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**Why do firms prioritise certain sustainable development goals?
An exploratory study**

By

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A report submitted in partial fulfilment of the requirements for the MSc
and/or the DIC.


7th September 2021

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Abstract

Declaring the 2020s the Decade of Action on the sustainable development goals (SDGs), the United Nations have called upon the private sector to increase their engagement with the SDGs. A key challenge presented by this engagement is the tendency of the private sector to prioritise SDGs. This is further complicated by the nascency of research into the problem, with study of the motivations and processes of SDG prioritisation and debate into its implications emerging only recently. This exploratory study aims to contribute to this emerging field by seeking to understand what SDGs firms have prioritised and why and, thus, further understanding of the problem by debating the implications of prioritisation and through developing a research agenda on the issue.

Using the GOLDEN database from the Leonardo Centre for Business for Society to provide a novel definition of SDG prioritisation defined by counts of action, this research shows that firms from the ICT and Oil & Gas sectors tend to prioritise SDGs 12, 4, and 8 while taking very little action on SDGs 17, 1, and 13. To explore the reasons behind prioritisation, a hierarchical time-series clustering method, using dynamic time warping as a distance metric, was undertaken to provide a basis for post-hoc investigation. Interpretation of clustering results suggest that sector is a good explanation for a firm's SDG prioritisation patterns, but its nation of origin is not. To further delve into the motivations and process of SDG prioritisation, a sample of groups of firms that frequently clustered together under different linkage methods were chosen for informal review of their recent sustainability or SDG publications. This review suggested that firms decide their SDG priorities by mapping them onto sustainability issues that they have found to be material to them.

In debating the implications of the results, it was argued that SDG prioritisation is a business reality driven by firms' restriction by limited resources and that materiality is a useful method for efficient allocation of these resources. The research agenda suggested by the findings and limitations of this paper is, thus, driven by the aim to maximise the breadth of corporate engagement with the SDGs, in line with UN's call, given the reality of materiality-based prioritisation.

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Why do firms prioritise certain sustainable development goals? An exploratory study



Executive Summary

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In September 2019, The General Assembly of the United Nations declared the 2020s the Decade of Action to deliver the Sustainable Development Goals (SDGs). Reflecting this, Secretary-General António Guterres called for ‘global action’ on the SDGs from UN Member States, ‘local action’ in domestic politics and policy, and ‘people action’ from various actors. Amongst those called on to provide ‘people action’ was the private sector – highlighted for the presence of “innovators and disruptors” and appealed to to adopt “new business models” in line with the SDGs.

A key problem with the private sector’s engagement with the SDGs is their tendency to skew their focus towards certain goals. Previous research has suggested that businesses across sector and location highlight SDGs 8 and 13 in their self-reported SDG prioritisations. Beyond this surface level, however, attempts to break open the ‘opaque’ process of corporate SDG prioritisation are only just beginning. Similarly, little debate has occurred on the implication of the process of prioritisation for the achievement of the 2030 Agenda. There is a critical need, then, for researchers to engage in the study of and debate on SDG prioritisation to better understand how business will answer the UN’s call to action and what corporate policies may drive greater engagement with the 2030 Agenda. This background motivates the undertaking of an exploratory study on SDG prioritisation with the following objectives:

1. Understand what SDGs firms have prioritised, using a count-based definition of prioritisation
 2. Explore reasons for the phenomenon of SDG prioritisation
 3. Contribute to the debate on SDG prioritisation’s implication for the 2030 Agenda
 4. Develop a research agenda on SDG prioritisation
-

Methodology

To meet objectives 1 and 2, data from the GOLDEN database was utilised. This proprietary database, based on scraping of corporate publications by natural language processing algorithms, provides counts of actions reported by a sample of firms, from the ICT and Oil & Gas sectors, on each SDG in a given year. Pursuing objective 1, treemaps of total actions taken reported by all the firms in each sector (e.g. Fig. 1) and line graphs of counts in each year, normalised by the number of reports in each year, were created. To provide a jumping off point for undertaking objective 2, a hierarchical time-series clustering approach was utilised under the assumption that clustered firms will have similar causes of SDG prioritisation. The method chosen, dynamic time warping, compares the profiles of each firm's actions on each SDG to each other, producing easily interpretable dendrograms, with very few assumptions about what leads to the similarity. From this point, the dendrograms (e.g. Fig. 2) were labelled by sector and by the firm's nation of origin to assess by eye the strength of these explanations for SDG prioritisation patterns. To pursue objective 2 more deeply, firms that appeared together across multiple clustering methods, suggesting they are strongly similar, were chosen for deeper, informal review of their most recent sustainability or SDG report.

Results

These methods showed that firms from the ICT sector prioritise SDGs 12, 4, and 8 most strongly, while those from the Oil & Gas sector focus on SDGs 4, 12, 3, 8, and 15. Firms from both sectors take very few actions on SDGs 17, 1, and 13. At the level of the sector, the ranking of these priorities change very little over the last decade. It was also found that a firm's sector appears a good explanation for its SDG prioritisation, whereas its country of origin was not.

The review of a sample of firms'

sustainability reports suggested that

this could be explained by SDG prioritisation being based on materiality assessments of general sustainability issues, in which firms map issues to relevant SDGs to define their priorities. Within this



Figure 1. Treemap of total actions taken by ICT firms, 2010-2020

review, a number of potential explanatory factors were identified for differences in materiality assessments and thus SDG priorities, including: the influence of sustainability framework; the role of sustainability leaders; and the influence of stakeholder bias in sampling and issue management.

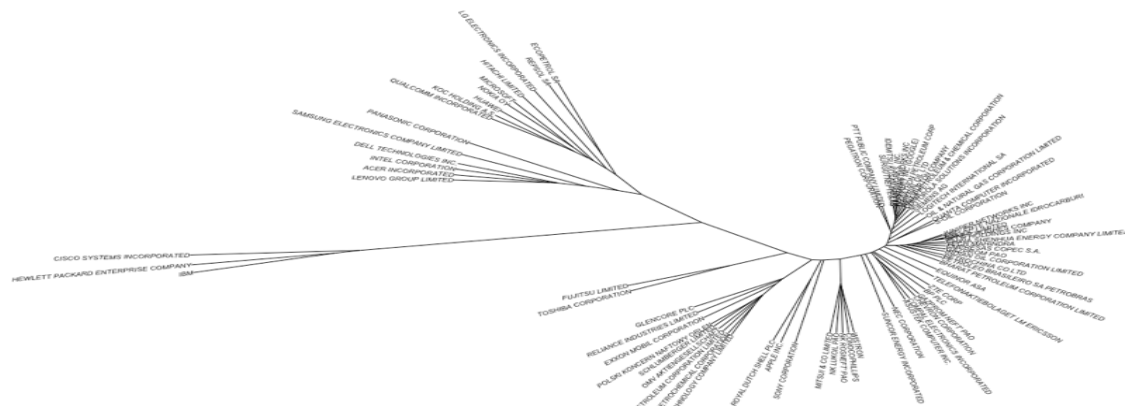


Figure 2. Dendrogram using Ward's linkage method

Discussion

SDG priorities as mapped material sustainability issues makes generally good sense in the context of findings on which SDGs. We would expect SDGs 12 and 8 to be material to firms as they relate to the core of businesses *as business*. The prioritisation of SDGs 4 and 3 also makes sense under an explanation of materiality given the obvious importance of these SDGs to stakeholders and the usefulness of educated and healthy workers to companies. Two results which do not make neat sense are the low prioritisation of SDG 13 by both sectors and the high prioritisation of SDG 15 by the Oil & Gas sector. SDG 13 has been shown to be a very high priority of companies, when measuring firm's self-described priorities, and would be intuitively expected to be highly material, given climate change's status as perhaps the defining environmental issue of our time. This misalignment could be explained by firms undertaking 'rainbow-washing' of the issue: identifying it as material and thus stating it as a priority but refraining from action, perhaps because of the difficulty or cost of the task. SDG 15, on the other hand, is generally shown to be described as a very low priority of firms but this analysis' finding of a large number of actions taken by Oil & Gas firms suggests the opposite. No strict analysis of Oil & Gas firms' material issues or self-described SDG priorities has been performed however – doing so would offer an opportunity to strengthen or falsify the suggestion that material issues define SDG priorities.

Objective 3 - Should we accept prioritisation?

If materiality is the accepted as the key motivator of SDG prioritisation, a critical question for researchers, policy-makers, and stakeholders is whether it is an acceptable criterion for prioritisation with regards to achieving the 2030 Agenda. Some critics argue that prioritisation itself allows firms

to ‘cherry-pick’ SDGs that are relevant to their current business practices without inducing real change, seemingly contributing to sustainable development while covertly continuing to contribute to the problems the concept seeks to solve – a process facilitated by materiality. Instead, firms should abandon prioritisation and take on all SDGs. However, this does not take into account the limited resources with which firms must work. Hence, prioritisation appears to be a business necessity and materiality an obvious candidate to realise efficient allocation of these resources. Yet, the goal of broader SDG engagement is a noble one and aligns with the UN’s call to action. The next, broad question for researchers is how to maximise the breadth of corporate SDG engagement given the reality of prioritisation based on materiality.

Objective 4 - Future research

The final objective of this research is a development of a research agenda towards this goal, guided by the findings and limitations of this study and other literature. From these, three key areas are identified for future research.

First and of highest priority, meeting a key limitation of this research, is a stronger investigation of the links between the firm’s material issues, described SDG priorities, and the number of actions taken on each SDG. This presents an opportunity to utilise natural language processing algorithms, similar to those used to create the GOLDEN database. Future researchers should note a potential difficulty for this process due to the obscurity with which firms describe their priorities. This process would also help to quantify the extent of ‘rainbow-washing’.

A second key area of research is on the process of materiality assessments itself, for which this research and previous literature suggest numerous topics for research. At the stage of initial issue development, the role of stakeholder engagement and the effect of the use of different sustainability reports is important. How these issues move forward to materiality analysis is also an important area of study – this study suggests a potentially important effect of sustainability professionals in this process. How these vary across sector and nation, investigated in this study, will also be of interest.

The final key area of research, perhaps the most crucial of all, is on the translation of the findings of the above research agenda into practical and acceptable policies for business in order that their contribution to the 2030 Agenda be maximised.

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1 Introduction

In September 2019, The General Assembly of the United Nations declared the 2020s the Decade of Action to deliver the Sustainable Development Goals (SDGs) (UNA-UK, 2020). These 17 goals and their related targets were accepted by the UN General Assembly in 2015 as representative of a “vision to end poverty, rescue the planet and build a peaceful world” (UN, 2020), to be achieved by 2030. They have since become a popular idea across development agents at various levels. Reflecting this, in his call to action for the Decade at the High-Level Political Forum on Sustainable Development, Secretary-General António Guterres called for ‘global action’ on the SDGs from UN Member States, ‘local action’ in domestic politics and policy, and ‘people action’ from various actors. Amongst those called on to provide ‘people action’ was the private sector – highlighted for the presence of “innovators and disruptors” and appealed to to adopt “new business models” in line with the SDGs (United Nations Secretary General, 2019).

A key issue with how business have engaged with the SDGs since their signing, which has strong implications for how they will answer the UN’s call, is their tendency to skew their attention to certain issues – a concept known as SDG prioritisation (Mhlanga, Gneiting and Agarwal, 2018). While seen by some as a necessary translation of the SDGs, developed primarily as a government-level concept, to business reality (Mhlanga, Gneiting and Agarwal, 2018), others criticise it as a means to seem SDG-aligned with no change in behaviour (Izzo, Ciaburri and Tiscini, 2020), perhaps contributing to the current underachievement of some SDGs (Sachs and Sachs, 2021). The problem of SDG prioritisation, then, has strong implications for the full achievement of the 2030 Agenda. However, good management of this problem is complicated further by a weak understanding of why firms prioritise the SDGs that they do, as will be shown. This motivates the development of the research questions of: 1) what SDGs have firms prioritised over the last decade and how has this changed?; 2) what might explain a firm’s prioritisation pattern?

To answer these research questions and thus facilitate a contribution to the debate on SDG prioritisation, the GOLDEN database (Leonardo Centre on Business for Society, 2021),

derived from corporate publications by natural language processing algorithms, was utilised. As Heras-Saizarbitoria, Urbietta, and Boiral (2021) note, the explicitness of SDG prioritisation by firms is varied: from direct reference to the use of the SDG icons as little more than decoration – or, indeed no information at all (Mhlanga, Gneiting and Agarwal, 2018). This presents an excellent opportunity to utilise a novel definition of prioritisation based on the count of actions taken on each SDG, provided by the GOLDEN database, to compare against previous research based on other methods that are based on firm's own definitions of prioritisation. This approach cuts through the rhetoric of companies and defines SDG prioritisation simply as the ranking of SDGs by the number of actions taken on them. Indeed, this definition allows us to analyse companies' behaviour on sustainable development from before the SDGs were signed in 2015, strengthening our conclusions to the research questions. Using this definition of prioritisation and these data, which sample the Oil & Gas and ICT sectors (previously unresearched sectors), exploratory data analysis is undertaken to answer research question 1. Research question 2 is framed as an exploratory task and thus an unsupervised clustering approach was utilised to understand what firms are similar to each other in terms of SDG prioritisation. In order to incorporate as full a description of a firm's SDG prioritisations as possible and best reflect the dynamic process of decision-making behind it, a time-series clustering method, utilising data from the GOLDEN database, was chosen – a novel approach. The results of this process were assessed by eye to understand whether sector and nation of origin explained clustering results. To further explore what might explain a firm's SDG prioritisation, companies that were frequently clustered together across different methods were selected for deeper, informal analysis of their sustainability reports.

It was found, in answer to research question 1 that firms tend to prioritise SDGs 12, 4, and 8 and focus very little attention on SDGs 17, 1, and 13, with this pattern showing little evidence of changing drastically over time. In exploring research question 2, it was found that a firm's sector appears a good explanation for its SDG prioritisation dynamics, but that its nation of origin was a poor one. From investigation of closely clustered firms to discover further possible answers to explain SDG prioritisation, it was found that firms appear to map the results from materiality assessments, a method of identifying sustainability issues that could affect the business (KPMG, 2014), onto the SDGs to define their priorities, a process

itself influenced by other factors such as sustainability leadership and other sustainability frameworks. In discussion of the implications of these results for the achievement of the 2030 Agenda, it will be argued that SDG prioritisation is an unfortunate necessity of firm's engagement with the goals, because of their limited resources, and that materiality assessments make sense as means to guide the allocation of these resources. Nevertheless, firms remain a key source of potential impact for all the SDGs, thus there is an urgent need for researchers to understand what influences the translation of materiality assessments to SDG prioritisations such that the private sector can be induced to act strongly on as many of the 17 SDGs as possible. The final aim of this research is the development of a research agenda on this topic.

The paper is structured as follows: Section 2 explores the literature, contextualising the research questions and defining the research gap that this paper contributes to filling; Section 3 describes the data and methods; Section 4 describes the results of the analyses; Section 5 discusses these results, debating implications for the private sector's contribution to the 2030 Agenda and the key areas for future research to focus on.

2 Literature Review

2.1 The Sustainable Development Goals

The development of the SDGs as representative of the 'future we want' came as a response to the present we have. A present of hundreds of millions of people existing in grinding poverty (World Bank, 2018); where women and girls face systematic challenges and inequalities (Razavi, 2016); and a time in which biodiversity incurs massive losses (WWF, 2020) and the climate dangerously changes (IPCC, 2021) because of the actions of humanity. The goal of sustainable development is to meet these, and other, challenges together. In other words, the goal of sustainable development is to meet the needs of the current generation without compromising the ability of future generations to meet their own needs (Brundtland *et al.*, 1987). Sustainable development came of interest to the international community, as represented by the United Nations, soon after the publication of the Brundtland report, becoming an important topic of debate at the Rio Earth Summit in 2012

(Jain and Islam, 2015). 20 years after this meeting, the United Nations Conference on Sustainable Development (Rio+20) was held. A key outcome of the conference was the beginning of a 3 year process to create a set of goals that would encourage focused action on the topic of sustainable development (Weitz *et al.*, 2018). This process refined the 17 Sustainable Development Goals we know today (Fig. 1) – with their achievement known as the 2030 Agenda (Mensah, 2019).

The global crisis of the COVID-19 pandemic has, however, been a stumbling block for progress towards achieving the 2030 Agenda. Some claim, indeed, that achieving the goals is now completely beyond reach (Naidoo and Fisher, 2020; Nature, 2020). In response, efforts to make the SDGs more achievable have been made, such as the Sustainable Development Solutions Network’s (SDSN) call to align the 17 goals into 6 ‘transformations’ (Sachs and Sachs, 2021). Crucially, however, the SDGs are still at the heart of this logic. As such, it appears that, even if actually achieving the goals has become unrealistic, they are still the most useful logic for sustainable development, particularly because of the strong buy-in from a variety of sectors and development agents. In the words of Guido Schmidt-Traub, executive director of the SDSN: “there is nothing else to replace the SDGs right now” (Nature, 2020).



