



Climate change reporting: What do we know about its determinants and capital market consequences?

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Key findings



1. Context of the project

All literature reviewed was published between 2016 and September 2022. Given the lag in the publication process of academic papers, most of these studies use data from the periods between 2008 and 2016, with the latest year covered being 2020. As a result, the studies reviewed drew their samples mostly from voluntary reporting settings that allowed companies to engage with relevant climate change disclosures while exercising discretion as to the depth and length of these disclosures.

2. Firms provided voluntary disclosures of low or, at best, moderate quality

Many companies were not disclosing key information related to scenario analysis, financial-related disclosures or the volume of their carbon emissions. Further, although unsurprising given the period of the data reviewed, they tended to remain silent over important issues such as their endeavours towards a net zero carbon economy, the amount of their potentially stranded assets and their response to environmental scandals. However, climate change reporting quality was improving over time.

3. Companies with specific governance characteristics exhibited higher quality of voluntary reporting

Having more gender- and ethnic-diversified boards was associated with better climate change reporting quality. However, no evidence was reported in support of directors' age or length of tenure being associated with climate change reporting practices.

4. Companies' country of domicile was associated with disclosure quality

The higher a country's environmental performance, the better the quality of climate change reporting by firms being domiciled in that country, and the higher the likelihood of those firms choosing to have their reporting assured by third party providers. Similarly, the stronger the public pressure and media exposure (especially negative), and employee and customer pressure faced by firms, the better quality their climate change reporting is. However, some evidence exists that firms in specific industries tend to demonstrate mimicking behaviours of reporting practices across countries.

5. Capital market participants perceived high levels of emissions as a risk

Evidence in capital markets literature indicated that the higher a listed firm's level of carbon emissions is, the lower its share price. The same association is found between firms' levels of carbon emissions and share price return. Additionally, firms with higher carbon emissions are found to face higher cost of debt.

6. Regulation and capital market consequences of climate change reporting

New regulation appears to strengthen the association between capital market outcomes (e.g., cost of debt, cost of equity capital, share price returns) and climate change reporting (i.e., firm specific information), indicative of regulation enhancing the information environment of listed companies in a capital market.

7. The importance of corporate governance

The review highlights encouraging evidence for companies to develop relevant corporate governance mechanisms (for instance, through the appointment of more independent directors), to adopt a more integrated thinking approach for their operations, and to actively include their shareholders/stakeholders in their sustainability and climate change-related activities.

8. Sustainability assurance

Scope exists for audit firms to expand their sustainability assurance activities, particularly for companies in low rule of law countries where companies more frequently seek to have their climate change-related disclosures assured, choosing audit firms as their assurance provider.

9. Financial vs. double materiality

On reflection of the findings of this review, we concur that the quality of climate change reporting may be jeopardised if companies solely focus on financial materiality. Hence, we welcome the recent endeavours of the IFRS Foundation for developing interoperability guidelines between IFRS-S and GRI Standards as well as between IFRS-S and ESRS for preparers and users of climate change reporting.



Foreword

The landscape of sustainability reporting in general, and climate reporting in particular, continues to evolve rapidly, both in the UK and internationally.

In the UK, the government is working to establish the UK Sustainability Reporting Standards (UK SRS) by assessing the suitability for endorsement in the UK of the two new standards issued by the International Sustainability Standards Board (ISSB). This initiative aims to enhance transparency and comparability in corporate sustainability disclosures, helping investors make informed decisions.

Internationally, the adoption of the ISSB's standards, such as IFRS S1 and IFRS S2, is gaining momentum, providing a unified framework for climate-related disclosures, with more standards on other topics on the way.

Understanding of the importance of climate governance is increasing. With that, expectations of improved climate reporting and disclosures are growing, driven by regulatory pressure, compliance concerns and stakeholder demand.

However, the degree of change within this area of regulation, made arguably more complicated by variances between regions in both the nature of requirements and pace of adoption, presents many challenges. At a time when the global economic environment is challenging, businesses must navigate a complex and dynamic reporting environment, balancing compliance costs and short-term performance pressures with the longer-term benefits of energy transition and sustainability transparency.

A question therefore arises as to the degree to which climate change reporting practice is compliance-driven as opposed to being designed to support longer-term opportunities such as improved risk management, investment attraction and market competitiveness.

This literature review from Diogenis Baboukardos, Evangelos Seretis and Ioannis Tsalavoutas aims to summarise and synthesise recent academic evidence on the topic, asking:

- what are the drivers of climate reporting and of its quality, and
- what is the evidence of the effect of climate reporting on various capital market outcomes (such as cost of debt, cost of equity capital, share price returns).

Given the timescales inherent in the performance and subsequent publication of academic work, most of the literature reviewed was based on historical data originated between 2008 and 2022. This was a period when companies principally engaged in voluntary reporting with discretion as to the depth and length of disclosures. Reporting practices and regulations have, clearly, moved on. Nevertheless, this review sets out findings and practical recommendations which continue to be relevant to the role of firm-level corporate governance and our understanding of environmental and stakeholder characteristics, cross-country differences and the critical role of regulation and assurance in ensuring trusted, relevant and transparent reporting.

James Baird

Chair of the Research Panel
February 2025

Executive summary

Motivation and purpose of the report

Various stakeholder and investor groups are putting pressure on firms to identify and report the risks and opportunities associated with the economic, ecological and social implications of climate change. During the last two decades, there has been a significant increase in the number of different types of reporting frameworks globally that relate to sustainability matters, covering topics such as climate change, emissions, pollution, water management, governance, and the wider context of their social responsibility. Ultimately, the combination of being pressured by different stakeholder groups for different types of information and variety of reporting frameworks has led to varying levels of quality of climate change reporting across firms. In response to this, there have been calls and significant initiatives from regulators and other institutional actors for a more consistent and coherent approach to reporting around climate change.

Based on the above, it has become apparent that climate change reporting will gain more prominence in the coming years. Thus, it is pertinent to explore recent evidence on the key drivers of related reporting quality. This will inform various actors (such as regulators, preparers, stakeholders, and investors) in the further development, implementation, regulation and use of climate change reporting. Further, climate change reporting standard setters (primarily the International Sustainability Standards Board (ISSB)) place significant emphasis on the interconnectedness between financial and climate change reporting and its relevance for investors' valuation perspectives, as well as the measurement of the financial costs and impact of transition and climate actions. A second question that arises, therefore, is what the evidence on the effect of climate change reporting on various capital market outcomes currently is.

Against this backdrop, this literature review aims at summarising and synthesising the most recent academic evidence on the topic of climate change reporting. Specifically, this report synthesises the related academic literature and brings into light recent evidence as to what we know about:

- a) companies' climate change reporting practices
- b) determinants of climate change reporting practice
- c) capital market consequences of climate change reporting practice.

Providing insights around these areas helps meeting the objective of this literature review, which is to serve as a useful reference to ICAS and its members for:

- a) influencing policy making
- b) supporting members to develop best practices of climate change reporting
- c) informing calls for future research on this area.

Mindful of these aims and objectives, this report attempts to provide a synthesis of the related recent literature on climate change reporting in a manner useful to a wider audience than only academic interests. Thus, in addition to collating and reporting evidence on the role of firm-level corporate governance, environmental and stakeholder characteristics, and cross-country differences, the review also puts an emphasis on the role of regulation and assurance. These two topics can be seen of particular importance for climate change reporting practice (as documented in the recent ICAS response to the Department of Business and Trade on its call for evidence on non-financial reporting; ICAS, 2023).

Method

For meeting the review objectives, we apply a systematic literature review. The review is based on 75 English-written, peer-reviewed articles published in accounting and other business-related academic journals, widely accepted as the most influential journals in their fields, between January 2016 and September 2022. Studies reviewed are grouped in the following three categories:

- 1) Descriptive studies of the climate change reporting quality
- 2) Determinants of climate change related reporting
- 3) Capital market consequences of climate change related reporting.

Given the length of the peer-review process of academic papers, most of the studies reviewed use data from the periods between 2008 and 2016, with the latest year covered being 2020. As a result, the studies drew their samples mostly from voluntary reporting settings that allowed companies to engage with relevant climate change disclosures while exercising discretion as to the depth and length of these disclosures. Moreover, during the underlying periods that have been studied, climate change was not as high in businesses' and governments' agendas as it is today. Hence, companies were not under strong regulatory and market forces to disclose extensively on climate change-related matters. It is against this backdrop that the findings of the review need to be considered.

Key findings

1. Many companies were not disclosing key information related to scenario analysis and financial-related disclosures or the volume of their carbon emissions (primarily their Scope 2 and Scope 3 emissions).
2. Although perhaps not surprising, given the period of the data reviewed, firms tended to remain silent over important issues such as their endeavours towards a net zero carbon economy, the amount of their potentially stranded assets and their response to environmental scandals they were involved in.
3. Climate change reporting quality has improved over time and the audit of financial-related climate change disclosures seems to contribute positively to bringing to light misleading and false reporting.
4. Firms with gender- and ethnic-diversified boards are associated with better climate change reporting quality. However, no evidence is found to support that a director's age or length of tenure relate to climate change reporting practice.
5. Firms with high volumes of carbon emissions disclose more information related to climate change. At the same time, there is some limited evidence that firms with superior environmental performance exhibit better climate change reporting as well.
6. Overall, the country in which a firm resides is a key influence in climate change reporting: firms based in countries with superior environmental/climate change performance exhibit better climate change reporting quality. In a similar vein, a country's environmental performance is found to be positively associated with a firm's decision to have their climate change disclosures assured by a third party. Companies that reside in low rule of law countries seek to have their climate change-related disclosures assured more often and they are likely to choose an audit firm as the assurance provider. However, there has been some evidence that firms in specific industries tend to demonstrate mimicking behaviours of reporting practices across countries.

7. Firms that face strong public pressure, high media exposure (especially negative) and high employee and customer pressure are found to exhibit better climate change reporting quality.
8. All studies examining the role of emissions' trading schemes/systems provide evidence of a positive association between participation in such schemes and climate change reporting quality.
9. Most studies suggest that climate change-related regulatory frameworks have a positive effect on climate change reporting quality. Nevertheless, a smaller number of studies do not find such association. Hence, evidence in this field of inquiry is arguably inconclusive.
10. The literature has rarely engaged in capturing actual levels of related climate disclosures and testing their association with capital market outcomes. In fact, the limited related evidence is mixed and thus inconclusive.
11. Almost universally, there is a negative (positive) association between carbon emissions and firm value or returns (cost of debt capital). However, there is lack of evidence on the role of climate change reporting quality on information risk and asymmetry proxies (e.g. liquidity and volatility).
12. The literature also reports a positive association between responding to the CDP and cost of debt proxies. This could mean that participating in the survey is a signal of more perceived risks.
13. New regulation appears to strengthen the association between capital market outcomes and climate change reporting, indicative of regulation assisting how the market reflects on climate change reporting.

Practical implications, recommendations, and suggestions for future research

- The findings can be encouraging evidence for companies to develop relevant corporate governance mechanisms (e.g. through the appointment of more gender- and ethnic-diversified boards), to adopt a more integrated approach in thinking about their operations, and to actively include their shareholders/stakeholders in their sustainability and climate change-related activities.
- The finding that firms are more likely to decide to have their climate change reporting assured if they reside in a low rule of law country suggests that there is a scope for audit firms to expand their activities in such institutional environments.
- Low quality of climate change reporting arguably limits the capacity of users to draw reliable inferences and make informed decisions over a firm's performance on climate change-related matters. Users may need to be more vigilant when they use climate change information provided by firms that engage less with their stakeholders/shareholders in their climate change-related activities.
- Regulation of climate change reporting appears to have positive effects on its quality. The findings support calls for the standardisation of climate change reporting.

- Our review reveals that stakeholders play a central role on the production of high-quality climate change reporting. Consequently, we suggest that a one-dimensional financial focus on climate change reporting may create informational ‘voids’ for users of climate change reporting. Regulators need to address this issue and identify appropriate ways to reconcile information needs of financial and non-financial stakeholders.
- The various climate change reporting standards currently in place may lead to a ‘multiverse’ of reporting regulation. Although this ‘reporting standards competition’ may have beneficial impact on the further development of standards, we urge regulators to consult the findings of our study, which highlight the differences in climate change reporting practices across countries.
- Future research should first attempt to capture the actual disclosures provided by firms in a systematic way, thus offering more refined and comprehensive metrics of climate change reporting. Second, future research could explore the role of environmental committees (and similar board activities), shareholder activism and integrated thinking within firms. Third, we urge future research to provide evidence on capital markets’ use of climate change related disclosures to assess firms’ risk and cost of capital, for which there is scarce evidence. Fourth, the review calls for investigation into the roles of regulation and assurance in enhancing the credibility and impact of climate change reporting on capital markets, highlighting the need for empirical evidence to guide improvements in reporting practices and policies.

1. Background and objectives

1.1 Motivation: stakeholder pressure and emerging reporting frameworks

Companies are facing an increasing pressure from various stakeholder and investor groups to take actions that mitigate the effects of climate change and transition to net zero. The year 2019 can be seen as a landmark year for climate change activism (Coppola and Blohmke, 2019) and the starting point, therefore, of a period of intense pressure for firms. Millions of people took to the streets worldwide to demonstrate their strong concerns over the climate change crisis (Watts et al., 2019). Since then, these concerns have become stronger and stronger. For example, according to a 2022 Pew Research Centre survey, three quarters of people in 19 developed countries across the world identify climate change as the top threat for their country (Poushter et al., 2022).

Investors are also key vocal stakeholder groups who engage in actions about climate change at a growing pace. For instance, the Climate Action 100+, an investor-led initiative that represents more than 700 investors with a total assets value of US\$68 trillion, strives to push companies to make clear commitments to reduce their carbon emissions and improve their climate change-related financial disclosures.¹ Similarly, the UN-Convened Net-Zero Asset Owner Alliance, which is comprised of 86 institutional investors with over US\$9.5 trillion assets under management, is committed to helping the world limit global warming to 1.5°C (in line with the Paris Agreement), supporting other relevant initiatives, and reporting on these matters. In line with this, according to a 2020 review of the Global Sustainable Investment Alliance, global sustainable investment in five major markets (United States, Canada, Japan, Australasia and Europe) increased by 15% compared to the previous two years, reaching US\$35.3 trillion.

This increasing pressure on companies to mitigate their effects on climate change is also manifested in the growing numbers of climate change-related lawsuits against companies (Setzer and Higham, 2023). According to Setzer and Higham (2023), many of these cases have been filed by investors over concerns in relation to the effects of climate change issues and transition costs to a net-zero environment upon the market value of the companies they have invested in. They focus both on future issues (i.e. actions companies should take to align their activities with the goals of Paris Agreement) and past issues (i.e. actions companies have taken in the past that impacted climate change). Amongst others, these lawsuits include allegations about companies’ climate change reporting practices. For instance, in 2016, a securities class action was filed against Exxon Mobil. According to the shareholder who filed this, Exxon Mobil failed to disclose information about its internal assessment of transition risk and this failure led to lower share prices (Climate Change Litigation Database, 2016). In addition, the 2023 lawsuit against Shell by ClientEarth, an environmental NGO that is also a company shareholder, has shown the increasing pressure firms are facing and the multifaceted ways stakeholders find to push companies to act in a more environmentally friendly way (The Guardian, 2023).

That’s why investor collaboration is important, as suggested by Chris Hohn, founder and head of the US\$35 billion in assets hedge fund TCI Fund Management. *“It is critical that all investors now work together to combine the power of annual disclosure of actual emissions and a plan to manage those emissions with an AGM vote,”* he says (Gara, 2021).

At the same time, during the last two decades, there has been a significant increase in the number of different types of reporting frameworks globally that relate to sustainability matters. These cover topics such as climate change, emissions, pollution and water management, as well as the wider context of social responsibility and governance.

1. <https://www.climateaction100.org/>

This plethora of different reporting frameworks is the product of various stakeholders, including local authorities, standard setters or other global bodies that have different focuses, capacities and objectives. This has resulted in the existence of a ‘multiverse’ of sustainability reporting (Baboukardos et al., 2023). Ultimately, this has led to varying levels of de facto quality² of climate change reporting.

In response to this, there have been calls and significant initiatives from regulators and other institutional actors for more common and coherent approach to reporting around climate change. For example, IFAC (2019) calls for policy initiatives, consistent regulation, climate risk assessment, and high-quality disclosures that advance climate action. Further, the Glasgow Climate Pact 2021 called for “rigorous standards and disclosure, [which] are essential to ensuring the integrity of private sector net zero plans,” (United Nations, 2021, pg.21). Moreover, in October 2021, the UK Government confirmed it would make it mandatory for large companies to disclose information in alignment with the Task Force on Climate-Related Financial Disclosures (TCFD) Recommendations for accounting periods starting on or after 6 April 2022 (UK Government, 2021).³ Further, the formation of the International Sustainability Standards Board (ISSB) by the IFRS Foundation in November 2021 and the adoption of the European Union Corporate Sustainability Reporting Directive (EU CSRD) in November 2022 can be seen as the two most important endeavours for the convergence of sustainability reporting around the world. In relation to the former, the ISSB has built upon previous reporting standards by the Climate Disclosure Standards Board (CDSB), the TCFD Recommendations, the Value Reporting Foundation’s Integrated Reporting Framework, the industry-based SASB Standards, and the World Economic Forum’s Stakeholder Capitalism Metrics and released its first two standards (the IFRS S1 ‘General requirements for disclosure of sustainability-related financial information’ and the IFRS S2 ‘Climate-related disclosures’) in June 2023. In relation to the latter, in April 2022, the European Financial Reporting Advisory Group (EFRAG) released, as part of its European Sustainability Reporting Standards (ESRS), the Draft of ESRS E1 ‘Climate Change’. In 2023, the European Parliament adopted the revised CSRD proposed by the European Commission and companies based in EU member states will have to apply the Directive and ESRS for the first time in the 2024 financial year (for reports published in 2025).⁴ In parallel to these developments, heated debate is taking place in the US in relation to the Stock Exchange Commission’s (SEC) final rules to require registrants to disclose certain climate-related information in registration statements and annual reports (Vanderford, 2023; 2024).

Based on the above, it becomes apparent that climate change reporting will gain more prominence in the coming years. Considering that various stakeholder groups and investors alike have expressed the desire for more accurate, reliable and relevant climate change reporting – and the increasing importance of such reporting – it is pertinent to explore recent evidence on the key drivers of related reporting quality. This aims at informing various actors (such as regulators, preparers, investors and other stakeholders) in the further development, implementation, and use of climate change reporting. Further, climate change reporting standard setters (primarily the ISSB) place significant emphasis on the interconnectedness between financial and climate change reporting and its relevance for investors’ valuation. Hence, a second question that arises is what the evidence on the effect of climate change reporting on various capital market outcomes is?

2. Various definitions of ‘reporting quality’ have been given in the accounting literature (Beattie et al., 2004). By quality, in this review, we refer to both ‘objective’ quantitative metrics (e.g. number of disclosures) and ‘subjective’ qualitative metrics (e.g. assigning different ‘weight’ to each disclosure, based on its perceived importance). These metrics have been used in the literature we review.

3. In December 2024, the UK Sustainability Disclosure Technical Advisory Committee (TAC) has published its final recommendations to the UK government, recommending endorsing IFRS S1 and IFRS S2 for use in the UK with minor amendments (UK Sustainability Disclosure TAC, 2024).

4. In October 2023, ESRSs were integrated in the European legal framework. They are now officially the reporting standards to be adopted by European firms for complying with the CSRD.

1.2 Aims and objectives

In light of the above, this systematic literature review aims at summarising and synthesising the most recent academic evidence on the topic of climate change reporting in a concise manner. Specifically, the aim of the project is to synthesise the related literature and bring to light recent evidence as to what we know about:

- a) companies’ climate change reporting practices
- b) determinants of climate change reporting practices
- c) capital market consequences of climate change reporting practices.

Providing insights around these areas helps to meet the objective of this literature review, which is to serve as a useful reference to ICAS and its members for:

- a) influencing policy making
- b) supporting members to develop best practices in climate change reporting
- c) informing calls for future research in this area.

