organisations, non-governmental organisations, consultancies and business organisations, many of which focused on analysing large surveys, such as the Carbon Disclosure Project and the 2010 Caring for Climate survey of 72 corporate signatories to the UN Global Compact and the UN Environment Programme Caring for Climate initiative (Acclimatise, 2009; Carbon Disclosure Project (CDP), 2012a, b, 2014; National Round Table on the Environment and the Economy (NRTEE), 2012; Pricewaterhouse Coopers (PWC), 2010; United Nations Global Compact et al., 2011). This literature therefore provided additional critical material on MNC adaptation. Finally, we also conducted an assessment of survey data underpinning the majority of quantitative studies of business adaptation (see Box 1). This assessment informed our analytical framework and identification of gaps in MNC adaptation research.

Box. 1. MNC ADAPTATION AND THE INVESTOR CARBON DISCLOSURE PROJECT

Given a paucity of systematic data as input to our analytical framework we undertook a quantitative review of responses to the Investor CDP survey by a subset of companies in the 2012 Global FT 500 list who voluntarily answered the questionnaires at two points in time: 2009 and 2010. Our final sample consisted of a total of 386 corporations. Our examination did not review open-ended questions.

We found the source an imperfect input for our three-part framework; not unexpected, since CDP investor's questionnaires were not designed with adaptation analysis in mind. Only in 2009 did it include a limited number of adaptation questions. We found sample size to limit representativeness and statistical accuracy; changes to survey questionnaires to limit tracking changes over time (see also Berry (2009) and Wellstead (2011)); and the voluntary nature of the survey to introduce sample selection bias (Brouhle and Harrington, 2009; Doda et al., In press; Matsumura et al., 2011). At a more basic level it remains unclear to what extent responses conflate adaptation with risk management, resilience, etc. Limited instrument validity and reliability suggest adaptation research reliant on CDP data to be at best exploratory. In-depth interviews can help to validate conclusions (see for example Agrawala et al (2011)).

The growing role of MNCs for overall adaptive capacity raises the desirability of a data collection effort specifically designed to monitor private sector adaptation. This would go beyond UNFCCC's Adaptation Private Sector Initiative (PSI) designed to assist developing countries to improve their understanding of climate change impacts and their vulnerability, and respond accordingly.

DRIVERS OF MULTINATIONAL CORPORATION ADAPTATION TO CLIMATE CHANGE

Understanding what might drive and motivate the private sector and in particular MNCs to adapt to climate change is critical as it can enable policy makers to provide and support favourable conditions for corporate adaptation and can provide entry points for non-profit organisations, international organisations and governments to engage with businesses on climate change adaptation (Hoffmann et al., 2009; National Round Table on the Environment and the Economy (NRTEE), 2012). Our review of the literature finds that private sector adaptation action appears to be motivated by a range of drivers external and internal to a business (Acclimatise, 2009; Agrawala et al., 2011; Beermann, 2011; Berkhout, 2012; Berkhout et al., 2006; Carbon Disclosure Project (CDP), 2012a, b; Crawford and Seidel, 2013; Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), 2012; Galbreath, 2011; Haigh and Griffiths, 2012; Hertin et al., 2003; Hoffmann et al., 2009; KPMG, 2012; National Round Table on the Environment and the Economy (NRTEE), 2012; Pricewaterhouse Coopers (PWC), 2010; United Nations Global Compact, 2013; United Nations Global Compact and United Nations Environment Programme (UNEP), 2012; Weinhofer and Busch, 2013; Wilby and Vaughan, 2011; World Business Council for Sustainable Development (WBCSD), 2008a). These drivers are discussed below, although we recognise that this internal/external division is slightly artificial, as the internal capabilities and processes of businesses are influenced by markets and shaped by and fitted to their external social and institutional environment (Berkhout, 2012; Linnenluecke et al., 2013).

Internal drivers

Internal factors and capabilities within a company can influence its decision to adapt to climate change (Berkhout, 2012; Galbreath, 2011; Hertin et al., 2003; Linnenluecke et al., 2013). Companies will seek to reduce costs, minimise disruption to their production and services, increase their profitability and improve their ability to do business, which can all be motivating factors for adaptation action. In addition, key decision makers such as executives, managers and change agents at lower levels of a company can play a key role in influencing a company's pro-environmental behaviour (Linnenluecke et al., 2013). Based on findings from the Caring for Climate survey UN Global Compact et al (2011) highlight the need for internal champions to identify and communicate climate risks and opportunities and support adaptation decision-making. However, very little research has been undertaken to investigate how decision makers within companies are responding to climate change and the role they have in influencing company-level action (Linnenluecke et al., 2013). In their paper focusing on private sector responses to climate change, Pulver and Benney (2013) suggest that organisational characteristics influence how companies experience, interpret and respond to climate risks. They state that foreign ownership, firm size, export orientation, financial performance all correlate with environmental performance and are likely organisational predictors of corporate engagement on climate change. Although they focus on mitigation aspects, these factors may be an important factor in a company's actions on adaptation to climate change.