Figure 3. The Sustainable Development Goals (UN, 2015)

2.2 What does sustainable development mean to the private sector?

Beginning in the mid-20th century and continuing for many decades, a strong debate occurred amongst academics and practitioners on the social role of business. On one side was a view most famously described by Friedman's (Friedman, 1970) exhortation that the "business of business is business", while on the other was the opinion that business had an obligation to act in terms that were "desirable in terms of the objectives and values of...society" (Bowen, 1953). This latter view was titled corporate social responsibility, or CSR. As the popularity of this viewpoint grew in the world of business, it began to mix with the similarly-emerging concept of sustainable development (Sardá and Pogutz, 2018; Tsalis *et al.*, 2020). The direct application of sustainable development thinking to companies emerged soon after, such as Elkington's (1994, 1998) seminal conception of the triple bottom line: "the simultaneous pursuit of economic prosperity, environmental quality, and social equity" (Elkington, 1998, p. 397). As Montiel and Delgado-Ceballos (2014) note, sustainable development emerged in management literature in 1995 (Gladwin, Kennelly and Krause, 1995) and the first efforts to operationalise the concept came a decade later (Bansal, 2005; Székely and Knirsch, 2005). 25 years later, the application of sustainable development to firms has divided into two conceptions (Dyllick and Muff, 2016). First is the continuation of the process just described, where in sustainable development is applied *to* firms. This process has generally become known as corporate sustainability, or as the old term CSR, and though there are no standardised definitions (Montiel and Delgado-Ceballos, 2014; Sardá and Pogutz, 2018), it can be generally described as the "successful market-oriented realisation and integration of ecological, social, and economic challenges to a company" (Schaltegger, Beckmann and Hansen, 2013, p.220). Second is the application of sustainable development *by* firms as a "consciously engaged agent" in the process of development (Blowfield, 2012, p. 415), rather than as a tool of governments (Scheyvens, Banks and Hughes, 2016). In other words, firms actively taken on the macro-level challenges of the world, rather than simply identifying small eco-efficiencies (Dyllick and Muff, 2016). A key example would be the conceptual shift from firms as providers of employment to conscious creators of quality jobs (Scheyvens, Banks and Hughes, 2016). Some have argued that firms should, indeed, take on a leadership role in sustainable development (Sachs,

2012), with its easy access to large financial resources seen as a key characteristic (Scheyvens, Banks and Hughes, 2016). Yet, it must be noted that others have criticised the shift (e.g. Rashed and Shah, 2021), pointing out that firms will tend to focus on short-term, core business objectives and neglect coherent and long-term development actions (Scheyvens, Banks and Hughes, 2016). Nevertheless, although likely not a silver bullet as a development agent, it is essential that the private sector considers sustainable development because, even in a passive frame, its actions will have consequences, both negative and positive, for meeting its challenges.

2.3 What do the SDGs mean to the private sector?

Representative of the shift of some parts of the private sector to the role of active sustainable development agent is the key part it played in the development of the SDGs. For example, Paul Polman, CEO of Unilever at the time, sat on the UN's High Level panel that was tasked to develop a 'bold and practical' vision for what should follow the Millennium Development Goals in 2015; a vision which developed into the SDGs (Scheyvens, Banks and Hughes, 2016). For some firms, however, this shift was related to the publication of the SDGs themselves: the goals were, in fact, the first introduction for some companies to the concept of sustainable development (Sachs and Sachs, 2021). Indeed, some firms may not have shifted to this active footing at all. Those that have, however, tend to frame their engagement with the SDGs as answering the UN's call for business to help create a more sustainable society. For example, the financial firm Citigroup sees itself as an important financier of the SDGs (Van der Waal and Thijssens, 2020). Similar motivations are evoked by firms by relating their engagements with the SDGs as representative of their intention to act as good corporate citizens, leading stakeholders in global society (Heras-Saizarbitoria, Urbietta and Boiral, 2021). The SDGs are also frequently framed as signposts for lucrative business opportunities. One estimate suggested some \$12 trillion could be made by engaging with the SDGs (Business and Sustainable Development Commission, 2017; Schönherr, Findler and Martinuzzi, 2017) and, unsurprisingly, firms, such as ANZ and Nestlé (Van der Waal and Thijssens, 2020), state an interest in doing so. Interestingly, however, García-Meca and Martínez-Ferrero (2021) find that SDG reporting has no significant effect on firm performance for companies outside of environmentally sensitive industries, like oil

& gas, or controversial sectors, like tobacco, which both face particularly high stakeholder pressure. The answer to this apparent contradiction is that the performance enhancement for other firms is suggested to come from SDG-catalysed innovation to exploit the new business opportunities (Scheyvens, Banks and Hughes, 2016; Kurz, 2020), which would likely not have been captured in the single year time-frame of García-Meca and Martínez-Ferrero's (2021) study. Matching this proactive business lens, the SDGs are also commonly framed in a defensive stance: as a framework to understand risk presented by the global challenges we face (Van der Waal and Thijssens, 2020). This framing has been held by firms such as BT and Mondi (Van der Waal and Thijssens, 2020) and is seen as an opportunity to check and redefine goals, strategies, and activities in the light of the risks described (Kurz, 2020). Rather depressingly, García-Meca and Martínez-Ferrero (2021) suggest that SDG reporting is often used, outside of environmentally sensitive or controversial sectors, as a means to camouflage or obfuscate the behaviour of the company. In other words, by 'rainbow-washing' themselves (Izzo, Ciaburri and Tiscini, 2020), firms can appear to managing the risk without actually do anything different. Indeed, it appears that most firms are silent or evasive in disclosing their motivations for engagement with the SDGs (Heras-Saizarbitoria, Urbieto and Boiral, 2021). We might expect these latter framings of SDGs to be those of firms that have not taken on an active footing towards sustainable development. Yet, of course, there is no reason that these different framings of the SDGs cannot exist simultaneously in the same firm. Firms desiring to make a true impact on the SDGs may nevertheless also desire the improvement of the company in stakeholders' estimations, and any related improvement in performance – although, it slightly diminishes the nobleness of the former wish.

Regardless of the exact way individual firms frame the SDGs, they have proven a popular concept across the private sector. A significant, parallel stream of research to that on framing and utilisation is that studying what features of companies lead to SDG engagement. Rosati and Faria (2019a), for example, find the institutional context of a firm's nation an important explanation. Firms in countries with higher levels of climate change vulnerability and a long-term orientation, for example, were found to be more likely to engage in SDG reporting. This generally aligns with Van der Waal and Thijssens (2020) findings that firms from Japan, Korea, and Taiwan are more likely to engage with the SDGs

than those from the US or BRIC-MINT countries. Where contradictions occur, such as Rosati and Faria's (2019) finding that SDG reporting is higher in more indulgent and individualised societies contrasting with Van der Waal and Thijssens' (2020) above suggestion about US firms, other explanatory factors are likely at work. Researchers have dedicated a significant amount of effort into understanding the effect of internal characteristics of firms on SDG engagement and have drawn a variety of conclusions. Larger companies, for example, are suggested to be more likely to address the SDGs (Rosati and Faria, 2019b; Van der Waal and Thijssens, 2020), perhaps more able to take on the costs (Hahn and Kühnen, 2013; Van der Waal and Thijssens, 2020), but those with superior competencies (in technology, marketing, etc.) were shown to be no more likely to engage (Rosati and Faria, 2019b). Characteristics of management and strategy also appear to have an effect on SDG engagement. Commitment to other sustainability-related initiatives, such as the Global Reporting Initiative (GRI) and the UN Global Compact, were found, for example, to increase the likelihood of engagement with the SDGs (Van der Waal and Thijssens, 2020). As did make up of the board of directors: firms with older boards of directors tended to be less likely to address the SDGs (Rosati and Faria, 2019b). As yet, however, little research has been conducting in trying to understand links between these characteristics of firms and their framing and utilisation of the SDGs.

2.4 Research and debate on SDG prioritisation: contextualising the research gap

As many researchers have noted, however, engagement with the SDGs does not necessarily equate to equal engagement with all 17 of the goals. Indeed, some firms choose to only engage with two or three SDGs, a phenomenon generally known as SDG prioritisation. (Mhlanga, Gneiting and Agarwal, 2018). Study of this phenomenon is nascent, made difficult by the lack of clarity (if present at all) with which firms describe their motivations for prioritisation (Heras-Saizarbitoria, Urbietta and Boiral, 2021). Empirical research on the topic, however, is developing but is already producing consensus on certain topics. For example, previous research commonly shows SDG 8 (Decent work and economic growth) as by far the most popular SDG for firms to prioritise. This was shown to be the case in multi-sector surveys (Mhlanga, Gneiting and Agarwal, 2018; PwC, 2019; Izzo, Ciaburri and Tiscini, 2020; Curtó-Pagès *et al.*, 2021), as well is in research on specific sectors – like the banking sector (Avrampou *et al.*, 2019; Sardanou *et al.*, 2021). Similarly, the least popular SDGs are

often found to be similar, with SDGs 14 and 15 commonly the bottom two. The other SDGs, however, are rarely in a consistent order across the literature. Consensus on the factors leading to the above prioritisations, however, has not yet been reached. Most often cited is that a firm's SDG priorities are related to the core of their business (e.g. PwC, 2019). This appears to be a very valid explanation for the primacy of SDG 8 across firms, the goal most closely related to the business of business. The importance of business proximity appears to extend to other SDGs too, with multi-national enterprises shown to be most likely to engage with SDG targets associated with the value chain of their business (Van Zanten and Van Tulder, 2018). Indeed, it is further promoted by the prioritisation by firms of goals very closely related to the business of their sector, e.g. SDG 2 by food and beverage companies and SDG 3 by pharmaceutical companies (Mhlanga, Gneiting and Agarwal, 2018). These strong sector ties appear, however, to be exceptions rather than the rule: Mhlanga et al. (2018) found little more sector-level consistency in their cross-sector survey, nor did Sardanou and colleagues (2021) in their deeper analysis of the banking sector, beyond SDGs 8 and 16, or Izzo et al. (Izzo, Ciaburri and Tiscini, 2020), beyond SDGs 8, 9, and 13, in Italian companies. The importance of location and the related factor of institutions has similarly provided a diverse set of explanations for SDG prioritisation. International institutions, like the UN Global Compact, have been shown to be related to firms placing more emphasis on certain SDGs (Avrampou *et al.*, 2019) while national level institutions appear to have a comparatively weaker effect: only a few firms align their SDG priorities with those of their national governments (Mhlanga, Gneiting and Agarwal, 2018), for example. However, other national institutions than governments do appear to influence SDG prioritisations. Van Zaten and Van Tulder (2018), for example, argue that the North American liability orientation ('substantial equivalence principle') leads them to articulate explicit responsibility for a narrow set of societal interests, thus they engage with fewer and more internally focused SDG targets than European MNEs. Research on informal institutions and the importance of stakeholder opinions, similarly, show a diversity of conclusions. Cultural norms, such as the importance of charitable giving (Van Zanten and Van Tulder, 2018), have been argued to influence which SDGs are engaged with by firms, as has the general interests of local communities in which MNEs are in business (Ike *et al.*, 2019). Interestingly, however, there appears to be no correlation with the SDG priorities of MNEs to the society of their home country (Ike *et al.*, 2019), which may be explained by the finding that stakeholder

engagement as the basis of SDG prioritisation is rare (Mhlanga, Gneiting and Agarwal, 2018).

While the empirical understanding of SDG prioritisation is growing, the debate on its implication is far behind and, indeed, appears rarely valued as a debate at all. Being value-neutral or simply not engaging with the debate appears to be the most common position in the literature while the number of authors who express opinions on the issue are small. At one end of the debate, prioritisation is seen as a necessary part of business engagement with the SDGs (Mhlanga, Gneiting and Agarwal, 2018). For example, Agarwal, Gneiting and Mhlanga (2017) argue that prioritisation is a necessity because firms have limited resources with which to engage and risk diluting impact on the SDGs by targeting too many. At the other, prioritisation is seen as an excuse for firms, largely guided by a profit-motive, to cherry-pick the most convenient SDGs for their purposes (Scheyvens, Banks and Hughes, 2016; Izzo, Ciaburri and Tiscini, 2020) and ignore those that would be difficult to engage with (Sachs and Sachs, 2021), or perhaps those that would actually lead to real change. This processes thus leads to the state of affairs which is described above: some SDGs are almost completely ignored. Instead, it is argued, firms should focus on all SDGs, including those that appear to be well-connected to business (Sachs and Sachs, 2021). This debate is at early stages but has strong implications for achieving the 2030 agenda and managing the private sector's role in doing so.

As can be seen from the above section, research and debate on SDG prioritisation is growing but is still nascent, with little consistency and consensus. This suggests an important need for an exploratory study within this research gap, a role this study aims to take on.

3 Materials and Methods

The data utilised in this research come from the GOLDEN database (Leonardo Centre on Business for Society, 2021). This proprietary database was constructed by the Leonardo Centre on Business for Society at Imperial College Business School, London. It was created utilising machine learning and natural language processing algorithms to mine information from publications on sustainability initiatives from the private and public sector. The

database contains count data on the reported actions sampled firms have taken on each SDG in a given year. Indeed, leveraging the power of machine learning, this database provides insights on sustainability activities occurring before the 2015 signing of the SDGs and those that are not explicitly linked to a target by the reporting company, allowing us to better understand the private sector’s contribution to the 2030 Agenda and the reasons behind them. This database is, however, under the protection of a non-disclosure agreement, preventing presentation of the data. However, a non-attributable sample is provided in Fig. 2 to allow readers to understand the database. For this study, a sample of the database, of firms from the ICT and Oil & Gas sectors, was used. These sectors are, intuitively, very different from each other. Thus, conclusions from taking them together may be valid for many other sectors. This provided yearly counts of reported actions on SDGs for 43 Oil & Gas companies and 40 ICT companies from 22 different companies. The dataset is further summarised in Table 1 and Figs. 3 and 4.

Table 1. The number of firms analysed each year

Year	Oil & Gas	ICT
2009	10	-
2010	21	30
2011	23	31
2012	26	32
2013	26	31
2014	32	33
2015	38	30
2016	37	33
2017	40	31
2018	39	35
2019	39	37
2020	-	17

company_na	pdfyear	SDG 1	SDG 2	SDG 3	SDG 4	SDG 5	SDG 6	SDG 7	SDG 8	SDG 9	SDG 10	SDG 11	SDG 12	SDG 13	SDG 14	SDG 15	SDG 16	SDG 17
1	2010	0	1	5	14	2	1	4	5	0	1	3	15	0	0	5	0	0
1	2011	0	0	4	8	2	1	5	5	0	1	3	21	0	0	3	0	0
1	2012	0	1	4	15	1	1	2	7	0	2	0	23	0	0	2	0	0
1	2013	0	2	9	21	1	0	3	5	0	1	2	24	1	0	3	1	0
1	2014	0	0	11	18	1	0	1	10	0	2	2	22	0	0	0	1	0
1	2015	0	1	13	19	1	1	0	5	0	3	1	26	0	0	1	1	0
1	2016	1	1	9	21	1	1	0	2	0	2	1	15	0	0	2	2	0
1	2018	0	0	6	14	1	0	1	5	0	3	0	18	0	0	1	6	0
1	2019	0	1	6	12	0	0	0	0	0	1	0	16	0	0	2	3	0
2	2016	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
2	2019	0	0	1	0	0	0	8	2	0	0	0	4	0	0	1	3	0
2	2020	0	0	0	0	0	0	5	0	0	0	0	4	0	0	4	0	0
3	2019	0	2	0	1	1	1	7	0	0	0	0	23	0	0	0	0	0
4	2010	0	0	0	1	0	0	0	8	0	0	0	2	0	0	0	0	0
4	2011	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0
4	2012	0	0	0	3	0	0	0	5	0	0	0	5	0	0	0	0	0
4	2013	0	0	0	2	0	0	0	7	0	0	0	3	0	0	0	1	0
4	2014	0	0	0	13	0	4	1	17	0	0	0	12	0	0	1	0	0
4	2015	0	0	0	7	0	5	5	13	0	0	0	15	0	0	0	0	0
4	2016	0	0	1	2	0	2	12	6	0	0	0	13	0	0	3	0	0
4	2017	0	0	0	3	0	6	11	5	0	0	0	9	0	0	4	0	0
4	2018	0	0	1	2	3	12	10	6	0	0	0	18	0	0	3	3	0
4	2019	0	0	2	5	0	7	14	4	0	0	0	22	0	0	5	1	0
4	2020	0	0	0	0	0	6	16	1	0	0	0	26	0	0	3	0	0