Specifically, as governments and capital market authorities are currently in the process of preparing and adopting new sustainability reporting regulations with a specific focus on climate change (e.g. ISSB, EFRAG and the European Commission, FRC), our literature review aims at enabling the ICAS’ various panels to contribute to relevant debates by providing policy recommendations. In addition, the mapping of the findings of prior literature is expected to reveal patterns on what drives good and bad reporting practices, as well as shed light on the capital market consequences of climate change reporting in different contexts. Such evidence is expected to be of help to ICAS members who are working in various corporate reporting stakeholder groups such as corporate reports preparers or assurance providers. These stakeholder groups shall gain insights useful for future practices of their organisations and their clients. Members working in the investment industry could gain insights for making more informed investment decisions. Finally, the ICAS Research Panel will be informed about gaps in the relevant literature and thus funding opportunities for future practice-relevant research.

Mindful of these aims and objectives, this report attempts to provide a synthesis of the recent literature on climate change reporting that appeals to more than an academic audience. Thus, in addition to collating and reporting evidence on the role of firm-level corporate governance, environmental, and stakeholder characteristics, on cross-country differences, as previous academic literature reviews do (Hahn et al, 2015; Borghei, 2021), the review has also put an emphasis on the role of assurance and regulation. These two topics are particularly important to climate change reporting practices, as documented in the recent ICAS response to the Department for Business and Trade on its call for evidence on non-financial reporting (ICAS, 2023).

The growing interest in climate change reporting has illuminated the need for enhanced reliability of such reporting through assurance. As early as October 2020, the International Auditing and Assurance Standards Board (IAASB) issued a staff audit practice alert that urges auditors to consider climate change risks when performing audits (IAASB, 2020) whereas in November 2024, it released its International Standard on Sustainability Assurance 5000 “General Requirements for Sustainability Assurance Engagements (IAASB, 2024)”.

Further the ESRS will require European firms to have their sustainability reporting verified by a third party with limited assurance. This literature review places particular emphasis on the determinants and capital market consequences of climate change reporting assurance.

In relation to regulation, there are mandatory reporting requirements such as the 2013 amendments of the 2006 Companies Act, which requires all companies listed on the London Stock Exchange to report their annual greenhouse gas (GHG) emissions in their director’s report, and national or international initiatives that focus on mitigating the risks of climate change (e.g. initiatives stemming from the 2015 Paris Agreement). Regarding the latter, countries bounded by such initiatives may exert

more pressure on companies to engage with activities (reporting included) to address climate change. As such, firms that fall into the scope of such agreements may behave differently than those that do not. This literature review identifies studies that examine such ‘structural breaks’ and discusses such evidence explicitly.

When reading findings of the studies reviewed, we urge readers to keep in mind that they refer to a time period when firms engaged primarily voluntarily with climate change reporting; businesses were not as alarmed in climate change issues as they are today, and the publication of the ESRS and ISSB standards had not taken place. Nevertheless, during this period we witness a significant increase in the number of studies focusing on climate change reporting. This is indicative of the growing interest in this research area. More importantly, as the analysis reveals, these studies provide useful insights over the quality of climate change reporting. This shall be of particular interest for standard setters, public authorities and users of such disclosures today.

1.3 Method and key findings

1.3.1 Method

To meet the review objectives, we apply a systematic literature review. This approach is chosen as it ensures the objectivity and comprehensiveness of the literature review (Fink 2014, Hanh et al., 2015). A systematic literature review results in an in-depth analysis of a defined body of literature, while also reflecting on multiple criteria related to the research design (e.g. the period under examination, research methods and research focus). The focus is not just on what the literature finds (Dumay, 2014; Guthrie & Parker, 2011; Guthrie et al., 2012). As such, descriptive analysis of the characteristics of the body of literature reviewed across the various criteria is an integral part of this type of review.

The review is based on 75 English-written, peer-reviewed articles published in accounting and other business-related academic journals widely accepted as the most influential journals in their fields (i.e. Economics, Ethics–Corporate Social Responsibility (CSR)-Management, Operations and Technology, Organizational Studies, Public Sector, Social Science and Strategy). To ensure that the review includes the most recent evidence in the literature that has not been reviewed by prior review studies (i.e. Borghei et al., 2021; Hahn et al., 2015), the review is focused on articles published between January 2016 and September 2022⁵. The initial focus of this report was the review of the literature over the determinants and capital market consequences of climate change reporting. After manually screening more than 370 articles that seemed potentially relevant for review, we identified a third category of studies relevant to the purpose of our report (i.e. descriptive studies of climate change reporting quality) and we grouped studies in the other two categories as follows:⁶

1) Determinants of climate change related reporting:

- Corporate governance characteristics (e.g. board diversity, board independence; environmental committee, ownership dispersion, institutional and family ownership)
- Sustainability-related characteristics (e.g. carbon performance, environmental policies, sustainability reporting)
- Country-level characteristics (e.g. environmental protection, legal system, culture)
- Stakeholder characteristics (e.g. public pressure, media exposure, employee pressure).

5. Hahn et al. (2015) review studies on the topic of ‘carbon accounting’ that were published between 2005 and February 2014. The study by Borghei (2021) uses bibliographic mapping for her review and hence it does not provide evidence of prior literature in a systematic and holistic way. For example, it reviews only seven studies on capital market consequences with six of those published prior to our review starting point (2016).

6. Given that the objective of the report is to review academic literature, we do not cover practice-relevant work such as the TCFD’s annual status reports. However, interested readers may visit the TCFD’s website to access these reports for additional reading: <https://www.fsb.org/publications/progress-reports/>.

2) Capital-market consequences of climate change related reporting:

- Equity valuation (e.g. share price returns, market value, Tobin-Q)
- Cost of capital (e.g. cost of equity, cost of debt)
- Information asymmetry (e.g. liquidity).

The review of these areas as covered in the literature is analysed in separate sections. Studies that tackle an issue from these categories in tandem with the role of assurance and/or regulations on climate change reporting, however, are grouped together and discussed in the respective sections.

1.3.2 Key findings

The review reveals that almost half (37) of the studies reviewed focus on what drives firms’ climate change reporting practice (i.e. falling into the Determinants category). The remaining half are almost equally split across the categories of Descriptive and Capital market consequences studies (18 and 21, respectively).

Studies in the Descriptive category report that firms’ climate change reporting quality was generally low or, at best, moderate in the periods examined. This indicates that many companies were not disclosing key information related to scenario analysis and financial-related disclosures and/or the volume of their carbon emissions (primarily their Scope 2 and Scope 3 emissions). Further, firms were not referring to the amount of their potentially stranded assets and their response to environmental scandals that they were involved in. At the same time, however, the related studies acknowledge that climate change reporting quality has been improving over time and that the audit supports more fulsome reporting due to the imposition of reporting in line with regulatory expectations. This is also evident when international agreements, such as the Paris Agreement, are introduced.

In relation to the findings of studies in the category Determinants, four themes emerge from the review, namely the firms’ corporate governance characteristics, sustainability characteristics, country of domicile characteristics, and stakeholder characteristics.

First, it emerges that companies with gender- and ethnic-diversified boards are associated with better climate change reporting quality. No evidence is found to support that directors’ age or length of tenure affect climate change reporting practice. Further, an interesting, and rather counter-intuitive, finding is that the presence of an environmental committee was not necessarily associated with better climate change reporting. As for the potential effect of ownership structure, only a handful of studies have examined it and hence, conclusive evidence cannot be drawn. This limited evidence suggests that the mitigation of agency problems (through managerial ownership) and percentage of institutional owners was associated with better climate change reporting. This is particularly the case when institutional owners were active in environmental-related matters.

As for sustainability characteristics, the most important and well-established finding in the literature is that firms with high volumes of carbon emissions disclose more information related to climate change. At the same time, however, there is some limited evidence that firms with superior environmental performance⁷ exhibit better climate change reporting as well. We observe evidence that firms that adopt an integrated approach in their operations (i.e., considering environmental and social impact of their operations) usually provide better climate change reporting. Further, our review reveals that firms’ carbon intensity and complex energy structure (proxied by the number of fuel types used) are associated with their decision to have their climate change disclosures assured by a third party.

7. Most of the studies reviewed use either the level of greenhouse gas emissions or composite measures of environmental performance as given by commercial databases, such as Eikon Refinitiv, as proxies of environmental performance.

Turning our attention to country characteristics, it appears that firms based in countries with superior environmental/climate change performance, exhibit better climate change reporting quality. In a similar vein, countries' environmental performance is found to drive firms' decision to have their climate change disclosures assured by a third party. Additionally, in line with the wider accounting literature (Leventis et al., 2023), some studies indicate cultural differences among countries drive firms to exhibit varying climate change reporting practices. The country in which a firm resides, therefore, is a key influential factor of climate change reporting.

Findings of the last theme within the category Determinants (i.e., stakeholder characteristics) show that firms that face strong public pressure, high media exposure (especially negative), and high employee and customer pressure are found to exhibit better climate change reporting quality.

When it comes to the role of regulation in climate change reporting, all studies examining the role of emissions' trading schemes/systems provide evidence of a positive association between participation in such schemes and climate change reporting quality. Further, a large part of the relevant literature finds climate change-related regulatory frameworks to have a positive effect on climate change reporting quality. Nevertheless, a smaller number of studies do not find such association and hence, arguably, evidence in this field of inquiry is inconclusive.

In relation to the last category of studies reviewed (i.e. Capital market consequences of climate change reporting), there are two areas where relatively consistent evidence is reported. Capital markets perceive high emissions as a risk factor and tend to penalise firms for that. Almost universally, there is a negative (positive) association between emissions and firm value or returns (cost of debt capital), while controlling for other factors that usually are associated with these market outcomes. Interestingly, the literature also reports a positive association between responding to the CDP survey and cost of debt proxies. This can be interpreted as an organisation's participation in the survey signalling more perceived risks (i.e. the act of participating is a flag of underlying risks). However, the literature has rarely engaged in capturing actual levels of related climate disclosures and testing their association with capital market outcomes. In fact, the limited related evidence is mixed and thus inconclusive. Actual disclosures are a more direct measure of communicating relevant information and, in sequence, alleviate or exacerbate investors' perceived risks.

When the literature explores whether these associations differ in the presence or introduction of new regulations related to climate change, the evidence is almost universal in concluding that such regulations do moderate these relationships. However, the direction of this moderation is not always consistent. Specifically, new regulation appears to strengthen the association between capital market outcomes and climate change reporting, indicative of assisting how the market reflects on climate change reporting.

Finally, in relation to the limited number of recent studies that examine capital market consequences of climate change reporting, while simultaneously considering the effect of assurance of such information and the perception of market participants about its role, the evidence is mixed and somewhat inconclusive.

1.4 Report outline

Chapter 2 describes the research design and method of analysis. Chapter 3 discusses the synthesis of the literature across the various themes of analysis. Chapter 4 concludes the report by outlining the practical implications and recommendations and suggest avenues for future research.

2. Method

We adopted a systematic literature review approach to illustrate the most 'state of the art' methods in recent climate change reporting academic literature (Paul et al., 2021). This approach "*encapsulates the process for assembling, arranging, and assessing existing literature in a review domain,*" according to Paul et al. (2021, p.2), effectively "*providing an audit trail of the reviewers' decisions, procedures and conclusions,*" (Tranfield et al., 2003, p. 209). This minimises the subjectivity involved in traditional narrative reviews and allows for greater validity and reliability (Tranfield et al., 2003; Massaro et al., 2016), which assist in replication and follow-up literature review studies (Tranfield et al., 2003).

As outlined by Fink (2014), Linnenluecke et al. (2020) and Tranfield et al. (2003), a systematic literature review effectively requires eight sequential steps. The details for the steps we followed are presented in Figure 1 and are outlined as follows.

The first step is the identification of the research objectives. As discussed in the introduction, the main purpose of our study is to review the most recent empirical studies on the quality, determinants, and capital market consequences in the climate change reporting literature.

In the second step, the target journals in which relevant literature will be searched from were identified. Considering that our purpose is to review sustainability reporting related studies and being informed by the previous literature reviews in this area (Borghei 2021; Hahn et al., 2015; Velte et al., 2020), we included in the journal list accounting journals and other outlets with significant contribution to the climate change reporting debate. Additionally, as is common in literature review studies (e.g. Cuomo et al., 2016; Leventis et al., 2023; Pugliese et al., 2009; Zattoni et al., 2020, 2023), to secure a critical mass of relevant papers and, to the best extent possible, the reliability of relevant academic inquiry, we started the selection of journals based on their ranking in the 2021 Academic Journal Guide by the Chartered Association of Business Schools in the UK (commonly known as CABS AJG list). In combination of these two criteria, we selected the 27 journals ranked as 3, 4 and 4* from the field of Accounting. Further, we included 12 journals ranked as 3, 4 and 4* from the fields of Economics, Ethics–CSR-Management, Operations and Technology, Organizational Studies, Public Sector, Social Science and Strategy and 19 journals which, although ranked lower in the CABS AJG list, have contributed substantially to this debate (e.g. European Management Journal; Journal of International Financial Management and Accounting; Sustainability Accounting, Management and Policy Journal). Appendix 1 provides the full list of the journals we covered.^{8,9}

In the third step, we identified the databases from which the relevant studies for review would be sourced. We used the Web of Science (WOS) database, provided by Thomson Reuters, as our main source because it provides extensive coverage of journals publishing articles in English. Second, as suggested by prior literature review studies (e.g. Ibrahim et al., 2022; Siddaway et al., 2019), to ensure that we cover all studies published in our target journals, we supplemented the search by using the EBSCO Business Source Premier. Finally, for the small number of journals that returned zero results in both databases, a separate search in journals' websites was conducted.

8. We acknowledge that journal rankings, as measures of research quality, have been widely criticised, especially when taken in isolation. While they may provide an indication of journal quality, they cannot always proxy for the quality of all articles published in the literature (see Tsalavoutas et al., 2020). However, our decision reflected the trade-off between the potential number of papers covered in the final review within a reasonable timeframe and their sufficient quality. Thus, we acknowledge that more papers might have been selected if some other reputable journal ranking list had been chosen (e.g. the Australian Business Deans Council Journal Quality List (ABDC)) or if we had extended the review to cover journals ranked in the categories of 2 or 1 in the CABS AJG list.

9. Overall, in addition to the accounting journals selected, we considered outlets with a substantial contribution to the climate change reporting debate. Journals from the finance domain were excluded as corresponding articles are mainly concerned with environmental/climate performance related issues, instead of reporting related issues. Indeed, prior literature reviews on the subject (e.g. Hahn et al., 2015; Borghei, 2021) have hardly identified relevant research papers in finance-related journals. However, we acknowledge that the exclusion of finance related journals poses a potential limitation in this study.

The search of relevant literature in our target journals was performed using climate change-related keywords. Hence, in the fourth step, we created a list of keywords that are commonly used in the climate change debate. To do so, we first conducted a frequency analysis of all words/phrases appeared in the 2017 TCFD Recommendations and the most recent GRI environmental-related standards (i.e. with code 300) using the MaxQDA software. Each member of the research team reviewed the list of words/phrases independently and created their own keyword list to be included in the study. Then, the three lists were compared and, after all discrepancies were resolved, the final list was constructed. Subsequently, all members of the research team performed an independent pilot keyword search in WOS and EBSCO Business Source Premier for a set of four journals to test that the search yields relevant results and to ensure that the collection of papers is made consistently. Based on this process, the final list of keywords was created. It included the following words, phrases and wildcards: 'carbon*' OR 'emission*' OR 'emit*' OR 'GHG' OR 'greenhouse*' OR 'climate*' OR 'CO2' OR 'Scope 1' OR 'Scope 2' OR 'Scope 3' OR 'Paris Agreement' OR 'Kyoto Protocol' OR 'TCFD' OR 'Task Force'. The list is similar to those used in previous reviews (Borghei et al., 2021; Hahn et al., 2015), though enhanced with keywords related to different categories of greenhouse gas emissions (GHG; e.g. 'Scope 1'), every potential variation of 'climate*', and keywords related to international agreements (e.g. Paris Agreement), allowing for a greater pool of potential papers for review. Subsequently, the keyword search was conducted in the paper title, abstract and author supplied keywords.

In the fifth step, we constructed the initial pool of articles potential for review. To ensure we reviewed the most recent evidence in the literature that had not been reviewed by prior review studies (i.e. Borghei et al., 2021; Hahn et al., (2015), we focused on the period between January 2016 and September 2022. A search for studies published until the end of September 2022 was performed in October 2022. The search resulted in 4,004 potentially relevant papers. Considering the timeframe and the journal selection, the number was relatively large; we attributed this to the broad meaning of some key terms (e.g., climate* and carbon*) and the inclusion of journals extensively examining issues around climate change or GHG emissions that do not relate to reporting aspects¹⁰.

The sixth step involved the screening of these potential articles and selecting those to be included in the review. As such, we first read the titles and abstracts of all these 4,004 articles and identified 371 papers that appeared potentially relevant to our review. Subsequently, the research team (including the research assistant) reviewed this set of papers; 296 articles were identified as irrelevant^{11,12}. Thus, 75 articles are included in the review. Appendix 2 lists the number of articles we review across different journals. From the 75 articles, 56 were published in journals ranked as 3* or higher, representing 74.67% of the sample under review. The majority of papers have been published in Business Strategy and the Environment (3*, 25.33%),¹³ followed by the Journal of Business Ethics (3*, 12%).

Step seven relates to the review of the articles by shedding light on their methodology and findings. The final step relates to the discussion of the practical implications and policy recommendations.

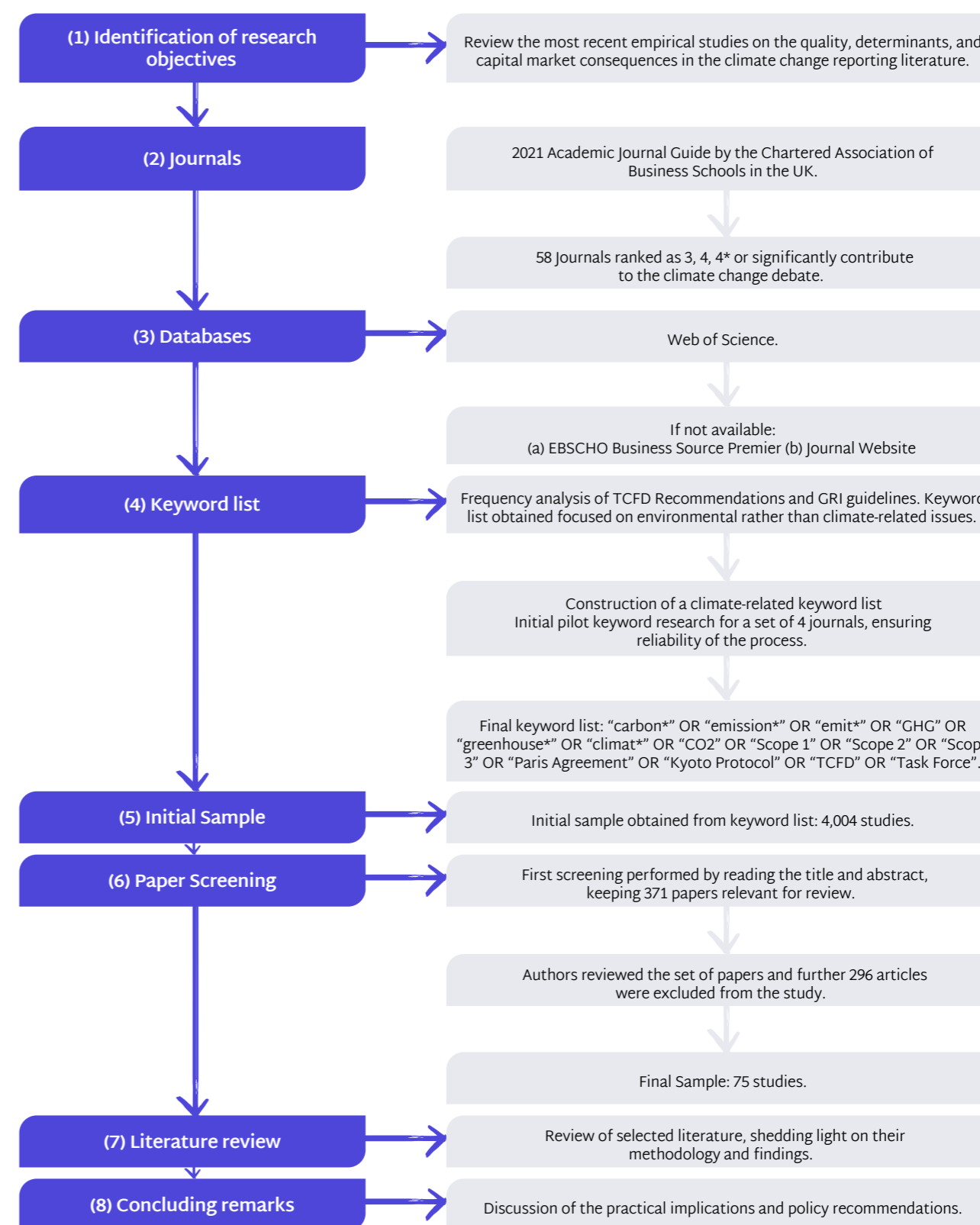
10. An illustrative example is the Energy Policy journal, which yielded a total of 1,895 studies, but only one study was included in the review.