External Drivers

Many businesses are already experiencing direct and indirect climatic impacts and anticipate that these will increase in the future (Agrawala et al., 2011; Carbon Disclosure Project (CDP), 2012a, 2014; Galbreath, 2011; Linnenluecke et al., 2011; Pricewaterhouse Coopers (PWC), 2010). These climatic impacts have been identified as one of the key drivers for private sector adaptation to

climate change, as businesses start to internalise and consider these risks in their investment decisions. Several studies note the importance of previous experience of extreme weather events or of gradual or average changes in climate (e.g. increase in average temperature) as key drivers for action (Agrawala et al., 2011; Crawford and Seidel, 2013; Galbreath, 2011; Haigh and Griffiths, 2012; National Round Table on the Environment and the Economy (NRTEE), 2012; Pricewaterhouse Coopers (PWC), 2010; Weinhofer and Busch, 2013), while others suggest that awareness of possible climate change impacts can drive corporate adaptation and lead to anticipatory adaptation responses (Arnell and Delaney, 2006; Gasbarro, 2013; Hertin et al., 2003; Hoffmann et al., 2009; Linnenluecke et al., 2012). Nevertheless in their analysis of the 2009 CDP data Agrawala et al (2011) found that although private sector awareness of climate risks was increasing, only a minority of businesses who responded to the survey had conducted risk assessments and fewer still had evaluated adaptation options, which suggests that awareness of climate risks alone will not be sufficient to drive large-scale adaptation action in the private sector.

Regulatory and legal drivers also play a critical role in stimulating private sector engagement by encouraging or requiring adaptation action by businesses. For example, studies of water supply companies in England and Wales have found that the regulatory environment played a critical role in encouraging adaptation action, as these companies are required to incorporate climate change in the water supply assumptions they use in their 25-year plans (Arnell and Delaney, 2006; Wilby and Vaughan, 2011). In addition, financial disclosure rules can require companies to disclose the physical risks from climate change when these risks impact a company's financial situation. Such disclosure rules or guidelines are in place for companies listed on exchanges in the US, Australia, Denmark, South Africa, Sweden and the UK (Crawford and Seidel, 2013). Governments also have a key role to play in encouraging MNC adaptation by providing credible, readily accessible scientific information, models and tools, co-financing research and development of new products and services, and forming public-private partnerships (Agrawala et al., 2011; Crawford and Seidel, 2013; United Nations Global Compact and United Nations Environment Programme (UNEP), 2012). For example, the Spanish government is supporting the development of new technologies to improve water resource management through CETaqua, a public-private partnership between the government, a university and the water company Agbar (United Nations Global Compact and United Nations Environment Programme (UNEP), 2012).

Reputational, corporate citizenship and stakeholder/investor pressures represent additional stimuli for private sector adaptation, as they may enhance the rationale to act. Companies can face increasing pressures from stakeholders, including insurers, banks, investors, regulators, civil society organisations, governments and customers, to address climate risks (Crawford and Seidel, 2013; National Round Table on the Environment and the Economy (NRTEE), 2012; Partnership for Resilience and Environmental Preparedness (PREP), 2012; United Nations Global Compact, 2013; World Business Council for Sustainable Development (WBCSD), 2008a). The Global Framework for Climate Risk Disclosure released in 2006 is a guidance from institutional investors to companies reporting on climate change and calls for them to report on the material and physical impacts that climate change may have on their business and operations as well as on the actions they can take to adapt to these impacts and the costs of such actions (Crawford and Seidel, 2013). However, some authors suggest that reputational drivers and corporate citizenship are unlikely to drive strategic adaptation and may instead only result in superficial and cosmetic changes (Agrawala et al., 2011; Pricewaterhouse Coopers (PWC), 2010; Pulver and Benney, 2013).

Market drivers also play a role, as companies seek to respond to changing demand, develop new products and services, access new markets and seize new business opportunities from climate change (Agrawala et al., 2011; Beermann, 2011; Carbon Disclosure Project (CDP), 2012a; Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), 2012; KPMG, 2012; Pricewaterhouse Coopers (PWC), 2010). As stated by the managing director of the Carbon Disclosure Project: "Adaptation is not only a story of risk management, but also of opportunity. Companies that act today may gain competitive advantage tomorrow […] Adaptation, in short, is good business" (Carbon Disclosure Project (CDP), 2014). Several sectors have recognised that adaptation represents new business opportunities, including the agricultural, consulting, water and insurance sectors. For example, in the insurance sector several of the leading global insurers and reinsurers consider adaptation as part of their quest for new growth markets. In addition, the UN Global Compact & UNEP (2012) report revealed that companies see a robust business case for strategic engagement on adaptation as they recognise the connections between their ability to operate and thrive and the well-being of the groups that make up their value chain, including suppliers, employees, customers and the people living in the areas in which they operate. However, it is worth noting that this report profiled companies who are part of the UN Caring for Climate Initiative and are thus most likely to be on the forefront of adaptation action.

