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The Firm's Integration Process of the Twin Pillars of Environmental Sustainability: Climate Change and Biodiversity Loss

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April 2024

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The firms' integration process of the twin pillars of environmental sustainability: climate change and biodiversity loss

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Abstract

This study examines the integration of climate change and biodiversity into business strategies and governance structures of listed firms on the Swedish stock exchange NasdaqOMX Large Cap. The results show clear disparities in the level of integration and the factors driving the integration process. All, but a few small firms, have integrated climate change into business strategies, and are ahead in the process of integrating it into governance structures. Biodiversity integration is lagging behind the integration of climate change. We also find that the integration process depends on the sustainability competences within the board unlike climate change when the board composition is less important. Additionally, our results show that firms require external pressures from, e.g., regulations to integrate biodiversity and climate change into business strategies and governance structures.

Keywords: biodiversity; climate change; sustainable finance; business strategy; governance structures; CSRD

1. Introduction

Climate change has dominated policy agendas, the academic research, and the media reporting for many years (Pinkse & Kolk, 2009; Legagneux et al, 2018; Andersson and Arvidsson, 2023; Arvidsson and Sabelfeld, 2023). Given the urgency and scale of the climate crisis this prioritization is not without cause. However, the narrow focus on climate change runs the risk of overshadowing other critical aspects of environmental sustainability not least biodiversity. The level of biodiversity loss is not only high, but it has also accelerated in recent years with estimates suggesting that the stock of natural capital per person have declined by 40 percent between 1992 and 2014 (Dasgupta, 2021). Despite the close link between climate change and biodiversity loss—each exacerbating the other's impact (Heller and Zavaleta, 2009; Weiskopf et al, 2020; IPBES, 2019) - biodiversity has received comparatively less attention (Panwar et al, 2022). The complex interplay between biodiversity and climate change underscores the necessity of adopting a holistic approach when it comes to environmental sustainability (Arvidsson, 2024). Concentrating exclusively on one aspect, whether biodiversity or climate change, could unintentionally aggravate the challenges associated with the other, or at the very least, complicate efforts to address both effectively. This interconnectedness suggests that business strategies aimed at mitigating climate change or preserving biodiversity should be designed with an awareness of their potential impacts on the broader environmental sustainability agenda.

The aim of this study is to examine the extent to which firms have incorporated biodiversity and climate change into their business strategies and governance structures. Given the prevailing emphasis on climate change, a central inquiry of our research is to determine how the integration of climate change compares with that of biodiversity. So far, research on the integration of biodiversity into firm strategies and governance structures is limited (Hassan and

Atkins, 2020; de Carvalho et al., 2022), and much of the existing literature evaluates firm strategies through the lens of external sustainability reporting (see e.g., Carvajal et al., 2021; de Carvalho et al., 2022; Panwar et al., 2022). A key contribution of our study is to go beyond the external reporting and to focus on the internal sustainability work of the firm. This in-depth analysis is made feasible by employing unique in-depth survey data from firms listed on the NasdaqOMX Large Cap Stock Exchange in Stockholm The survey is designed to study the sustainability practices of large and publicly traded firms on the NasdaqOMX stock exchange through an annual survey that poses detailed questions about various aspects of environmental sustainability. The level of detail of survey questions enables us to delve deeper than external reports, offering a comprehensive examination of the progress firms are making in integrating climate change and biodiversity considerations into their business strategies and governance structures. With a high response rate of approximately 70 percent annually, the survey provides a good representation of the sustainability initiatives of these large firms. In the analysis we employ data from the 2022 and the 2023 survey waves, which focused on the integration of climate change and biodiversity respectively.

Building on previous research we outline four hypotheses related to factors that may affect the integration of biodiversity and/or climate change into a firm's business strategy and governance structure: i) the size of the firm, ii) the board composition, iii) public policies, and iv) industry affiliation. These four hypotheses are tested using logistic probability models. Our results confirm that the integration of climate change has progressed faster compared to biodiversity and that all but a few smaller firms have to a relatively high degree integrated climate change into both their business strategies and governance structures. Biodiversity on the other hand is far less integrated. Unlike for climate change, integration of biodiversity is primarily caused by having recruited a person with environmental sustainability competence to serve on the board.

We also find that some firms in anticipation of new and upcoming EU environmental sustainability reporting regulations have begun to integrate biodiversity into business strategies and governance structures to a greater extent than before. These results suggest that we may expect more firms to include biodiversity considerations in their environmental sustainability work in the future. So far, our results suggest that firms are on a similar journey as with climate change where practices, business strategies, and governance structures have evolved over time to take into account climate change risks, impacts, and opportunities (see e.g., Andersson and Arvidsson, 2023b).

The rest of the paper is organized as follows. We present our hypotheses in Section 2. Section 3 contains the data. The empirical results are presented in Section 4. Finally, Section 5 concludes the paper.