Figure 4. A snapshot of the GOLDEN database – firm names removed

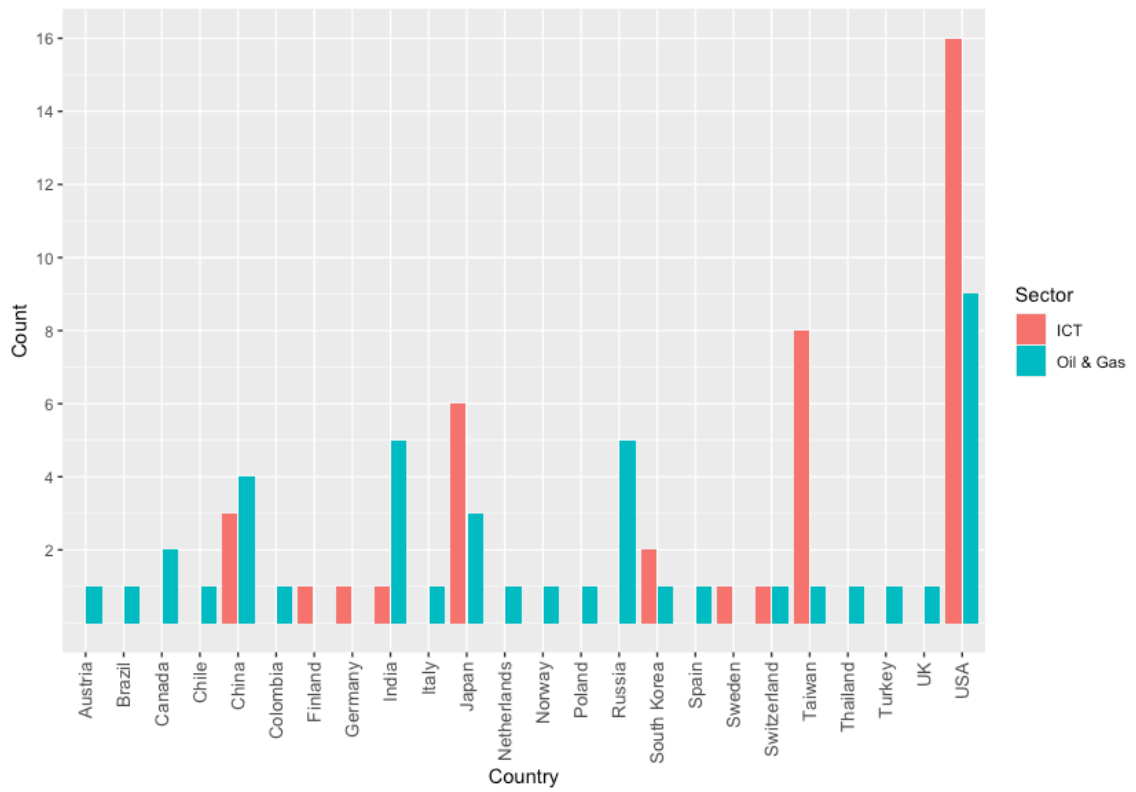


Figure 5. Bar graph of the number of firms in the dataset

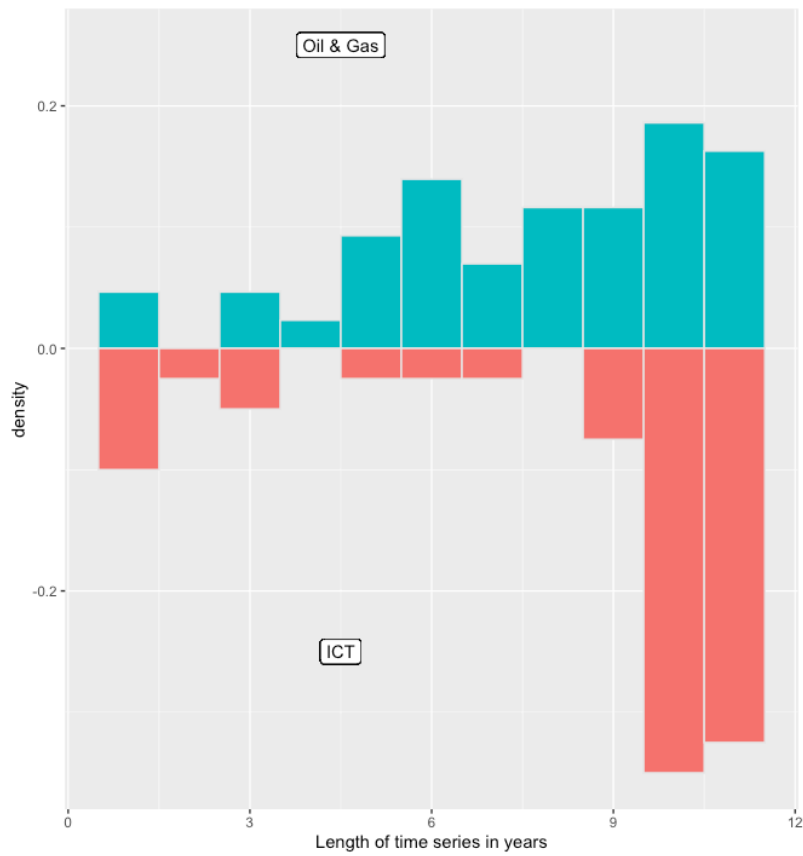


Figure 6. Histogram of lengths of time-series

To understand answers to research question 1, the above data were plotted as tree maps, to easily understand which SDGs have been most prioritised, defined as the ranking of most acted-upon SDGs. Also, to understand changes in prioritisation over time stacked line graphs of the number of actions taken on each SDG in a given year, normalised by the number of firms analysed in each year (Table 1), were also plotted.

To explore answers to research question 2, a time-series clustering approach was used. This was chosen because it can provide insight into which firms are similar, allowing us both to test previous explanations as well as to provide basis for post-hoc interpretation that can guide future research and policy makers. For preparation for use in time-series clustering, the dataset was cleaned by removing firms for which there was only a single year of data. This removed the ICT firms Amazon Inc., HTC Corporation, NETAPP Inc., and WIWWYN Corporation and the Oil & Gas firms Valero Energy Corporation and World Fuel Services. Some firms in the dataset have time-series that are interrupted, usually by only one year. These firms are retained for analysis because we are interested in a very coarse understanding of dynamics, simply whether a change in SDG prioritisation came before or after another. In this sense, we are interested in the 'shape' of the time-series, not in relation to actual time intervals (Aghabozorgi, Shirkhorshidi and Wah, 2015). The remaining firms' time-series were then converted into a set of matrices, where each member is a matrix corresponding to a firm where the SDG count variables span the columns and the year intervals the rows. This process was completed separately on the ICT and Oil & Gas datasets, before the two sets of matrices were bound together. The exact method was chosen from the set of recommendations in Aghabozorgi, Shirkhorshidi, and Wah's (2015) review of time-series clustering over the last decade. Because the time-series in this study are relatively short and few in number, a shape-based approach with no dimensionality reduction was utilised because of lack of concern regarding computational load. Dynamic time warping (Berndt and Clifford, 1994) was chosen as the distance metric for this study because of an interest in finding similar shapes of time-series and small differences in lengths and interval regularity of the time-series, as discussed above. Because of the exploratory nature of this study and the early stage of research into SDG prioritisation, a hierarchical clustering approach was taken. This avoids the need to predefine the number of

clusters, for which there is no precedent, and provides excellent visualisation for post-hoc interpretation. For similar reasons, following Maharaj, D’Urso, and Caiado (2019) and Everitt et al. (2011), seven common linkage methods were utilised: single linkage, complete linkage, weighted and unweighted pair group method average (W/UPGMA), weighted and unweighted pair group method centroid (W/UPGMC), and Ward’s method. This method was undertaken in R version 3.6.0 (R Core Team, 2019), using the *dtwclust* package (Sardá-Espinosa, 2017, 2019) – script appears in the Appendix 1. Using the *tsclust* function and the above parameters for clustering, seven dendrograms were produced, which were interpreted by eye – aided by colouring nodes based on variables of interest, such as firm location and sector. These were presented as unrooted because there is no expectation of descendancy from a common ancestor of SDG prioritisations. To further explore explanatory factors for SDG prioritisation patterns, firms that appeared close to each other in several dendrograms were chosen for further research. The firms were identified using the *tanglegram* function from the *dendextend* package (Galili, 2021) applied to the results of complete, WPGMA, and Ward’s linkage methods – all of which produced strong clustering. The reports chosen were the most recent sustainability (or CSR or SDG) report available. While lacking in the explanatory power of a full, formal literature review, this method was deemed sufficient to identify some common features between firms.

4 Results

4.1 What SDGs have been prioritised?



Figure 7. Treemap of total actions taken by ICT firms, 2010-2020



Figure 8. Treemap of total actions taken by Oil & Gas firms, 2009-2019

Fig. 5 shows a treemap of the total number of actions taken on each of the SDGs by the sample firms from the ICT sector between the years 2010 and 2020. The treemap shows that SDG 12 was the highest priority SDG, followed by SDGs 4 and 8. Conversely, SDGs 17, 15, 1, 13, and 14 were the least prioritised, in ascending order. This offers a subtly different picture of SDG prioritisation to previous literature. For example, in their survey of firms SDG engagement, PwC (2019) found the 'technology, media, & telecoms' sector, the closest corollary to the ICT sector of this study, also finds SDG 4, 8, and 12 to be in the top 5 SDGs prioritised by the sector. However, SDG 8 was found to be the highest priority and 12 equal fourth. Indeed, SDG 13 was found to be second highest priority of the sector, a strong departure from the findings of this study.

Fig. 6 shows a treemap of the total number of actions taken on each of the SDGS by the sample firms from the Oil & Gas sector between the years 2009 and 2019. The treemap shows that SDGs 4, 12, 3, 8, and 15 were the highest priorities over the decade, in descending order, while SDGs 17, 1, 13, and 9 were the lowest, in ascending order. As with the ICT sector, these findings differ subtly with previous research. In PwC's (2019) survey of the energy utilities & resources sector, the closest corollary to the Oil & Gas sector, found that firms prioritise SDGs 13, 8, 7, 9, and 12. Most of note being the strong difference in the prioritisation of SDG 13.

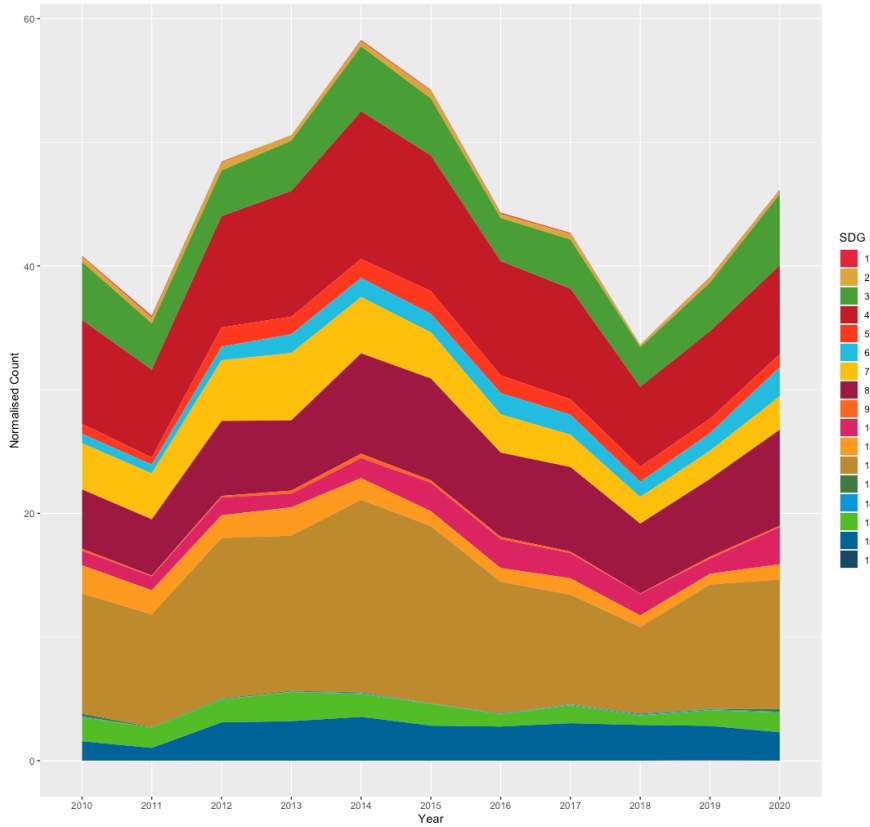


Figure 9. Stacked line graph of normalised count of actions taken on SDGs by ICT firms, 2010-2020

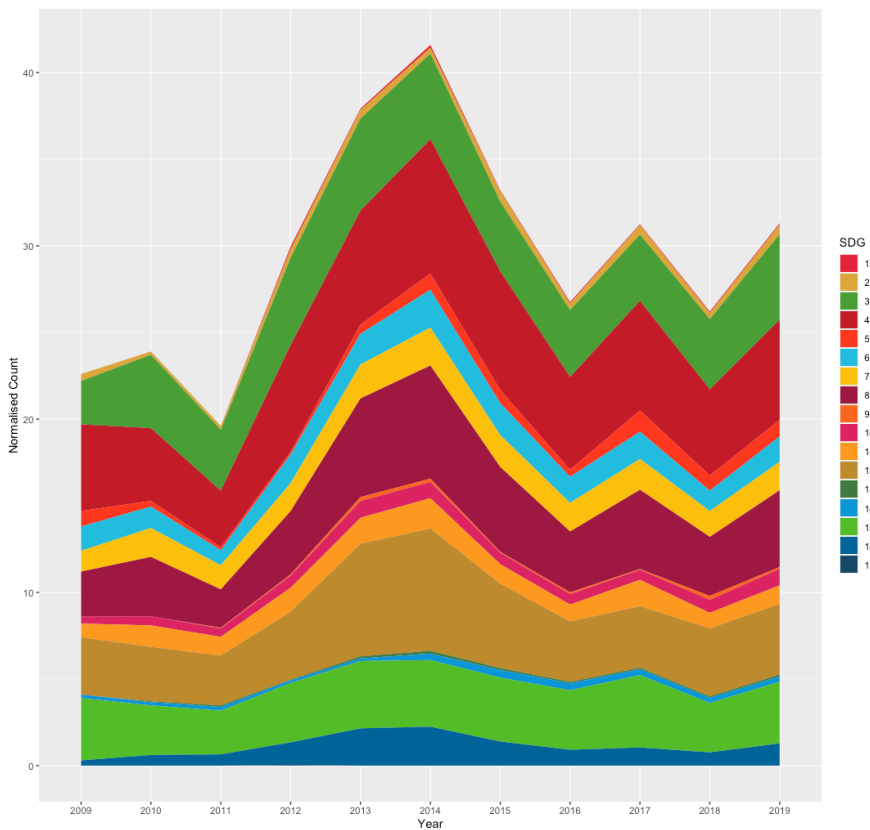


Figure 10. Stacked line graph of normalised count of actions taken on SDGs by Oil & Gas firms, 2009-2019

Figs. 7 and 8 shows stacked line graphs of the actions taken on each SDG by the sample firms in the ICT sector in the years 2010 to 2020 and the Oil & Gas sector between 2009 and 2019 respectively, normalised by the number of firms analysed in each year, giving insight into the changes in prioritisation over time. In both sectors, in terms of proportion, actions appear generally consistent, suggesting that prioritisation patterns did not change significantly over the decade at the level of the sector. However, there is interesting dynamics in the number of actions taken. Both sectors display a peak in activities in 2014 and a decline after. For the ICT sector this decline is strong, before rallying in in 2018. In the Oil & Gas sector, on the other hand, the decline is shorter and smaller, with the total number of activities entering sine-like variation year to year. Because of the uniqueness of the GOLDEN dataset, no previous research exists with which to compare this finding. The increase in actions seen in both sectors running up to 2015 may be explained by the heightened visibility of sustainable development at the time, related to the signing of the Paris Climate Accords and the declaration of the SDGs themselves in that year. Both sectors declined in the number of SDG-related actions after the SDGs were unveiled, which is a somewhat perplexing finding. However, it appears that the declines observed are regressions to the previous levels of action after this interest abated. This may suggest that the SDGs were nothing more than a fad to business and did little to actually catalyse increased action on sustainable development topics, which appeared to be increasing anyway (Fig. 8).

4.2 What induces prioritisation?

4.2.1 What firms are similar?

Figs. 9, 10, 11, and 12 show the unrooted dendrograms produced by hierarchical clustering using single, unweighted group average, unweighted group centroid, and weighted group centroid linkage methods. These methods produce no particular clustering, or very few in the case of the unweighted group average method (Fig. 10). This may suggest that firms are, in general, unique in their SDG prioritisation dynamics. However, there is evidence that some of these methods are poorly equipped to deal with the data used in this study, which undermines making inferences from them. The dendrogram produced by single linkage (Fig.

9), for example, may have been produced because of the ‘chaining effect’, to which single linkage is liable, wherein entities can be placed in the same, elongated cluster (Everitt *et al.*, 2011; Maharaj, D’Urso and Caiado, 2019). Similarly, the dendrogram produced by the weighted group centroid method (Fig. 12) shows the presence of ‘reversals’, wherein the fusions of clusters into the hierarchy does not occur in a monotonic sequence, undermining the interpretation of the dendrogram.