MULTINATIONAL CORPORATION ADAPTATION RESPONSES

Categorising adaptation responses

Building on the above section on drivers for MNC adaptation, this section considers emergent MNC adaptation responses. A number of typologies of adaptive action have been proposed in the diverse literature examining adaptation processes (Burton, 2009; Smit et al., 2000). There are thus various ways in which MNC adaptation responses can be categorised. A common distinction is between anticipatory/proactive and reactive adaptation (Smit et al., 2009). Reactive adaptations are implemented in response to a climate hazard or extreme event such as flooding that necessitates an urgent response. Proactive adaptation is becoming increasingly urgent for business to reduce or avoid adverse climate impacts and to seize beneficial opportunities (Munasinghe and Swart, 2005). There are some examples of pioneering proactive MNC responses such as IBM's development of a software system to collect and analyse weather, rainfall and water-level data to support local government and emergency decision making on flood threats and evacuation plans (Forstater et al., 2009). However, proactive business stances have been hampered by perceived uncertainty about the magnitude and timing of impacts, as well as a lack of policy and regulatory incentives (National Round Table on the Environment and the Economy (NRTEE), 2012). Reactive approaches continue to dominate and be perceived by corporations as sufficient (Kolk and Pinkse, 2005). This standpoint is often based on the view that existing management structures are adequate to manage climate related risks or that handling slow onset climate changes is simply an extension of well-established incremental adjustments to other changes or risks (National Round Table on the Environment and the Economy (NRTEE), 2012).

Adaptation processes can be divided further into three broad categories: no adaptation actions, no regret or 'soft' adaptation measures or thirdly, the implementation of 'hard' adaptation measures (Agrawala et al., 2011). In other words, MNC adaptation responses can be understood as ranging from indifferent or 'wait and see' to active. Some companies are yet to take any adaptation

measures. This 'no adaptation' response can be attributed to multiple factors, which are often company specific. For example, given the incremental and long-term nature of some adaptation measures combined with economic pressures, business executives may defer adaptive action and others may opt not to pursue any immediate adaptation if vulnerability assessments reveal no significant climate risks to the business (Agrawala et al., 2011; National Round Table on the Environment and the Economy (NRTEE), 2012; Tomorrows Company, 2013). No adaptation can also be a result of inter alia regulatory, financial, political, as well as informational and knowledge barriers to adaptation faced by corporations (Repetto, 2008).

No regret/soft adaptation activities characteristically address current climate variability concerns and are co-beneficial to existing operations, while also supporting resilience to climate variability and risks. In some cases, they are likely to have been undertaken irrespective of predicted climate change impacts. Such measures usually entail adapting existing procedures and operations to be more flexible or resilient to climate change. Examples include early warning systems, insurance schemes and 'green infrastructure' such as restoration of wetlands. While more difficult to cost than hard structural measures, some authors (Hallegatte, 2009; Markandya et al., 2014) suggest that because soft adaptation measures can be easier to reverse they may be more suitable for some companies in dealing with uncertain climate and policy contexts. Agrawala et al (2011) identify no regret or soft adaptation as the most common response amongst private sector companies in their study. 'Hard' adaptation actions typically have a specific adaptation purpose and entail actions such as adjusting infrastructure and technology, often requiring significant investments (Markandya et al., 2014). The implementation of hard adaptation measures commonly relates to industry sectors, such as mining, that are reliant on long-term fixed assets (Gledhill et al., 2013; KPMG, 2012). Rather than being mutually exclusive, no regret, soft and hard adaptation measures can be implemented simultaneously by MNCs.

Responses by level of MNC engagement and type of risk faced

Drawing on CDP data, several authors (Crawford and Seidel, 2013; Kolk and Pinkse, 2005 2008) have developed detailed analyses of how MNCs are addressing climate change risks. Based on their investigation of CDP data from 136 Global S&P 500 companies Kolk and Pinkse (2005) propose a useful typology (ranging from 'cautious planner' to 'explorer' corporations) for categorising MNCs according to their emergent climate change response strategy[a]. They found that the majority (67%) of corporations fall in the narrow range of 'cautious' (little to no specific climate measures in place) to 'emergent' planners (early stages of considering a more comprehensive and concrete climate strategy). Only 5% of corporations were classified under their definitive cluster: 'horizontal explorers' (exploring and entering new markets and opportunities, sometimes through partnerships). Our review of the literature broadly affirms this trend with the most common MNC adaptation responses falling under cautious or emergent planner categories, often with a strong internal focus.

Some climate risks are internal, some emerge across supply chains and others relate to external risks such as shareholder expectations and regulatory markets (National Round Table on the Environment and the Economy (NRTEE), 2012). Given their diversity, MNCs experience different combinations of these risks, which in turn result in either internal or external responses, or both. Commonly reported methods used by MNCs to manage physical climate change risks include using conventional business

continuity or emergency preparedness plans, conducting a specific environmental vulnerability assessment, investing in upgraded equipment or infrastructure, transferring risk through insurance policies, and using climate change specific research or forecasting models to supplement conventional risk management activities (Crawford and Seidel, 2013; Gasbarro, 2013; Hertin et al., 2003). IPIECA's (2013) and Gasbarro's (2013) assessments of the oil and gas sector suggests that climate risk management is key to decision making frameworks in these industries with several companies undertaking the aforementioned risk management methods, although most did not specifically mention adaptation. While many companies use existing risk management frameworks in their approach to climate change adaptation these may be inadequate to deal with climate risks in the future (Crawford and Seidel, 2013). The above methods of managing physical climate risks often also apply to non-physical risks such as market and finance risks. Multiple additional categories of private sector response to climate change can be identified in the literature: risk management strategies, climate change sensitivity analyses, changes in operational practices; activities in political arenas; changes in corporate governance; public awareness campaigns, capacity building, entering new product markets/diversification; working with existing suppliers to ensure minimisation of climate impacts, geographical diversification and relocation, inter-firm co-operation; changes in operational practices; research collaborations and initiating partnerships or collaborations for supporting adaptation (Agrawala et al., 2011; Crawford and Seidel, 2013; Galbreath, 2011; Haigh and Griffiths, 2012; KPMG, 2012; Linnenluecke et al., 2013; Pulver and Benney, 2013; Sussman and Freed, 2008; The global oil and gas industry association for environmental and social issues (IPIECA), 2013; Tomorrows Company, 2013) . These adaptation response categories can be interpreted further as material (e.g. loans for adaptation measures, insurance, infrastructure investment) or non-material (e.g. capacity building and changes in policies and institutional frameworks), which can be implemented simultaneously.