2. Theoretical background and literature review – four hypotheses

There are several potential factors, both internal and external, that may explain why a firm choose to integrate environmental sustainability in general, and biodiversity and climate change in particular, into their business strategy and governance structure. These factors include improved risk management (Carvalho et al., 2022; George et al., 2015), and improved management of scares resources (Biloslavo et al., 2018; Wolff et al., 2018), both which may reduce potential costs for the firm. Other factors include enhanced business opportunities by pioneering new technologies to reduce dependencies and impacts on nature as well as cutting costs or providing new business opportunities (Xie et al., 2022). There are also potential positive reputational effects among customers and investors that may enhance sales and reduce the cost of capital (Krause and Matzdorf, 2019; Lebdioui, 2022; de Boer and Aiking, 2021;

Gatti et al., 2022). External stakeholders, and public policies may also mandate or incentivise firms to enhance their sustainability efforts (He et al., 2021).

As most firms, considered in our study, are subject to similar external pressures and opportunities we need to examine additional firm specific characteristics to understand differences in the level of integration of biodiversity and climate change considerations. Based on the literature we develop four hypotheses that focus on firm *size* (Hypothesis 1), *board composition* (Hypothesis 2), *regulatory exposure* (Hypothesis 3), and *industry affiliation* (Hypothesis 4).

The first hypothesis is,

Hypothesis 1: *Larger firms are more likely to integrate biodiversity and climate change into their business strategy and governance structure*. *Size of the firms matters in particular for biodiversity.*

There are a few potential channels through which firm size may affect the likelihood for a firm to integrate biodiversity and climate change into its business strategy and governance structure. First, larger firms face greater scrutiny by external stakeholders such as investors, customers, government agencies, the media, and non-governmental organizations (Udayasankar, 2008; Forcadell et al., 2022). In a society where environmental concerns rank at the top of the public agenda, it becomes a necessity for larger firms in the public spotlight to commit to the public sustainability agenda to maintain its legitimacy among the external stakeholders (Cormier and Magnan, 2013). For smaller firms that do not face the same level of scrutiny these external pressures may not be as large. On the other hand, integration of biodiversity and climate change

may also provide financial benefits such as higher shareholder values and lower cost of capital (Flammer, 2015; Dhaliwal et al., 2011; Plumlee et al, 2015), which could incentivise also smaller firms to integrate biodiversity and climate change into their business strategies and governance structures. Though, some studies such as Bhandari and Javakhadze (2017) questions these positive effects.

Second, the integration of biodiversity and climate change is costly. Especially biodiversity, which requires more advanced analytical methods and tools to identify risks, dependencies and opportunities (Kennedy et al., 2022; Nedopil, 2022). Thus, firms need to devote more resources to develop the tools and metrics to map, report, and integrate biodiversity considerations into its business strategies and governance structures. Larger firms are more likely to have the available resources to devote to biodiversity compared to smaller firms (Udayasankar, 2008) indicating that the effect of firm size is potentially stronger for biodiversity compared to climate change. Overall, we thus posit that larger firms are more likely to integrate biodiversity and climate change into business strategies and governance structures and that the effect is most pronounced for larger firms.

In our second hypothesis we focus on the internal processes of the firm. We hypothesise that,

Hypothesis 2: *The integration of biodiversity and climate change into corporate strategies and governance structures hinges on the board's active involvement and expertise in line with the global environmental sustainability agenda. The board is particularly important for the integration of biodiversity.*

How much a firm engages with the global environmental sustainability agenda depends partially on the characteristics of the managers and the board members (Davidson et al., 2018). Research shows that the education and training, personal views, and their prior experience of environmental sustainability issues among the managers and the board members impact the level and quality of the sustainability work of the firm (Dalla Via and Perego, 2018; Lewis et al., 2014; Parker, 2014; Peters and Romi, 2015). However, as external pressures on firms to address climate change has grown rapidly in recent years, we expect the composition of the board to matter less for the integration of climate change compared to the integration of biodiversity. All or most firms are likely to respond to the climate change agenda irrespective of the composition of the board.

Part of the external pressures on climate change comes from public policies within the European Union mandating firms to map and report on environmental related risks, impacts, and dependencies. This leads us to our third hypothesis,

Hypothesis 3: *Governmental policies serve as a catalyst, encouraging firms to integrate biodiversity and climate change into their business strategies and governance structures.*

Announced in 2019, the EU's Green Deal serves as a comprehensive framework aimed at transforming the union into a modern, resource-efficient, and competitive economy, targeting net-zero carbon emissions by 2050 and decoupling economic growth from resource consumption (European Commission, 2023b). Part of the EU Green Deal is the Corporate Sustainability Reporting Directive (CSRD) that mandates large firms to identify and report on a range of social and environmental sustainability risks, impacts and dependencies (European Commission, 2023c). Associated with the CSRD are the European Sustainability Reporting

Standards (ESRS) that sets the reporting standard. The CSRD and the ESRS empower external stakeholders to assess a firm's sustainability performance, thereby reinforcing external pressures on firms to mitigate their adverse environmental impacts. Additionally, this mapping and reporting process aims to equip firms with the essential common ground to generate data, and frameworks needed to integrate environmental sustainability into their business strategy and governance structure. Evaluating the climate-related, and especially biodiversity related, risks, impacts, and dependence is difficult (see e.g., Nedopil, 2022), which may prevent the integration of biodiversity into business strategies and governance structures. By providing a common framework, government policies not only incentivise the integration, but also enables it.