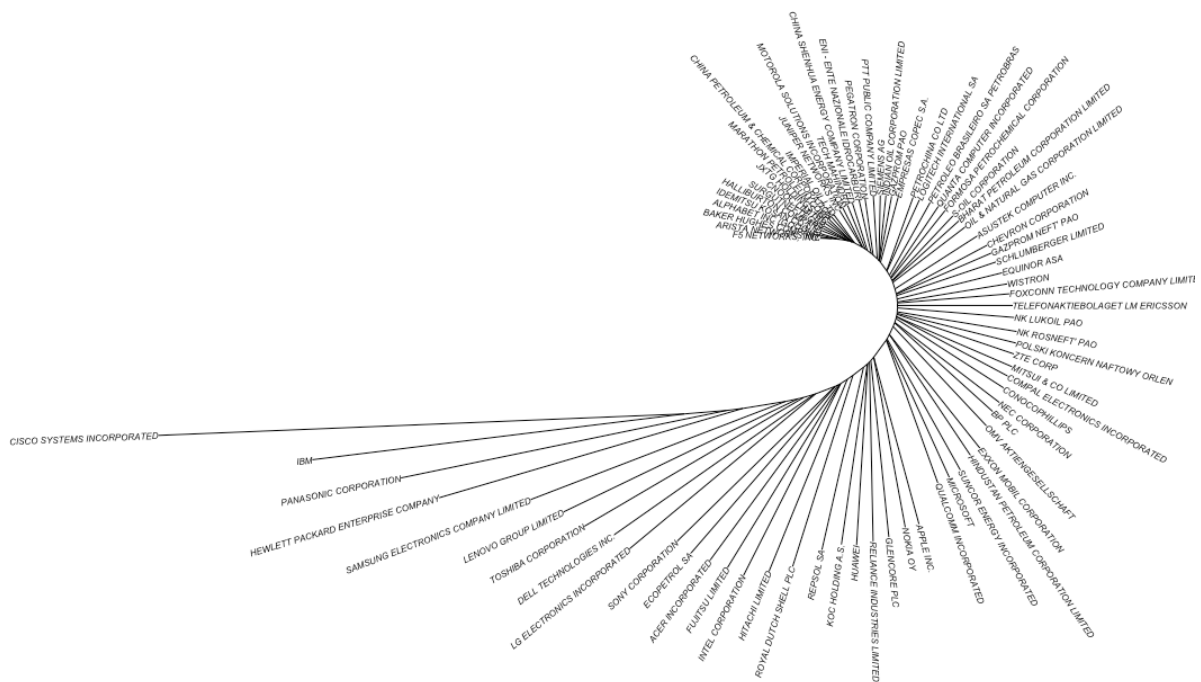


Figure 11. Unrooted dendrogram using single linkage

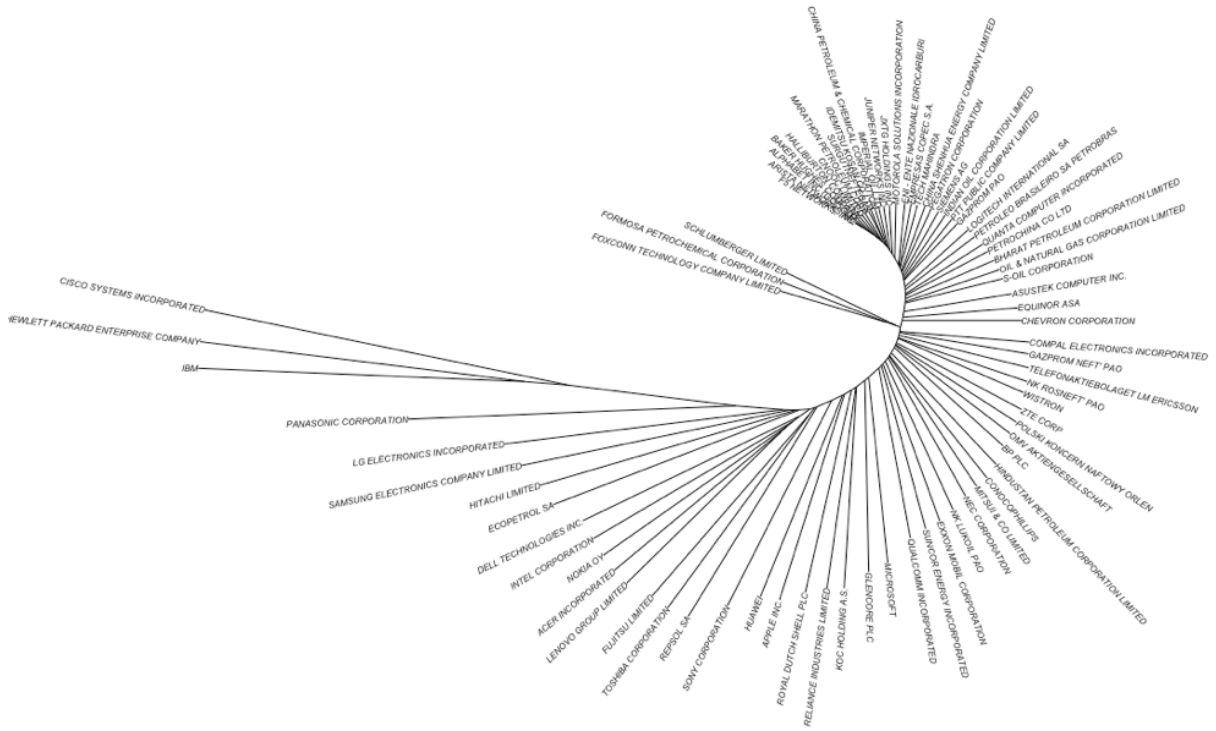


Figure 12. Unrooted dendrogram using unweighted group average linkage

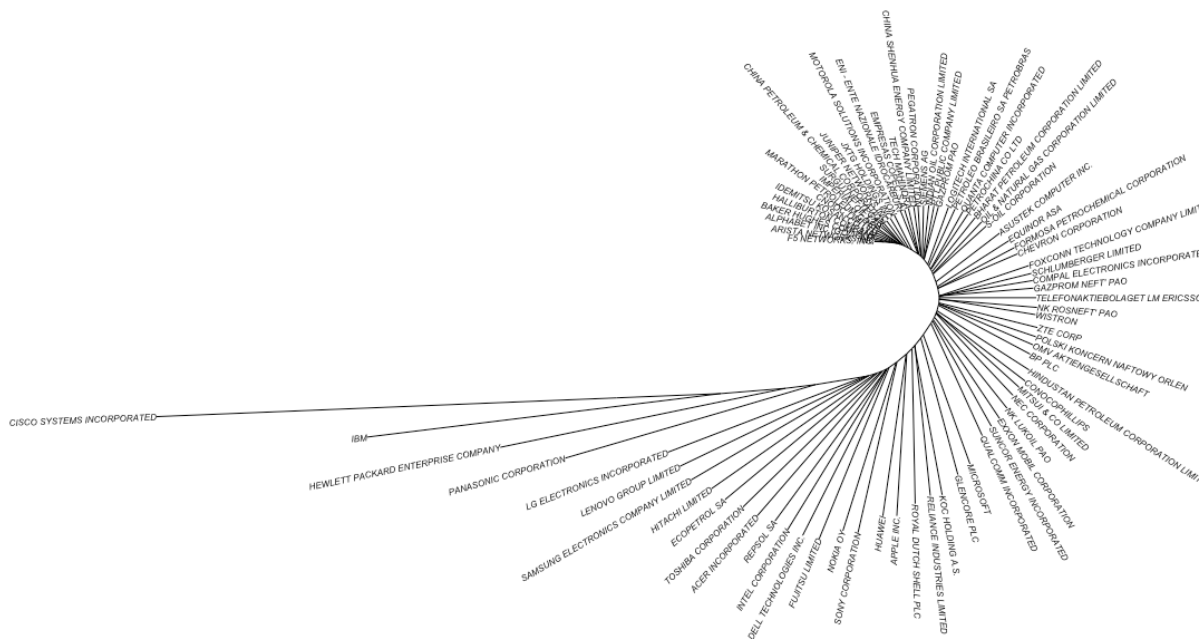


Figure 13. Unrooted dendrogram using unweighted group centroid linkage

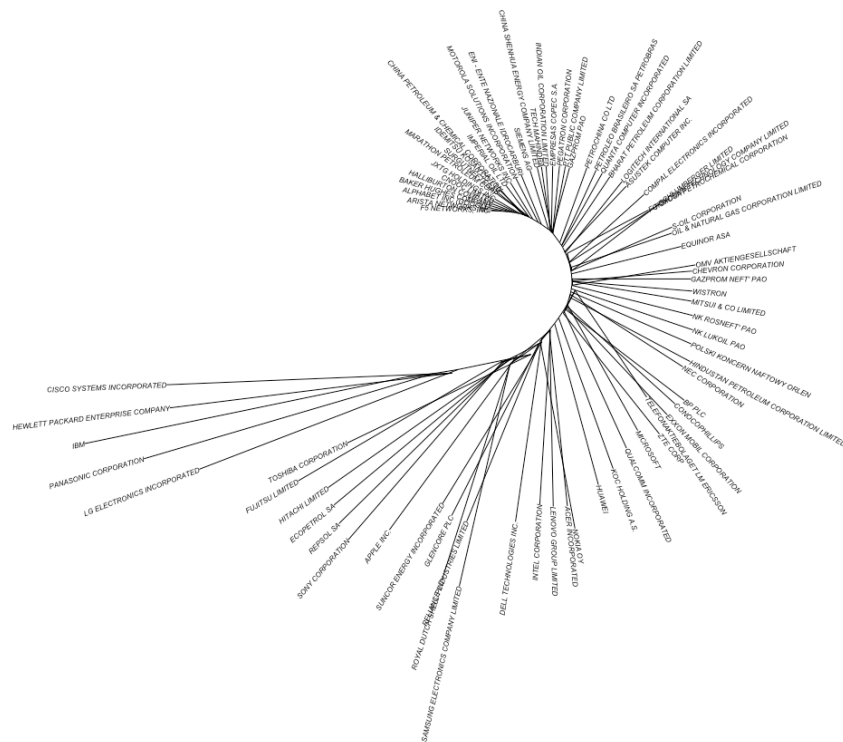


Figure 14. Unrooted dendrogram using weighted group centroid linkage

Figs. 13, 14, and 15 show the unrooted dendrograms produced by hierarchical clustering using complete, weighted group average, and Ward’s method. These methods produce dendrograms with clear clustering, suggesting that common factors are influencing these common SDG prioritisation dynamics. It is these dendrograms that we will take forward for further analysis.

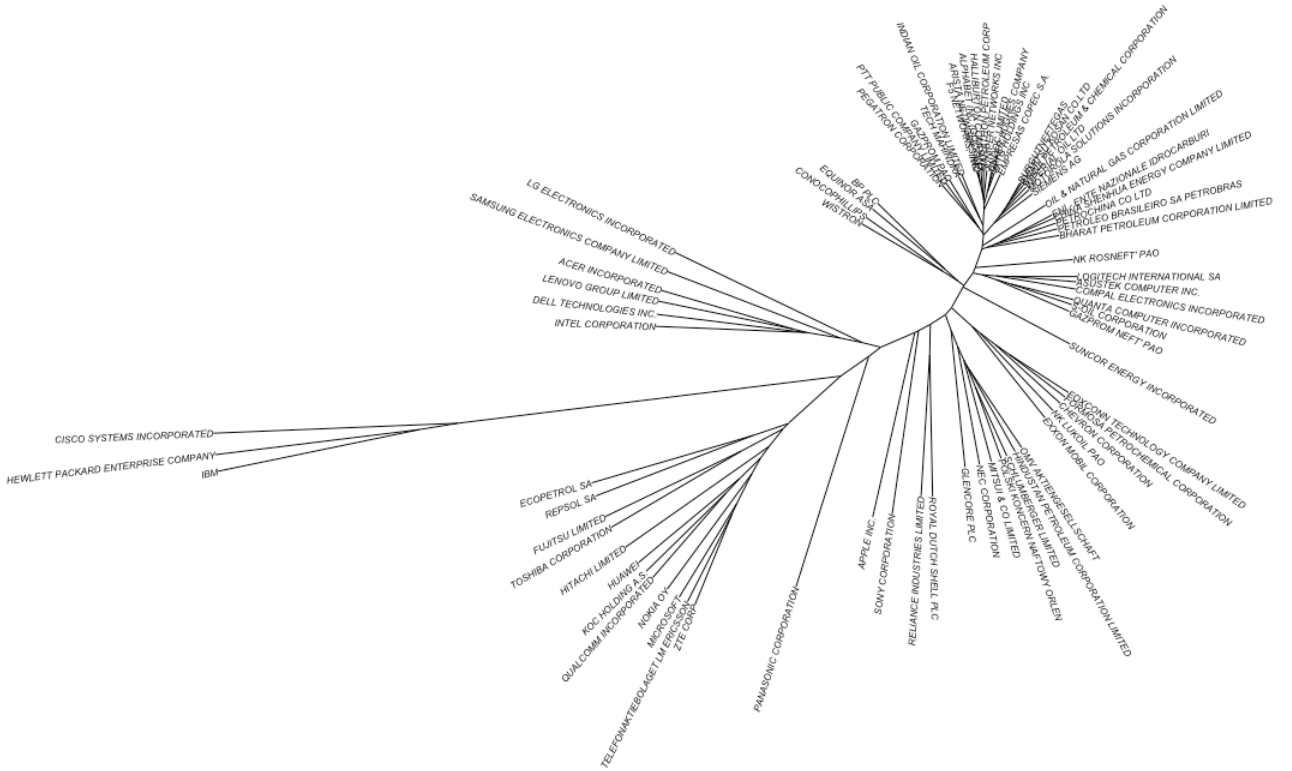


Figure 15. Unrooted dendrogram using complete linkage

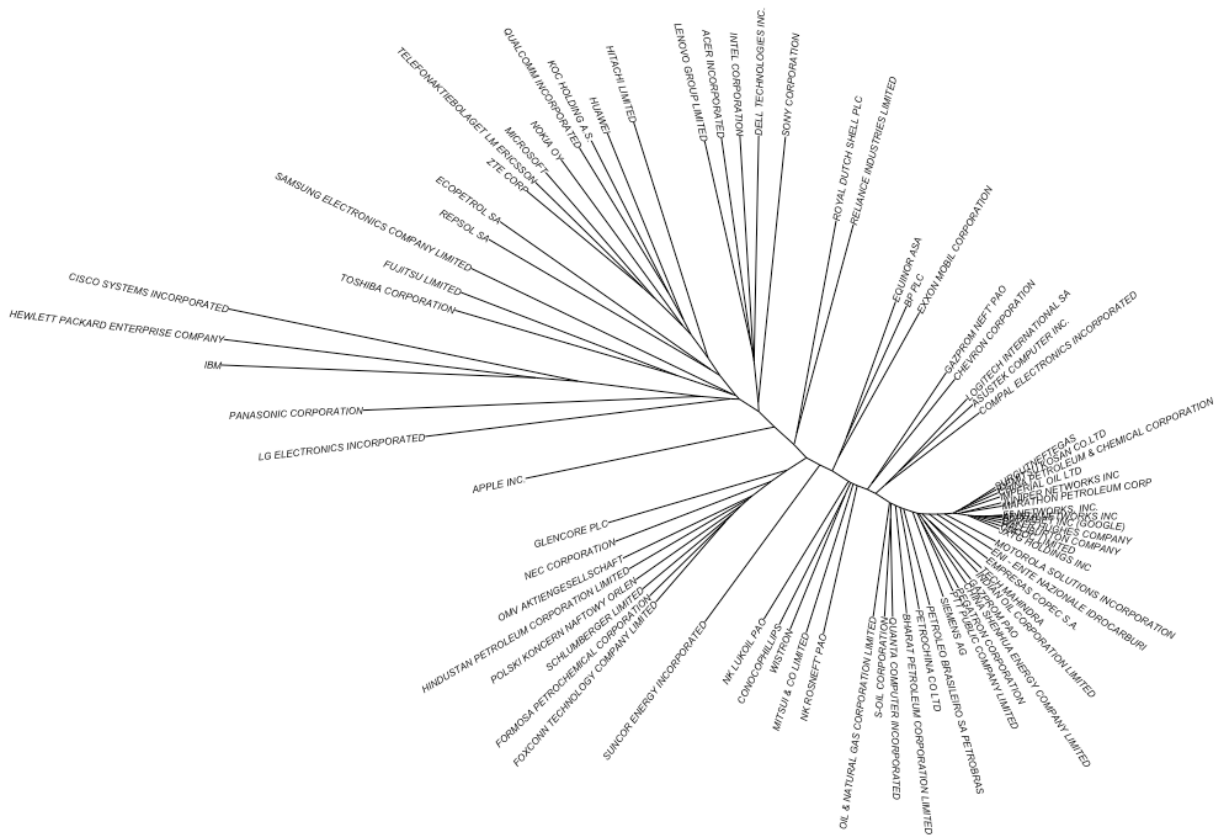


Figure 16. Unrooted dendrogram using weighted group average linkage

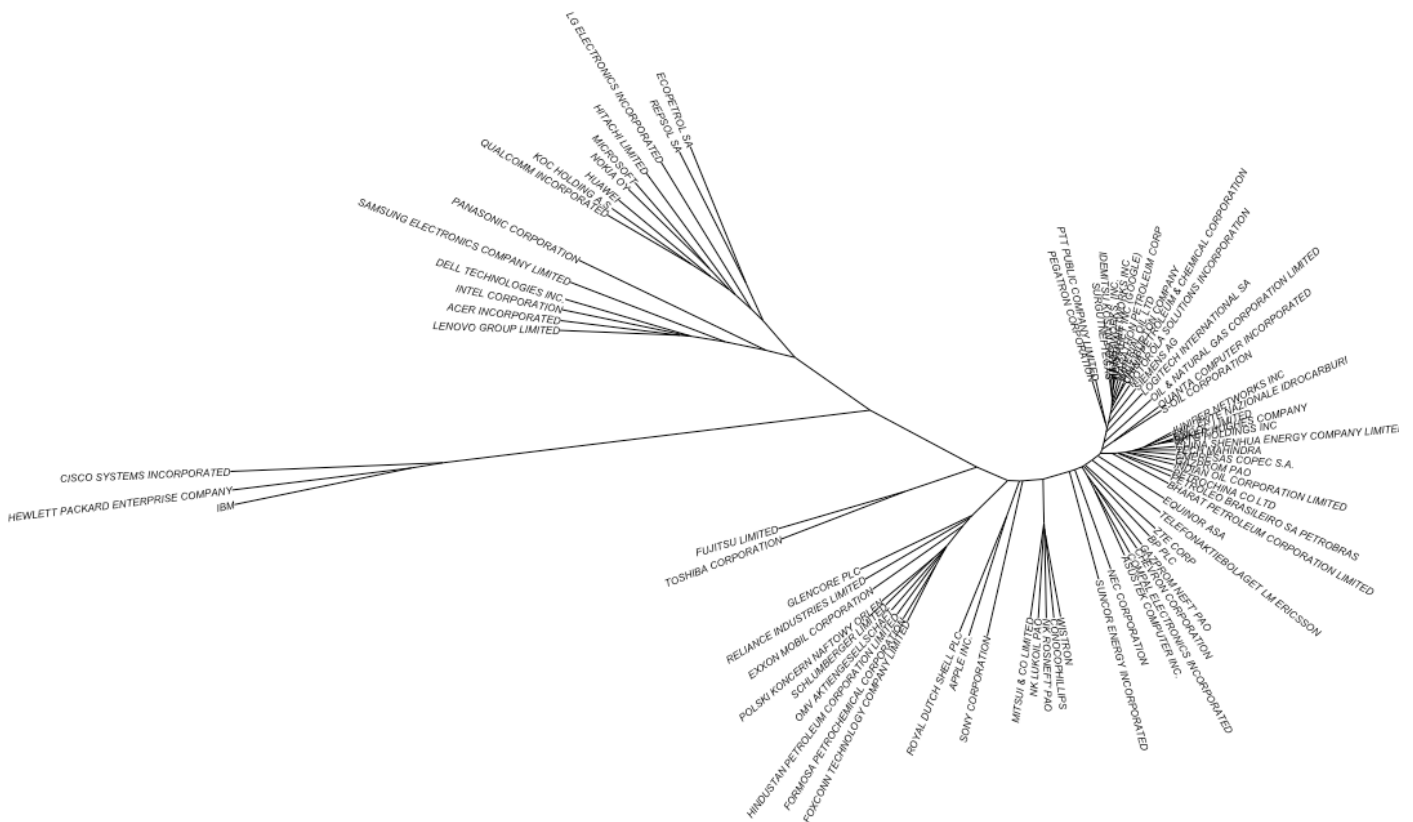


Figure 17. Unrooted dendrogram using Ward's linkage

4.2.2 The importance of sector

Fig. 16, 17, and 18 show the dendrograms produced by complete, weighted group average, and Ward's linkage methods labelled by sector. All three dendrograms are generally similar in that most sub-clades mostly consist of firms from the same sector, with one or two members from the other. This suggests that sector is an important explanatory factor for explaining SDG prioritisation dynamics. However, despite firms from either sector generally clustering at opposite ends of the dendrogram to each other, the presence of multi-sector clusters suggests that individual firm-level characteristics are still important. This finding differs from previous findings that a firm's sector is a generally poor explanation for SDG prioritisation (Mhlanga, Gneiting and Agarwal, 2018; Izzo, Ciaburri and Tiscini, 2020). It is worth noting, however, that this study analyses fewer sectors than previous research. It may be that, with a larger sample of sectors, the general dominance of sub-clades by firms from one sector may disappear.