The above response categories can be disaggregated into a multitude of specific adaptation actions dependent on MNC sector, region and other firm specific factors such as company size and history, product type and complexity and supply chain configurations. As a specific adaptation response in the consumer products sector India Unilever transformed laundry detergent to need less rinsing with a consequent predicted annual saving of 14 billion litres of water in the region and, for the water sector, Siemens is working on technology to reduce the cost and energy intensity of sea to drinking water conversion (Forstater et al., 2009). Often, these specific adaptation measures are undertaken as collaborative ventures between business and public or third sector actors.

Some MNCs in the insurance industry have explored the issue of climate change by collaborating with scientists, publicly engaging in policy debates, and also assessing the climate impacts on and opportunities for their own products (Mills, 2009). They do this on their own or through sectoral initiatives, such as ClimateWise and UNEPFI's Insurance Working Group, as well as industry organisations such as the Chartered Insurance Institute, the Geneva Association and national trade bodies. Surminski (2010) provides an illustration of how some insurers are engaged in risk reduction activities in the context of climate adaptation. The initiatives include raising awareness of disaster risks, promoting action by government, developing new modelling and risk assessment capabilities and supporting action by individuals through incentives, information, financial support and terms and conditions for policies.

Related to the above point on the insurance industry acting in collaboration, MNCs and the private

sector more broadly are increasingly acting through partnerships with the state, local communities and with other businesses as part of their adaptation responses (Agrawala et al., 2011; National Round Table on the Environment and the Economy (NRTEE), 2012; SIDA et al., 2009; United Nations Global Compact and United Nations Environment Programme (UNEP), 2012; World Business Council for Sustainable Development (WBCSD), 2008b; World Economic Forum (WEF) et al., 2008). For example, the R4 Rural Resilience initiative is a public-private partnership with Oxfam, WFP and Swiss Re aimed at enabling poor farmers and other food insecure households to manage weather and climate vulnerability through a comprehensive and affordable risk management program that develops long-term resilience (World Food Programme and Oxfam). Other MNCs such as SABMiller and Nestle have adopted a strong partnership ethos to support improved resource management decisions and facilitate local knowledge sharing in the communities in which they operate (Wales, 2014). Public-private collaboration on resilience building and adapting to climate change are often most effective when linked objectives exist within a sector but opportunities to scale-up such co-operative arrangements have been inadequately exploited (Kolk and Pinkse, 2008).

OUTCOMES OF MULTINATIONAL CORPORATION ADAPTATION

Evaluation of adaptation to climate change by private sector in general and by MNCs specifically has not received much attention in business and management academic literature (Goodall, 2008; Patenaude, 2011). One of the challenges for the evaluation of outcomes by MNCs is the lack of incentives for companies to share the information about their climate risk exposure and actions to address it, since it can be sensitive for their competitiveness (Agrawala et al., 2011). While there are a range of case studies and illustrative examples, no comprehensive measure exists to calculate the impact of adaptation activities. Measuring and tracking climate resilience is inherently difficult, not just in the context of the private sector (Surminski, 2013; Wilby and Vaughan, 2011). Furthermore the interplay of different actions and the difficulty in defining baseline conditions without the interventions make attribution of impact to a particular adaptation response a challenging task. For example, reduced damages from flooding could be due to changes in planning control or construction of new flood defences or an artefact of natural variability in the flood regime (Wilby and Vaughan, 2011). There are also the challenges of differences between private and societal effects, with a potential of private actions leading to maladaptation as discussed below.

Defining the outcomes of adaptation

The analysis of the outcomes of particular decisions and actions requires clarity on the objectives. In the case of adaptation the challenge is the lack of consensus on what constitutes a successful adaptation and the diversity of the definitions of adaptation being applied in the literature. As noted earlier, some studies view adaptation as the enhancement of the adaptive capacity to empower organisations and societies to adapt to change, while others focus on direct implementation of adaption activities to help reduce vulnerability to climate risks, of actions to exploit opportunities, or a combination of all of the above (Adger et al., 2005; Brooks, 2003; McKenzie Hedger et al., 2008).

If adaptation is seen as a decision process, then the evaluation of outcome is concerned with availability of tools and capacity to inform decisions. If adaptation is understood as a result, e.g. improved resilience, reduction of impacts and exposure to them, then the evaluation of outcome focuses on the long term effectiveness of the decisions. However such evaluation may be

complicated due to uncertainty of how adaptation will work under the changing conditions; differences between short-term and long-term impacts of an adaptation action; unintended spill-over effects onto other actors; dependence of adaptation on the actions by others and uncertainty about the future (Adger et al., 2005).