The CSRD replaces the Non-Financial Reporting Directive (NFRD) that came into effect in 2018 and extends the reporting requirements to five specific environmental standards (European Commission, 2023a): Climate change (E1), Pollution (E2), Water and Marine Resourses (E3), Biodiversity and Ecosystems (E4), and Resource Use and Circuar Economy (E5). The CSRD is based on the "double materiality" perspective, i.e., firms are required to report both on their impacts on the environment, and on how environmental issues create financial risks and opportunities for the firm. However, firms are only required to report "material information" and may disregard environmental sustainability areas that are not deemed material to the firm (European Commission, 2023). While we would expect the CSRD to have a more pronounced effect on the integration of biodiversity into business strategies and governance structures compared to climate change, the firms' approach towards assessing materiality may weaken this effect.

The first year to report in accordance with the CSRD is for the financial year 2024 with reports published in 2025. Given that our survey is undertaken prior to the CSRD comes into effect the impact of the CSRD is potentially diminished. Nevertheless, we may still observe firms responding in anticipation of the new regulatory framework by updating existing practices (He et al., 2021). The European Commission published a draft version of the CSRD already in 2021, and there have been several rounds of consultation before the adoption of the final regulation. Thus, there has been ample time for firms to begin to adjust and adapt before the CSRD comes officially into effect.

The concept of materiality within the CSRD framework implies that the extent to which a firm integrates biodiversity and climate change into its business strategy and governance structure might be connected to the potential impact that biodiversity loss and/or climate change could have on the firm. Given the varying implications across the value chain, this leads us to our fourth and final hypothesis:

Hypothesis 4: *Industry affiliation significantly influences the extent to which firms incorporate environmental sustainability into their business strategies and governance structures.*

Industry affiliation could influence the likelihood of a firm integrating environmental sustainability into its business strategies and governance structures via multiple potential channels. Firstly, the nature and extent of direct risks, impacts, and dependencies differ across industries. For instance, upstream production firms are generally more reliant on the environment than downstream firms engaged in consumer sales. Moreover, upstream firms with a pronounced direct environmental impact may amplify their environmental efforts to gain credibility among external stakeholders despite their negative impacts (Hummel and Schick, 2016; Andersson and Arvidsson, 2023b). On the other hand, firms closer to the final consumer

are more closely scrutinized by their customers and are thus more likely to be directedly affected by shifting societal norms than firms positioned in the early stages of the value chain (Brower & Mahajan, 2013; Shabana et al., 2017). Although there may be industry differences, which industry that is the most likely to integrate environmental considerations is clearly an empirical issue.

3. Survey data and econometric method

3.1 Survey data

We test the four hypotheses using survey data from large and publicly traded firms listed on the NasdaqOMX Stock Exchange in Stockholm. The scope of the in-depth survey[1] was designed to study the corporate sustainability work of Swedish firms across six Global Industry Classification Standard (GICS) sectors: Materials, Industrial Goods, Consumer Discretionary, Consumer Staples, Banks, and Diversified Financial Institutions. These industries have been selected due to their relatively large direct, or indirect, environmental impact. A detailed list of firms is available in Appendix A. In total the sample consists of 86 firms.

The in-depth survey is conducted annually, beginning in 2020, with subsequent rounds in 2021, 2022, and 2023. The survey is conducted electronically in English, reflecting the corporate language of these large and multinational firms. It is directed to the Head of Sustainability, with copies sent to other members of the management team, such as the CEO, CFO, and Investor Relations Manager. Interviews with respondents indicate that while the Head of Sustainability typically takes the lead in filling out the survey, various members of the management team also contribute to the responses. Each firm is given a two-month window to complete the survey,

[1] The survey is part of the project Swedish Corporate Sustainability Ranking of which Susanne Arvidsson is principal investigator. The ranking is a joint venture between Lund University and the two leading Swedish business papers Dagens Industri and Aktuell Hållbarhet.

during which three reminders are sent out. The response rates show an upward trend of the years, ranging from 56 per cent in 2020 to 72 per cent in 2023.

As firms that are included are large, often multinational, they are not representative of the entire population of Swedish firms. However, they are among the most influential firms in Sweden in terms of both their environmental and financial impacts. These firms are recognized as international pioneers in environmental sustainability (Cahan et al., 2016; KPMG, 2015; 2019), possibly due to Sweden's stringent environmental policies, which are considered among the most rigorous globally (Anderson et al., 2020; Karlsson, 2021). Therefore, our sample can be seen as indicative of best practices in the field among large multinational firms.