11. Consistent with Fink (2014), divergence of opinions was resolved through discussion between the authors and the research assistant, ensuring the validity of the process.

12. The main reasons for exclusion are focus on firms' climate-related strategies, carbon abatement, carbon pricing and, primarily, carbon performance. Regarding the latter, most studies use carbon emissions as a proxy of carbon performance. This stream of literature is beyond the scope of reporting, which is the focus of our review. Further, conceptual papers that do not empirically examine climate change reporting are also excluded.

13. The number of papers reviewed from the journal Business, Strategy and the Environment is comparable with that in Hahn et al. (2015) and Borghei (2021). This is not surprising considering the journal's aim to advance the understanding of green business strategies.

Figure I. Methodological approach



3. Findings

In this chapter, we discuss the findings of the literature review. We start by giving an overview of the literature and how it has developed over the last six years we are examining (2016-2022). In section 3.2, we discuss studies that explore the quality of firms' climate change reporting in a descriptive and interpretive manner. In section 3.3, the studies that examine the determinants of climate change reporting quality are analysed. In section 3.4, we turn our attention to the capital market consequences of climate change reporting as evidenced by the literature. In the two final sections, 3.5 and 3.6, the role of assurance and regulation of climate change reporting as evidenced in the literature are discussed.

3.1 How the climate change reporting literature is developing

We begin the discussion of our findings by reporting in Table 1 the number of studies included in our review, divided across the three groups in which we categorised them based on their focus. The information in the table pinpoints the areas that have been over- or under- explored. It is noted that, out of the 75 studies reviewed, the study of Flammer et al. (2021) features in both categories of Determinants and Capital market consequences as it examines both aspects of climate change reporting.

During the review process and the allocation of the relevant studies across the two main categories (i.e., Determinants and Capital market consequences), we identified 18 studies that examine the issue of climate change reporting quality in a descriptive manner. As such we created a third corresponding category (i.e. Descriptive studies on quality of climate change disclosures) and discuss them separately. We elaborate on the findings of these studies in section 3.2 below. The category of Determinants of climate change reporting quality is the one with the larger number of studies under review (37/76). The determinants that this stream of literature explores are disaggregated across four themes: firm-level corporate governance characteristics (12 studies); firm-level sustainability-related features (10 studies); country-level influential factors (nine studies); and stakeholder characteristics (six studies). We discuss this stream of the literature in section 3.3. In the category of Capital market consequences of climate change reporting, we identify 21 studies that are disaggregated across three themes: equity valuation (11 studies); cost of capital (eight studies); and information asymmetry (two studies).

On reflection of other strands of the accounting literature that deal with voluntary or mandatory disclosures (Tsalavoutas et al., 2020), as well as information in prior literature reviews for this stream of literature (Borghei et al., 2021; Hahn et al., 2015), the proportion of studies we identify across each of the three categories (i.e., Descriptive, Determinants, Capital market consequences) is broadly consistent. The 'outlier' perhaps is the relatively large number of studies we identify for the Capital market consequences category. However, as indicated by the details discussed in section 3.4, the number of studies in this category increases because, in most cases, researchers tend to rely on data available in databases regarding proxies of climate change reporting quality. Instead, the norm in other strands of the accounting literature that examines capital market consequences of voluntary and/or mandatory disclosures is to manually collect such information from companies' reports.

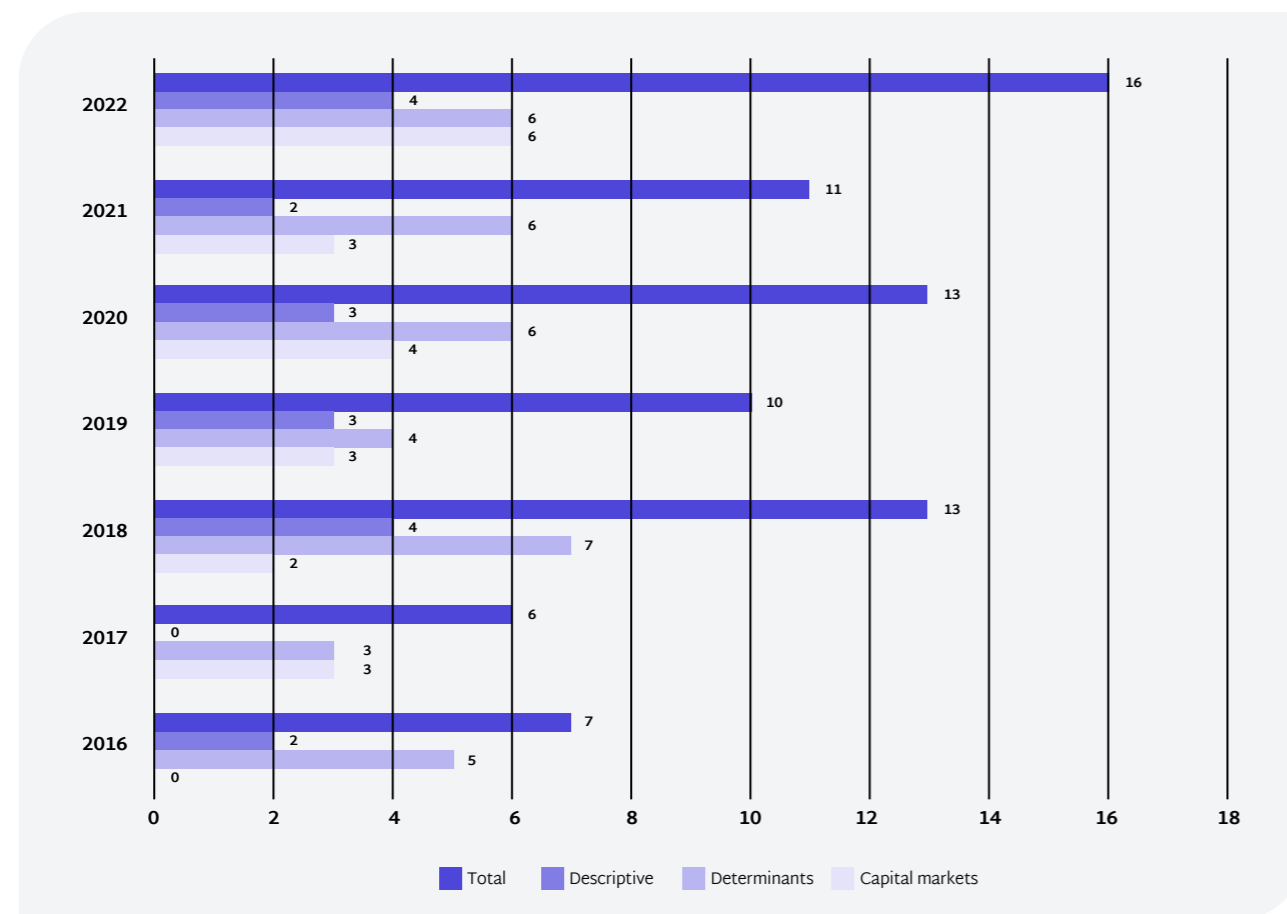
Table 1. Studies included in the literature review.

| Category | Studies | Total |
|---|--|-----------|
| 1 – Descriptive studies on quality of climate change reporting | | |
| | Ferguson et al. (2016); Haque et al. (2016); Comyns (2018); Kansal et al. (2018); Talbot & Boiral (2018); Tang & Demeritt (2018); Eljido-Ten & Clarkson (2019); Ferreira et al. (2019); Tang (2019); Bebbington et al. (2020); Cubilla-Montilla et al. (2020); Pitrakkos & Maroun (2020); Chang et al. (2021); Demaria & Rigot (2021); Boiral et al. (2022a); Boiral et al. (2022b); Rajic et al. (2022); Ryan & Tiller (2022) | 18 |
| Subtotal | | 18 |
| 2 – Determinants of climate change reporting | | |
| 2.1 – Corporate governance | Ben-Amar et al. (2017); Liu et al. (2017); Elsayih et al. (2018); Faisal et al. (2018); Jaggi et al. (2018); Terlaak et al. (2018); Bui et al. (2020); Chithambo et al. (2020); Tingbani et al. (2020); Flammer et al. (2021); Lahyani (2022); Mardini & Lahyani (2022) | 12 |
| 2.2 – Sustainability | Depoers et al. (2016); Ott et al. (2017); Datt et al. (2019a); Datt et al. (2019b); Hsueh (2019); Lemma (2020); Mahmoudian et al. (2021); Fan et al. (2021); Wedari et al. (2021); Jiang et al. (2022) | 10 |
| 2.3 – Country-level | Alrazi et al. (2016); Comyns (2016); Zhou et al. (2016); Luo et al. (2018); Kouloukoui et al. (2019); Datt et al. (2020); Mateo-Márquez et al. (2020); Mateo-Márquez et al. (2021); Perkins et al. (2022) | 9 |
| 2.4 – Stakeholders | Guenther et al. (2016); Kraft (2018); Li et al. (2018); Antonini et al. (2021); Callery (2022); Chithambo et al. (2022) | 6 |
| Subtotal | | 37 |
| 3 – Capital market consequences of climate change reporting | | |
| 3.1 – Equity valuation | Baboukardos (2017); Griffin et al. (2017); Liesen et al. (2017); Cooper et al. (2018); Alsaifi et al (2020); Johnson et al. (2020); Choi et al. (2021); Choi & Luo (2021); Flammer et al. (2021); Andrus et al. (2022); Ott & Schiemann (2022) | 11 |
| 3.2 – Cost of capital | Jung et al. (2018); Albarrak et al. (2019); Lemma et al. (2019); Gerged et al. (2020); Palea & Drogo (2020); Khan et al. (2022); Matsumura et al. (2022); Morrone et al. (2022) | 8 |
| 3.3 – Information asymmetry | Schiemann & Sakhel (2019); Adhikari & Zhou (2022) | 2 |
| Subtotal | | 21 |
| Total | | 76 |

Notes: (a) The study by Flammer et al. (2021) is counted twice as it examines both determinants and capital market consequences; (b) Articles are presented in order of publication date and then alphabetically, based on first author's surname; (c) Articles published in 2022 are those that had been published up until the end of September 2022.

Figure II reports the number of studies for each of the three categories in which the studies are classified (i.e., Descriptive, Determinants and Capital market consequences) by year of publication. The figure depicts the growing interest of the literature in climate change reporting. Although in the earlier years (2016 and 2017) the total number of papers published are seven and six respectively, in more recent years, the number has increased substantially. Despite only including studies published up until the end of September 2022, we notice that the 16 of these studies were published in these nine months. The increase in the number of studies published by year can be primarily attributed to the Capital market consequences category. This indicates the growing interest of the accounting literature on how climate change reporting affects investors' decision-making process. Further, we observe a rather constant number of studies focusing on the determinants of climate change reporting quality and on exploring the quality of such disclosures over the years.

Figure II. Number of studies published annually across three categories: Descriptive, Determinants and Capital Markets.



Notes: (a) The study by Flammer et al. (2021) is counted twice as it examines both determinants and capital market consequences; (b) articles published in 2022 are those that had been published up until the end of September 2022.

Figure III reports the number of years analysed in the 18 studies of the category Descriptive. We see that most of the empirical evidence in these studies is based on data from the period 2012-2016. The most recent evidence is from only one study that focuses on 2020 (Ryan & Tiller, 2022). Further, it is noted that although some studies provide a longitudinal analysis of a rather long window, the period of data coverage can now be considered somewhat dated and, arguably, the findings do not depict current reporting practices (for instance Comyns (2018) examines the window between 1998 and 2016). Instead, a fair number of other studies focus on one or only a few years of analysis (i.e. Cubilla-Montilla et al. (2020) zooms in exclusively on 2015). Indeed, most studies in this category examine climate change reporting either over one year or over a short window of up to four years. This trend can be explained by the fact that capturing firm-level climate change reporting requires extensive resources for data hand-collection and researchers are constrained due to limited time and resources. This background indicates that there is a lag in the empirical evidence provided by the literature and suggests that more studies are needed to examine most recent years' reporting practice considering the tectonic shifts and focus on climate change reporting and related regulations/frameworks that have taken place since 2020.

Figure III. Years covered in the empirical analysis of the studies in the category: Descriptive.

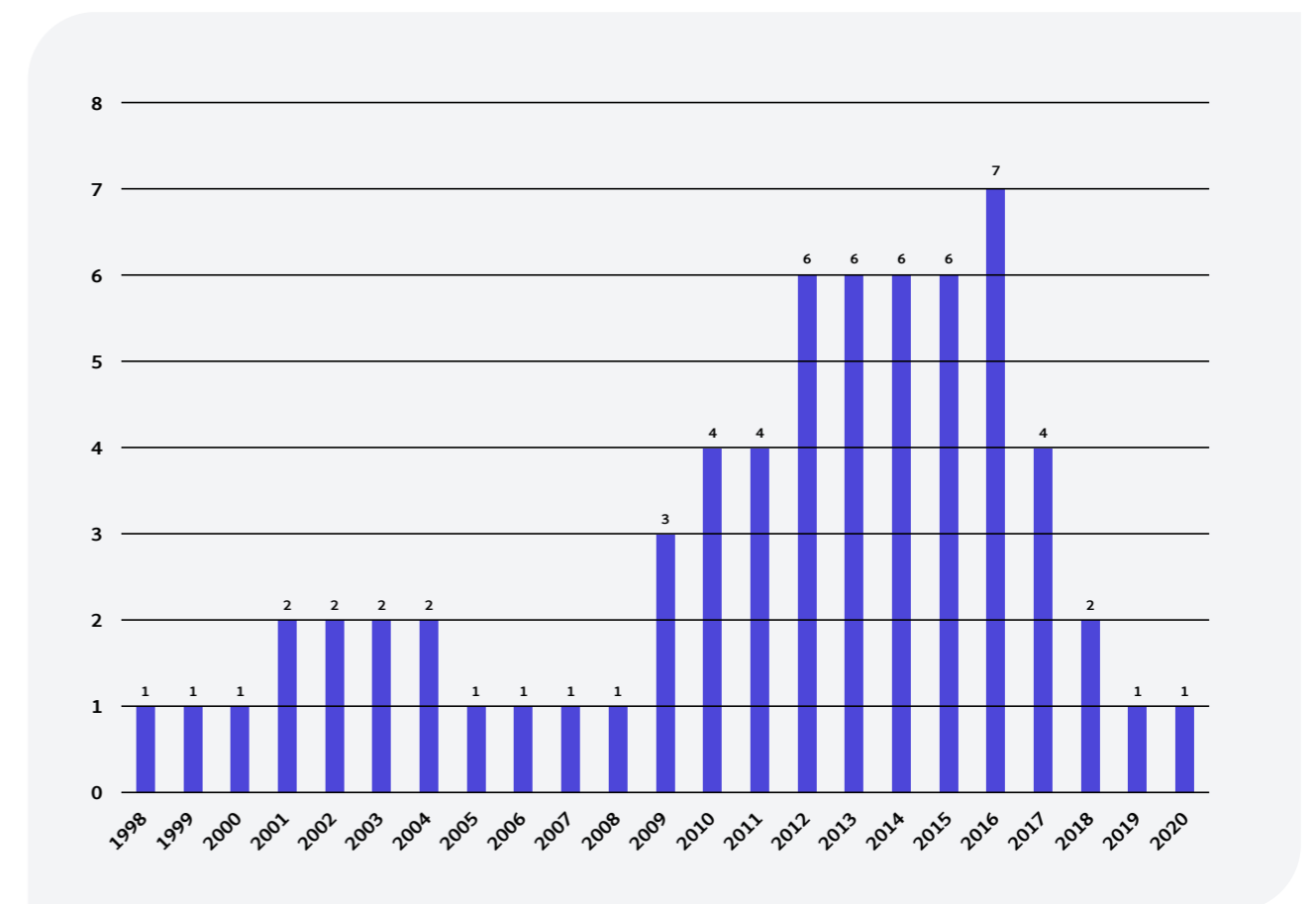
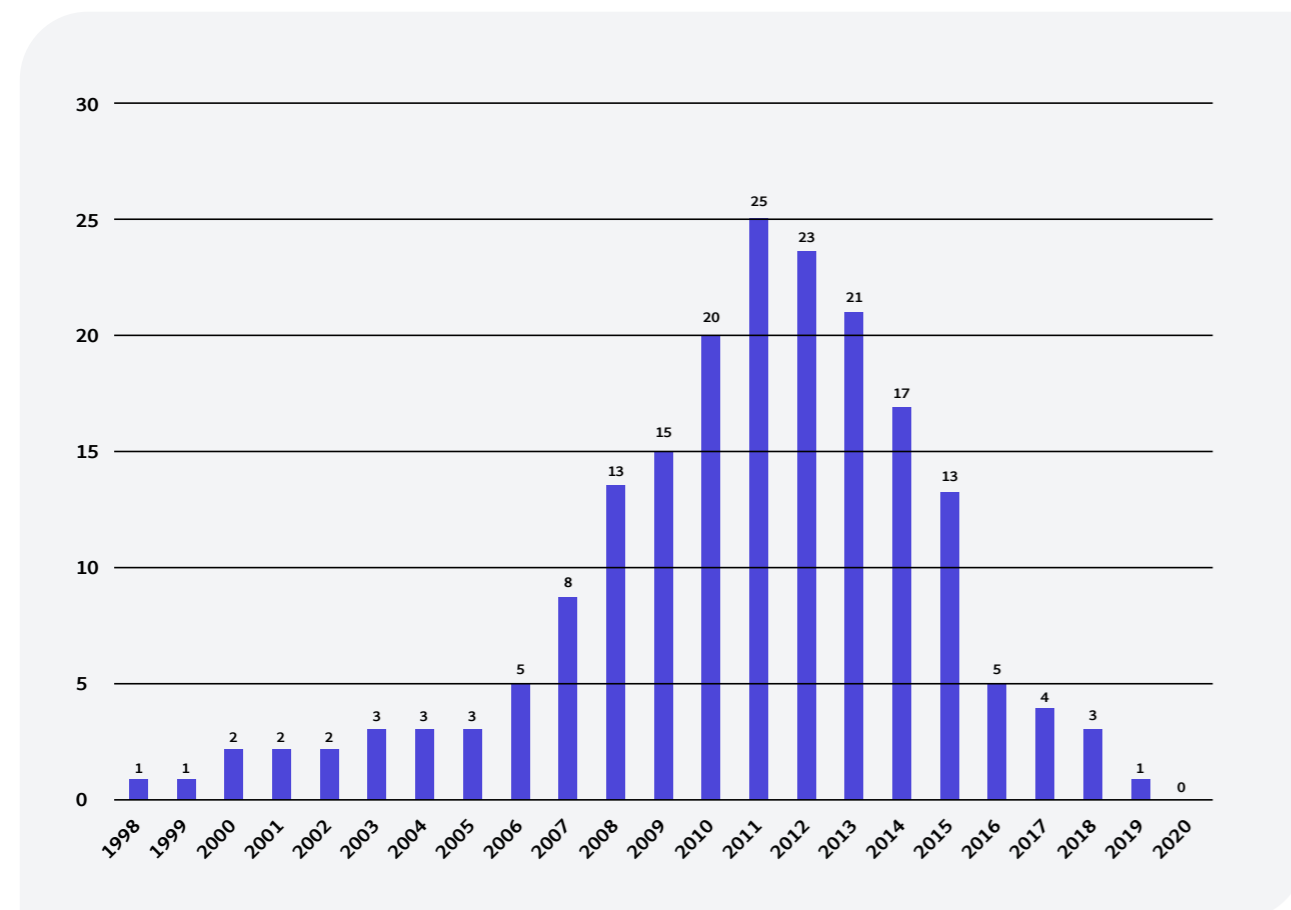