Further distinction can be made between the outcomes of adaptation that are internal to an MNC and external ones. Internal outcomes relate to the impact of adaptation responses evaluated against the MNC's performance and the resilience and adaptive capacity of the company and its supply chains. It could also include evaluation of business opportunities realized in relation to adaptation. External outcomes refer to the impact of adaptation responses by the MNCs on wider society, including on adaptation responses, adaptive capacity, resilience and overall development of communities and the local and national economy. This would also include potential mal-adaptation. Given the importance of the MNCs to the local economies, particularly in developing countries (Jain and Puri, 1981; Newfarmer, 2001; Zhang, 2014), this aspect of MNC adaptation becomes of great interest to policy makers.

Internal outcomes

As noted earlier, climate change adaptations can be similar to and entangled with other strategic choices that MNCs face to adapt to external pressures and therefore may occur as part of standard risk management or planning processes (Agrawala et al., 2011; Berkhout et al., 2004). Management and organisational theory literature suggests that organisational adaptation can involve enhancing organisational performance through direct adaptation to existing (or expected) contingencies; and/or enhancing adaptive capacity (Berkhout et al., 2004; Collis, 1994).

A framework for the evaluation of internal outcomes of MNCs' climate change adaptation therefore could include a set of quantitative and qualitative assessment tools or indicators linked to both aspects - the corporations' performance, as well as to its ability to adapt and respond to changing external conditions.

Indicators of performance could include losses avoided, reduced insurance costs, change of exposure due to changed production location, and ability to maintain business continuity in the face of climate change impacts. Several studies show examples of companies reporting performance, business continuity and ability to meet obligations towards customers among the principal objectives and outcomes of their adaptation responses (Arnell and Delaney, 2006; Crawford and Seidel, 2013; Haigh and Griffiths, 2012; United Nations Global Compact and United Nations Environment Programme (UNEP), 2012). For example, all water supply companies in England and Wales surveyed by Arnell and Delaney (2006) stated that their aim in adapting to climate change was to continue to provide current standards of service, and to enhance these standards where necessary. Haigh and Griffiths (2012) report similar trends for the energy sector, where companies are for example implementing measures to ensure supply reliability can be maintained through hotter summers.

Evaluation of the ability to adapt could include the ability to make changes to avoid risks arising from climate change; the capacity to recover from losses from climate impacts; and the capability to pursue opportunities arising from adaptation (Berkhout et al., 2004). The Economics of Climate Resilience study applied this approach to the UK and evaluated adaptive capacity across sectors,

although they did not look into the adaptive capacity of individual companies (Department for Environment Food and Rural Affairs (Defra)).

Some companies will have a mixture of objectives for their adaptation responses targeting both their performance and their ability to adapt. For example, the health company Merck has developed a global water strategy and global water policy throughout its supply chain to respond to possible changes in water supplies. The company has also implemented business continuity planning to respond to interruptions of supply or production due to exceptional weather events (Carbon Disclosure Project (CDP), 2013).

While the above has provided some examples of indicators or measures of success of adaptation responses, these are by no means providing a comprehensive picture of a company's resilience or adaptive capacity. A lot depends on location, type of business activity, and company size (Surminski, 2013). There is a clear need for further analysis in this area.

Measuring how a company takes advantage of climate opportunities seems more straightforward – here the indicators could be range of products and services that address 'adaptation needs', for example resilient building materials, flood risk management services, water conservation technologies or new agricultural products (Agrawala et al., 2011; Surminski, 2013).

External outcomes

Adaptation responses by MNCs also have impacts on the communities, regions and countries in which they operate. External outcomes of MNC adaptation need to be analysed in the context of their influence on building resilience and reducing vulnerability of communities that they affect. Companies also recognise that their internal adaptation efforts may have limited value if the surrounding communities and infrastructure are not resilient to future climate impacts (The global oil and gas industry association for environmental and social issues (IPIECA), 2013). The concept of resilience of societies however is not universally defined and many different vulnerability indicators and assessments exist (Füssel and Klein, 2006; Kelly and Adger, 2000; Pelling and Manuel-Navarrete, 2011; United Nations Framework Convention on Climate Change (UNFCCC), 2008). Most approaches to evaluation of adaptation focus on either adaptation costs or vulnerability and risk management (United Nations Framework Convention on Climate Change (UNFCCC), 2008). MNCs, being responsible for a sizeable share in the local economy directly and through their supply chains, particularly in developing countries, are likely to have a significant impact on overall resilience and adaptive capacity of societies. No studies directly exploring external outcomes of the MNC adaptation have been identified in the review. Some examples however were reported through individual case studies. For example, the UN Global Compact and UNEP (2012) report provides examples of external outcomes of adaptation responses by ten case study companies from the Caring for Climate and CEO Water Mandate initiative. These companies reported external outcomes in terms of benefits for the wider communities alongside the internal outcomes of their adaptation responses. For example, Coca-Cola is applying a methodology to calculate and quantify the benefits of its community water partnerships. Its water stewardship efforts in India have enabled the company to achieve full balance between the groundwater used in beverage production and the amount of water the company is replenishing to communities. This programme delivers internal, as well as external outcomes.