We draw on data from two waves of the survey, the 2022 survey that focused on climate change, and the 2023 survey that focused on biodiversity. The analysis centres on eight specific questions that address the integration of these environmental concerns into business strategies, as detailed in Table 1, and six questions related to the integration into governance structures, see Table 2. We will use these questions as our dependent variables in the empirical analysis. In terms of business strategies, the first two questions, Q1 and Q2, probe the extent to which firms have evaluated the resilience of their strategies against the backdrop of climate change and biodiversity loss. The following pair, Q3 and Q4, assess the presence of transition plans addressing climate change mitigation and biodiversity loss respectively. Questions Q5 and Q6 explore the implementation of policies aimed at managing the significant risks, impacts, and dependencies associated with climate change and biodiversity. The final two questions, Q7 and Q8, investigate the adoption of voluntary frameworks by firms, specifically the Task Force for Nature-related Financial Disclosure (TFND) for biodiversity and the Task Force for Climate-related Financial Disclosure (TFCD) for climate change. These two private frameworks are

designed to guide firms in the comprehensive integration of climate change and biodiversity considerations—mapping, assessment, and reporting on related dependencies, impacts, risks, and opportunities (DIRO)—into their operational practices. Although other private initiatives exist, these frameworks are particularly prevalent among Swedish firms, as our survey data suggests. Andersson and Arvidsson (2023b) found for example that several firms have adopted the TCFD framework as a learning tool in preparation for the CSRD when it came to climate change.

To assess the integration of climate change and biodiversity into governance structures, we focus on six key questions We begin by asking whether the firm has assigned specific roles to individuals responsible for executing transition plans aimed at mitigating biodiversity loss (Q9) and tackling climate change (Q10). Additionally, we investigate if the performance evaluation of managers incorporates non-financial metrics related to biodiversity (Q11) and climate change (Q12). We also investigate whether the firm has developed an incentive program that rewards efforts in biodiversity and climate change mitigation (Q14 and Q15).

Hypotheses 2 (board competence) and 3 (regulatory exposure) are also tested using questions from the survey, while Hypotheses 1 (firm size) and Hypothesis 4 (industry affiliation) are tested using the market size and a dummy variable indicating industry affiliation respectively.

H2 is examined through Q16, which asks: "*Do you have a board competence profile related to sustainability?*", and H3 is explored through Q17: "*Have you started a process to comply with CSRD reporting requirements?*", see Table 3. Respondents can answer each question with "yes," "working on it," or "no."

Question	Response options	Survey wave
Q1: Have you analysed the resilience of your business strategy in relation to *biodiversity loss*?	Yes, no, working on it.	2023
Q2: Have you analysed the resilience of your business strategy in relation to *climate change*?	Yes, no, working on it.	2023
Q3: Do you have a transition plan for *biodiversity* mitigation?	Yes, no, working on it.	2023
Q4: Do you have a transition plan for *climate change* mitigation?	Yes, no, working on it.	2023
Q5: Have you adopted any policies to manage your material impacts, dependencies, risks, and opportunities in relation to *biodiversity*?	Yes, no, working on it.	2023
Q6: Have you adopted any policies to manage your material impacts, dependencies, risks, and opportunities in relation to *climate change*?	Yes, no, working on it.	2023
Q7: Do you adopt the TNFD (The Task Force for Nature related Financial Disclosure) framework?	Yes, no, working-on-it	2023
Q8: Do you adopt the TCFD (The Task Force for Climate related Financial Disclosure) framework?	Yes, no, working-on-it	2023

Table 1. Survey questions related to the integration of biodiversity and climate change into business strategies.

Question	Response options	Survey wave
Q9: Have your company identified and appointed a key person(s) to carry out the transition plan for biodiversity loss mitigation?	Yes, no, working on it.	2023
Q10: Have your company identified and appointed a key person(s) to carry out the	Yes, no, working on it.	2022

transition plan for climate change mitigation?		
Q11: Are the managers evaluated from non-financial performance measures related to biodiversity?	Yes, no, working on it.	2023
Q13: Are the managers evaluated from non-financial performance measures related to climate change?	Yes, no, working on it.	2022
Q14: Are you adopting biodiversity-related incentive programmes?	Yes, no, working on it.	2023
Q15: Are you adopting climate change related incentive programmes?	Yes, no, working on it.	2022

Table 2. Survey questions related to the integration of biodiversity and climate change into business strategies.

Question	Response options	Survey wave
Q16: Do you have a competence profile related to sustainability in the board?	Yes, no, working-on-it	2023
Q17: Have you initiated a process to comply with the CSRD reporting requirements	Yes, no, working-on-it.	2023

Table 3. Survey questions used to test hypotheses 2 and 3.