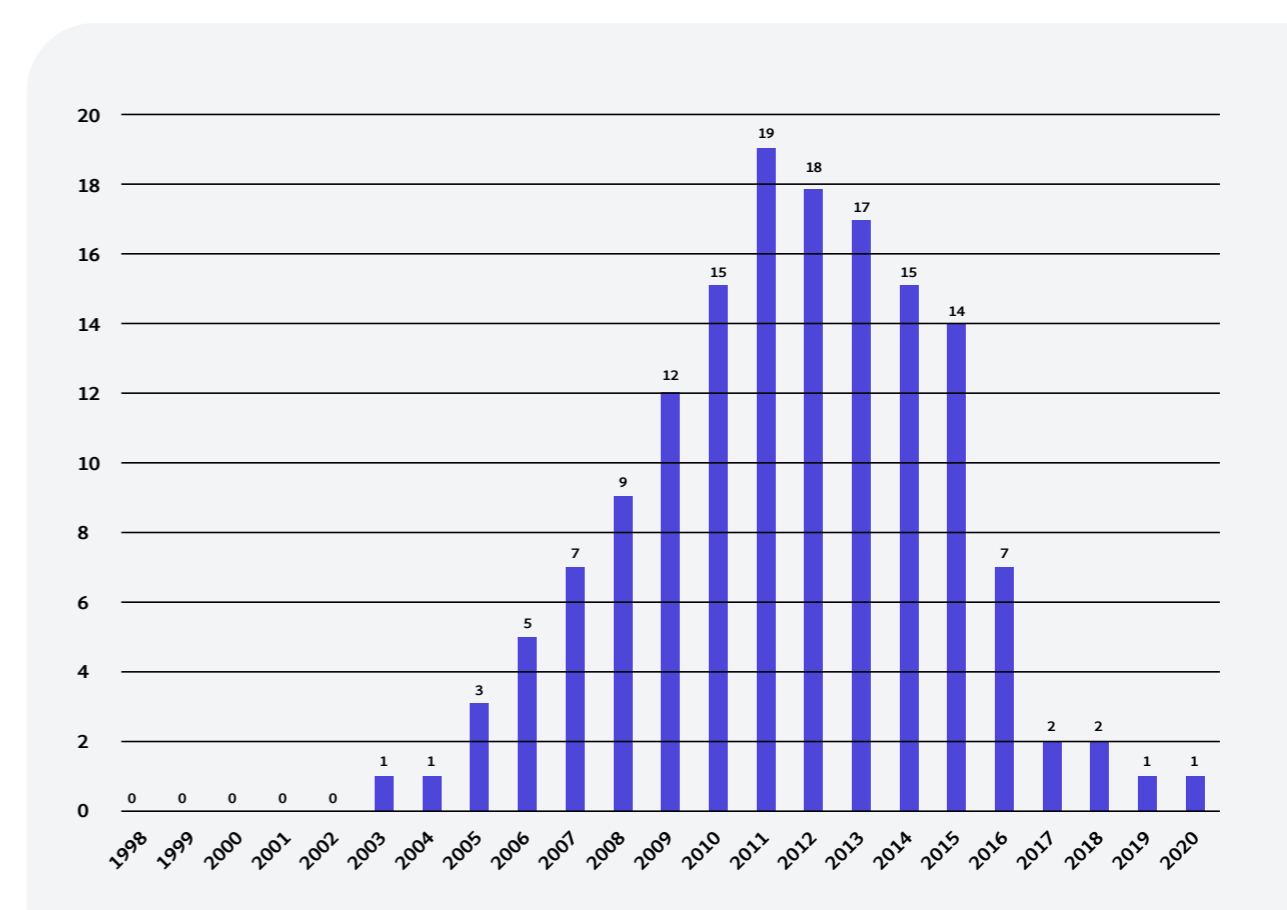
Figure IV reports the number of years analysed in the 37 studies of the category Determinants. Although 25 out of the 37 studies use secondary data from commercial databases and other sources, most of the empirical evidence in this category is based on rather dated data. Eighteen studies use data that cover the periods 2008 to 2015, while the most explored year are between 2010 and 2013. Since the studies in this category use econometric tools for their empirical analysis, most of them employ longitudinal data that cover, on average, 5.5 years for their analysis.

Figure IV. Years covered in the empirical analysis of the studies in the category Determinants.



Finally, figure V reports the number of years analysed in 20 out of the 21 studies¹⁴ in the Capital market consequences category. Similar to the studies in the category Descriptive, these studies cover, on average, 7 years in their analysis from the period 2009-2015 primarily. Only one study found examines data from the years 2017-2018 (Paea & Drogo, 2020), while another covers the period between 2017-2020 (Khan et al., 2022). The remaining 19 studies focus on older periods and hence the evidence provided, although published recently, cannot be considered contemporary.

Figure V. Years covered in the empirical analysis of the studies in the category Capital market consequences.



Notes: The figure is based on sample periods of 20 out of the 21 studies that focus on capital market consequences, given that the study by Johnson et al. (2020) applies an experimental research design.

To conclude, figures I-V highlight that although our review covers the most recent studies about climate change reporting, there is a considerable gap between the date of publication of these studies (i.e. 2016-2022) and the periods that they examine. In total, only 14 out of the 75¹⁵ studies cover in their empirical analysis years that overlap with the years covered by our review. In fact, none of these 14 studies cover the years 2021 and 2022.

14. The study of Johnson et al. (2020) is not included in this analysis as it is based on an experimental research approach and the period when the experiment was conducted is not reported.

15. The total of 75 studies discussed in this section excludes the experiment by Johnson et al. (2020) and includes the study of Flammer et al. (2021) in both the Determinants and Capital market consequences categories as it examines both topics.

3.2 Descriptive studies on climate change reporting quality

This section focuses on the 18 studies in the category Descriptive.¹⁶ A key feature of this strand of the literature is the variety of methods applied for capturing the levels or type of climate change reporting. Six studies take an interpretivist approach and analyse the content of firms' climate change disclosures without using an index for measuring the 'levels' or 'quality' of disclosures (Ferguson et al., 2016; Haque et al., 2016; Tang and Demeritt, 2018; Tang, 2019; Bebbington et al., 2020; Boiral et al., 2022b). The remaining two thirds of those studies ground their analysis on structured indices that draw items from the CDP survey (Elijido-Ten & Clarkson 2019), the GRI Standards (Talbot & Boiral, 2018; Cubilla-Montilla et al., 2020; Chang et al., 2021; Boiral et al., 2022a; Rajic et al., 2022), the TCFD Recommendations (Demaria & Rigot, 2021) or indices constructed by the authors themselves, independent from such standards/guidelines (Comyns, 2018; Kansal et al., 2018; Ferreira et al., 2019; Pittrakkos & Maroun, 2020; Ryan & Tiller, 2022). However, two of these (i.e. Talbot & Boiral, 2018; Elijido-Ten & Clarkson 2019), in addition to the indices they employ, adopt a quasi-interpretative approach for their analysis and focus on the content of the reporting – specific items from the indices – and do not provide overall statistics.

Of the studies that use structured indices for examining the quality of climate change reporting, eight studies focus on the 'big picture', effectively providing overall disclosure scores of their sample firms (Comyns, 2018; Kansal et al., 2018; Cubilla-Montilla et al., 2020; Pittrakkos & Maroun, 2020; Chang et al., 2021; Demaria and Rigot, 2021; Rajic et al., 2022; Ryan & Tiller, 2022).

Comyns (2018) and Demaria and Rigot (2021) highlight firms' continuous effort to enhance and improve their climate change-related reporting practices and adherence with related frameworks. Comyns (2018) examines climate change reporting by Exxon Mobil, Royal Dutch Shell and BP for the period between 1998-2016 and finds that all three companies show an upward trend in their disclosure scores. Similarly, Demaria and Rigot (2021) perform an exploratory study on French firms' adherence with the TCFD Recommendations over the period 2015-2018. Using a TCFD-based disclosure index, their results indicate an increase of TCFD-related disclosures over time, from 37% in 2015 to 65% in 2018, with the highest disclosure levels being exhibited by firms in the energy, finance, materials and transport sectors. This is arguably an expected finding, considering that TCFD Recommendations were released in 2017, and one would expect a gradual improvement in disclosures provided. Nevertheless, in the year after the release of TCFD Recommendations (i.e., 2018), firms do not exhibit higher score in all TCFD-relevant disclosures. On the one hand, they are found to engage more with disclosures about metrics and risk management (74%). On the other hand, they engage less with disclosures about strategy, financials, and scenario analysis (46%). Similarly, Cubilla-Montilla et al. (2020) and Chang et al. (2021) find that firms focus primarily on disclosures about metrics. Cubilla-Montilla et al. (2020) focus on 201 Fortune Global 500 companies from 15 countries that prepare their sustainability reports in accordance with the GRI Standards in 2015 and they report that, on average, 71.1% of these companies disclose emissions-related metrics. Chang et al. (2021) focus on the construction sector and compare reporting practices between construction consulting and construction contracting firms from different parts of the world. They find, inter alia, commonalities in GRI-based, emissions-related metrics disclosed, with the mean disclosure score being 43% for consulting and 36% for contractor firms.

Despite the initial positive evidence, most papers highlight challenges and inconsistencies in disclosing climate change-related information. In particular, Comyns (2018) indicates that, although the GHG disclosure scores present an upward trend, there is not a standardised reporting approach among the sample firms. Demaria and Rigot (2021) also present low compliance levels on financial impact, scenario analysis and Scope 3 emissions and they raise concerns about the related information being dispersed across various reports. Similar concerns over carbon-related disclosures are also expressed by Rajic et al. (2022).

16. While we classify 18 studies in this category, the studies by Boiral et al. (2022a) and Tang (2019) are discussed in section 3.5 and the studies by Ferguson et al. (2016) and Ferreira et al. (2019) are discussed in section 3.6, given that they focus on assurance and regulation of climate change reporting, respectively.

The study investigates the extent of environmental performance disclosures reported by 75 food companies around the world in their sustainability reports in 2018 and 2019. The findings by Rajic et al. (2022) indicate substantial discrepancies between firms' reporting practices and GRI Standards' requirements about carbon emissions. Specifically, using a scale from zero to three (zero indicating non-disclosure to three indicating comprehensive disclosure), they find that the mean disclosure score of carbon-related disclosures is 1.19 for Scope 1 emissions, 0.31 for Scope 2 emissions, and 0.52 for Scope 3 emissions.

Second, a recurring theme across the papers is the opaqueness on climate-change related disclosures, the methodologies followed for the estimation of metrics (e.g., GHG emissions), and lack of incentives for assuring relevant information. Kansal et al. (2018) examine sustainability-related disclosures of 44 Indian public sector enterprises, after the introduction of CSR guidelines by the Department of Public Enterprises in 2010. Their results, inter alia, suggest very low climate change-related disclosure scores, but also absence of quantitative information and discussion over the emission management. Talbot and Boiral (2018) examine the level of non-compliance with GRI climate change-related indicators (EN16 and EN17) of 21 companies in the energy sector worldwide during the period 2009-2013. All companies in their sample are found to follow GRI requirements only partially for these indicators, with the rate of companies that do not comply or only partially comply with these requirements being 95.2%. Also, some of the companies examined are found to disclose increasingly opaque information over time and conceal information about the measurement and methodology applied. Similar findings are reported by Ryan and Tiller (2022) and their exploratory study for a set of New Zealand firms. Motivated by the forthcoming mandatory application of TCFD Recommendations in New Zealand, and using a set of firms that most likely will be subject of the regulation, the authors document inconsistent and mediocre disclosures in terms of GHG emissions and assurance. More specifically, 65% of firms under examination do not provide GHG emissions, 56% do not specify the consolidation approach for their emissions, 36% do not adopt the GHG Protocol and 51% do not opt in for assurance of their climate change reporting.

Third, prior literature underlines extensive disclosure discrepancies between firms with high- and low-environmental performance and emission levels (Elijido-Ten & Clarkson, 2019; Pittrakkos & Maroun, 2020). Specifically, Elijido-Ten and Clarkson (2019) compare a sample of 63 large international companies with superior environmental performance (measured by their listing in the 'Corporate Knights' list of the 'Global 100 Most Sustainable Corporations in the World') with 63 similar companies that are not included in the Corporate Knights list as of 2010. They find that firms listed in the Corporate Knights list disclose information about their climate risks and opportunities more often than firms that are not part of the list. Specifically, 36 and 45 out of the 63 firms in the list discuss more than three climate risks and opportunities, respectively. On the contrary, only 35 and 27 out of the 63 firms that are not included in the list discuss more than three climate risks and opportunities respectively. Pittrakkos and Maroun (2020) investigate the quality of carbon disclosures by analysing the annual and sustainability reports of the 50 largest South African firms (as of 2016). By splitting their sample firms into high- and low-carbon emitters, they illustrate that high-emitting firms disclose more information (mean disclosure score 72.20%) than low-emitting firms (mean disclosure score 43.80%), albeit this difference is not statistically significant. Focusing on the disclosures provided through integrated reports, they show that the differences in disclosures provided by high vis-à-vis low emitting firms are even more prominent.

The four studies that adopt an interpretive approach for their analysis (Haque et al., 2016; Tang & Demeritt, 2018; Bebbington et al., 2020; Boiral et al. (2022b) provide some additional insights over firms' incentives to disclose climate change-related information.

First, Haque et al. (2016) suggest that the low levels of climate change related disclosures are associated with corporate management misperceptions. They conduct a survey among climate change experts from various stakeholder groups in Australia to explore the usefulness of a climate change disclosure index they propose and identify a number of extra disclosure items that are expected by these experts. These items refer to board oversight, executives' engagement, emissions accounting, liabilities related to climate change risk, benchmarking, and external affairs. As a second step, they examine the climate change reporting practice of five Australian companies in 2012 and they find that such disclosures are effectively absent from their reports.

Through interviews, they attribute their findings on executives' lack of understanding about stakeholders' information needs, and unwillingness to learn more about them.

Second, more recent studies (i.e., Tang & Demeritt, 2018; Boiral et al., 2022b) underline the financial, reputational and regulatory incentives as motivating factors for firms' climate related disclosures. Tang and Demeritt (2018) focus on the UK context. Motivated by the introduction of mandatory GHG emissions reporting in 2013, they analyse relevant disclosures from the annual reports of 168 UK listed firms for the period 1 June 2013 to 30 September 2014. They conclude that there are three broad rationales for these levels of reporting: financial (i.e. related to costs from climate change and benefits from reductions of GHG), reputational (by indicating their commitment to address the risks associated with climate change), and regulatory (by explaining that reporting is driven by regulatory requirements). These factors, however, vary depending on the industry the firms operate in and/or the regulations relevant to them. In their exploratory study, Boiral et al. (2022b) conduct a qualitative content analysis of 72 sustainability reports from 15 car manufacturers that are accused of unethical behaviours related to the measurement of diesel vehicle pollutant emissions (i.e., Dieselgate scandal) during the period 2013-2017. The study reports that, prior to 2015, 60% of the firms analysed are very optimistic about the environmental performance of diesel engines, and concepts such as 'clean diesel' or 'EcoDiesel' are frequently mentioned. The authors note that all these firms continue to promote the environmental benefits of their diesel models for the period 2015-2017, despite the Dieselgate scandal. However, in response to the public debate about the scandal, firms adopt narratives that attempt to recognise the existence of external pressures as well as adoption of measures to respond to these pressures. Inter alia, the study concludes that the sustainability reports analysed are relatively opaque and disconnected from the accusations made against the companies.

Finally, Bebbington et al. (2020) provides significant insights on the reporting and disclosure practices around an important part of climate change-related disclosure, the fossil fuel reserves. Specifically, Bebbington et al. (2020) inter alia examine the reporting and disclosures in relation to fossil fuel reserves, in terms of two opposing arguments. One is that the current and prospective international climate agreements might set fuel reserves redundant and, thus, 'unburnable', while the second is that these reserves are still positively considered and used for valuation purposes. The authors review the disclosure regulations in various countries and analyse fuel-related corporate disclosures for 35 firms, listed in seven countries, across two time-periods (2011 and 2014). The disclosures revolve around the areas of climate change risks and GHG emissions. Bebbington et al. (2020) report a rising incidence of disclosure across both categories between the two years of analysis. The incidence of disclosure does vary by country, with China in particular, as well as Russia (to an extent), having relatively lower levels of disclosure. Further, they conclude that the issue of 'unburnable' carbon is not perceived a material item for disclosure by firms.

Overall, the findings of these descriptive studies suggest that firms' climate change reporting quality is low or, at best, moderate. Firms fall short in key elements of reporting such as scenario analysis and financial-related disclosures. Many firms even fail to disclose their GHG emissions; primarily their Scope 2 and Scope 3 emissions. Further, firms are found not to consider the impact that of a net-zero carbon economy may have on their operations (such as the amount of stranded 'unburnable' assets they own) and do not respond to public outcries about their negative environmental impact (e.g. the 'dieselgate' scandal in the car manufacturing industry). Nevertheless, the quality of climate change reporting is found to improve over time. Finally, these studies identify firms' carbon performance, executives' stance towards stakeholders' information needs, and financial, reputational, and regulatory pressures as drivers of climate change reporting quality.

3.3 Determinants of climate change reporting

This section focuses on the 37 studies in the category Determinants. While reviewing the main focus of each study, four broad themes emerged: Corporate governance determinants; Sustainability-related determinants; Country-level determinants; and Stakeholder determinants. In the following subsections the findings of these four themes are discussed.

3.3.1 Corporate governance determinants

About one-third of the studies in this category (12 out of 39) examine various corporate governance characteristics as determinants of climate change reporting. Most of these studies (nine out of 12) heavily draw their climate change reporting proxies from the CDP survey, although they take various approaches on its use. More specifically, Ben-Amar et al. (2017) and Terlaak et al. (2018) focus on whether companies respond to the CDP survey; Elsayih et al. (2018), Lahyani (2022), and Mardini & Lahyani (2022) rely on CDP scores; Liu et al. (2017), Faisal et al. (2018), Bui et al. (2020), and Flammer et al. (2021) construct an index based on CDP questionnaire items; and Jaggi et al. (2018), Chithambo et al. (2020) and Tingbani et al. (2020) construct an index independent of CDP. Table 2 provides a summary of the main findings of the studies in this category.

The information in the table reveals that this strand of the literature focuses less frequently on the 'usual' firms' corporate governance characteristics that have been examined in the past (Hahn et al., 2015) such as board size, board independence, and presence of executive directors in the board. Instead, recent studies put more emphasis on board diversity (gender, age, ethnicity), ownership structure (managerial, government or family ownership) and other environmental-related characteristics (i.e. environmental shareholder activism and climate governance). Overall, the findings indicate that board independence, board diversity, and, to a lower extent, managerial and institutional ownership, are key determinants of firms' decision to engage with climate change reporting and to provide climate change disclosures of superior quality.

Table 2. Main findings of studies that focus on corporate governance determinants of climate change reporting.

| Topics of governance characteristics | Characteristic under examination | Climate change reporting proxy | | | |
|--------------------------------------|----------------------------------|--------------------------------|-----------|-----------------|------------------------|
| | | CDP response | CDP Score | CDP-based index | Self-constructed index |
| Board characteristics | Composite board quality | | | 0 | |
| | Size | | | | + |
| | CEO age | | | | - |
| | Independence | | +,+ | | + |
| | Gender diversity | + | 0,+ | | + |
| | Ethnic diversity | | +,+ | | |
| | Age diversity | | 0 | | 0 |
| | Tenure diversity | | 0 | | |
| | Composite diversity | | + | | |
| | Environmental committee | | 0 | | 0,+ |
| Ownership | Managerial ownership | | + | | |
| | Ownership concentration | | | | - |
| | Government ownership | | | 0 | |
| | Institutional ownership | | | | + |
| | Family ownership | -/+ | | | |
| | Reporting regulation* | | | + | |
| Other | Shareholder activism | | | + | |
| | Climate governance | | | + | |

“+” denotes a positive association, “-” denotes a negative association, “-/+” denotes a U-shaped association, and “0” denotes no significant association.

A comma distinguishes the findings of different studies that examine the same characteristic.