Finally, external outcomes of MNC adaptation should be evaluated in terms of potential mal-adaptation. For example, while a shift towards more industrialised forms of building houses provides better control from climatic conditions during construction, prefabrication could also introduce new vulnerabilities. A higher degree of standardization in the building industry would also reduce the ability to respond to regionally diverse climatic conditions and may increase vulnerability to long-term rises in temperature (Hertin et al., 2003). Similarly, MNC efforts to reduce exposure to climate risks through changing location or supply base, can have concomitant adverse impacts on communities dependent on supply chain linkages for jobs or on land for food production (Forstater et al., 2009). Evaluation of such negative outcomes may fall outside of the consideration by MNCs due to being outside of the objectives of their adaptation responses. This is therefore a critical area for policy makers to pay attention to, in order to ensure that adaptation by MNC contributes in a positive way to overall resilience of the communities. Demonstrating to MNC actors and policy makers how maladaptation can manifest in practice is critical, especially since this 'negative' aspect highlights the multi-dimensional and multi-scalar implications of MNC adaptation for wider societal resilience (Forstater et al., 2009).

REFLECTIONS ON THE CURRENT UNDERSTANDING OF MULTI-NATIONAL CORPORATIONS AND CLIMATE ADAPTATION

The analytical framework presented in this paper has allowed us to consider MNC adaptation along three dimensions: what triggers and stimulates adaptation action ('drivers'), what type of action is taken ('response'), and what are the implications of these actions ('outcome'). Figure 2 advances our three-tiered framework to include additional components and feedback loops that characterise MNC climate change adaptation and emphasises the broader societal context that has a constraining or facilitative effect on such adaptations. Feedback loops in particular deserve attention as additional entry points to advance MNC and overall societal adaptation.

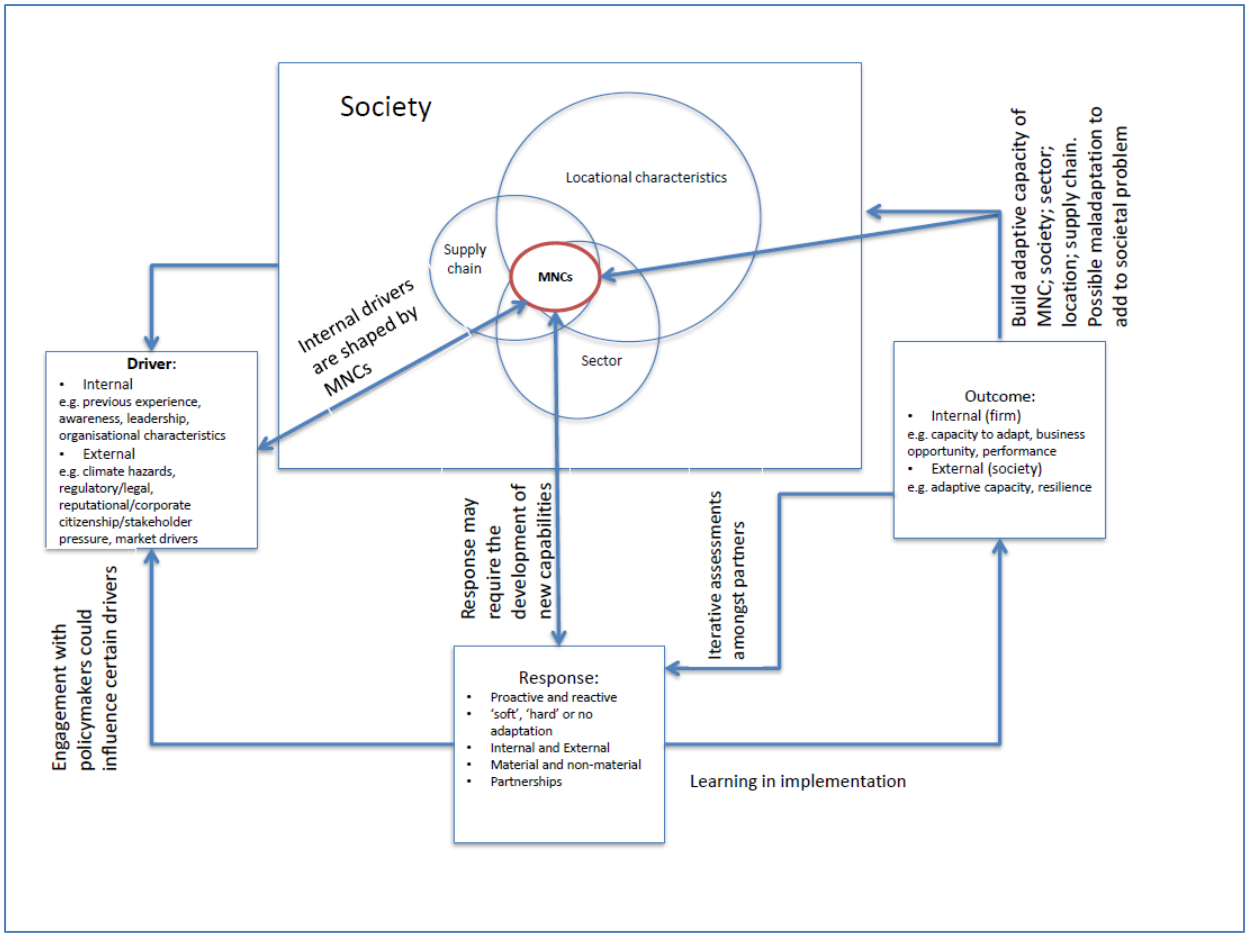

Figure 2. Extended analytical framework for understanding MNC adaptation

As depicted in Figure 2, our review of the literature has identified a range of internal (organisational characteristics, leadership) and external (physical, regulation, reputation and market-based) drivers for private sector adaptation. This review has also identified that much of the literature available on private sector adaptation focuses on responses. MNCs' adaptation responses range from targeted or 'hard' adaptation actions, such as climate-proofing infrastructure, to 'no regret' measures such as new planning processes, to 'no action/ wait-and-see'. Examples of MNCs' adaptation responses include material (physical investment) or non-material (capacity building). MNCs' presence in diverse settings often calls for a combination of response types. Finally, our review identified a paucity of information on outcomes of MNC adaptation responses. In particular there is no comprehensive measure of how MNC adaptation contributes to societal and organisational resilience. We have outlined a way forward to evaluate outcomes as it is critical to prevent maladaptation.