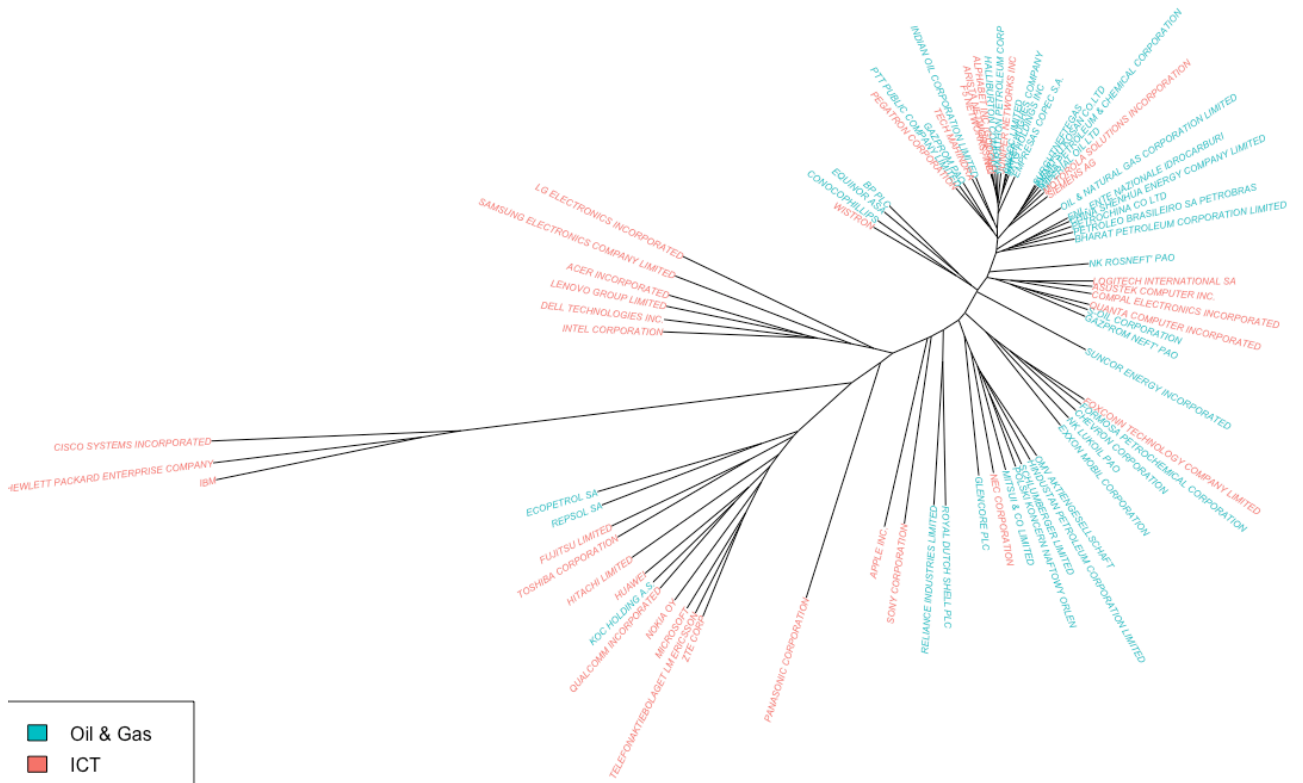


Figure 19. Unrooted dendrogram using complete linkage, labelled by sector

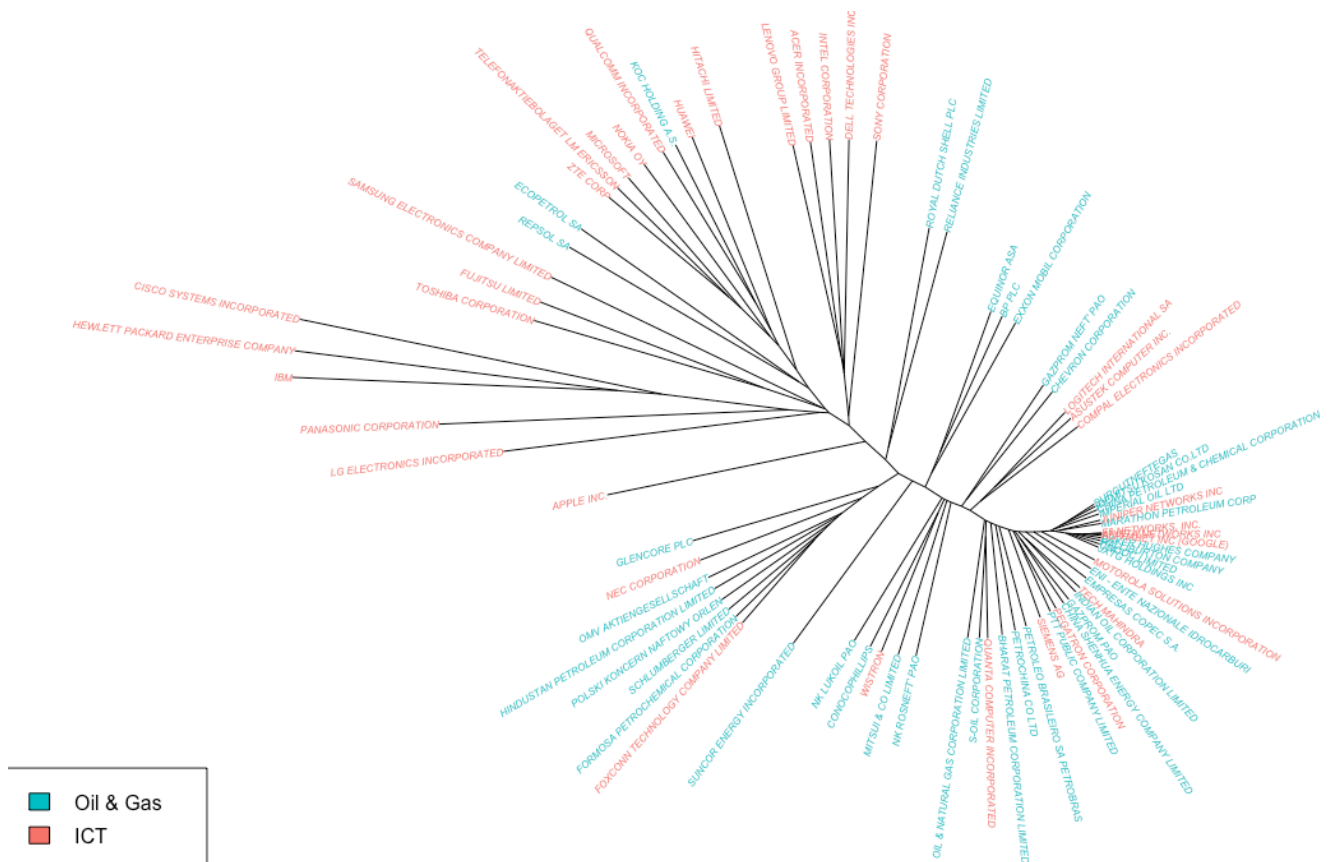


Figure 18. Unrooted dendrogram using weighted group average linkage, labelled by sector

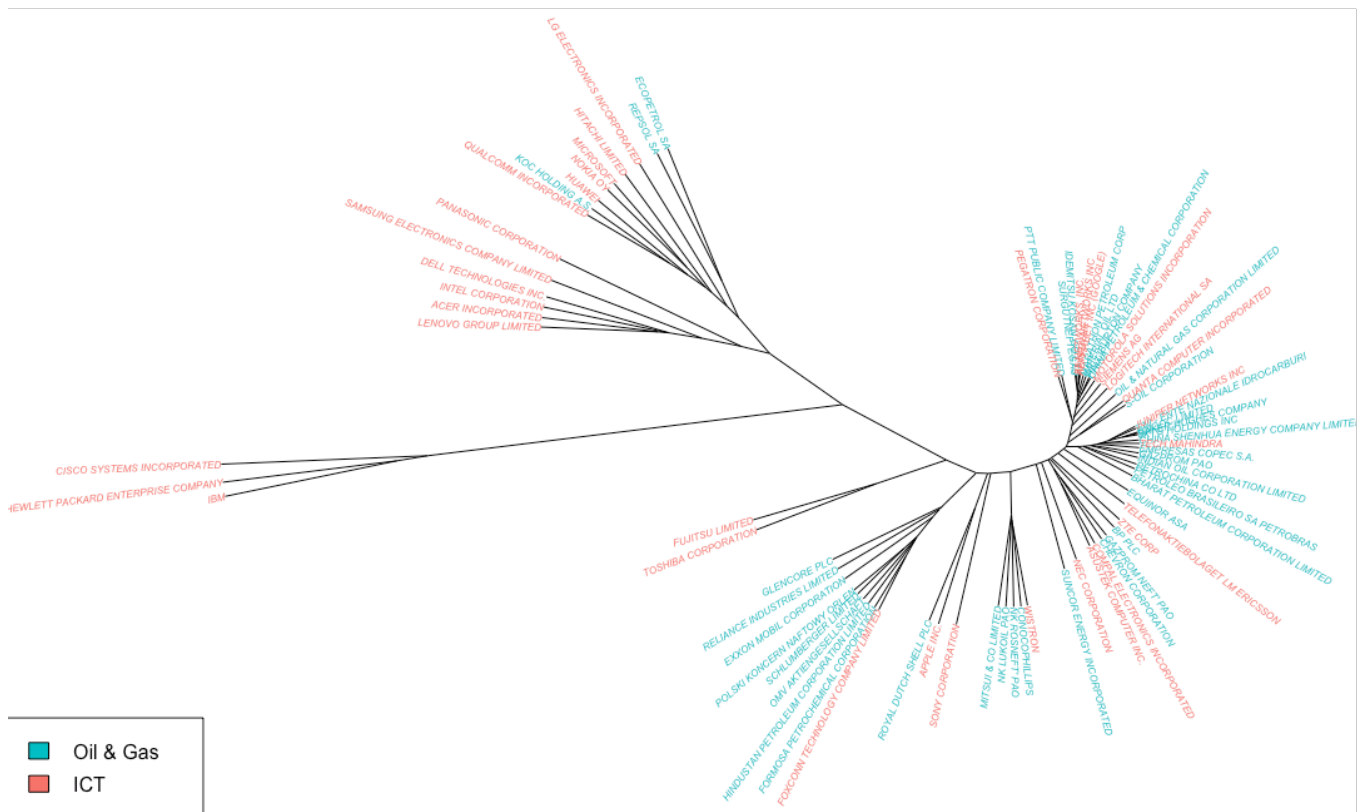


Figure 20. Unrooted dendrogram using Ward's linkage, labelled by sector

4.2.3 The importance of nation of origin

Figs. 19, 20, and 21 show the dendrograms produced by complete, weighted group average, and Ward's linkage methods labelled by the firm's country of origin. This appears to be a poor explanation of the shape of these dendrograms: firms from the same country do not tend to cluster together. As discussed in section 2.4, the importance of a firm's nation of origin, and the implicit effects of national institutions, to its SDG prioritisation is an emerging topic with no clear consensus. Some research suggests that country-level effects, such as climate change vulnerability (Rosati and Faria, 2019a) and legal institutions (Van Zanten and Van Tulder, 2018), have effects on SDG reporting adoption and prioritisation, respectively. While others suggest that national institutions have little effect (e.g. Mhlanga, Gneiting and Agarwal, 2018). This analysis supports the latter conclusion: nation of origin does not appear to be a particularly strong determinant of SDG prioritisation. Indeed, even with reason to believe that the country effect may be stronger or weaker in different

countries, such as Van der Waal and Thijssens (2020) suggestion that Japanese companies are more affected by their country of origin, no single country entirely clusters together, suggesting that other factors are at work.