*The findings on the influence of reporting regulation on climate change reporting are discussed in detail in section 3.6.

In relation to board characteristics, Chithambo et al. (2020) analyse UK companies’ annual reports, sustainability reports, and websites for the year 2011 and inter alia confirm earlier studies’ findings that firms’ board size is positively associated with the quality of climate change disclosures. They also show that CEO age is negatively associated with these disclosures. Further, Elsayih et al. (2018), Lahyani (2022), and Jaggi et al. (2018) find a positive association between firms’ climate change disclosures’ quality and board independence. Elsayih et al. (2018) focus on a sample of Australian firms for the period 2009-2012, whereas Lahyani (2022) uses a sample of French firms for a longer window (2010-2019). Both studies rely on disclosure scores as given by the CDP. Jaggi et al. (2018) use a sample of Italian firms for the period 2010-2013, employ a self-constructed index and employ two different approaches in measuring firms’ disclosure scores. They show that their results are conditional to the score measurement applied. When one point for each disclosure item is assigned (unequally weighted disclosure index), no significant results are found. When, however, they assign points to each disclosure items based on assumptions on each items’ perceived information importance, the results turn significant.

Gender diversity is examined by four studies. Ben-Amar et al. (2017) examine the effect of board gender diversity on Canadian firms’ decision to respond to the CDP survey for the period 2008-2014. Elsayih et al. (2018) and Lahyani (2022) examine CDP scores as a function of board gender diversity. Tingbani et al. (2020) examine the association between board gender diversity and climate change disclosure scores of UK firms for the period 2011-2014, employing a self-constructed index. While Ben-Amar et al. (2017), Elsayih et al. (2018), and Tingbani et al. (2020) find a positive relationship, Lahyani (2022) shows no significant association. However, Lahyani (2022) finds a positive association between climate change reporting quality and ethnic diversity. Similarly, Mardini and Lahyani (2022) find a positive association between board ethnic diversity and CDP scores for a sample of French companies for the period 2010-2018. Board age and tenure diversity are not found to be related to CDP scores (Lahyani, 2022). Finally, Lahyani (2022) constructs a composite measure of board diversity as constructed by the Governance Institute of Australia and Watermark Search International. This is comprised of five distinct types of diversity namely gender, cultural background skills/experience, age, tenure and independence. The overall diversity measure is found to be positively associated with CDP scores.

Perhaps not surprisingly, recent studies have also examined the association between climate change reporting quality and the existence of an environmental committee within the board of directors. Contrary to what one might expect, Elsayih et al. (2018) and Tingbani et al. (2020) do not report any significant association. Only Jaggi et al. (2018), find their self-constructed index score to be positively associated with the presence of an environmental committee.

The second broad corporate governance topic examined by the studies we review relates to ownership structure. While six studies fall into this topic, each one examines a different type of ownership, in a different setting and during different time periods. Hence, the evidence on the role of ownership structure cannot be evaluated as conclusive. Specifically, Elsayih et al. (2018) inter alia examine the association between levels of managerial ownership and CDP Scores and find a positive association. Similarly, a positive association between higher levels of institutional ownership and climate change reporting quality is found by Jaggi et al. (2018). These findings indicate that firms with shareholding managers and institutional shareholders exhibit a higher level of transparency in relation to climate change matters. On the contrary, Chithambo et al. (2020) inter alia show that UK firms with higher ownership concentration tend to provide lower levels of climate change disclosures in 2011, and Faisal et al. (2018) do not find a significant association between government ownership and climate change reporting quality in Indonesian firms for the period 2011-2014. Government-owned corporations are also examined by Liu et al. (2017) in the Australian context.¹⁷

17. Liu et al. (2017) focus on the effect of climate change reporting regulation, thus their findings are discussed in section 3.6.

The last type of ownership examined in recent years is family ownership. Terlaak et al. (2018) examine a sample of Korean firms for the period 2008-2013 and find that as family ownership increases between 0% and 50%, the probability of firms to respond to the CDP survey decreases. However, the probability increases for family ownership above 80%. This indicates that there is a U-shaped relationship between family ownership and engagement with climate change reporting. Low and medium levels of family ownership affect climate change reporting decisions negatively and very high levels of family ownership affect climate change reporting decisions positively. In addition, they show that although the presence of CEO who is also member of the family-owner does not affect climate change reporting, the U-shaped relationship between family ownership and response to the CDP survey is evident only for the sub-sample of firms with a family CEO (Terlaak et al., 2018). These findings indicate the importance of family ownership and management on firms' climate change reporting practices.

Finally, two studies do not fall in either of the two broad topics discussed above. Bui et al. (2020) uses two composite measures – one on board quality and one on climate governance – to examine their association with CDP scores. The board quality measure includes the presence of women and independent directors on the board, the size of the board, CEO duality, and whether executives are given financial incentives. The climate governance measure takes into account whether the board is responsible for climate matters, whether the company provides climate-related incentives to its executives, how frequently climate change issues are reported, what is the horizon of climate change risks taken into account (i.e., short, medium or long term), and whether there is a board-level environmental committee. Although they do not find a significant association between CDP scores and quality of the board, they find a positive association between CDP scores and climate governance. Flammer et al. (2021) examine to what extent environmental shareholder activism affects US firms' reporting on climate-related regulatory, physical, and other risks for the period 2010-2016. They show that the extent of disclosures is positively associated with the number of environmental-related proposals shareholders make in a year. Further, they show that this association is stronger when the proposals are initiated by institutional shareholders, and even stronger if initiated by long-term institutional shareholders.

3.3.2 Sustainability-related determinants

This category consists of 10 studies that examine firms' sustainability-related determinants of climate change reporting. Specifically, as proxies of climate change reporting quality, two studies use firms' decision to respond to the CDP survey (Ott et al., 2017; Hsueh, 2019), four studies rely on the CDP score (Hsueh, 2019; Lemma, 2020; Mahmoudian et al., 2021; Jiang et al., 2022),¹⁸ two studies use scores based on self-constructed indices for measuring climate change reporting quality (Depoers et al., 2016; Wedari et al., 2021) and one study uses a score calculated with index the items of which are based on the CDP (Datt et al., 2019a). Finally, two studies focus on the determinants of companies' decision to have their climate change reporting assured (Datt et al., 2019b; Fan et al., 2021).¹⁹ Table 3 provides a summary of the main findings of these studies.

The key takeaway from these studies is that firms' engagement with climate change related disclosures varies with their level of environmental performance (as proxied by carbon intensity) and with particular characteristics of their operations (such as adoption of integrated approach in their operations, fuel types used for their operations and industry classification).

18. The study of Hsueh (2019) uses two different proxies of climate change reporting quality (i.e. CDP response and CDP score). Hence, it appears twice in the discussion.

19. Datt et al. (2019b) and Fan et al. (2021) are discussed in section 3.5, which focuses explicitly on the topic of climate change reporting assurance.

Table 3. Main findings of studies that focus on firm-level sustainability-related determinants of climate change reporting.

| Topic of sustainability characteristic | Characteristic under examination | Climate change reporting proxy | | | | |
|--|----------------------------------|--------------------------------|-----------|-----------------|------------------------|------------|
| | | CDP response | CDP Score | CDP-based index | Self-constructed index | Assurance* |
| Carbon performance | Carbon intensity | 0(+) | +,+ | - | + | +,+ |
| | CDP Leadership Index | | + | | | |
| Reporting | Discrepancy in reporting | | | | + | |
| | Sustainability reporting | +(0),0 | 0 | | | + |
| Operations | Environmental certification | +(0) | | | | |
| | Integrated approach | +(0) | +(0) | | | |
| | Environmental R&D | 0 | + | | | |
| | Energy structure | | | | | + |
| | Industry | | | | | + |

“+” denotes a positive association, “-” denotes a negative association, and “0” denotes no significant association. A comma distinguishes the findings of different studies that examine the same characteristic.

When a study examines one characteristic while using two alternative measurements, the information in brackets () relates to the findings of the second alternative measurement.

*The findings of the studies that focus on climate change reporting assurance are discussed in detail in section 3.5.

In most of these studies, the effect of firms' carbon performance, proxied by firms' carbon intensity, is examined as a determinant of climate change reporting quality (Ott et al., 2017; Datt et al., 2019a; Datt et al., 2019b; Lemma, 2020; Mahmoudian et al., 2021; Fan et al., 2021; Wedari et al., 2021; Jiang et al., 2022). Carbon intensity is usually measured as the ratio of carbon emissions to sales. Hence, a larger value of carbon intensity depicts lower carbon performance.²⁰ An alternative carbon intensity metric used by Jiang et al. (2022) is the ratio of firm's total Scope 1 and Scope 2 emissions divided by total cost of goods. Finally, Mahmoudian et al. (2021) use the performance score a company obtains by CDP as proxy of carbon performance. To this end, we note that these studies do not explicitly refer to carbon performance and they take various approaches on what this metric reflects. Datt et al. (2019a), Mahmoudian et al. (2021), and Jiang et al. (2022) explicitly state that their metric reflects firms' carbon performance. Datt et al. (2019b), and Wedari et al. (2021) simply refer to carbon emissions, whereas Ott et al. (2017) use carbon intensity as a proxy of a firm's overall environmental performance. Finally, Lemma et al. (2020) use carbon intensity as a proxy of a firm's carbon risk exposure and Fan et al. (2021) use it as a proxy of firm's carbon information asymmetry. Despite the various definitions given, the focus of many studies on similar metrics of firms' level of carbon emissions reflects the importance of this characteristic as a potential driver of climate change reporting quality.

20. For making their results more intuitive, some studies use the negation of carbon intensity as proxy of carbon performance. The smaller the (negative) carbon intensity ratio is, the better a firm's carbon performance is. For presenting results in a consistent manner, Table 3 presents results as if carbon intensity had positive values.

Indeed, as shown in Table 3, four studies (Lemma et al., 2020; Mahmoudian et al., 2021; Wedari et al., 2021; and Jiang et al., 2022) find a positive association between different metrics of carbon performance and climate change reporting quality. Specifically, Lemma et al. (2020) use a sample of South African listed companies, which respond to the CDP survey during the period 2011-2015. Similarly, Mahmoudian et al. (2021) and Jiang et al. (2022) focus on US firms that respond to the CDP survey for the years 2011-2014 and 2012-2015, respectively. Further, focusing on a sample of Australian firms for the years 2016 and 2017, Wedari et al. (2021) measure climate change reporting quality using a self-constructed index that is based on various sources (such as TCFD, GRI, ISO 14064, and ASSET4 database). They all find that firms with higher carbon intensity (and hence lower carbon performance) exhibit higher climate change reporting quality. The opposite results are found by Datt et al. (2019a), who use a sample of US firms that respond to the CDP survey in 2011 and 2012 and show that firms' climate change reporting quality, as gauged by a score calculated by using a CDP-based disclosure index, is negatively associated with their carbon intensity (hence the lower the emission the higher the quality). Finally, Ott et al. (2017) use an international sample of firms that respond to the CDP survey for the years 2006-2010 and show that although the decision of a company to respond to the survey is not associated with its carbon intensity, its decision to publish the whole questionnaire with its responses is positively associated with its carbon intensity.

In relation to the effect of firms' sustainability reporting behaviour on their climate change reporting, results are rather inconclusive. On the one hand, Ott et al. (2017) show that the decision of a company to respond to the CDP survey is associated with its decision to publish sustainability-related disclosures either through a stand-alone report or through a distinct section within its annual report. However, they do not find any significant association between a company's sustainability disclosures and its decision to publish the whole questionnaire with its responses to the CDP survey. Further, for a sample of large international firms, Hsueh (2019) find no association between firms having a dedicated sustainability section in their websites and their decision to respond to CDP survey as well as their climate change reporting quality as measured by the CDP score. Finally, Depoers et al. (2016) emphasise measurement issues in carbon performance using a sample of French listed firms for the period 2007-2009. Particularly, they show that some firms use different sources when they report their carbon emissions in their corporate reports than when they report under CDP guidelines. They show that firms that report lower emissions in their corporate reports than in their CDP questionnaire tend to provide more methodological details about their measurement approach.

Lastly, we identify a broad topic of various characteristics that are examined as potential drivers of climate change reporting. Broadly speaking, these characteristics can be categorised as relevant to firms' operations. Ott et al. (2017) show that firms with certified environmental management systems are more likely to respond to the CDP survey but do not publish their CDP questionnaires more often. Hsueh (2019) explores three different characteristics. Two relate to whether a firm takes an integrated approach in its activities either by having sustainability in the core of its mission or by incorporating sustainability in its decision-making processes and day-to-day operations. She finds that although the latter drives both firms' decision to respond to CDP and the quality of reporting as measured by the CDP, the former affects firms' CDP score only. Finally, she shows that when firms invest on environmental R&D activities, they do not respond more often to CDP survey, but these that they respond provide climate change reporting of better quality.

3.3.3 Country-level determinants

About one-quarter of the studies in this category (nine papers) examine various country-level characteristics as determinants of climate change reporting. Four of the nine studies rely on data from the CDP survey for their empirical analysis (Luo et al., 2018; Mateo-Márquez et al., 2020; Mateo-Márquez et al., 2021; Perkins et al., 2022), whereas three studies employ a self-constructed disclosure index (Alrazi et al., 2016; Comyns, 2016; Kouloukoui et al. 2019). Finally, two studies focus on what determines firms' decision to have their climate change reporting assured by a third party and the choice of the assurance provider (Zhou et al., 2016; Datt et al., 2020).²¹

21. Zhou et al. (2016) and Datt et al. (2020) are discussed in section 3.5, which focuses explicitly on the topic of climate change reporting assurance.

Table 4 provides a summary of the main findings of the studies in this theme. Previous literature reviews on relevant themes have reported little evidence on country-level factors of climate change reporting, except for country-specific reporting regulations and international treaties (primarily the Kyoto Protocol) (Hahn et al., 2015).

Our review reveals new evidence on the role that country-level determinants such as countries' environmental/climate change performance, stakeholder orientation, rule of law, and cultural background play on companies' climate change reporting behaviour. We identify four topics of country-level characteristics examined: countries' outlook on environmental issues, legal system, culture, and domicile. An overall conclusion that can be drawn is that the environmental outlook of the country a firm is domiciled in does affect its climate change reporting (Alrazi et al., 2016; Comyns, 2016; Mateo-Márquez et al., 2020, 2021). Similarly, the legal system and stakeholder orientation of the country where firms are based in has important effects on their climate change reporting practices (Zhou et al., 2016; Datt et al., 2020).²² Further, evidence about countries' cultural traits (Luo et al., 2018; Perkins et al., 2022) and companies' domicile (Comyns, 2016; Kouloukoui et al., 2019) can be seen as inconclusive.²³

22. These findings can be subject to sectoral mimicking cross border practices as also discussed on pages 42-43 (with reference to Comyns (2016)).

23. Alrazi et al. (2016), Comyns (2016), Mateo-Márquez et al. (2020), and Mateo-Márquez et al. (2021) inter alia examine some regulatory effects such as countries' environmental policy stringency and the presence of an emissions trading scheme in a country. As such, their findings on regulation in particular, are discussed in section 3.6, which focuses explicitly on the topic of climate change reporting regulation.

Table 4. Main findings of studies that focus on country-level determinants of climate change reporting.

| Topic of country characteristics | Characteristic under examination | Climate change reporting proxy | | | |
|--|---|--------------------------------|------------|------------------------|------------|
| | | CDP response | CDP Score | Self-constructed index | Assurance* |
| Outlook on environmental issues | Country's environmental/climate change performance | | | + | + |
| | Country's environmental policy stringency** | + | 0,+ | | |
| | Public level of concern about climate change | 0 | + | | |
| | Companies' commitment with climate change reporting | + | + | | |
| | Emissions trading scheme (ETS)** | | + | +,+(+) | |
| Legal system | Code law/stakeholder orientation | | | | +(+),+ |
| | Rule of law | | | | -(-) |
| Culture | Power distance† | | -†, -†(††) | | |
| | Uncertainty avoidance | | +†(0††) | | |
| | Long term (Future) orientation | | 0†(0††) | | |
| | Masculine orientation | | -† | | |
| | Gender equality | | 0†† | | |
| | Individualism | | -† | | |
| | Institutional collectivism | | -†† | | |
| | In-group collectivism | | 0†† | | |
| | Assertiveness | | -†† | | |
| | Performance orientation | | 0†† | | |
| | Humane orientation | | 0†† | | |
| Domicile | European vs non-European firms | | | 0 | |
| | Local vs foreign firms (in Brazil) | | | + | |

“+” denotes a positive association, “-” denotes a negative association, and “0” denotes no significant association.

“†” indicates cultural traits as measured by Hofstede (2010).

“††” indicates cultural traits as measured by House et al. (2004).

A comma distinguishes the findings of different studies which examine the same characteristic.

When a study examines one characteristic while using two alternative measurements, the information in brackets () relates to the findings of the second alternative measurement.

* The findings of the studies that focus on climate change reporting assurance are discussed in detail in section 3.5.

** The findings of the studies that focus on the influence of countries' environmental policy stringency and emissions trading scheme (ETS) on climate change reporting are discussed in detail in section 3.6.

With regards to countries' outlook on environmental issues, by analysing an international sample of firms that operate in the generating electricity industry in 2007, Alrazi et al. (2016) examine whether firms that are based in countries with superior commitment towards the environment exhibit better climate change reporting. They show that firms' climate change reporting quality (measured by a self-constructed index motivated by the GHG Protocol, the GRI Standards and other indices) is positively associated with the overall environmental performance of the country they are based in.²⁴ In an additional test, Alrazi et al. (2016) examine the effect of a country's environmental performance on 'soft' vis-à-vis 'hard' disclosures. By 'soft' disclosures they refer to information that can be easily replicated and difficult to be verified, whereas 'hard' disclosures refer to information that is more objectively credible and difficult to be imitated. Their results hold for 'soft' disclosures only.

A second topic explored by recent studies refers to the public level of concern about climate change a country exhibits. Mateo-Márquez et al. (2021) examine an international sample of firms from various industries for the year 2015 and show that the level of concern about climate change a country's population exhibits (measured by the Pew Research Center's 2015 Global Attitudes Survey²⁵) is positively associated with companies' climate change reporting quality (proxied by the CDP score) in the country. However, they show that the level of concern does not affect firms' decision to respond to CDP survey. In other words, public's general awareness over climate change issues does not affect a firm's decision to engage with climate change reporting, but when a firm decides to engage with such disclosures, it exhibits superior quality.

Further, Mateo-Márquez et al. (2021) examine whether a company's decision to respond to the CDP survey and their climate change reporting quality are affected by other companies' level of engagement with CDP survey within the country; they find a positive effect on both reporting metrics. This can be seen as an isomorphic tendency within countries: the more companies engage with climate change reporting, the more likely other companies within the country will engage and, at the same time, improve the quality of reporting.

In relation to countries' cultural traits, Luo et al. (2018) and Perkins et al. (2022) examine the effect of cultural characteristics on firms' climate change reporting. The former focuses on Hofstede et al. (2010) power distance cultural dimension solely. Using an international sample of firms from 32 countries for the years 2009-2013, they show that the more unequally power is distributed within a country, the lower the quality of climate change reporting (as measured by the CDP score) is. This indicates that, in environments with higher power distance, powerful institutions, like large firms, will not be questioned for their activities by the society and hence have more leeway on how they report on climate change issues. The latter study examines a variety of cultural dimensions as measured by Hofstede et al. (2010) and alternatively by House (2004). Analysing an international set of firms for 2012 and 2013, they first confirm Luo et al.'s (2018) findings by showing that a countries' power distance cultural dimension (as measured by both Hofstede et al., 2010 and House et al., 2004) negatively affects firms' climate change reporting quality (as given by the CDP score). Further, they examine whether firms' climate change reporting is affected by high levels of uncertainty avoidance within a society. High levels of uncertainty avoidance characterise societies that feel more threatened by unknown factors and hence their members prefer to avoid being exposed. Perkins et al. (2022) find mixed evidence with regards to uncertainty avoidance: Although they find a positive association between uncertainty avoidance with climate change reporting quality when using Hofstede et al. (2010) cultural dimension measure, they find no significant association when using the House et al. (2004) measure. The positive association can be attributed to firms following the norms of the local business community and avoid potential exposure to risks. Nevertheless, mixed evidence indicates that there is need for further research on this issue.