A critical reflection on the knowledge gaps

While many businesses are aware of climate change impacts only a minority has actually started responding to those potential impacts and developed adaptation measures (Agrawala et al., 2011; Carbon Disclosure Project (CDP), 2012a; UK Trade and Investment (UKTI), 2011). Sectoral differences, variations in organisation structure, corporate culture and the regulatory environments make comparisons between MNCs difficult. Furthermore the scale of operations makes local adaptation efforts at a subsidiary level hard to detect. Some reported activities may be part of a

group strategy, while others occur only in a local context, not reflected within the overall company reporting. Our assessment and review has shown that the existing literature offers only limited insights on MNC climate adaptation, with gaps remaining in our knowledge about drivers, responses and in particular in relation to the evaluation of outcomes of adaptation actions.

While the drivers identified in this review are the most commonly cited drivers for private sector adaptation to climate change, there is still a paucity of work within the academic literature specifically investigating what drives businesses to adapt to climate change (Linnenluecke et al., 2013; Linnenluecke et al., 2012). Indeed, a systematic assessment of the relative importance of the different drivers, in particular internal ones, in inducing action is missing. In addition, although many of the examples provided in the literature focus on MNCs, there is rarely an attempt to unpick what is meant by the term private sector and distinguish between MNCs and small and medium enterprises. Yet the global nature of MNCs and their cross-country operations means that they face multiple and often conflicting pressures from the institutional and regulatory environments of their home country, the host countries and the global industry. The drivers for adaptation by the headquarter company and by the subsidiaries will likely be quite different, as they will be subject to different legal and regulatory environments, social and cultural values and norms, as well as stakeholder and customer pressures (Levy and Kolk, 2002). A better understanding of drivers by sector, geography and type of MNC and private sector in general would allow the identification of policy entry points for stimulating their engagement in adaptation.

Additionally, our review suggests that MNCs are still predominantly at early stages in adaptation responses, often making slight adjustments to existing practices without full consideration of climate change risks. As such multinationals have to date tended to respond to climate adaptation concerns through several key overarching strategies: redesigning or developing new practices and products within their own operations to improve resilience to climate impacts; by building a resilient workforce and redesigning or developing new products and services that assist vulnerable countries and communities to adapt to climate and other risks; through initiating partnerships with governments, communities and other actors to develop resilience-building policies and practices, stopping service for product provision, or ignoring climate change. While recent surveys and related reports on private sector adaptation initiatives reach broadly similar conclusions, certain discrepancies exist. For example, while the UN Global Compact et al's (2011) review of the Caring for Climate survey reveals that the insurance industry represents the primary example of private sector engagement in adaptation, KPMG's (2012) assessment of the Private Sector Initiative (PSI) data points to the food and beverage sectors, and energy and water utilities as having the highest number of adaptation initiatives. Thus, attempting to elicit conclusive adaptation response trends among specific MNC sectors is a complex task. Furthermore, while business attention to the climate change challenge has grown in recent years, few companies appear to be adopting a clear and structured response strategy to incorporating adaptation into regular business activities and operations (National Round Table on the Environment and the Economy (NRTEE), 2012).

Our review has also identified a large gap in the analysis of outcomes of adaptation as applies to the private sector and to MNCs in particular. The literature offers very little about the impact of the implementation of adaptation actions both for MNCs and for the communities, or about the conditions for the intended outcomes of adaptation to be achieved. There is thus a need for further studies on the performance outcomes of adaptive capacity, evaluating the conditions under which

adaptive capacity has intended consequences. This has also been identified by MNCs as a need for further investigation: through the ClimateWise insurance industry initiative several insurers have agreed to focus more on the outcome and impact of their climate activities (Pricewaterhouse Coopers (PWC), 2014). With climate change still being relatively new on companies' radar it may take some time for the specific empirical evidence to be generated at scale. Similarly, we have not identified any systematic research focusing specifically on the outcomes of the MNC adaptation and their interplay with policy environment. There is a clear need for further analytical and empirical research in this area. Accordingly we suggest that a systematic approach to the measurement of internal and external outcomes would firstly need clarity on the definition of adaptation and criteria of what consists 'success'; and secondly, an understanding of the link between actions that build MNC adaptive capacity and actual implementation. The former would link to internal process-related results; the latter would start with an assessment of the redesign or development of new practices and products. For assessing the performance of a project where implementation involves interacting with communities we would expect at a minimum for MNC adaptation to contribute to broader societal adaptation in two main ways: through a more resilient workforce, or in the form of new products and services to assist the vulnerable.

Further to the above gaps in knowledge about drivers, responses and evaluation of MNC adaptation, we have identified several additional key policy relevant limitations and gaps on MNC adaptation to climate change. These relate to terminological confusion, concern about maladaptation and multi-sectoral partnerships.