Survey responses can be subject to various errors (see, for example, Bryman, 2015; Creswell, 2017; Trochim, 2006), including a response bias, where the answers may not truly reflect the respondents' views or beliefs. This might occur due to social desirability bias where respondents provide answers they believe to be more socially acceptable rather than their true thoughts. To mitigate the risk of receiving falsely affirmative responses, we introduced a "working-on-it" response option. This allows firms to indicate progress without committing to a definitive "yes," thereby reducing the likelihood of false “yes” answers. By studying the responses over time we find that most firms provide truthful answers. The "working-on-it" option is not merely a soft no answer but often signifies a transition phase, moving from "no" to "yes" as firms implement new policies (Andersson and Arvidsson, 2023b, 2024). During the pandemic, we observed

some firms pausing or even rolling back the adoption of new sustainability policies, reflected in a shift from "working-on-it" back to "no" (Andersson and Arvidsson, 2024). Overall, the size of a potential bias in the responses appears to be low.

3.2 Econometric method

We test the four hypotheses using logistic probability models, where each model measures the likelihood that a firm integrates biodiversity and/or climate change into its business strategy and governance structure, based on the questions from Tables 1 and 2. We set up a distinct model for every question in the survey. As is discussed in Section 4, the number of 'yes' responses related to biodiversity is quite limited. Therefore, we have combined the 'yes' and 'working-on-it' responses into one category. In the empirical models, a response of 'yes' or 'working-on-it' is coded as 1, and a 'no' response is coded as 0.

To test the first hypothesis (H1), which examines the impact of firm size, we include the logarithm of nominal market capitalization in U.S. dollars as an explanatory variable. In line with H1, we expect a positive parameter estimate, indicating that larger market capitalization increases the likelihood of integrating biodiversity and climate change into both the firm's business strategy and governance structure. For the second hypothesis (H2), which focuses on the competence of the board, we include Q16 in the model. Here, affirmative responses are coded as 1, while 'working-on-it' and 'no' responses are coded as 0. This means that for a firm to affirm H2, it must indicate sustainability competence on the board. Merely being in the process of recruiting such competencies does not qualify as a positive affirmation of H2. We anticipate a positive parameter estimate, particularly regarding biodiversity integration.

The third hypothesis (H3) assesses the influence of public regulations, tested through the responses to Q17. Similar to H2, 'yes' responses are coded as 1, and both 'working-on-it' and

'no' responses are coded as 0. Lastly, the fourth hypothesis (H4) explores the effect of industry affiliation and is tested using a categorical variable indicating the industry to which the firm belongs. We categorize firms into three main industries: upstream firms (materials and industrial goods), downstream firms (consumer durables and consumer staples), and financial firms. Due to the limited number of firms in some GICS industries, as noted in Appendix A, we do not model each industry separately but rather group them into these broader categories.

Specifically, we estimate the following model:

$$logit\left(P\left(Y_{Qi}=1\right)\right)=\beta_0+\beta_1\log(market\ cap_i)+\beta_2 Board_i+\beta_3 CSRD_i+$$

$$\beta_4 Industry_i+\varepsilon_i. \quad (1)$$

where Y_Q is one of the questions in Table 1 and 2, *i* denotes firm, *market cap* is the market capitalization, *Board* refers to Q16, and *CSRD* to Q17. The variable *Industry* represents our industry classification of upstream, downstream, and financial. Finally, ε is the error term, and β the parameter vector.

4. Descriptive statistics

The aggregated responses by industry (upstream, downstream, and financial) regarding the integration of biodiversity and climate change into their business strategies are depicted in Figures 1 to 4. The responses concerning governance structures are compiled in Table 1. It is evident that firms have devoted more attention to climate change than to biodiversity. Over fifty percent of firms across all three industries report having analysed the resilience of their business plans against climate change (Figure 1), possessing a transition plan for climate change (Figure 2), and implementing policies to manage the material dependencies, impacts, risks, and opportunities associated with climate change (Figure 3). Financial firms exhibit a higher rate of

affirmative responses to all three questions compared to the upstream and downstream industries. The discrepancy between the upstream and downstream industries is marginal, with the higher affirmative response rate alternating between the two. A minimal number of firms, regardless of their industry, provide a "no" answer to any of the questions related to climate change. Most firms that do not answer "yes" provide a 'working-on-it' response. The exception to this trend is the adoption of the private and voluntary TCFD framework, see Figure 4, where up to 40 percent of downstream firms have responded negatively. Nonetheless, a majority are either already compliant with or are in the process of adopting this framework.