24. As measured by the Yale Center for Environmental Law & Policy, Yale University and the Center for International Earth Science Information Network, Columbia University. More information can be found here: <https://epi.yale.edu/>

25. More details about the Pew Research Center's 2015 Global Attitudes Survey can be found here: <https://www.pewresearch.org/global/2015/06/23/spring-2015-survey/>

With reference to the cultural dimension of future orientation, Perkins et al. (2022) do not find any significant association using both Hofstede et al. (2010) and House et al. (2004) approaches. When it comes to the cultural dimension of masculinity (as defined and measured by Hofstede et al., 2010), Perkins et al. (2022) find a negative association with climate change reporting. Considering Hofstede et al. (2010) states that more masculine societies are characterised by preference for material rewards and achievement, it can be argued that these societies will regard climate change issues as of second order and hence may engage less with the related reporting. Nevertheless, the dimension of performance orientation measured by House et al. (2004), which refers to similar societal characteristics (such as focus on competitiveness and materialism), does not identify an effect on climate change reporting. Assertiveness by House et al. (2004) can be also linked to masculinity by Hofstede et al. (2010) as it refers to societies which value directness in communication, competition, and success. As the findings indicate that assertiveness is negatively associated with climate change reporting quality, they can be seen as corroborating the findings on masculinity. In a similar vein, the dimension of humane orientation (as defined and measured by House et al., 2004), which can be seen as the opposite of masculinity as it refers to societal characteristics like promotion of well-being and care for other members of the society, is also found to not be significant.

Two more cultural traits including individualism (as measured by Hofstede et al (2010)) and institutional collectivism (as measured by House et al. (2004)) are found to be negatively associated with climate change reporting quality by Perkins et al. (2022). Individualism refers to members of societies that focus primarily on themselves and their very immediate family. The negative association indicates that firms residing in countries ranked high in individualism are not incentivised to provide climate change reporting of high quality. Institutional collectivism measures are similar to individualism cultural traits, although in the opposite manner (high values reflect low individualism). The results confirm the findings of the individualism measure. Finally, the cultural dimensions of long term (future) orientation as measured by Hofstede et al. (2010) and House et al. (2004) and the cultural dimensions of gender equality, and in-group collectivism (as measured by House et al. (2004)) are not found to affect climate change reporting quality.

The last topic examined by recent studies refers to the effect of companies' domicile on climate change reporting. Comyns (2016) employs a self-constructed index and measures reporting quality in two alternative ways. The first is based on a content analysis of annual and sustainability reports using a disclosure index that draws from various reporting principles (such as the GRI, the GHG Protocol, and the Petroleum Industry Guidelines for reporting GHG Emissions) and the second is based on keyword count. The keyword list draws from climate change related reports (such as the IPCC Third Assessment Report, the IPCC Fourth Assessment Report, and the GHG Protocol). By analysing multinational oil and gas corporations for the years 1998-2016, she finds that oil and gas companies headquartered in Europe do not exhibit higher climate change reporting quality (as measured by both proxies). This is a rather surprising finding considering that companies residing in Europe are seen as more proactive in climate change issues. A potential explanation is that companies operating in the same sector demonstrate mimicking behaviours and hence their domicile is not influential to their reporting practices (Comyns, 2016). Finally, Kouloukoui et al. (2019) examine a sample of firms listed in the Brazilian stock exchange for the period 2009 to 2014. They show that firms founded in developed countries (what they call 'international companies') exhibit a higher quality of climate change reporting compared to companies founded and operating in Brazil only. For the measurement of reporting quality, they count the times a number of keywords in their sample firms' sustainability reports.

3.3.4 Stakeholder determinants

This category consists of six studies that examine stakeholder-level characteristics as determinants of climate change reporting. Two studies examine the related determinants of the decision of companies to respond to the CDP survey (Li et al., 2018; Callery, 2022), whereas Guenther et al. (2016) use the CDP score as proxy of climate change reporting quality and explores its determinants. Finally, Kraft, (2018), Antonini et al. (2021), and Chithambo et al. (2022) employ a self-constructed disclosure index for measuring firm level climate change reporting quality and explore their determinants. Table 5 provides a summary of the main findings of these studies.²⁶

The general conclusion that can be drawn on reflection of the information in the table is that companies' engagement with climate change reporting is directly related to their stakeholder pressure – particularly from media, employees, customers and peers (i.e. companies from the same industry).

Table 5. Main findings of studies that focus on stakeholder determinants of climate change reporting.

| Topic of stakeholder characteristics | Characteristic under examination | Climate change reporting proxy | | | |
|--------------------------------------|----------------------------------|--------------------------------|--------------|-----------|------------------------|
| | | CDP response | CDP drop out | CDP score | Self-constructed index |
| Regulation | Regulatory pressure* | | - | + | 0(-) |
| | Lobbying* | | | | 0(-) |
| General public | Public pressure (presence of) | + | - | + | + |
| | Public pressure (absence of) | | | | - |
| Media | Media exposure (overall) | | | + | |
| | Media exposure (positive) | - | | | |
| Other | Employee pressure | + | - | + | |
| | Customer pressure | + | - | + | |
| | Peer pressure | + | - | | |

“+” denotes a positive association, “-” denotes a negative association, and “0” denotes no significant association. When a study examines one characteristic while using two alternative measurements, the information in brackets () relates to the findings of the second alternative measurement.

* The findings on the influence of regulatory pressure and lobbying on climate change reporting are discussed in detail in section 3.6.

26. Table 5 reports findings for five out of the six studies of this theme. The study of Chithambo et al. (2022) categorises stakeholders into three groups using factor analysis. Each group includes a number of rather disparate types of stakeholders and hence the results are hard to be reported in a summary table. For instance, shareholders and the local community are categorised in the same group as 'providers stakeholders' and NGOs, competitors, and media are categorised in the same group as 'social stakeholders'. Nevertheless, the findings of the study are discussed.

Although a relatively small number of studies examine stakeholder effects, they examine a rather large number of related determinants. We identify three topics within this theme: regulation²⁷ (Guenther et al., 2016; Kraft, 2018; and Callery, 2022), general public pressure (Guenther et al., 2016; Kraft, 2018; Callery, 2022; and Antonini et al., 2021), and media exposure (Guenther et al., 2016; Li et al., 2018). Also, three characteristics are unclassified, and we group them as ‘others’ (Guenther et al., 2016; and Callery, 2022). Overall, the findings of these studies indicate that the firms’ decision to engage or disengage with climate change reporting, as well as their reporting quality, are affected in varying directions by a wide range of stakeholders.

Specifically, in relation to general public pressure, Guenther et al. (2016) draw from an international sample of firms during the period 2008-2011 and examine whether firms’ climate change reporting quality (as measured by CDP score) is affected by the power that general public has to make its voice heard and accounted for by the government (as measured by the World Bank’s World Governance Index).²⁸ The same proxy is used for social pressure (i.e. social freedom, also measured by the Worldbank’s World Governance Index), but different proxies for climate change reporting (i.e. response to the CDP survey and drop out from the CDP survey); these are examined by Callery (2022) using an international sample of firms between 2003-2015. Further, Kraft (2018) examines whether the substantiveness of corporate reporting quality is associated with the number of disruptive activities made by environmental organisations (a proxy of ‘social movements’) for a sample of US utilities firms during the period 2000-2010. All three studies show that the higher the public pressure is, the better the firms’ climate change reporting quality is. Finally, Antonini et al. (2021) examine whether the election of Donald Trump as President of the United States influences the length of climate change reporting provided by a sample of US firms over the period 2014-2018. They show that after the election of President Trump, pro-Trump firms headquartered in the US exhibited a significant reduction in the length of their climate change disclosures within the whole of their sustainability reports, as well as within their CEO letter only. This indicates the extent to which President Trump’s supporters are in line with his views on climate change. Antonini et al. (2021) also showed that in states with more President Trump supporters, public pressure for companies to disclose issues related to climate change was smaller than states with fewer President Trump supporters (what we call ‘absence’ of public pressure).

Media also plays a significant role in firms’ climate change reporting quality. First, Guenther et al. (2016) show that the number of controversies firms face each year (as measured by the commercial database ASSET4) is positively associated with their CDP score. In addition, Li et al. (2018) show that the more positive a firm’s coverage by the media is, the less likely the firm will respond to the CDP survey. To demonstrate this, they analyse a sample of Chinese firms for the years 2008-2012 and use the positive versus negative news published for each firm as proxy of media exposure. They conclude that a firm’s response to environmental news is driven by the content of the news. Firms with positive media exposure feel ‘safer’ and hence choose to disclose less, whereas firms with negative exposure attempt to legitimise their activities through climate change reporting.

Guenther et al. (2016) examine how firms’ climate change reporting is affected by the pressure of two other stakeholder groups, namely employees and customers. Employees is measured as the workforce/employee quality score of a firm, and customers is measured as the client management score of a firm. Both have been taken from the commercial database Thomson Reuters ASSET4. Their findings suggest that the power of both stakeholder groups positively affect firms’ climate change reporting quality. Similar results for employee and customer stakeholder groups are reported by Callery (2022), who shows that a firm’s decision to respond (as well as stop responding) is positively (negatively) associated with employee/workforce quality and customer loyalty (as measured by Thomson Reuters ASSET4). In addition, Callery (2022) finds that a firm’s decision to engage in (opt out of) the CDP survey is positively (negatively) affected by the percentage of firms within the same industry that participate in the CDP survey. This last finding suggests that firms exhibit a mimetic behaviour and that peer pressures drive their decisions.

27. Guenther et al. (2016), Kraft (2018), and Callery (2022) inter alia examine some regulatory effects such as the election of President Trump in the US, the introduction of State and National regulation, and lobbying. As such, these studies are discussed in section 3.6, which focuses explicitly on the topic of climate change reporting regulation.

28. For details about the World Bank’s World Governance Index see here: <https://info.worldbank.org/governance/wgi/>

Finally, Chithambo et al. (2022) conduct a survey of 86 UK firms in order to determine their perceived stakeholder pressure in relation to climate change disclosures. In the survey, the following stakeholder groups are identified: stakeholders that provide crucial resources (shareholders, community and investors), social stakeholders (NGOs, competitors and media), organisational stakeholders (suppliers, customers and employees), and the government as regulatory stakeholder. Using a self-constructed index of 60 items – based on various reporting frameworks such as GHG Protocol, GRI, DEFRA and CDSB – they show that climate change reporting quality is positively associated with organisational and regulatory stakeholders, but not with stakeholder providers and social stakeholders. These findings can seem unexpected considering the number of studies that indicate the significant role of particular stakeholder groups such as shareholders and media on firms’ climate change reporting quality. At the same time, the study confirms the important role of governments on climate change reporting practice.

3.4 Capital market consequences of climate change reporting

3.4.1 Observations regarding the research design and overview of findings in this stream of literature

As indicated in section 3.1, the 21 studies we review in this strand of the literature are disaggregated across three themes of consequences: equity valuation, cost of (debt or equity) capital and information asymmetry. The number of studies in these three themes varies significantly. Before discussing in more detail, the evidence across the three types of capital market consequences explored in this stream of the literature, we highlight the key observations arising from our review as these are summarised in Table 6.

First, as explained by Jung et al. (2018), academic literature commonly includes terms such as ‘climate change risk’, ‘environmental risk’ and ‘carbon risk’, which are often used interchangeably. The studies we review appear to consider “carbon risk as a subset of environmental risks comprising ‘any corporate risk related to climate change or the use of fossil fuels,’” (Jung et al., 2018 with reference to Hoffmann & Busch 2008, p. 514). With the understanding that “a firm’s exposure to carbon risk increases the uncertainty of its future cash flows due to both known and currently unknown regulatory, physical and business hazards,” (Jung et al., 2018, p. 1152), the most common climate change disclosure proxy employed in these studies is information related to greenhouse gas emissions (16 times across the 21 studies). Even though this indicates significant focus on emissions, in contrast to the majority of earlier studies in the area that “address carbon performance and neglect disclosure,” (Velte et al., 2020, p.15), we note that 14 of these 16 studies attempt to provide additional information. Specifically, some studies employ a disclosure proxy in relation to emissions, but not explicitly emissions alone (i.e. a dummy variable capturing the disclosure of emissions (Albarrak et al. 2019; Flammer et al., 2021)). Other studies employ the actual emissions or accompanying relevant disclosures. The latter includes whether the emissions are reported in the CDP survey (e.g., Griffin et al., 2017; Cooper et al., 2018), or clarity or completeness of emissions related information (e.g., Andrus et al. 2022; Liesen et al., 2017, respectively), whether carbon emissions are validated by a third party (e.g., Ott & Schiemann, 2022), or the introduction of a related regulation (e.g., Baboukardos, 2017).²⁹ The remaining seven studies explore the capital market consequences of other proxies that capture firm level disclosures (e.g. scores provided by CDP (Alsaifi et al. 2020; Lemma et al., 2019) or scores based on self-constructed (Khan et al., 2022) or CDP based (Schiemann & Sakhel, 2019) disclosure indices).

29. The evidence on the influence of assurance of climate change disclosures on the capital market consequences of such disclosures is discussed in detail in section 3.5. The evidence on the influence of the existence or introduction of a climate change related regulation on the capital market consequences of climate change disclosures is discussed in detail in section 3.6.

Second, we identify two areas for which relatively consistent evidence is reported in this stream of studies. It can be inferred that capital markets perceive high levels of emissions as a risk factor and tend to ‘penalise’ firms for that. Almost universally, there is a negative (positive) association between emissions and firm value or returns (cost of debt capital), while controlling for other factors that usually are associated with these market outcomes. Interestingly, the literature also reports a positive association between responding to the CDP survey and cost of debt proxies. This can imply that a firm’s participation in the survey is perceived as a signal of greater risks. However, in direct contrast to the studies in the Descriptive category (see section 3.2), only a handful of studies that use a self-constructed index as a proxy to capture climate change disclosure. Finally, evidence on the association between a company’s CDP score and a capital market outcome is mixed and thus inconclusive.

Table 6. Main findings of studies that focus on capital market consequences of climate change reporting.

| Capital market consequences theme | Climate change reporting proxy | | | | | | | |
|---|--------------------------------|--------------|-----------|-----------------|------------------------|------------------------------|---|-------------------------------------|
| | Disclosure of emissions | CDP response | CDP Score | CDP-based index | Self-constructed index | Climate strategy disclosures | Assurance of climate change disclosure* | Climate change related regulation** |
| Equity valuation topics | | | | | | | | |
| Market value | - , - , - , - , - | 0 , + | + | | | + | 0 , + , + | + , + , - |
| PE ratio | | | 0 | | | | | |
| Tobin’s Q | | | -/+ , +/- | | | | | |
| Firm level market returns | - , - | 0 | | + | | | | |
| Risk return volatility | - | + | | | | | | |
| Portfolio returns | + | | | | | | | |
| Cost of capital topics | | | | | | | | |
| Cost of debt | + , + , + | + , + | 0 | | | | - | - , + |
| Credit rating | | | | | + | | | |
| Cost of equity | -/+ | 0 | - , 0 | | - , - | | | |
| Weighted average cost of capital (WACC) | + | | - | | | | | |
| Information asymmetry topics | | | | | | | | |
| Bid-ask spreads | -/+ | - | | - | | | | - , - |

“+” denotes a positive association, “-” denotes a negative association, “-/+” denotes a U-shaped association, “+/-” denotes an inverted U-shaped association and “0” denotes no significant association.

A comma distinguishes the findings of different studies that examine the same characteristic.

*The findings on the influence of assurance on capital market consequences of climate change reporting are discussed in detail in section 3.5.

**The findings on the influence of regulation on the capital market consequences of climate change reporting are discussed in detail in section 3.6.

3.4.2 Equity valuation

In the paragraphs that follow, we summarise the findings of the studies we classify in this category of the literature. Before doing so, we outline our observations on key research design features of this specific sub-set of the literature.

Overall, although the studies have been published recently, the data they cover is relatively dated, with the majority focusing on the late 2000s or early 2010s. Moreover, the studies largely employ data from the US, with only one study covering EU firms and one covering the UK. Moreover, no study uses a disclosure index method to capture firms’ disclosures on climate change. They mostly use a relevant metric for emissions (e.g. total emissions, carbon intensity) or whether firms respond to CDP survey. When the climate change reporting proxy is the emissions metrics, studies show a negative association between firm value or returns and the related proxy. In contrast, when the proxy is based on the CDP survey data, the association between the firm value or returns and the related proxy tends to be positive. Nevertheless, given that there is a handful of studies that examine the association between a type of climate change reporting and equity valuation outside the US, readers are urged to consider generalisations of these findings with some caution.

Liesen et al. (2017) use hand-collected information on quantitative GHG emissions for companies from 17 European countries for the period 2005 to 2009 and build portfolios based on three characteristics: disclosure (disclosure vs absence of quantitative GHG emissions); disclosure completeness (disclosure of both Scope 1 and Scope 2 emissions or otherwise); and climate change performance (companies’ levels of absolute GHG emissions performance). Subsequently, they regress portfolios on a standard four factor model extended for industry effects. They find that investors achieve abnormal risk-adjusted returns of up to 13.05% annually by exploiting inefficiently-priced positive effects of (complete) GHG emissions disclosure and good corporate climate change performance in terms of GHG efficiency. In light of these findings, Liesen et al. (2017) conjecture that the costs associated with carbon disclosure and management do not exceed the benefits and also urge investors for the use of such information.

Griffin et al. (2017), Cooper et al. (2018) and Flammer et al. (2021) use data from US companies for significantly overlapping periods; their analysis revolves around CHG emissions, concurrent disclosures in 8-K filings (Griffin et al., 2017) and disclosures in the CDP survey. All three studies find a negative association between emissions and firm value, suggesting that equity market participants incorporate GHG information into valuation judgments. However, this relationship is also influenced by the firm’s reputation for corporate social responsibility (Cooper et al., 2018)³⁰ and companies that voluntarily disclose climate change risks, following environmental shareholder activism, tend to have higher market values post-disclosure (Flammer et al., 2021). These findings suggest that provision of disclosure of emissions to the CDP survey is perceived as a useful step in the right direction by equity market participants, who source information from channels other than the CDP and value transparency around firms’ exposure to climate change risks.

Alsaifi et al. (2020) employ a sample of non-financial UK firms for the period 2007 to 2015, using the firms’ CDP disclosure score as a proxy for climate change reporting and inter alia test its association with various market level outcomes. Along the same lines of finding by Cooper et al. (2018) and Flammer et al. (2021) in the US context, while they find a negative association between the disclosure score and the risk return volatility, they find a positive association with price to book ratio.³¹

30. In fact, Cooper et al. (2018) report that for any given level of GHG emissions, the higher the firm’s CSR score, the greater the adverse impact on firm value. Cooper et al. (2018) interpret this finding as ‘a fallen angel effect’, suggesting that good CSR performance cannot protect firms from being penalised for high carbon risk exposure.

31. Alsaifi et al. (2020) also test the association between the disclosure score implied cost of equity capital and report no significant association between the two.

Finally, Johnson et al. (2020) is the only study that employs an experimental research design. They investigate whether non-professional investors value firms depending on the strategies they use to mitigate GHG emissions. They hold constant a firm's financial performance, investment in emissions mitigation, net emissions and participants' valuation judgements are effectively reflective of the differing strategies. These strategies include making operational changes, which reduces emissions attributable to the firm, and purchasing offsets, which reduces emissions unattributable to the firm. In line with the prior evidence about the influential role of supplementary information to emissions, Johnson et al. (2020) find evidence that non-professional investors value the firm more highly when it primarily uses an operational change strategy versus an offsets strategy, but this result only occurs when the firm's prior sustainability performance is below the industry average. Johnson et al. (2020) argue that this difference in firm value is consistent with the notion that non-professional investors believe information about a firm's emissions management strategy is material.

3.4.3 Cost of capital

The studies in this category are even fewer than those in the previous one, but they look at different countries/contexts. They also differentiate from the previous sub-set in that they mostly focus on the early 2010s and use different proxies for climate change reporting. This may explain the overall inconclusive findings about the association between climate change reporting and cost of equity capital. The overall findings on the association between climate change reporting and cost of debt capital seem more conclusive in that the association tends to be positive (hence climate change reporting induces higher perceived firm risk by debt holders).