Regarding terminology concerns, adaptation is a relatively new concept for MNCs, and terms such as 'resilience', 'risk management' and 'supply chain management' are frequently used instead to describe relevant actions. This makes it difficult to ascertain whether actions can be considered as fundamental shifts towards explicit climate change adaptation or are extensions of existing risk management or Corporate Social Responsibility (CSR) strategies. It is also difficult to understand whether actions described by MNCs relate to short-term resilience or long-term adaptation. Further challenges relate to assigning specific adaptation outcomes to actions and the lack of systematic analysis and recording of such responses in the literature. Relatedly, a key question that remains is whether emerging multinational strategies and projects on climate change are truly forms of adaptation or simply examples of business as usual or 'green washing'. There is great need to extend analysis to include a more representative sample of the MNC population beyond the more vocal companies.

Historically, MNCs have often played the role of 'problem-solving units' under power sharing arrangements between them and governments, international organisations, citizen groups or non-governmental organisations (Mathews, 2003; Prüszner, 2011). Collaborative arrangements between public, private and third sector actors for tackling complex environmental and socio-economic problems are not new, but have proliferated in recent decades. Public-private partnerships (PPPs) or multi-sectoral, multi-stakeholder partnerships are receiving increasing attention as key instruments for tackling climate change concerns as they harness the strengths of private, public and non-profit partners (Dyer et al., 2013; Forsyth, 2010; Pinkse and Kolk, 2012b). Yet, these public-private or multi-sectoral partnerships are not a panacea and have been subject to long standing critique in sustainability and other literature (Koppenjan and Enserink, 2009; Pinkse and Kolk, 2012a). In

particular, differing goals such as private sector profit motives versus not for profit organisation goals or inequitable risk transfers can lead to complications.

A further major gap is the lack of critical assessment of the risk of maladaptation by MNCs. Considering the growing demand for private sector engagement in adaptation, particularly within developing countries (Biagini and Miller, 2013; Pauw and Pegels, 2013; Pauw, 2014), it is critical to understand if and how actions by MNCs can benefit or hinder societal adaptation, growth and development efforts, particularly in developing countries. This is a critical policy question to enable governments to amplify synergies between MNC-led and government-led adaptation efforts in the countries where MNCs operate and to minimize potential adverse impacts. In addition, another area that merits further analysis is the extent to which various forms of partnerships on adaptation between MNCs, governments, NGOs and academia influence the capacity to adapt and implementation of adaptation action both for the MNCs and the communities.

Finally, private sector adaptation remains a nascent area of investigation and would greatly benefit from further interdisciplinary research and integration of the lessons learnt. For example, applying insights from risk management and organisational change literature to climate change-related stimuli, as well as building upon the more extensive literature on CSR would help generate relevant knowledge on MNC adaptation. These fields have to date remained largely disconnected and produced very little interdisciplinary discussion (Linnenluecke et al., 2013; Linnenluecke and Griffiths, 2013).

CONCLUSION

Growing interest among policy makers to 'engage with the private sector' and MNCs in particular has brought the expectation that MNCs will play a key role in driving adaptation. The very extensive and diverse body of work reviewed here notwithstanding, additional research is still required to understand more fully the relative importance of different drivers of MNC adaptation, the extent that adaptation responses embody climate change risk substantially, and the impacts or outcomes of adaptation measures for societal and organisational resilience. Key limitations are in part due to lack of conceptual clarity about adaptation and of benchmark objectives and evaluative criteria. Our review summarises insights from the recent literature into how researchers and adaptation experts have approached MNC adaptation, as well as how companies themselves have presented their activities. However, we notice that while providing useful pointers, this often does not provide the answers to key questions that decision makers' may have. More investigative and analytical work is required, reaching across disciplines and enhancing our knowledge base with the aim of offering some clear guidance to governments and businesses alike. Thus as we reviewed the state of knowledge on MNC adaptation and identified actionable research gaps we have also highlighted entry points for policymakers and other actors.

Based on our analysis, we suggest moreover that such guidance would benefit from a comprehensive evaluation of outcomes of adaptation responses by MNCs to a set of objectives, from reducing vulnerability of the MNCs itself, of its supply chain and of the community where it operates; building adaptive capacity of the MNCs, its supply chain and of the community where it operates; to transferring as well as adopting technologies and acting on opportunities related to adaptation. An adaptation-focused systematic data collection effort to monitor MNCs and more broadly private sector adaptation could support such efforts. Determining synergies with national

adaptation policies and an appropriate mix of public policy and market responses requires better understanding of internal and external drivers and responses of corporate adaptation as well as their outcomes. In other words, what is needed is better clarity on the broader context and a consideration of 'what we need to know about MNC adaptation and why'. Determination of 'what do we need to know about MNC adaptation and why?' clearly depends on the state of current knowledge relative to the problems that need addressing: for a business it may be a question of better understanding the actions by competitors or assessing climate resilience of suppliers. For governments, the focus may be on how much action can be expected privately, what policies are required to support and/or incentivise adaptation action, or how to avoid maladaptation. The articulation of an appropriate mix of public policy and market responses depends on a better understanding of the current level of corporate adaptation.

NOTES

[a] While Kolk and Pinkse focus mostly on mitigation examples, the strategy configurations also apply to adaptation responses.

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