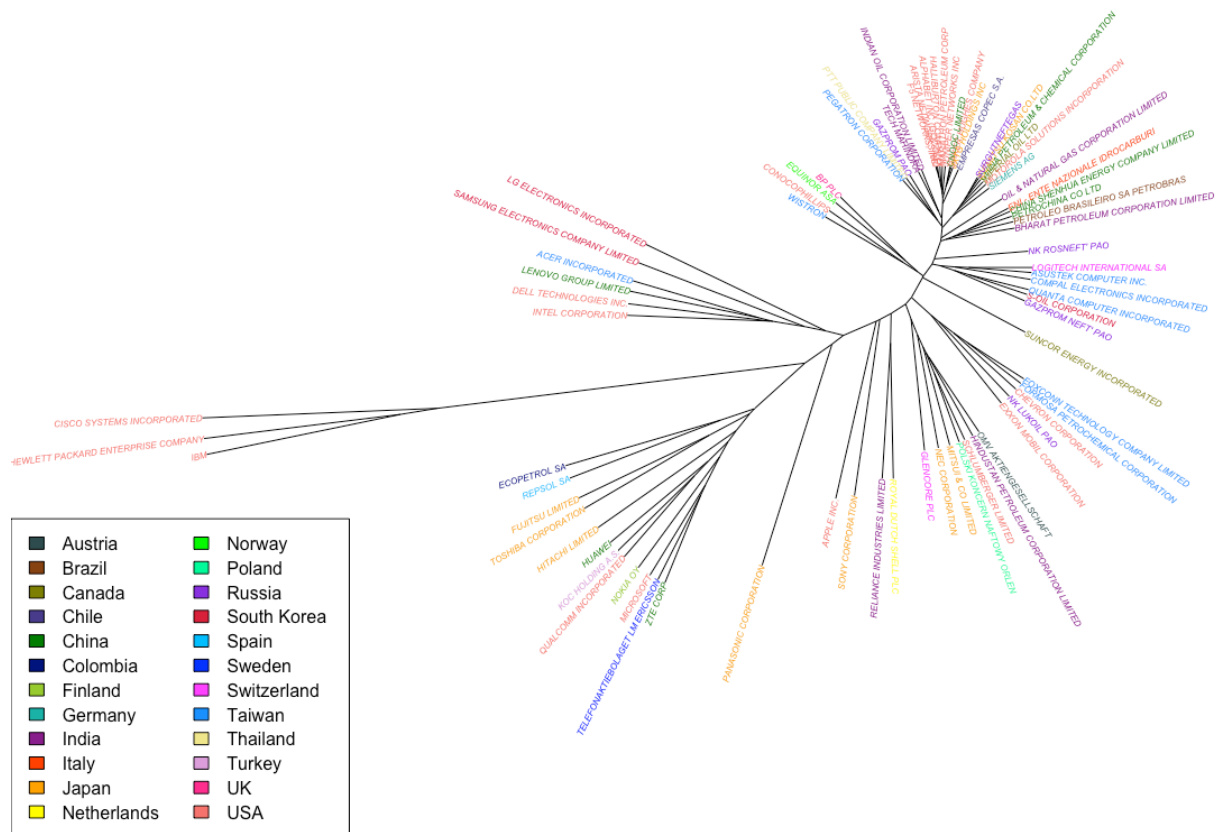


Figure 21. Unrooted dendrogram using complete linkage, labelled by country

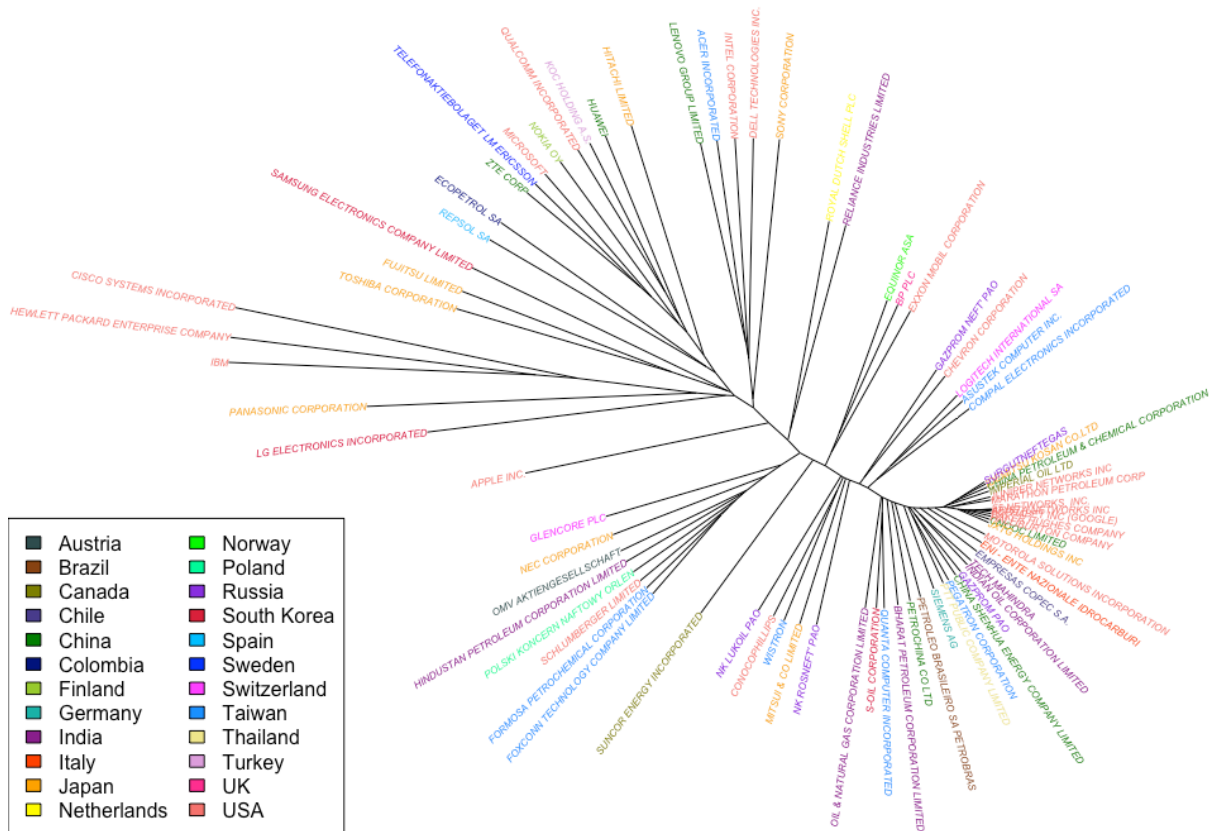


Figure 22. Unrooted dendrogram using weighted group average linkage, labelled by sector

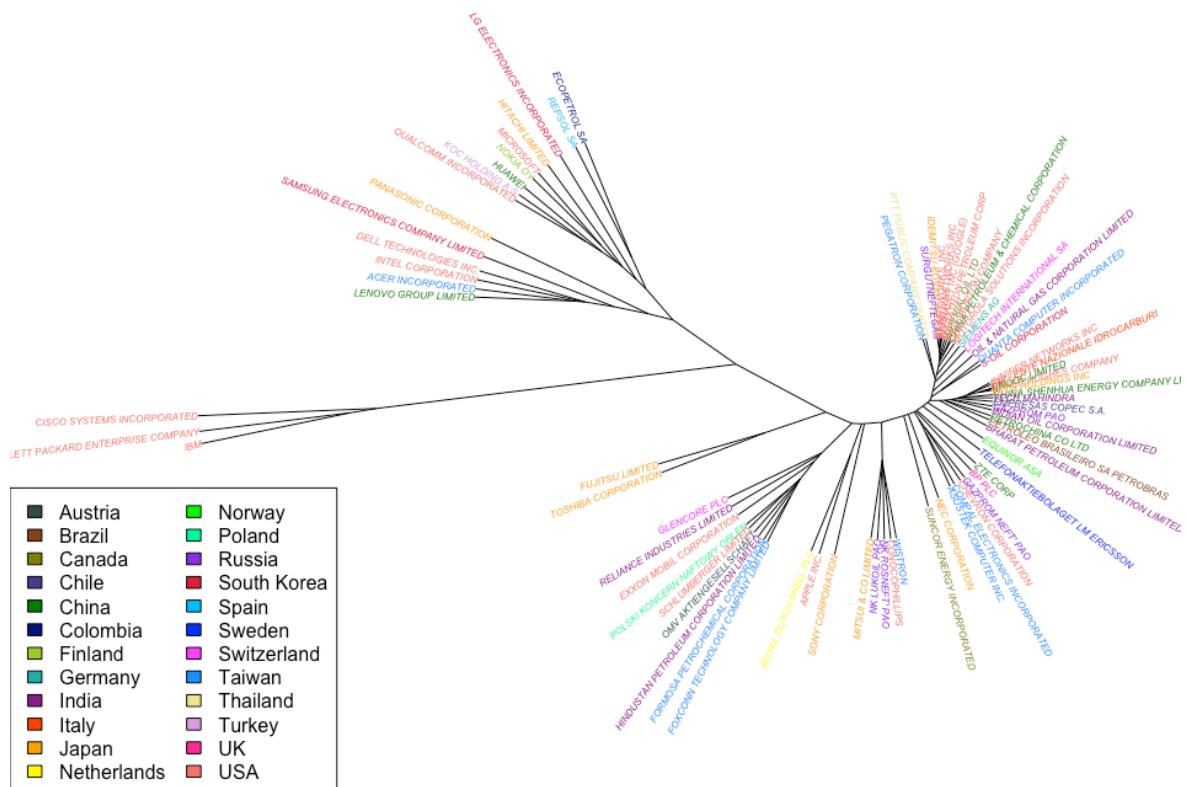


Figure 23. Unrooted dendrogram using Ward's linkage, labelled by country

4.2.4 Exploring other explanations

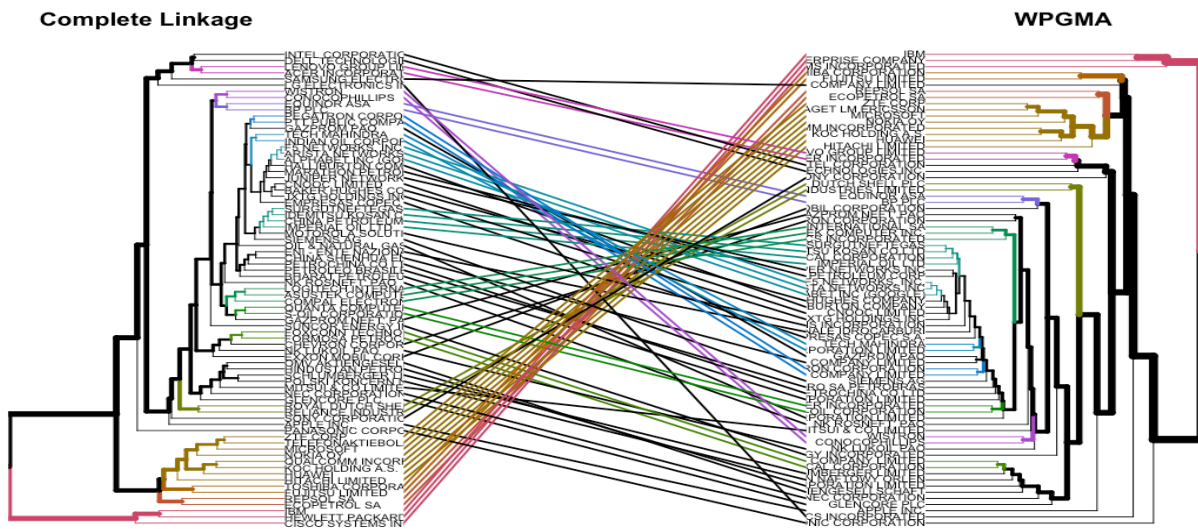


Figure 26. Tanglegram of Complete and WPGMA linkage dendrograms

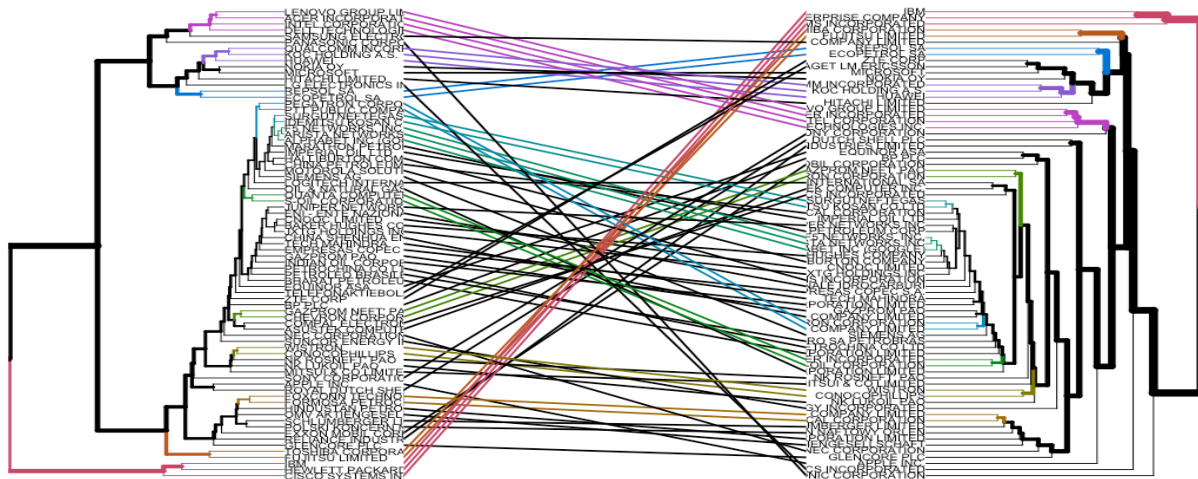


Figure 24. Tanglegram of Ward's and WPGMA linkage dendrograms

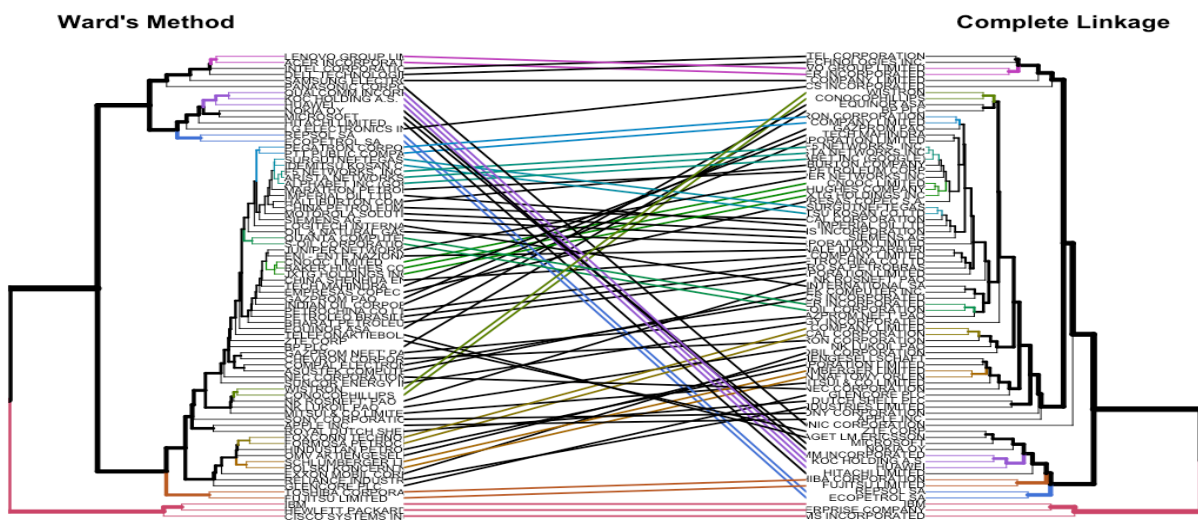


Figure 25. Tanglegram of Ward's and complete linkage dendrograms

Figs. 22, 23, and 24 show the tanglegrams used to choose firms for further analysis. From these, three groups of firms were chosen: *i*) Lenovo (2020), Acer (2020), Intel (2021), and Dell (2021); Huawei (2020), Microsoft (Art and Emejulu, 2020). Koç (2020), and Repsol (2020); and *iii*) Equinor (2020) and BP (2020). Firms in groups *i* and *ii* appeared in the same cluster in all three tanglegrams, while those in group *iii* were identified from the complete and WPGMA tanglegram (Fig. 22), in order that a cluster of Oil & Gas companies were analysed, reflecting group *i*'s constitution of ICT firms.

From this crude analysis, it was difficult to find specific factors that would separate these three groups. However, a key theme, which itself suggests other themes, that appeared across all the firms analysed is that firms choose SDG priorities by mapping them onto pre-determined sustainability strategies and issues. In other words, SDGs do not appear to be the main goal for companies' sustainability and sustainable development actions; rather, they are a secondary label. Crucially, it appears from the companies analysed that the sustainability issues chosen, and thus the SDGs prioritised, are those that are material to the company. The determination of the sustainability issues and strategies are also conducted in a fundamentally similar way: materiality assessments. These begin with the sourcing of sustainability issues. A major source for these are the numerous frameworks for companies in relation to sustainability. For example, Dell (2021) utilised the GRI, Sustainability Accounting Standards Board (SASB), and Taskforce for Climate-related Financial Disclosures (TCFD) frameworks to develop topics. In some cases, however, the SDGs themselves are one of the frameworks utilised in this process, e.g. Intel (2021). Indeed, the SDG-related framework of the UN Global Compact is often utilised too, e.g. Equinor (2020). This is often supported by stakeholder engagement, generally in the form of a survey, wherein topics are developed and ranked. Lenovo (2020), for example, surveyed and engaged with customers, employees, local communities, business groups, and others to develop theirs. In some companies, the results of these development stages are passed to sustainability leaders for review. At Acer (2020), for example, the chief sustainability officer reviews survey results before passing them to the members of a sustainability committee. Using the results of the surveys, issues are plotted for external relevance (often labelled 'stakeholder concern' or similar) and internal relevance (often labelled 'impact' or similar). The placement of issues in this matrix defines their materiality. Finally, then, these material topics are mapped onto

one or more SDGs. This could be done directly, as at BP (2020), or by grouping several issues into a group that relates to a specific topic, such as ‘cultivating inclusion’ at Dell (2021), which is then mapped to relevant SDGs.

SDG prioritisation as materiality aligns generally with the finding that sector is a good explanation for SDG prioritisation, but that there is significant variation under this, explaining the clustering we see. We would expect firms in the same sector to be generally similar in the material issues they identify, especially if guided by the sectorial materiality frameworks of SASB. But, differences in the stakeholders and capabilities of each company, for example, explains individual differences in materiality and, thus, SDG prioritisation. Indeed, it also aligns with the above finding, and previous research (Mhlanga, Gneiting and Agarwal, 2018; PwC, 2019), that firms place high priority on SDGs 8 and 12. As core to the business, these SDGs would score highly in internal concern and thus be considered very material. This same explanation would also make sense for the strong prioritisation of SDG 4 by the ICT sector as it becomes an ever more important supplier of educational resources. However, it can also explain the relatively strong prioritisation of SDGs that do not appear to be central to the business, such as SDG 4 by the Oil & Gas sector, as they may, nevertheless, be of concern to stakeholders. The finding that firms do not emphasise SDGs 1 and 17 also makes sense under this explanation. While some authors (Mhlanga, Gneiting and Agarwal, 2018; Kurz, 2020) have argued that SDG 1 is business-relevant, the materiality of poverty to a business is, intuitively, at best indirect and thus would be unsurprising to be found as immaterial to companies. The same can be said of the largely government-aligned SDG 17. The same, however, cannot be said of SDG 13 – the implication of this result is discussed below. While being supported by some previous research (Mhlanga, Gneiting and Agarwal, 2018), the conclusion of materiality-based prioritisation is, however, caveated by the small sample size and crude analysis method. For example, Heras-Saizarbitoria, Urbieto, and Boiral (2021) analysis of 1370 firms suggest that only very few tie SDG prioritisation explicitly to materiality analysis. Indeed, some firms, such as Huawei (2020), Microsoft (Art and Emejulu, 2020), and Repsol (2020), all of which appear in the same cluster, report contributions to other SDGs that they do not list as priorities from their materiality analysis. Despite these caveats, evidence from this research is compelling for the conclusion that SDG priorities are little more than mapped material sustainability issues.

5 Discussion

The above results provide answers to our research questions: firms tend to prioritise SDGs 12, 4, and 8 and focus very little attention to SDGs 17, 1, and 13, with the ranking of these priorities changing very little over the last decade. It was also found that a firm's sector appears a good explanation for its SDG prioritisation, whereas its country of origin was not. A brief, informal review of several firms' sustainability reports suggested that this could be explained by SDG prioritisation being based on materiality assessments of general sustainability issues.