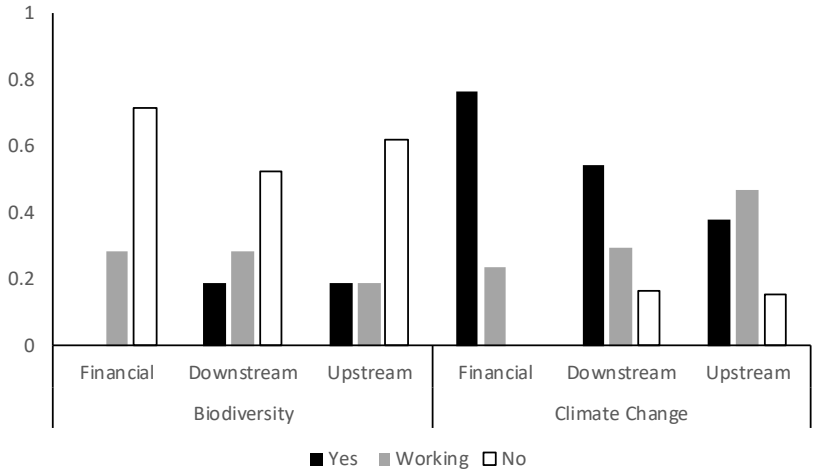

Figure 1. Proportion of firms that have studied the resilience of their business plans in relation to biodiversity and climate change.

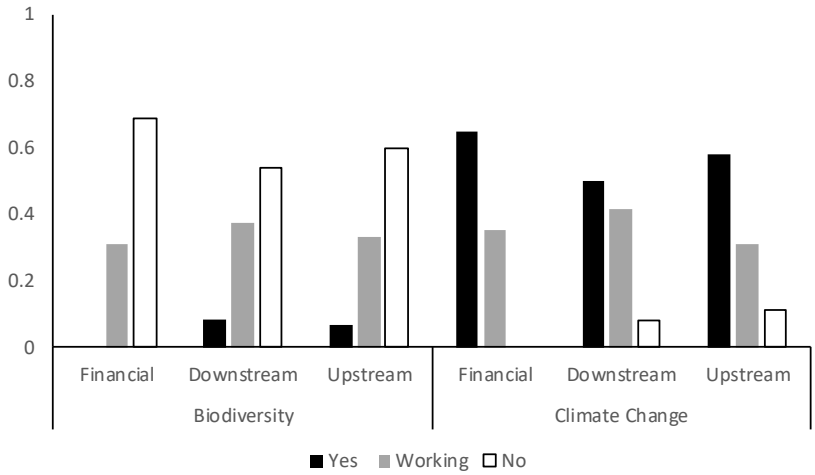

Figure 2. Proportion of firms that have a transition plan for biodiversity and climate change mitigation.

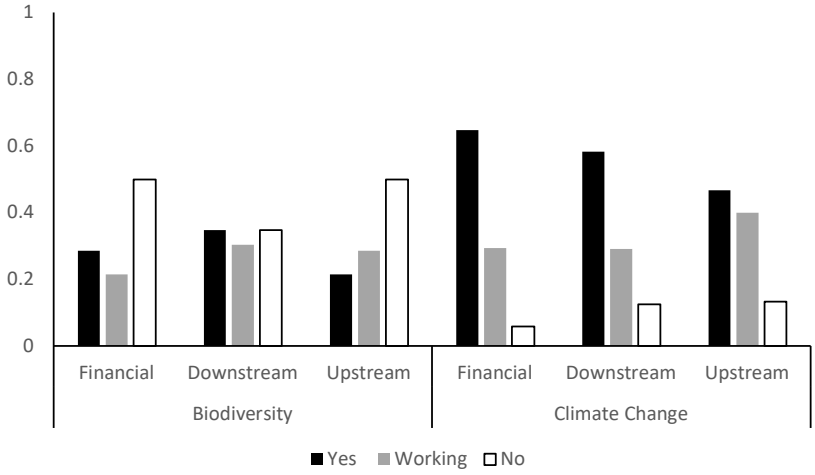

Figure 3. Proportion of firms that have adopted any policies to manage your material dependencies, impacts, risks, and opportunities in relation to biodiversity and climate change.

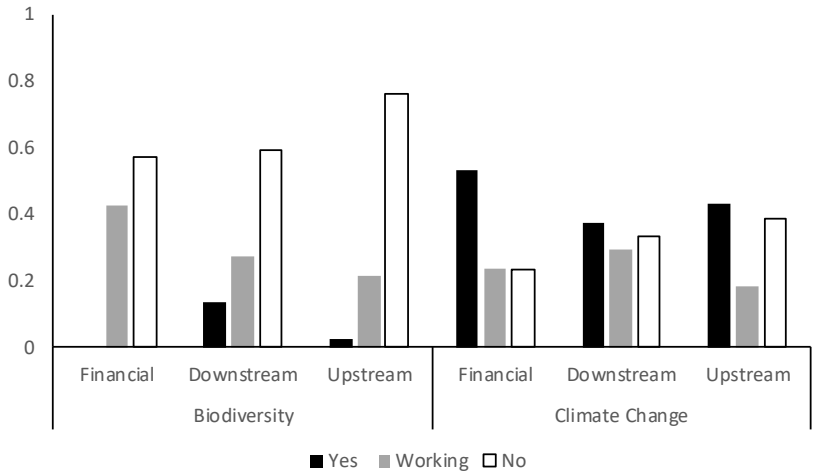

Figure 4. Proportion of firms that have adopted the TNFD (biodiversity) or TCFD (climate change) frameworks.