Lemma et al. (2017) use data for firms traded on the Johannesburg Securities Exchange (JSE), for the period 2010 to 2015, and draw on data from CDP for identifying their disclosure score as well as Scope 1 GHG. While they report no association between emissions and overall (or equity) cost of capital, they report that voluntary carbon disclosure is negatively associated with overall (and equity) cost of capital. They interpret this evidence as equity market participants' information risk is reduced in light of the additional disclosure. Further, they find that this relationship is not moderated by the level of emissions.

Albarrak et al. (2019) develop a measure (iCarbon) that captures carbon information that non-financial firms with a Twitter account – and which are also listed on the US NASDAQ stock exchange – make on Twitter over the period 2009–2015. Then, they test the association between these disclosures and their implied cost of equity capital (COE). Additionally, in the spirit of Cooper et al. (2018), they consider the potential direct and/or moderating effect of Bloomberg's ESG disclosure score on the COE and the relationship between iCarbon and COE, respectively. In line with the evidence by Lemma et al. (2017), they find that iCarbon is significantly negatively associated with COE. However, they report that the ESG score is neither associated with COE nor it moderates the relationship between COE and iCarbon.

Jung et al. (2018) focus on the Australian context and use a sample of non-financial firms for the period 2009 to 2013. They measure carbon-related risk exposure as the firm's historical carbon emissions while they simultaneously consider firms' carbon risk awareness, proxied inter alia by either a) the firm's willingness to respond to the CDP survey or b) an indicator variable set equal to one if the firm makes carbon-related disclosures through the CDP, a CSR report, its annual report or its website, and zero if none of these applies. In line with the evidence about the influence of emissions on firm value and that of additional/complementary disclosures on firm value and cost of equity discussed earlier, Jung et al. (2018) document a positive association between cost of debt and carbon risk in general. The effect is significantly lower (i.e. effectively negated) for firms exhibiting carbon risk awareness.

Morrone et al. (2021) focus on 61 companies listed in the S&P Energy 500 and thus domiciled internationally for the period between 2003 and 2016. They inter alia examine the association between GHG emissions and cost of debt and, similarly to Jung et al. (2018), report a positive association.

Khan et al. (2022) use a self-constructed 14-item disclosure index and collate carbon reporting related information (QCR) primarily from firms sustainability reports. They use a sample of 300 company-year observations between 2015 and 2020 from top listed firms of New Zealand and explore the association of the level of QCR on market reputation (proxied by S&P credit ratings). Khan et al. (2022) report that, despite the majority of firms having disclosed unaudited carbon information, QCR is positively associated with the market reputations of firms. The latter is an additional finding suggestive of the beneficial role of complementary disclosure.

3.4.4 Information asymmetry

We identify only two studies examining the association between climate change reporting and information asymmetry (Adhikari and Zhou, 2022; Schiemann and Sakhel, 2019). As the study of Schiemann and Sakhel (2019) is discussed in the following section,³² we refrain from making any general conclusions here which would be based on one study only. Adhikari and Zhou (2022) explicitly focus on the role of climate change disclosures and information asymmetry (proxied by bid-ask spreads). They employ a sample of S&P 500 US firms in carbon-intensive industries for the period between 2005 to 2016 and test the potential differential effect of the varying level of responses to the CDP survey. Firms are first categorised in five groups: firms responding to the CDP survey in a timely manner and opting to have the information be made publicly available; firms answering the survey late; firms answering the survey but choosing to keep the information private; firms declining participation; firms that do not complete the survey; and firms offering no response. In the cross-sectional analysis, Adhikari and Zhou (2022) find that firms that decline to disclose carbon emission information, firms that provide incomplete information and firms that do not respond to the CDP survey have higher information asymmetry than firms that provide complete information and opt to make it available to the public. Further, using a pre- and post-disclosure comparison, Adhikari and Zhou (2022) find that the market responds to first-time carbon emission disclosure with decreases in the relative bid-ask spread. Additionally, only firms that participate, provide complete disclosures and opt to make it available to the public enjoy the largest reduction in bid-ask spreads, which is followed by firms that provide incomplete information. Other firms do not experience a reduction in information asymmetry. These findings are in line with the evidence of the beneficial role of complementary disclosure discussed earlier in relation to market value and cost of capital effects.³³

3.5 Assurance of climate change reporting

Providing a form of assurance around climate change reporting is currently a heavily-debated topic, with different standard setters taking different positions. For instance, while the ISSB does not include a requirement for assurance of climate change disclosures in its IFRS S2, EFRAG's ESRS requires limited assurance. Of the 75 studies we review, we find nine studies that explore assurance-related issues. Two of them fall into the Descriptive category, four into the Determinants category, and three into the Capital market consequences category.

In relation to the Descriptive category, Boiral et al. (2022a) explore 17 car manufacturers' adherence with climate change-related GRI Standards for the period between 2014 to 2017. They report measurement issues, such as plurality of methodologies followed and a divergence in the information disclosed. The authors report no significant difference in data quality between third-party assured and non-assured sustainability reports. Further, Tang (2019) discusses the introduction of an audit mandate as specified in China's Audit Law in 2009. According to this regulation, the state auditor shall conduct special independent carbon audits to governmental agencies, state-owned enterprises (SOEs) and other organisations that use funds provided by the government for 'green' initiatives (i.e. projects intended

32. The study by Schiemann and Sakhel (2019) is discussed in the context of assurance in the next section.

33. The study by Gerged et al. (2020) discussed in section 3.6 in the context of regulation the inter alia use bid-ask spreads as sensitivity tests and report a negative association between the spreads and UK firms' annual Scope 1 and Scope 2 emissions.

to reduce GHG emissions and improve energy efficiency). His findings indicate a significant increase (123 occasions) in such audits between the five-year period between 2009 and 2013. He shows that, in the auditing process, it is not uncommon for companies to provide misleading or even false financial information related to GHG-emissions reduction activities. This evidence highlights the crucial role of auditing financial-related climate change reporting as a mechanism of enhancing the reliability and quality of climate change reporting.

As for the Determinants category, two studies examine the sustainability-related determinants of firms' decision to have their climate change disclosures assured by a third party (Datt et al., 2019b; and Fan et al., 2021), and two studies examine country-level factors of climate change reporting assurance (Zhou et al., 2016; and Datt et al., 2020). Datt et al. (2019b) examine a sample of US firms that responded to the CDP survey in the years 2010-2013, while Fan et al. (2021) examine an international sample of companies that responded to the CDP survey between 2011-2015. Both studies show that firms' carbon intensity (i.e. measure of a firm's carbon performance) is positively associated with the firm's decision to engage with assurance. These findings indicate that higher-polluting firms tend to seek for assurance of their climate change reporting. Further, Fan et al. (2021) examine a number of operations-related characteristics, namely firms' complex energy structure (proxied by the number of fuel types used), participation in carbon-intensive sector (proxied by participation in the materials, utilities or energy industries), and quality of climate change reporting (proxied by CDP score). They show that all three characteristics are drivers of the decision to opt for assurance of climate change reporting. However, the association is rather weak between assurance and participation in carbon-intensive sectors.

In relation to country-level factors of climate change reporting assurance, the primary focus of these studies is the legal origins of the country's system a company resides in. Zhou et al. (2016) use an international sample of firms that respond to the CDP survey in the period 2008-2011. They show that firms that reside in stakeholder-oriented countries (i.e. countries with code law legal systems and a stakeholder-oriented business culture) are more likely to engage with assurance compared to firms that reside in shareholder-oriented countries (i.e. countries with common law legal systems and a shareholder-oriented business culture). Datt et al. (2020) use a similar sample of companies for the period 2010-2014 and show that companies residing in code law countries are more probable to opt in for assurance. Further, Zhou et al. (2016) show that a country's rule of law (measured as investors' perception about a country's strength of its legal environment) is negatively associated with a firm's decision to have its climate change reporting assured. This is a rather counterintuitive finding. A potential explanation can be that in countries with low rule of law score, companies are more vigilant about exhibiting credibility of their voluntary climate change reporting. In a separate analysis, Zhou et al. (2016) also examine the drivers of the choice of the assurance provider. They show that firms in stakeholder-oriented countries, as well as firms residing in countries with low rule of law scores, choose accounting firms for assuring their climate change reporting more often than firms residing in shareholder-oriented countries and firms in countries with high rule of law score. Further, Zhou et al. (2016) show that the effects on firms' decision to have the climate change reporting assured and to choose an accounting firm as assurance provider are partially explained by the strength of companies' corporate governance mechanisms. Finally, Datt et al. (2020) also examine the effect of a country's climate change performance (as proxied by the Climate Change Performance Index (CCPI) of the Germanwatch and Climate Action Network Europe) and find that the higher the CCPI the more probable a company to have its climate change reporting assured is.

In relation to the three recent studies that examine capital market consequences of climate change reporting, while simultaneously considering the effect of assurance of such information and the perception of market participants about its role, the evidence is mixed and somewhat inconclusive.

Studies do not uniformly show assurance to be associated with firm value. While Andrus et al. (2022) find a positive association between external assurance of carbon emissions and firm value for an international sample of firms from various industries during the period between 2010 to 2015, Ott and Schiemann (2022) do not find a significant association for a sample of US firms in carbon-intensive industries for the period between 2006 to 2014. Nevertheless, both studies show that, under specific conditions, assurance plays a significant role on the association between firm value and carbon reporting. Ott and Schiemann (2022) decompose carbon emissions into an expected ('normal') level for the industry and an unexpected ('abnormal') level for the industry; they show that the latter is more (negatively) relevant in the presence of assurance. Further, Andrus et al. (2022) explore whether different information traits of voluntary climate change disclosures are associated with market value (proxied by Tobin's Q) and show that disclosures' completeness (assessed based on the CDP score) is positively associated with Tobin's Q metric when such disclosures are assured.

Finally, Palea and Drogo (2020) examine the association between cost of debt and external verification of carbon emissions for a sample of European firms during 2010-2018. They find some evidence of negative association between external verification and cost of debt which can be attributed to debtors trusting more climate change reporting when is verified. Nevertheless, this relationship holds only for firms that exhibit high emissions and for the period before the 2015 Paris Agreement.

3.6 Regulation of climate change reporting

In recent years, climate change reporting has been subject to regulatory initiatives in various parts of the world and the accounting literature demonstrates a growing interest in this topic. Our review identifies two studies examining the quality of climate change reporting in a voluntary vis-à-vis a mandatory setting, eight studies examining regulation-related characteristics as potential determinants and seven studies exploring the role regulation plays on the capital market consequences of climate change reporting. In summary, the evidence of these studies indicates that after a climate-related regulation is mandated, companies engage more and better with climate change reporting. Also, it is shown that the stringency of the regulatory environment determines firms' climate change reporting quality. Further, the presence of an emissions trading scheme is associated with better climate change reporting. Finally, as per the capital market consequences of regulation, recent studies show that the introduction of climate-related regulation is associated with changes in the capital market consequences of climate change reporting in terms of firms' market valuation, cost of capital, and liquidity (i.e. bid-ask spread).

Ferreira et al. (2019) compare the retail sector's decarbonisation strategies of 27 international retailers between 2014-2015 (before the Paris Agreement) and 2016-2017 (after the Paris Agreement). Among other findings, they show an increase of 15% in the number of firms engaging with standardised reporting of their environmental activities and impact after the Paris Agreement. These companies engage primarily with CDP and the GHG Protocol.

While adopting a critical perspective, Ferguson et al. (2016) focus on UK firms that participate in the UK Emissions Trading Scheme (ETS – voluntary setting) and the UK Carbon Reduction Commitment (CRC - mandatory setting) energy efficiency scheme. Specifically, they use discursive analysis of 99 reports from 24 firms that participate in these schemes over a nine-year period (2001 to 2009) and investigate their disclosure strategies for identifying and commenting on how they position themselves within the climate change debate. Ferguson et al. (2016) report that firms follow specific communication techniques that underline their incentives to voluntary disclose. For example, they report that some firms opt for the strategy of 'rationalisation' in order to emphasise the organisational 'opportunities' resulting from climate change and related crises. Additionally, they highlight a shift towards the employment of the 'differentiation' strategy in the mandatory CRC period. Under this communication strategy, companies attempt to displace responsibility by presenting either government or suppliers as barriers to progress.

With regards to the literature on determinants, there are eight relevant studies, which fall into three broad topics: regulatory framework (Guenther et al., 2016; Liu et al., 2017; Kraft, 2018; Mateo-Márquez et al., 2020; Mateo-Márquez et al., 2021; Callery, 2022), emissions trading schemes (Alrazi et al., 2016; Comyns, 2016; Mateo-Márquez et al., 2020), and lobbying (Kraft, 2018).

As for the first topic, recent literature explores climate change reporting practices under a newly introduced regulation, but also under existing regulatory frameworks' stringency and pressure in various settings. In summary, a large part of the literature shows a positive association between the existence of regulatory frameworks about climate-related issues and firms' climate change reporting quality. Nevertheless, some studies fail to show such association and hence the evidence can be seen as inconclusive.

Specifically, Liu et al. (2017) examine whether the Australian government-owned, non-listed corporations have changed their reporting behaviour after they are required to report their carbon emissions under the National Greenhouse and Energy Reporting Scheme (NGERS) in 2009. Their findings show that there is an increase in the quality of climate change reporting (as measured by a CDP-based index) after the implementation of the new regulation. This is unique evidence over the role of government ownership in a setting where common market forces are absent (Liu et al., 2017).

Further, Mateo-Márquez et al. (2020) examine the role of countries' regulatory stringency (as measured by the Environmental Policy Stringency Index from the OECD) on firms' climate change reporting quality (as measured by the CDP survey) in an international sample of firms that responded to the CDP survey in 2015. They find that firms residing in countries with high Environmental Policy Stringency score exhibit a higher CDP score. In a similar vein, Guenther et al. (2016) examine the association between climate change reporting quality (as measured by the CDP survey) and the stakeholders' perception of a country's quality of environmental protection regulation as measured by the Germanwatch. Their results confirm a positive association between a country's quality of environmental protection regulation and climate change reporting quality. Callery (2022) shows, for an international sample of firms, that their decision to opt in as well as opt out the CDP survey is positively associated with the existence of regulation about firms' carbon emission in the country they reside. Specifically, the presence of regulation motivates firms to respond to the CDP survey and disincentivises them from dropping out. Finally, Kraft (2018) focuses on US firms and examines whether the introduction of renewable portfolio standard laws, which require investor-owned electric utilities to generate or purchase a certain percentage of renewable energy, is associated with firms' climate change reporting quality (as proxied by an index constructed by the researcher). He does not find any significant association between either state or national laws and reporting quality. Finally, it should be stressed that, to a large extent, these studies do not examine climate change reporting regulation per se. Hence, there is a need for more research on how reporting regulation affects firms' climate change reporting practice.

The second regulatory-related topic identified by our review is related to the existence of an ETS in the country a firm is resident. Although ETSs are primarily directed to force companies to reduce their carbon emissions by making it too expensive for them to pollute, they indirectly can play a regulatory role as they usually require firms to report their total emissions. For that reason, extant literature approaches ETS as a proxy of a country's regulatory stringency (Mateo-Márquez et al., 2020). All three studies examining the effect of ETSs on firms' climate change reporting find a positive association. In particular, Alrazi et al. (2016) and Mateo-Márquez et al. (2020) find a positive association between firms' domicile in a country with an active ETS and their climate change reporting quality measured by a self-constructed index and the CDP score respectively. Finally, Comyns (2016) finds that firms' climate change reporting quality (measured by a self-constructed index) is associated with firms having installations regulated by the EU ETS regardless of whether the firm is domiciled in a country regulated by the EU ETS. This finding further strengthens the position that ETSs plays an important role as indirect regulation on climate change reporting.

The last topic refers to lobbying and is examined by one study only. Kraft (2018) shows that US-based electric utilities firms' climate change reporting quality is negatively associated with their presence in congressional debates about relevant regulation. However, he finds no association with state-level lobbying (proxied by commissioners being previously employed for an electric utility firm).

Turning our attention on the capital market consequences of climate change reporting regulation, seven studies examine this issue. These studies reveal a positive role of regulation by increasing the perceived reliability of climate change related information by market participants. This is reflected on a stronger association of climate change related information and a capital market outcome. Moreover, accompanying disclosures that provide insights around the risks associated with emissions appear to be more relevant after the introduction of a new, or the presence of, a more stringent climate change regulation.

Specifically, Choi and Luo (2021) employ a large sample of non-financial firms from 28 countries for the period between 2008 and 2015. After controlling for firms' likelihood to provide voluntary carbon disclosures (proxied by publicly disclosing carbon emission information through their participation in the CDP), they find that the levels of total Scope 1 and Scope 2 emissions are negatively related to firm value. This is in line with the findings in other studies previously discussed. However, they also find that this negative impact is more prominent for firms in countries that have a national ETS and more stringent environmental regulations.

Using data on carbon emissions reported by non-financial Australian companies for the period between 2009 and 2015, Choi et al. (2021) also find inter alia that the level of Scope 1 emissions is negatively associated with firm market value. However, somewhat in line with Choi and Luo (2021), the negative effect became stronger after the introduction of the Australian emissions pricing scheme and the Clean Energy Bill in July 2012. When firms are separated according to whether they provide voluntary carbon information by participating in the CDP survey – in addition to their mandatory disclosures – negative effects of direct emissions are found in the group with low disclosure scores and in the group with poor carbon management performance. This is interpreted as poor carbon performance is less tolerable when not accompanied by enhanced disclosure that could assist in understanding the risks associated with emissions.

Motivated by the 2015 Paris Agreement, Palea and Drogo (2020) use a sample of non-financial firms from 13 eurozone countries for the period between 2010 and 2018, and investigate the association between Scope 1 and Scope 2 carbon emissions, as well as the cost of debt financing. In line with related literature, they find a positive association between cost of debt and carbon emissions. However, although this finding holds for the high emitting firms before the Paris Agreement, such firms are not further penalised in the subsequent period, and the less-polluting firms started being charged a higher spread for their emissions, but only in the period after the Agreement. In parallel, Palea and Drogo (2020) also test the potential effect of firms' voluntary carbon information by participating in the CDP survey. They report that only the participation in the survey from the sub-sample of high-polluting firms is associated with lower cost of debt and, in fact, the finding is driven by the post Paris agreement period.

In the US, companies are required to disclose material climate risk in Form 10-K. However, the regulation leaves room for judgment from the managers' point of view, resulting in a lack of consensus on whether climate risk is material to the firms and about the likelihood of enforcement of disclosure regulations. Using a self-constructed proxy (based on the SASB Materiality Map™) for market expectations of climate risk materiality, Matsumura et al. (2022) employ a sample of S&P 500 US firms for the period between 2008 and 2016 and test whether the association between disclosing climate risks in 10-Ks and implied cost of equity capital (COE) varies with market expectations of climate risk materiality. They find that disclosing firms' COE is significantly lower than non-disclosing firms' COE. In industries in which perceived climate risk is material, disclosing firms' COE is even lower than non-disclosing firms. Further, in industries in which the market does not expect climate risk to be material, disclosing firms' COE is again lower than non-disclosing firms.

Gerged et al. (2020) is motivated by the regulation that required all listed firms in the UK to report their annual Scope 1 and Scope 2 GHG emissions in their annual reports from 2013. The study uses a sample of FTSE 350 for the period between 2011 and 2016 and examines the effect of firms' disclosing GHG emissions on the implied COE. The authors find a nonlinear association between emissions and COE. Specifically, they report a negative association between the level of emissions with COE up to a certain level, which is known as the turning point; then, any increase in emissions is likely to increase the COE. Furthermore, they document a moderating effect of the 2013 carbon disclosure regulation on the emissions–COE nexus. In an additional analysis, Gerged et al. (2020) inter alia report similar associations between information asymmetry (proxied by average bid–ask spreads) and emissions, as well as the moderating effect of the introduction of the carbon emissions regulation. These findings arguably add some nuance to the earlier findings by Baboukardos (2017) on the same topic. He uses data for the period 2011 to 2014 and employs a large sample of non-financial UK listed firms. The study finds that the magnitude of the negative association between GHG emissions and market value decreased after the introduction of the reporting regulation.