As discussed above, the conclusion that a firm's SDG priorities are mapped from material sustainability issues aligns generally well with findings about the SDGs that firms have taken most action on, the definition of prioritisation used in this paper. Suggesting, in other words, that firms will act the most on the SDGs that are most material to them. This logic aligns well with SDG prioritisation defined in other ways, by survey (PwC, 2019) and by analysing corporate literature (Mhlanga, Gneiting and Agarwal, 2018; Izzo, Ciaburri and Tiscini, 2020; Curtó-Pagès *et al.*, 2021), with SDGs stated to be high priority also being the most acted upon, suggesting a common source – suggested here to be materiality assessments. There are, however, two exceptions in the findings of this research that do not appear to fit this explanation. First, it was shown that, in both the ICT and Oil & Gas sectors, SDG 13 had very few actions taken on it (Figs. 5 and 6). In the literature SDG 13 is generally found to be of the highest priority to firms across sectors (Mhlanga, Gneiting and Agarwal, 2018; PwC, 2019; Izzo, Ciaburri and Tiscini, 2020; Curtó-Pagès *et al.*, 2021) suggesting the powerful importance of the issue of climate change in materiality analyses. The low number of actions suggests just the opposite: firms do not see climate change as a material issue. This apparent contradiction, however, might be explained by firms undertaking massive 'rainbow-washing' on SDG 13. Recognising its importance to stakeholders through materiality assessments but deciding against action because of other reasons, perhaps the difficulty or cost of the task with generally no legal obligation to do so, firms list SDG 13 as a high priority in their rhetoric to retain legitimacy but take no action. Second, it was shown that the Oil & Gas sector takes a relatively large number of actions on SDG 15, suggesting it is highly material to firms in the sector. SDG 15, however, generally ranks as one of the

lowest priority SDGs in other literature (Mhlanga, Gneiting and Agarwal, 2018; Avramiou *et al.*, 2019; Izzo, Ciaburri and Tiscini, 2020), suggesting it is not material to the sector. This contradiction, unlike the above, is almost impossible to explain under the suggestion that materiality is the key criterion of SDG prioritisation: we would not expect a firm to take a significant amount of action on an immaterial SDG. Crucially, however, no research has been undertaken on the material issues or self-described SDG prioritisation of Oil & Gas firms. A finding that such firms do not find terrestrial biodiversity to be material or prioritise SDG 15 would be strong falsifying evidence for this theory.

However, there does appear to be strong enough evidence to, at least, discuss the implications of SDG prioritisation based on materiality. What, then, does the influence of materiality on SDG prioritisation mean for the private sector's contribution to the 2030 Agenda? From the results presented here, the main implication is that the private sector's contribution will be weighted towards the goals that are material to it, with comparatively little action on those that are not considered material. If we are to achieve the 2030 Agenda, what, if anything, should be done about this state of affairs?

One option is to do nothing, accepting that the private sector is not the silver bullet for solving all sustainable development problems in the 2030 Agenda (Scheyvens, Banks and Hughes, 2016), but that it can be useful for certain SDGs. By identifying and prioritising the SDGs that are most material to them, firms can maximise their contributions due to alignment with their core competencies and value chains (Schramade, 2017). If, in their intuitive diversity, the ICT and Oil & Gas sectors are accepted as an appropriate cross-section of the private sector as a whole, this contribution will predominately be to SDGs 12, 4, and 8 – which appears unlikely to shift strongly over time (Figs. 7 and 8). However, as can also be seen (Figs. 5 and 6), there will be significant contributions to many of the other SDGs, reflecting the individual sets of material issues identified by each firm in their different sectors and contexts. Indeed, because of the linked nature of the SDGs, contributions to one SDG can have indirect, positive effects on others (Dalampira and Nastis, 2020; Swain and Ranganathan, 2021). Yet, it is not abundantly clear that the SDGs that firms take most action on are the most interlinked. Others have argued SDG 5 as the most interlinked goal (Hepp, Somerville and Borisch, 2019), shown here to be under acted

upon by the private sector, while network analysis on SDG targets ranks only one target from the SDGs this research has shown to be a corporate priority as highly interlinked, SDG 12.2 (Allen, Metternicht and Wiedmann, 2019). Although it is difficult to know the full range of SDGs that would be acted upon by the totality of the private sector, the conclusion that it would be weighted to certain SDGs appears strong. The implicit conclusion for the 2030 Agenda, then, is that other development agents must focus their attention on the SDGs that the private sector neglects. Further research would be needed to align competencies of different agents to different goals.

But does this allow the private sector too much slack and, moreover, does it neglect the opportunity to use the private sector's considerable capacities on all the SDGs (Scheyvens, Banks and Hughes, 2016; Sachs and Sachs, 2021)? Recalling above discussion of the SDGs as an impression management tool (section 2.3), there is reason to criticise the concept of prioritisation as a means for firms to seem to be tackling sustainable development issues without changing anything. As this research suggests, firms utilise materiality assessments to identify relevant sustainability issues that are then mapped to the SDGs. A critical view of this approach is that this the process does not, in fact, reflect identification of value-addition or competency-alignment but rather a process of 'cherry-picking' (Izzo, Ciaburri and Tiscini, 2020) or 'match-making' (Mhlanga, Gneiting and Agarwal, 2018) that does not lead to any real change, instead done to satisfy stakeholders (García-Meca and Martínez-Ferrero, 2021). Coupling this lack of SDG-aligned innovation with impression-management cover from SDG 8 to continue to grow, prioritisation is argued to be a contributing factor to the paradoxical increase in SDG alignment throughout the economy with the deepening of the social, environmental and economic problems they are formulated to solve (Sachs and Sachs, 2021). Prioritisation, at best, skews efforts towards certain goals or, at worst, actively contributes to the continuation or magnification of the problems the goals seek to ameliorate. For some authors, then, the best course of action is to end the process of prioritisation and push for companies to take action on all SDGs. Sachs and Sachs (2021), for example, call for firms to consider SDGs regardless of their proximity to business, effectively eschewing the process of materiality-based prioritisation. Instead, they push for firms to adopt a 'do no harm' principle and consider SDGs in relation to the impacts of their supply- and value-chains on societal and environmental well-being, guided by stakeholder

engagement. While this is a noble desire, it seems unrealistic for all firms to truly adopt. This is mostly associated with the simple fact that firms have limited resources (Agarwal, Gneiting and Mhlanga, 2017). Thus, regardless of whether firms engage with the SDGs out of a desire to create positive impact or simply to gain stakeholder approval, these limited resources must be allocated in such a way as to create value in the most efficient way. Materiality assessments provide a mechanism for such an allocation, allocating resources towards the SDGs that are most material - to those that will create the most value. Prioritisation of SDG's, then, is an unfortunate by-product of this essential mechanism.

It appears, therefore, that materiality-based SDG prioritisation is a reality of corporate engagement with the goals. What direction, then, does future research, guided by the limitations and implications of this study, need to take on the topic to ensure the maximum contribution of the private sector over the coming decade? From the findings and implications of this study, there are three key areas for future research.

First and of highest priority, meeting a key limitation of this research, is a stronger investigation of the links between the firm's material issues, described SDG priorities, and the number of actions taken on each SDG. This would likely require an extensive review of corporate literature and thus may be a useful opportunity to leverage the power of natural language processing algorithms, as has been done to construct the GOLDEN database. This may be complicated by the relative obscurity with which firms describe their priorities (Mhlanga, Gneiting and Agarwal, 2018), which could impede satisfactory training of an NLP algorithm. Research on this topic would help to strengthen or falsify, as discussed above, the suggestion that materiality is at the heart of the private sector's prioritised engagement with the SDGs. Indeed, this avenue of research would also provide an opportunity to quantify the extent of 'rainbow-washing'. Explaining why rainbow washing occurs would likely also be a fruitful endeavour, particularly for any suggestions in how it might be controlled. Intuitive potential explanations are strong stakeholder pressure for the SDG (García-Meca and Martínez-Ferrero, 2021), perhaps coupled with the prevailing legislative institutions (Van der Waal and Thijssens, 2020), which may both interact with the cost and difficulty of meeting the issue.

A second key area for research is on the process of the materiality assessment itself, in which the brief review of sustainability publications (section 4.2.4) suggested there to be a number of factors that may influence firms' SDG prioritisations (both reported and count-based). At the stage of initial issue development, many firms reference stakeholders as a key source; these included customers, employees, experts, and others. As their opinions may eventually lead to SDG priorities, it is important to understand more about who these stakeholders are, what they believe, and crucially how they have been sampled to assess what biases are being taken forward to prioritisation. Another major source for issues are the myriad sustainability frameworks available to firms, including the GRI, UNGC, and the TCFD, a recently developed framework. Subscription to the UNGC, for example, has previously been shown to be associated with comparatively greater focus on SDGs 8, 3, 5, 4, 12, 9, and 13 (Avrampou *et al.*, 2019) but the process of this influence is still unknown. This is particularly relevant given the coming release of another framework, the Taskforce on Nature-related Financial Disclosures (TNFD). If it is true that sustainability frameworks do influence SDG prioritisation by changing materiality analysis, then the private sector's take up of the TNFD may lead to improved prioritisation and action on the biodiversity-related SDGs 14 and 15 – both of which are generally lowly prioritised (Mhlanga, Gneiting and Agarwal, 2018; Avrampou *et al.*, 2019; Izzo, Ciaburri and Tiscini, 2020) and acted upon (Figs. 5 and 6). How these issues are then taken forward into materiality assessments may also be an important source of bias. As discussed, some companies involve sustainability managers at this point. Corporate leaders have been shown to have an effect on SDG engagement (Rosati and Faria, 2019b), thus investigation into their effect on prioritisation is warranted. Other questions, such as how many issues are taken forward and if issues from certain sources are favoured would also be interesting. Indeed, understanding why, if any, issues are left out of materiality assessments would be of great importance – such as for their cost or difficulty. Investigations into the effect on the materiality-prioritisation logic of a firm's wider context would also be warranted. This study suggests that sector, caveated by the small sample size, has an effect on SDG prioritisation, however in what parts of the process this effect is felt is unclear. A firm's country of origin, on the other hand, was shown not to have an effect in this analysis. There is reason to believe, however, that the approach used to come to this conclusion is limited. For example, many of the firms analysed in this study are multi-nationals, meaning that their country of origin may not be the same as that in

which the SDG-aligned action is taken. Given this limitation and the presence of institutional explanations for prioritisation in previous literature (section 2.4), further investigation is warranted. Other factors of interest include: size (Van der Waal and Thijssens, 2020), competencies (Rosati and Faria, 2019b), and age of firm – this latter factor may hint at the presence of institutional learning (Zollo, Cennamo and Neumann, 2013) influencing the materiality-prioritisation logic.

These broader explanatory factors are particularly important in regards to the final key research theme suggested by this analysis: how to encourage firms to take on the results of research and thus increase their contributions to the 2030 Agenda. The answers to research questions in this process theme (Zollo, Cennamo and Neumann, 2013) may likely differ by sector, nation, age of firm, etc. but, to unleash the full potential of the private sector, these contexts must be taken into account. Indeed, this avenue of research could be seen as the crucial one in mobilising the fullest answer of the private sector to the call to action on the SDGs in the coming Decade.

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Appendix 1 – R Code

```
library(ggplot2)
library(dtwclust)
library(ggdendro)
library(ape)
library(randomcoloR)
library(purrr)
library(dendextend)
library(dplyr)
library(treemap)
library(stringr)

SDG_colours <- c('#E5243B','#DDA63A','#4C9F38','#C5192D','#FF3A21',
                '#26BDE2','#FCC30B','#A21942','#FD6925','#DD1367',
                '#FD9D24','#BF8B2E','#3F7E44','#0A97D9','#56C02B',
                '#00689D','#19486A')
OG_master <- read.csv('O+G Master.csv')
OG_master_SDGs<- cbind(OG_master[,2:3], OG_master[,259:275])
SDGs <- c('SDG.1', 'SDG.2', 'SDG.3', 'SDG.4', 'SDG.5', 'SDG.6',
          'SDG.7', 'SDG.8', 'SDG.9', 'SDG.10', 'SDG.11', 'SDG.12',
          'SDG.13', 'SDG.14', 'SDG.15', 'SDG.16', 'SDG.17')
OG_SDG_totals <- read.csv('O+G SDG totals.csv')
ICT_SDG_totals <- read.csv('ICT SDG totals.csv')
ICT_SDG_totals_long <- read.csv('ICT SDG totals long.csv')
OG_SDG_totals_long <- read.csv('OG SDG totals long.csv')
SDG_totals <- read.csv('SDG totals.csv')

# Data Summary

DS_bar <- read.csv('DatSum Bar.csv')
ggplot(DS_bar, aes(x= Country, y = Count, fill = Sector)) +
  geom_bar(position = 'dodge2', stat = 'identity') +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1, size = 10)) +
  scale_y_continuous(breaks = c(2,4,6,8,10,12,14,16,18))

DS_hist <- read.csv('DatSum Hist.csv')
ggplot(DS_hist, aes(x=x) ) +
  # Top
  geom_histogram( aes(x = OG, y = ..density..) , fill="#00BFC4" , binwidth = 1, color ='grey91') +
  geom_label( aes(x=4.5, y=0.25, label="Oil & Gas"), color="black") +
  # Bottom
  geom_histogram( aes(x = ICT, y = ..density..) , fill= "#F8766D", binwidth = 1, color="grey91") +
  geom_label( aes(x=4.5, y=-0.25, label="ICT"), color="black") +
  xlab("Length of time series in years")

# Treemap of SDG actions taken

treemap(OG_SDG_totals, 'SDG', vSize = 'Count', vColor = 'Colour', type = 'color', fontcolor.labels =
'white')
```



```
treemap(ICT_SDG_totals, 'SDG', vSize = 'Count', vColor = 'Colour', type = 'color', fontcolor.labels = 'white')
```

```
# Line plots of SDGs
```

```
ggplot(ICT_SDG_totals_long, aes(fill=factor(SDG), y=Normalised, x=Year)) +  
  geom_area() + scale_fill_manual(values = SDG_colours) + labs (y = 'Normalised Count', fill = 'SDG') +  
  scale_x_discrete(limits = ICT_SDG_totals_long$Year)
```

```
ggplot(OG_SDG_totals_long, aes(fill=factor(SDG), y=Normalised, x=Year)) +  
  geom_area() + scale_fill_manual(values = SDG_colours) + labs (y = 'Normalised Count', fill = 'SDG') +  
  scale_x_discrete(limits = OG_SDG_totals_long$Year)
```

```
## TS clustering
```

```
# Making list of matrices
```

```
OG_noSings <- read.csv('O+G No singletons.csv')  
OG_companies <- as.data.frame(OG_noSings[,2])  
colnames(OG_companies) <- "Firm"  
OG_values <- as.data.frame(OG_noSings[,259:275])  
OG_full <- cbind(OG_companies, OG_values)  
OG_with_names <- split(OG_full, OG_full$Firm) # splits df into a list of matrices based on the values  
of the second argument  
OG_df <- lapply(OG_with_names, function(x) { x["Firm"] <- NULL; x })  
OG_firms <- OG_full$Firm  
OG <- list()  
for (firm in OG_firms) {  
  OG[[firm]] <- as.matrix(OG_df[[firm]])  
}
```

```
ICT_noSings <- read.csv('ICT No singletons.csv')  
ICT_companies <- as.data.frame(ICT_noSings[,2])  
colnames(ICT_companies) <- "Firm"  
ICT_values <- as.data.frame(ICT_noSings[,268:284])  
ICT_full <- cbind(ICT_companies, ICT_values)  
ICT_with_names <- split(ICT_full, ICT_full$Firm) # splits df into a list of matrices based on the values  
of the second argument  
ICT_df <- lapply(ICT_with_names, function(x) { x["Firm"] <- NULL; x })  
ICT_firms <- ICT_full$Firm  
ICT <- list()  
for (firm in ICT_firms) {  
  ICT[[firm]] <- as.matrix(ICT_df[[firm]])  
}
```

```
All <- c(OG, ICT)  
Firms <- names(All)
```

```
# Clustering
```

```
hclust_methods <- c("single", "complete", "average", "mcquitty", "centroid", "median", "ward.D2")
```

```
All_list <- list()
```

```

All_list <- tsclust(All, type = 'h', distance = 'dtw',
                  control = hierarchical_control(method = hclust_methods),
                  preproc = NULL)
names(All_list) <- hclust_methods

# Plot

All_labels <- read.csv('All_labels.csv')
Firms_2 <- as.vector(All_labels$Firm)
Sectors <- setNames(as.vector(All_labels$Sector_code), Firms_2)
Countries <- setNames(as.vector(All_labels$Country_Code), Firms_2)
col_vector_C <- c('#2f4f4f', '#8b4513', '#808000', '#483d8b', '#008000', '#000080',
                 '#9acd32', '#20b2aa', '#8b008b', '#ff4500', '#ffa500', '#ffff00', '#00ff00',
                 '#00fa9a', '#8a2be2', '#dc143c', '#00bfff', '#0000ff', '#ff00ff', '#1e90ff',
                 '#f0e68c', '#dda0dd', '#ff1493', '#f8766d')
col_vector_S <- c('#00BFC4', '#F8766D')
col_vector_R <- c('red', 'green', 'blue')

# Single
plot(as.phylo(All_list[[1]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, no.margin = T)

# Complete
plot(as.phylo(All_list[[2]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, no.margin = T)
plot(as.phylo(All_list[[2]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, tip.col = col_vector_S[Sectors],
no.margin = T)
plot(as.phylo(All_list[[2]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, tip.col = col_vector_C[Countries],
no.margin = T)
legend('bottomleft', legend = c('Austria', 'Brazil', 'Canada', 'Chile', 'China', 'Colombia',
                               'Finland', 'Germany', 'India', 'Italy', 'Japan', 'Netherlands',
                               'Norway', 'Poland', 'Russia', 'South Korea', 'Spain', 'Sweden',
                               'Switzerland', 'Taiwan', 'Thailand', 'Turkey', 'UK', 'USA'), ncol = 2, fill = col_vector_C)

# UPGMA
plot(as.phylo(All_list[[3]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, no.margin = T)

# WPGMA
plot(as.phylo(All_list[[4]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, no.margin = T)
plot(as.phylo(All_list[[4]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, tip.color = col_vector_S[Sectors],
no.margin = T)
plot(as.phylo(All_list[[4]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, tip.color =
col_vector_C[Countries], no.margin = T)
legend('bottomleft', legend = c('Austria', 'Brazil', 'Canada', 'Chile', 'China', 'Colombia',
                               'Finland', 'Germany', 'India', 'Italy', 'Japan', 'Netherlands',
                               'Norway', 'Poland', 'Russia', 'South Korea', 'Spain', 'Sweden',
                               'Switzerland', 'Taiwan', 'Thailand', 'Turkey', 'UK', 'USA'), ncol = 2, fill = col_vector_C)

# UPGMC
plot(as.phylo(All_list[[5]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, no.margin = T)