For biodiversity, the predominant response across all industries is "no" on all questions, marking a clear contrast to the responses related to climate change. Here financial firms do not show a higher inclination towards "yes" answers. Depending on the specific question, between 20 and 40 percent of firms indicate that they are in the process of integrating biodiversity into their strategies, with only between five and 20 percent having completed the integration process.

Our results show that when it comes to biodiversity firms have primarily adopted a risk management approach. When it comes to biodiversity firms are most likely to report that they have implemented policies to manage the material dependencies, impacts, risks, and opportunities related to biodiversity (Figure 3). Conversely, they are the least likely to report the adoption of the voluntary TNFD framework for mapping, assessing, and reporting (Figure 4). A notable finding is that several firms claim to have adopted relevant policies without having first analysed the resilience of their business plans (Figure 1) or developed a transition plan (Figure 2) for biodiversity. This clearly demonstrates that the integration of biodiversity is

lagging behind climate change and raises questions regarding the firms' real commitment to the global biodiversity agenda.

Question		Financial			Upstream			Downstream		
		Yes	WO[a]	No	Yes	WO	No	Yes	WO	No
Have your company identified and appointed a key person(s) to carry out the transition plan for	Biodiversity	35	30	35	28	33	38	50	0	50
	Climate change	95	5		95	3	3	94	0	6
Are the managers evaluated from non-financial performance measures related to	Biodiversity	14	5	81	7	7	85	0	14	86
	Climate change	65	35	0	64	17	19	56	13	31
Are you adopting a biodiversity/climate-change incentive programmes?	Biodiversity	9	14	77	2	7	90	0	0	100
	Climate change?	65	15	20	51	32	16	29	12	59

Table 1: Integration of biodiversity and climate change into governance structures by industry.
Note: a. WO stands for working-on-it.

When examining governance structures, the difference in how biodiversity is integrated compared to climate change is as significant as the difference observed in the integration into business strategies. An overwhelming majority of firms, 94-95 percent depending on the industry, have appointed a key person to implement the climate change transition plan, as shown in Table 1. In contrast, only 28 percent of upstream firms and up to 50 percent of downstream firms have done the same for biodiversity. These figures reflect the smaller proportion of firms that have a biodiversity transition plan in place.

When it comes to evaluating managers, a large majority of firms consider non-financial performance metrics related to climate change, with an additional 13 to 35 percent of firms currently developing such evaluation criteria. However, for biodiversity, over 80 percent of

firms report *not* using non-financial performance measures in management evaluations. The adoption of biodiversity-related incentive programs is even less common, with 100 percent of downstream firms, 90 percent of upstream firms, and 77 percent of financial firms reporting no adoption. In contrast, for climate change, 65 percent of financial firms and 51 percent of upstream firms have established such programs, while only 29 percent of downstream firms report having done so. Considering the confirmed importance of measures, evaluations and incentive programs for directing focus, motivating employees and steering organisational change, our results questions whether biodiversity will move up on the firms' agendas in the near future (Arvidsson, 2024).

In summary, our results underscore that these large, listed firms are more inclined to incorporate climate change considerations into their business strategies and governance structures. Although we acknowledge an emerging trend towards integrating biodiversity it is still on a rudimentary level.

5. Regression results

We begin our analysis by examining the regression outcomes regarding the integration of biodiversity and climate change into the business strategies of firms, as presented in Table 2. The econometric results corroborate H1, showing that larger firms are more inclined to incorporate both biodiversity and climate change considerations into their business strategies, regardless of the specific question asked. The only exception is for the adoption of climate-related policies aimed at managing material dependencies, impacts, risks, and opportunities, where the parameter, though positive, does not reach statistical significance. For all other questions, the market capitalization parameter exhibits statistical significance at the 5 per cent level. Based on the levels of statistical significance, it appears that the firm size is particularly

influential in both the formulation of a transition plan and the adoption of the TNFD/TCFD frameworks. For having a transition plan or implementing new policies firm size is less important.