Finally, Schiemann and Sakhel (2019) use a self-constructed index that draws input from firms' responses in the CDP questionnaire for 717 European companies during the period between 2011 and 2013. They find that information asymmetry (proxied by average of all daily bid–ask spreads) is generally smaller when firms report about their physical risks. Moreover, they find that reporting of a higher exposure to physical risks is associated with lower information asymmetry for firms falling under the regulation of the EU ETS, whereas for other firms the direction of the relationship reverses.

4. Concluding remarks: practical implications, recommendations, and suggestions for future research

The ever-growing interest of regulators, public authorities, preparers and users in climate change reporting call for a better understanding of what firm characteristics are associated with firms' reporting practices, as well as the consequences such reporting has in capital markets. Further, considering the current endeavours for regulating climate change and, more broadly, sustainability reporting across the world (Baboukardos et al., 2023), firms' climate change reporting practices and quality is of particular importance.

In light of the above, this systematic literature review provides a comprehensive overview of the academic research findings published over the period 2016–2022 on the determinants and capital market consequences of climate change reporting. In addition, this report covers descriptive academic research on the quality of climate change reporting. It is important to stress that due to the rather long peer-review process required for an academic study to be published, the studies reviewed, although published up to 2022, empirically cover years up to 2020. Hence, the findings of our review relate to voluntary, and largely unstandardised, reporting settings. Nevertheless, this review provides relevant to a mandatory reporting regime evidence on the country- and company-level characteristics associated with good climate change reporting, and what the capital market consequences of climate change reporting are.

Our findings are expected to be relevant to a wide range of ICAS stakeholders. As ICAS has clearly stated, its commitment is to strengthen its members' understanding and awareness of climate change issues and to provide its members with support to value climate change reporting (GAA, 2022). The findings are expected to be relevant for preparers and users of such reporting, as well as other ICAS stakeholders. Further, given that the evidence we summarise is based mostly on unregulated regimes prior to the release of the IFRS Sustainability Standards and ESRS, this report aims at supporting standard setters and policy makers in the development of effective regulations. Finally, this report identifies research gaps and provides suggestions to ICAS and academics more widely for future research endeavours. These are discussed in turn in the sub-sections that follow.

4.1 Practical implications and recommendations

Our literature review can be of interest to various ICAS stakeholders, namely preparers, auditors, and users of climate change reporting.

Based on our review, should firms wish to enhance their climate change reporting quality, they can consider taking actions that are aligned with the following findings. The literature found that firms that exhibited superior climate change reporting tended to have a more diverse board of directors (especially in terms of gender and ethnicity) and more independent directors. Further, adopting an integrated thinking approach in firm decision making (Adams, 2017) – by taking into consideration financial as well as environmental and social implications of their operations – was associated with better or more voluminous climate change reporting. This was shown by studies that examine specific aspects of firms' environmental/sustainability performance (such as belonging to sustainability leadership indices, engaging with environmental R&D, and acquiring environmental certifications). Another potentially useful finding for preparers is the positive association between firms' climate change reporting quality and active engagement of their shareholders and other stakeholders such as employees, customers and media pressure. Consequently, the findings can be encouraging evidence for companies to develop relevant corporate governance mechanisms (through the appointment of more diverse and independent directors), to adopt a more integrated thinking approach for their operations, and to actively include their shareholders/stakeholders in their sustainability and climate change-related activities. Finally, our review shows that companies that were enrolled in an emissions trading scheme provided information of better quality. Considering the recent development of carbon markets (Favasuli and Sebastian, 2021), companies may consider their voluntary involvement with carbon credits markets as an additional mechanism of enhancing their climate change reporting.

Turning our attention to auditors, previous studies have provided some preliminary evidence that voluntarily assured climate change reporting was not necessarily of higher quality than a non-assured one. A potential reason for that could be the plurality of reporting standards and measurement methods applied by the companies. As audit firms have a large share of the assurance market, it is advisable to ensure that companies engage with acceptable reporting standards in a complete and reliable manner. The recently released International Standard on Sustainability Assurance (ISSA) 5000 by the International Auditing and Assurance Standards Board (IAASB, 2023) can be seen as an important stepping stone towards this direction. Indeed, ICAS has also stated its support for the development of ISSA 5000 (ICAS, 2023). Further, our review reveals that firms' decision on whether to have their climate change reporting voluntarily assured varied with companies' country of residence. Companies residing in low rule of law countries sought to have their climate change reporting assured more often; they chose to have their reports assured by an accounting firm. Based on that, there appears to be a scope for audit firms to expand their activities in such institutional environments. This can be mutual beneficial for the audit firms and the companies.

As there is a growing interest among investors and other stakeholders over risks and opportunities companies are facing in relation to climate change, as well as their adaptation and mitigation activities, our findings suggest that firms' voluntary reporting practices were far from optimal. Firms were found to provide limited disclosures that hindered the capacity of users to draw reliable inferences and make informed decisions over a firm's performance on climate change-related matters. Although the standardisation of climate change reporting is expected to enhance its quality, users of such disclosures may need to be vigilant when using these reports. In fact, it appeared that, in a voluntary setting, even the assurance of such disclosures by a third party did not necessarily ensure the quality of climate change reporting and hence it could not be seen as a clear signal of quality. The discussion above on preparers can be read through the lens of users' needs as well. For instance, users may need to be more vigilant when they use climate change information provided by firms that engage less their stakeholders/shareholders in their climate change-related activities and have less diverse and independent board of directors.

As a final remark for all three ICAS stakeholder groups indicated above, as climate change reporting is found to have important capital market consequences, there is a need for ensuring its quality and relevance to financial providers' decision-making process. Preparers, auditors, and users are all key players for ensuring high quality of climate changing reporting. Hence, active coordination towards that goal from all stakeholder groups is pertinent.

4.2 Policy implications and recommendations

As ICAS has also committed to support the development and alignment of international regulations and disclosure frameworks of sustainability and climate change reporting (GAA, 2022) – and as standard setters, public authorities and local governments are currently in the process of regulating and standardising climate change reporting in various jurisdictions across the world – our review is of particular relevance.

At the moment, three main 'blocks' in climate change reporting have emerged. First, the 'investor-centric' approach of ISSB, which focuses on the financial relevance of climate change reporting. Second, the GRI Standards, which take a more 'stakeholder-centric' approach (although the information required by these standards are relevant to investment decisions as well). Third, the 'double-materiality' approach of ESRS, which reconciles the two approaches of ISSB and GRI. Our review, although focused on a period before the release of the IFRS Sustainability Standards and the ESRS, may provide some useful insights on the future of climate change reporting. Specifically, our review reveals that the importance of climate change reporting for investment decisions, as well as climate change reporting quality, was affected by presence and/or pressure from stakeholders with no direct financial interest in companies. Hence, a one-dimensional focus on climate change reporting may create informational 'voids' for users of climate change reporting. Regulators need to address this issue and identify appropriate ways to reconcile information needs of financial and non-financial stakeholders. To that end, we believe that the Statement of Cooperation signed by EFRAG and GRI (EFRAG & GRI, 2021),³⁴ the Memorandum of Understanding signed by IFRS Foundation and GRI (IFRS Foundations & GRI, 2022), and the high degree of alignment between the ESRS E1 and the IFRS S2 announced in summer 2023 (IFRS Foundation, 2023)³⁵, are useful developments towards a holistic approach in climate change reporting.

At the same time, our review can inform the debate over the recently released SEC final rules for disclosures on certain climate-related information in registration statements and annual reports. Although the initial 2022 US SEC proposal on extensive financial-focused climate change disclosure requirements was not particularly welcome by some US companies (Vanderford, 2023), and the final regulations passed in March 2024 are under certainty (Vanderford, 2024), our review reveals that climate change reporting has valuation relevance for capital market participants, whereas relevant regulation appears to enhance its reliability. Consequently, the findings of this review support calls for the standardisation of climate change reporting.

34. <https://www.efrag.org/sites/default/files/sites/webpublishing/SiteAssets/EFRAG%20GRI%20COOPERATION%20PR.pdf>

35. <https://www.ifrs.org/news-and-events/news/2023/07/european-comission-efrag-issb-confirm-high-degree-of-climate-disclosure-alignment/>

Similarly to the above discussion, the various climate change reporting standards currently in place would lead to a 'multiverse' of reporting regulation (Baboukardos et al., 2023). Since the beginning of 2024, EU firms are required to comply with the ESRS. Countries like Brazil and the UK, however, are in the process of issuing national regulations that are based on IFRS Sustainability Standards.³⁶ It is yet unclear how other countries in the rest of the world will respond. Our review highlights that, in absence of regulation, companies' climate change reporting varies considerably across countries. The existence of multiple regulations may result to an undesirable polyphony with companies residing in different countries being subject to more- or less-strict reporting regulations. Companies based in multiple countries might also have to comply with different – and potentially contradicting – reporting frameworks. Although this 'reporting standards competition' may have beneficial impact on the further development of the standards, we urge regulators to consult the findings of our study that highlight the differences in climate change reporting practices amongst countries.

Finally, our review highlights the potentially favourable effects of assurance on both the quality of climate change reporting and its capital market consequences, in voluntary reporting and assurance settings. Regulators/standard setters need to (re)consider their stance over the issue of assurance. In particular, in the IFRS Sustainability Standards, no reference to assurance is made. Considering that disclosures required by the IFRS S2 will not necessarily be disclosed within the financial statements and related notes, their quality can be questionable and their capital market consequences less (or not) favourable.

4.3 Suggestions for future research

As it is revealed from our review, most of the studies published in the recent past focus on the drivers of climate change reporting practice and much less on the capital market consequences of such reporting. Although studies in both areas provide some interesting insights, a number of important issues are still underexplored and worth further investigation. In this sub-section, we provide suggestions for future research avenues that ICAS and its stakeholders may consider. We first discuss future research suggestions related to the determinants of climate change reporting practice and then to its capital market consequences.

To begin with, there is still scope for the examination of corporate governance mechanisms' role on climate change reporting. Although many companies have already established environmental committees within their boards to improve their efforts towards battling climate change, and hence enhance their environmental profile, our review indicates that an environmental committee is not often found to be associated with better climate change reporting. Considering that such committees are expected to play a central role in reporting, future research is needed to explore the reasons for this 'failure' and propose solutions to enhance the role and outputs of environmental committees. We urge such research to be qualitative in nature or based on in-depth case studies, which are scant in the literature. and, Gendron (2009, p. 123) highlights that "*qualitative research constitutes a relevant research method in the development of better understandings of complex accounting realities and processes*". Such studies provide rich insights about behaviours, beliefs and institutions and assist in identifying patterns across research sites (Leventis et al., 2023). Second, some preliminary evidence signals that shareholder activism is associated with better climate change reporting. Nevertheless,

36. Specifically, in December 2024, the UK Sustainability Disclosure Technical Advisory Committee (TAC) has published its final recommendations to the UK government, recommending endorsing IFRS S1 and IFRS S2 for use in the UK with minor amendments (UK Sustainability Disclosure TAC, 2024). Additionally, "the Brazilian Ministry of Finance and the Comissão de Valores Mobiliários (CVM) have announced that the ISSB IFRS Sustainability Standards will be incorporated into the Brazilian regulatory framework, setting out a roadmap to move from voluntary use starting in 2024 to mandatory use on 1 January 2026." See <https://www.gov.uk/guidance/uk-sustainability-disclosure-standards> and <https://www.ifrs.org/news-and-events/news/2023/10/brazil-adopts-issb-global-baseline/>, respectively.

as discussed earlier, this finding cannot be seen as conclusive as it reflects evidence from a handful of studies that focus on a particular context/country. Hence, more research is needed to empirically confirm this association as well as to explore what mechanisms are used by active shareholders to push companies report better.

Additionally, it appears that companies that consider the environmental and social impact in their daily operations exhibit better climate change reporting. This finding supports the notion of ‘integrated thinking’ (Adams, 2017) to decision-making and operations within an organisation. Nevertheless, as integrated thinking is a relatively new concept, more research is needed to understand better how such an approach can be implemented by firms and how it can be reported through an Integrated Reporting approach. Again, qualitative research and in-depth case studies could provide rich evidence on participants related views, behaviours and attitudes. Further, our review shows that country-specific characteristics are strongly related to firms’ climate change reporting practice.

Another interesting aspect worth further investigation is the role of climate change-related regulation. As our review shows, the results on regulation are inconclusive. This indicates that merely making regulatory reforms does not necessarily lead to changes in firms’ practice. Future research may explore what drives regulatory effects. For instance, looking at how regulation is planned and implemented, and how its implementation by companies is overseen by authorities. To this end, we need to stress that while our review covers the relevant literature published in recent years (2016 to mid-2022), with only a handful of exceptions, the sample periods covered relate to climate change reporting in non-mandatory reporting regimes and certainly prior to the implementation of the ESRS and ISSB standards. Importantly, we note that the existing literature largely relies on disclosure scores or related proxies as provided by third parties (or self-reported by the firms in third parties). However, there is very limited evidence on the actual disclosures provided by firms and captured by researchers in a systematic way.

Turning our attention to capital market consequences literature, our review shows that most of previous studies focus on market valuation implications of climate change reporting and, to a much less extent, on cost of capital. Based on that, the evidence on how capital markets use climate change related disclosure to assess firms’ risk is limited. Although, cost of capital can be seen as a proxy of risk, there are only four studies that explore this issue. In addition, our review identifies that no study has examined the association between climate change disclosures and firms’ market risk. Considering the central role risk has on climate change reporting, we urge future research to provide evidence on these issues.

Further, it is worth highlighting that most of studies on capital market consequences use as proxy of climate change reporting firms’ carbon emissions level or data from the CDP survey. The former is obviously one dimension of firms’ exposure to climate change. Nevertheless, it fails to gauge the depth and breadth of relevant disclosures. Future studies could fill this gap by adopting more refined and comprehensive metrics of climate change reporting such as the use of disclosure indices or various textual analysis techniques (e.g. natural language processing). Such research can be better facilitated now given that specific frameworks exist (e.g. TCFD, ISSB IFRS S2, & ESRCS E1) and researchers can develop their research instruments based on those. In addition, future research is needed to better understand the role of reporting regulation as well as of assurance on the relationship between climate change reporting and capital markets. Regulation and assurance are seen as two important mechanisms for enhancing the reliability, credibility and relevance of climate change reporting. Nevertheless, our literature review revealed that there is little empirical evidence about their role on capital markets.

Finally, considering the IASB’s recently introduced project on how financial statements can better reflect climate change-related risks (IFRS Foundation, 2023),³⁷ the continuous consideration of connectivity between IFRS Accounting and IFRS Sustainability Standards (IFRS Foundation, 2023),³⁸ the ongoing debate over the SEC’s final rules on extensive financial-focused climate change disclosure requirements, and the first year of application of ESRS in the EU, we believe that ICAS should support research project(s) which will inform current developments in climate change reporting. Some potentially interesting topics can be the application of connectivity of information at the back- and front- ends of annual reports, identification and disclosure of climate change-related risks in the financial statements, and the benefits and drawbacks in applying the ESRS – to name but a few.

Future research on the above topics will not only enrich our theoretical understanding over the drivers of climate change reporting, but will also provide useful insights on what companies and public authorities can do should they intend to improve climate change reporting practice.

37. <https://www.ifrs.org/news-and-events/news/2023/03/connectivity-in-practice-the-iasbs-new-project-on-climate-related-risks-in-the-financial-statements/>

38. <https://www.ifrs.org/news-and-events/news/2023/03/connectivity-what-is-it-and-what-does-it-deliver/>

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7. Appendices

Appendix 1: List of target journals for the systematic literature review

| PANEL A: JOURNALS RANKED HIGHER IN THE CABS AJG 2021 LIST (4*, 4, 3) | |
|--|---|
| Accounting | Economics |
| Journal of Accounting Research | Ecological Economics |
| Accounting Review | Environmental and Resource Economics |
| Accounting, Organizations and Society | Journal of Environmental Economics and Management |
| Journal of Accounting and Economics | |
| Review of Accounting Studies | Ethics – CSR – Management |
| Contemporary Accounting Research | Business and Society |
| British Tax Review | California Management Review |
| Journal of Accounting, Auditing and Finance | Journal of Business Ethics |
| Journal of Accounting Literature | |
| Journal of International Accounting, Auditing and Taxation | Operations and Technology |
| International Journal of Accounting | Manufacturing and Service Operations Management |
| British Accounting Review | |
| Critical Perspectives on Accounting | Organizational Studies |
| Management Accounting Research | Organization and Environment |
| Abacus | |
| Accounting Forum | Public Sector |
| Financial Accountability and Management | Environment and Planning C: Government and Policy |
| European Accounting Review | |
| Journal of Business Finance and Accounting | Social Science |
| Foundations and Trends in Accounting | Business Strategy and the Environment |
| Accounting Horizons | |
| Auditing: A Journal of Practice and Theory | Strategy |
| Behavioural Research in Accounting | Strategic Management Journal |
| Journal of the American Taxation Association | Strategic Organization |
| Accounting, Auditing and Accountability Journal | |
| Journal of Accounting and Public Policy | |
| Accounting and Business Research | |

PANEL B: JOURNALS RANKED LOWER IN THE CABS AJG LIST 2021 (2, 1)

| Accounting | Finance |
|--|--|
| Accounting Research Journal | Journal of Applied Corporate Finance |
| Australian Accounting Review | |
| Current Issues in Auditing | International Business & Area |
| International Journal of Auditing | Thunderbird International Business Review |
| Journal of International Financial Management and Accounting | |
| Managerial Auditing Journal | Regional Studies, Planning and Environment |
| Sustainability Accounting, Management and Policy Journal | Corporate Social Responsibility and Environmental Management |
| Australasian Accounting, Business and Finance Journal | |
| Pacific Accounting Review | Sector |
| | Energy Policy |
| Economics | |
| B.E. Journal of Economic Analysis and Policy | Social Science |
| | Journal of Industrial Ecology |
| Ethics – CSR – Management | |
| Australian Journal of Management | |
| Business and Politics | |
| European Management Journal | |
| Management Decision | |

Appendix 2: Number of relevant articles in the selected journals

| Journal Title | Field | No of papers reviewed | % of papers reviewed |
|--|--|-----------------------|----------------------|
| 1. Strategic Management Journal (4*) | Strategy | 1 | 1.33% |
| 2. Contemporary Accounting Research (4) | Accounting | 2 | 2.67% |
| 3. Review of Accounting Studies (4) | Accounting | 1 | 1.33% |
| 4. Accounting and Business Research (3) | Accounting | 2 | 2.67% |
| 5. Accounting Forum (3) | Accounting | 3 | 4.00% |
| 6. Accounting, Auditing and Accountability Journal (3) | Accounting | 1 | 1.33% |
| 7. Auditing: A Journal of Practice and Theory (3) | Accounting | 1 | 1.33% |
| 8. British Accounting Review (3) | Accounting | 4 | 5.33% |
| 9. Business and Society (3) | Ethics - CSR - Management | 1 | 1.33% |
| 10. Business Strategy and the Environment (3) | Social Science | 19 | 25.33% |
| 11. Critical Perspectives on Accounting (3) | Accounting | 1 | 1.33% |
| 12. European Accounting Review (3) | Accounting | 1 | 1.33% |
| 13. Financial Accountability and Management (3) | Accounting | 1 | 1.33% |
| 14. Journal of Accounting and Public Policy (3) | Accounting | 2 | 2.67% |
| 15. Journal of Business Ethics (3) | Ethics - CSR - Management | 9 | 12.00% |
| 16. Journal of Business Finance and Accounting (3) | Accounting | 2 | 2.67% |
| 17. Organization and Environment (3) | Organizational Studies | 5 | 6.67% |
| 18. Accounting Research Journal (2) | Accounting | 4 | 5.33% |
| 19. Australian Accounting Review (2) | Accounting | 2 | 2.67% |
| 20. Australian Journal of Management (2) | Ethics - CSR - Management | 1 | 1.33% |
| 21. Energy Policy (2) | Sector | 1 | 1.33% |
| 22. International Journal of Auditing (2) | Accounting | 1 | 1.33% |
| 23. Journal of International Financial Management and Accounting (2) | Accounting | 1 | 1.33% |
| 24. Sustainability Accounting, Management and Policy Journal (2) | Accounting | 5 | 6.67% |
| 25. Corporate Social Responsibility and Environmental Management (1) | Regional Studies, Planning and Environment | 4 | 5.33% |
| Total | | 75 | 100.00% |

Note: Journals are first presented based on the ranking in the CABS AJG list and then in alphabetical order.




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