```

```

# WPGMC
plot(as.phylo(All_list[[6]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, no.margin = T)

# Ward's
plot(as.phylo(All_list[[7]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, no.margin = T)
plot(as.phylo(All_list[[7]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, tip.color = col_vector_S[Sectors],
no.margin = T)
plot(as.phylo(All_list[[7]]), type = 'unrooted', lab4ut = 'a', cex = 0.5, tip.color =
col_vector_C[Countries], no.margin = F)
legend('bottomleft', legend = c('Austria', 'Brazil', 'Canada', 'Chile', 'China', 'Colombia',
'Finland', 'Germany', 'India', 'Italy', 'Japan', 'Netherlands',
'Norway', 'Poland', 'Russia', 'South Korea', 'Spain', 'Sweden',
'Switzerland', 'Taiwan', 'Thailand', 'Turkey', 'UK', 'USA'), ncol = 2, fill = col_vector_C)

# Identifying common clusters
complete <- as.dendrogram(All_list[[2]])
WPGMA <- as.dendrogram(All_list[[4]])
ward <- as.dendrogram(All_list[[7]])
dendlist(ward, complete) %>%
  tanglegram(highlight_distinct_edges = FALSE, # Turn-off dashed lines
  common_subtrees_color_lines = TRUE,
  common_subtrees_color_branches = TRUE,
  main_left = "Ward's Method", main_right = 'Complete Linkage',
  axes=F, columns_width=c(2,2,2), margin_inner = 8,
  dLeaf = 0.2, lwd = 2)
dendlist(ward, WPGMA) %>%
  tanglegram(highlight_distinct_edges = FALSE, # Turn-off dashed lines
  common_subtrees_color_lines = TRUE,
  common_subtrees_color_branches = TRUE,
  main_left = "Ward's Method", main_right = 'WPGMA',
  axes=F, columns_width=c(2,2,2), margin_inner = 8,
  dLeaf = 0.2, lwd = 2)
dendlist(complete, WPGMA) %>%
  tanglegram(highlight_distinct_edges = FALSE, # Turn-off dashed lines
  common_subtrees_color_lines = TRUE,
  common_subtrees_color_branches = TRUE,
  main_left = "Complete Linkage", main_right = 'WPGMA',
  axes=F, columns_width=c(2,2,2), margin_inner = 8,
  dLeaf = 0.2, lwd = 2)

```

Appendix 2 – Ethics Application

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ICREC - SETREC APPLICATION FORM

Part 1 (to be completed by all)

Section 1: Details of Principal Investigator	
For all projects the Principal Investigator (PI) must be employed by Imperial College London or hold an honorary contract. For all student projects, the student's supervisor must be named as PI. Student, co-investigator and collaborator details must be added to Section 14.	
1. Name (incl. title)	Dr Mike Tennant
2. Position (at Imperial College London)	Principal Teaching Fellow
3. Faculty	Natural Sciences
4. Division/ School/ Department	Centre for Environmental Policy
5. Email <i>Imperial College email</i>	m.tennant@imperial.ac.uk
7. Summary of skills (experience relevant to the study and in any procedures to be used) <i>(350 characters max)</i>	Dr Tennant is an experienced researcher in the field of corporate sustainability and has supervised many students in this area.

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Section 2: Research type	<ol style="list-style-type: none"> 1. Are you conducting research? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> 2. Are you conducting a service evaluation, audit or public involvement? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> 3. Does your study only involve analysis of secondary data which is publicly available, and permission is not required to access the data? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
<p>If you answered no to question 1 and yes to questions 2 or 3, your study does not need ethics approval and you will need to complete this form but not the other ethics documentation.</p>	

Section 3: Filter for ICREC and SETREC	<ol style="list-style-type: none"> 1. Is the primary aim of the research answering a human health related question? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> 2. Is the primary aim of the research answering a non-health related science, social science, engineering or technology related question? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> 3. Is the primary aim of the research to answer an educational question? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
<p>If you answered yes to question 3 your ethics application needs to be submitted to the Education Ethics Review Process (EERP) using their forms. https://www.imperial.ac.uk/research-and-innovation/support-for-staff/education-ethics/how-to-apply/</p>	

<p>Section 4: Risk level categorisation</p> <p>This section determines the research risk level and if the application requires full committee review.</p>	<p>a) Does the research involve drugs/medication? <i>If yes, please attach the SmPc.</i> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>b) Does the research involve genetically modified materials? <i>If yes, please also complete appendix two and attach the GM Safety Committee letter.</i> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>c) Will you be recruiting vulnerable participants? i.e. children (15 years or younger), adults (16 years or over) who are unable to consent, people in care, the mentally ill or individuals with learning difficulties? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>d) Will participants take part in the study without their explicit consent? i.e. studies involving deception. Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>e) Will you be recruiting prisoners or young offenders? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>f) Is there any aspect of the proposed research which could potentially cause harm to the reputation of the College? i.e. could the research be considered controversial or prejudiced? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>g) Could participants disclose any illegal or harmful activity due to the nature of the research? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>h) Will personally sensitive subjects be discussed that have the potential to induce stress, anxiety or negative consequences for the participant? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>i) Will the researcher be in a position of influence or authority over the participants that could give rise to a perceived pressure to participate? i.e. lecturers/teachers and students. Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p>
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<p>Section 4: Continued</p> <p>Risk level categorisation</p> <p>This section determines the research risk level and if the application requires full committee review.</p> <p>Meeting dates and submission deadlines ICREC/SETREC.</p>	<p>j) Does the study involve physically intrusive procedures, administration of substances, use of bodily fluids, tissues, DNA or RNA? <i>Use of relevant material must be registered with Imperial College Tissue Bank under the College HTA license.</i> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>k) Does the study involve ultrasound or sources of non-ionizing radiation? i.e. radiation, MRI, or fMRI. Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>l) Are there any potential conflicts of interest, or what could be perceived by an outside observer as conflicts of interest? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>m) Will undue incentives for participants be offered? Incentives should be proportionate to the burden imposed and justified by the benefits. Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>n) Are you using any medical device in the UK that is CE/UKCA marked but is being used outside its product limitation? Or are you using any non-CE/non-UKCA marked product(s)? <i>For more information on regulating medical devices.</i> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>o) Does the proposed research raise any ethical issues that are not covered above? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p>
<p>If you answered YES TO ANY of the questions a) to o), your study is considered high risk and you must complete the entire application, parts 2, 3 and 4 of this form. If you answered NO TO ALL the questions above, your study is considered low risk. Complete parts 2 and 4, skipping part 3.</p>	

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Part 2 (to be completed by all)

Section 5: Project Description	
1. Full title of study	Understanding corporate sustainability transition through the lens of operational activities
2. P code or cost code and study funder (only if applicable to study)	N/A
3. Lead organisation (who has overall responsibility for the study)	Centre for Environmental Policy, Imperial College London
4. List of location(s) where study will be conducted	UK
5. Proposed start date <i>From start of advertising and/or recruitment</i>	4 th June 2021
6. Proposed end date <i>To end of data collection</i>	8 th September 2021

Section 6: Project Summary
Provide a summary of the project in lay terms : a brief description of reasons for doing the study, the aims, how data will be disseminated and any expected benefits to the participant, researchers or others. (500 words max)
<p>The project seeks to contribute to understanding how firms transition towards sustainability by analysing patterns in their self-reported sustainability-related behaviours (“operational activities”). The project aims to discover if firms tend to behave in similar ways with regards to operational activities over time. If they do, how many types of patterns are there? The causes of any diversity in pattern types will then be discussed: for example, do firms from the same sector tend to behave in a similar way? Finally, the implications for effective management of sustainability transition, given the observed evidence, will be discussed. The project will use the GOLDEN dataset, utilised and managed by the Leonardo Centre at Imperial College Business School. The GOLDEN dataset is a unique collection of some five million sustainability initiatives reported by 13,000 firms,</p>

created by utilising a set of text analysis and natural language processing algorithms.

There are no expected benefits to the researcher.

Section 7: Research Methods

What methods will you be using in this study? Briefly describe in lay terms: what will happen, the number of times and any data collection techniques. (500 words max)

The data utilised in this study has already been collected, by GOLDEN. The method used in this study is a type of time series clustering method. An unsupervised algorithm dynamically tries to find the optimal alignment between two time series, effectively giving a measure of the similarity of their shape. Pairwise running of this algorithm for every time series in the data set gives a measure of the similarity of any given time series to every other. This allows for the building of a tree diagram that represents more or less similar patterns and groups of patterns. Certain descriptive aspects of firms, such as sector or location, are available within the dataset which can be used to statistically test the results. Other factors, such as the well-theorised-upon drivers of corporate sustainability integration, lack data (nor would it be feasible to collect such data), thus will be used to interpret the clusters and the patterns displayed by the firms within them.

Section 8: Participant Recruitment

Provide details of methods of recruitment, participant inclusion and exclusion criteria and the number of participants you are aiming to recruit. Include details of any incentives (such as financial reimbursement). (500 words max)

Attach as separate documents (if applicable):

- Recruitment and advertising material (email, poster, social media advert)
- Oral information scripts

N/A

Section 9: Informed Consent

Include details of how you will be obtaining consent.

- i. Detail the process for ensuring informed consent of all research participants.
- ii. The withdrawal process(es).
- iii. If vulnerable persons are to be used in the study, give separate specific information on how you will ensure consent.
- iv. If participants whose first language is not English are to be recruited, state clearly how the details of the study will be explained, and the consent processed.

N/A

Section 10: Ethical Summary

Has any part of this proposal received prior ethics approval?

Yes No

Is this study subject to local ethics approval?

Yes No

If yes, list all local approvals required.

If yes or if rejected, please give details and attach any relevant documents.
(150 words max)

Provide details of what you consider to be the ethical issues surrounding this project: your own physical safety, COVID-19 safety measures, data protection/ confidentiality and how you have addressed this. Include details if you will inform participants of the results. If the study is of a sensitive nature include information regarding signposting to relevant support groups.

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If you answered yes to any questions in section 3, please provide specific information on those ethical issues and how they will be mitigated. Detail any PPI undertaken as part of study set up or design.

(500 words max)

This project presents no greater threats to physical safety or COVID-19 exposure than day-to-day life as it is a desk-based project, thus common practices (compliant with the current UK government guidelines) will be followed. The primary ethical issue faced by this project is the use of the GOLDEN dataset, access to which is contingent on the signature of a non-disclosure agreement. This NDA prohibits the sharing of any raw data from the dataset and possession of any raw data beyond the agreed study time limits, ending 8th September. Following the terms of the NDA, in order to protect the dataset all work will be held only on a laptop and backed up to Office 365, which are both password-protected and only accessible to Benjamin Stimpson. At no point will raw data be shared with anyone outside the project and all data will be deleted from both these locations on the 8th September 2021.

Section 11: Documentation checklist

Mark as either Yes/
No/ In process

- a. Do Imperial College' insurers need to be notified about your project?

If your project is running abroad and is not qualitative or data only, or if your project is interventional and involves pregnant women, children under 5 or more than 5000 participants you may need additional insurance cover. [Insurance for studies](#), email the [insurance team](#) with any insurance enquiries.

If yes, please provide confirmation that insurance cover has been agreed.

Yes No In process

- b. Has your research project been independently peer reviewed?

This can be organised by the [Peer Review Office](#) (within the RGIT). If you answered yes to any questions in section 3, you may be asked to ensure the study is peer reviewed. However, the study does not have to use the RGIT's office for peer review.

Yes No In process

- c. Are you developing a mobile app?

See the [mobile app webpage](#) for more information.

Yes No In process

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	<p>d. Have you had a Disclosure and Barring Service (DBS) check carried out? If yes, when (add date). For more information about DBS, check government guidance and the College website. Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> In process <input type="checkbox"/></p> <p>e. Do you need a contractual agreement in place? For further information, please contact your faculty research service. Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> In process <input type="checkbox"/></p> <p>f. Do you have permissions to use the data in your study? This may be required if you are looking at secondary data. Yes <input type="checkbox"/> No <input type="checkbox"/> In process <input checked="" type="checkbox"/></p> <p>g. Has Imperial College's Risk Assessment procedure been followed? Contact your departmental administrator for further information. Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> In process <input type="checkbox"/></p>
--	--

<p>Section 12: Confidentiality and management of personal and other research data</p>	<p>a. I understand it is the responsibility of the researcher to ensure all research data is securely stored during and after the study in accordance with College Guidelines, Codes of Practice, Policies and Procedures. Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p> <p>b. I confirm that all the processing of personal information related to the study will be in full compliance with the GDPR. Including but not limited to, the creation of all necessary documentation (PIS, Data Protection Impact Assessments, Consent forms etc.) Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p>
--	--

Part 3 (only to be completed if **yes** was answered to any question in section 4)

<p>Section 13: Mitigation of Risks and Safeguarding</p>
<p>Explain the precautions taken to protect the health and safety of researchers, participants and others associated with the project.</p> <p>You need to safeguard the wellbeing and safety of children and adults at risk involved in research activities. Safeguarding means taking all reasonable steps to prevent harm,</p>

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<p>exploitation, and abuse from occurring; protecting people, especially adults 'at risk' and children, from that harm; and responding appropriately when harm does occur.</p> <ul style="list-style-type: none"> • Explain what information you have on the potential harms this research can address or exacerbate for researchers, participants and wider communities. • Explain how you are building the rights of potential or actual victims/ survivors of safeguarding incidents into the research design, including questions and methodology, to ensure respect, dignity and safety. <p>Visit the website for more information on safeguarding for research. (500 words max)</p>
N/A
<ul style="list-style-type: none"> • I will ensure that access to (community-based – for studies outside of the UK) complaint mechanisms to raise safeguarding concerns are built into the programme design and are discussed and explained with participants. Yes <input type="checkbox"/> No <input type="checkbox"/> • I am willing to modify or even cancel planned research if potential harm to researchers, participants or communities is too great. Yes <input type="checkbox"/> No <input type="checkbox"/> • I will ensure that we and our research partners reach a shared understanding of safeguarding Yes <input type="checkbox"/> No <input type="checkbox"/>

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Part 4 (to be completed by all)

Section 14: Co-investigators/ Collaborators

If there are more than four co-investigators, please use a separate sheet and follow the format below.

1. Name	Benjamin Stimpson
2. Position <i>Incl. organisation, company, institution</i>	Student, MSc Environmental Technology, Imperial College London
3. Role in the study <i>(what contributions you will make and relevant experience)</i>	Student researcher – will conduct research and write manuscript
4. Email <i>Work not personal</i>	Benjamin.stimpson20@imperial.ac.uk

1. Name	Rossella Arcucci
2. Position <i>Incl. organisation, company, institution</i>	Research Fellow, Department of Computing & Leonardo Centre, Imperial College London
3. Role in the study <i>(what contributions you will make and relevant experience)</i>	Co-supervisor. Member of the Leonardo Centre and experienced researcher in data science
4. Email <i>Work not personal</i>	r.arcucci@imperial.ac.uk

1. Name	
2. Position <i>Incl. organisation, company, institution</i>	
3. Role in the study <i>(what contributions you will make and relevant experience)</i>	
4. Email <i>Work not personal</i>	


1. Name	
2. Position <i>Incl. organisation, company, institution</i>	
3. Role in the study <i>(what contributions you will make and relevant experience)</i>	
4. Email <i>Work not personal</i>	

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Signatures Page - PI Declaration

I declare that:

- I undertake to abide by the ethical principles underlying the Declaration of Helsinki (1964) and subsequent amendments and good practice guidelines on the proper conduct of research.
- I undertake to abide by the Data Protection Act 2018 and General Data Protection Regulation (Europe) and any applicable local laws.
- I undertake to abide by all local laws and regulations for non-UK research.
- I will report any adverse or unforeseen events or protocol violations and deviations which occur to the Ethics and Research Governance Co-ordinator within 24 hours.
- I will provide an [annual progress report](#) of the project until the end of the study.
- If I register my study on a public database, i.e. ClinicalTrials.gov, I will report results on that database within one year of study completion.
- I will provide [notification of the end or early termination of](#) the research project.
- I will provide [notification of amendment](#) to ICREC/SETREC if there are any changes to the research protocol or personnel which affect the ethical aspects of the project.
- I will assist ICREC/SETREC in any continuing review of the project deemed necessary by the Committee or Faculty Members.
- All information on this form is correct.

PI Name	Mike Tennant	
PI Signature		Date 25/05/2021
If full committee review is required would you be willing to attend the ICREC/SETREC meeting to answer any questions about your proposal?	Yes	

Any attendance must be by the PI named in section four. Attendance at the meeting will give you the opportunity to answer any ethics questions raised by the committee.

Head of Department (please indicate below your decision and the reasons for it)			
Decision		Referral to Committee	
Reason			
Signature		Date	
Name			