	Have you analysed the resilience of your business strategy in relation to [biodiversity loss/climate change]?		Do you have a transition plan for [biodiversity/climate change] mitigation?		Have you adopted any policies to manage your material impacts, dependencies, risks, and opportunities in relation to [biodiversity/climate change]?		Do you adopt the [TNFD/TCFD]	
	Biodiv.	Climate change	Biodiv.	Climate change	Biodiv.	Climate change	Biodiv.	Climate change
Market cap	.27* (.14)	.50** (.22)	.48*** (.16)	.63** (.29)	.28** (.14)	.33 (.21)	.47*** (.16)	.96*** (.24)
Board	1.2** (.50)	-.08 (.70)	1.3** (.52)	-.23 (.86)	1.1** (.49)	.70 (.71)	.91* (.54)	-.02 (.57)
CSRD	1.7* (.90)	-.82 (.96)	-.02 (.79)	-.31 (1.3)	2.0* (1.1)	-.98 (.94)	1.03 (.83)	-1.93* (1.02)
Down-stream	-.46 (.67)	---	-1.1 (.71)	---	-.15 (.66)	.37 (1.2)	.67 (.68)	.02 (.79)
Up-stream	.33 (.28)	-.02 (.36)	.24 (.29)	.18 (.46)	.37 (.29)	.09 (.39)	.50 (.30)	.60 (.33)
Constant	-3.0*** (1.11)	-1.3 (1.40)	-4.5*** (1.3)	-1.6 (1.7)	-2.5** (1.1)	-.50 (1.4)	-5.1 (1.3)	-5.9*** (1.6)
Pseudo R2	.133	.104	.162	.141	.133	.092	.175	.301

Table 2. Regression results. Integration of biodiversity and climate change into business strategies.
Note: ***, **, and * denotes statistical significance at the 1%, 5%, and 10% significance level respectively.

The evidence for H2 is mixed. In the case of biodiversity, there is a statistically significant relationship between the presence of sustainability expertise on the board and the analysis of the resilience of the business strategy, the adoption of a transition plan, and the implementation of specific policies to manage material dependencies, impacts, risks, and opportunities.

Furthermore, board competence is also related to the adoption of the TNFD framework although on a lower statistical significant level. For climate change, there is no relationship between board competence and the integration of these considerations into business strategies. Thus, we both confirm and reject the results of previous studies that has highlighted the importance of board competence (Dalla Via and Perego, 2018; Lewis et al., 2014; Parker, 2014; Peters and Romi, 2015). These results can be interpreted in two different ways. First, that board competence matters more for environmental issues that have received relatively less attention in media, policy, and the public debate. Alternatively, in the initial phases of developing expertise in a new sustainability field, like biodiversity, the competence of the board in this field is crucial in fostering commitment and directing scarce resources to the emerging area.

As our findings show, board composition has an important influence on biodiversity integration but not on climate change. Considering the relatively high rates of "yes" and "working-on-it" responses for climate change (Figure 1-4), it seems that climate change is an area most firms today are actively engaging with the climate agenda, rendering board competence less critical. Conversely, for biodiversity, board competence is still a critical factor.

Firms that have evaluated the implications of the forthcoming CSRD regulation are somewhat more inclined to start integrating biodiversity into their business strategies, confirming H3. However, this effect is modest and only statistically significant at the 10 percent level. Here it is important to note that the correlation between board competence and preparing for the CSRD is -0.02 showing that the preparation for the CSRD is not driven by board competence within the field of sustainability. In the context of climate change, there is a slight negative association with the adoption of the TCFD framework and the preparation of the CSRD. Specifically, firms that are adapting to the CSRD regulation seem to be moving away from the TCFD. This finding

aligns with the research of Andersson and Arvidsson (2023b; 2024), who observed that listed Swedish firms employed the TCFD as a preparatory tool in anticipation of future regulatory requirements. Consequently, the evidence supporting H3 is somewhat limited. Finally, we find no support for H4. Industry affiliation does not impact the integration or biodiversity or climate change into the firms' business strategies.

	Have your company identified and appointed a key person(s) to carry out the transition plan for biodiversity loss mitigation?		Are the managers evaluated from non-financial performance measures related to biodiversity/climate change		Are you adopting biodiversity-related/climate change incentive programmes?	
	Biodiv.	Climate change	Biodiv.	Climate change	Biodiv.	Climate change
Market cap	.34* (.15)	.35 (.45)	.24 (.17)	.41** (.20)	.06 (.17)	.46** (.20)
Board	1.2** (.51)	0.72 (1.6)	1.7** (.66)	-1.1 (.79)	1.60** (.71)	.51 (.62)
CSRD	-.26 (.81)	-3.1* (1.8)	1.7** (.82)	.34 (1.19)	.90 (.82)	---
Upstream	-.76 (.70)	-2.4 (2.0)	.04 (.75)	-1.40 (.90)	-.02 (.84)	-3.2*** (.89)
Downstream	.15 (.30)		.27 (.32)	---	.46 (.32)	-.04 (.37)
Constant	-2.1** (1.1)	2.4 (2.7)	-4.3*** (1.4)	-.28 (1.3)	-3.3** (1.4)	-1.5 (1.3)
Pseudo R2	.121	.227	.156	.120	.108	.229

Table 3. Regression results, integration of biodiversity and climate change into governance structures.
Note:

Turning to the integration of biodiversity and climate change into governance structures, we find less support for all four hypotheses compared to the integration into business strategies. Potentially this is explained by the fact that firms first adjust their business strategies and that modifications of governance structures follow at a later stage. Previous studies show that firms are more prone to formulate strategies related to different sustainability fields than they are keen

on updating and changing their governance structure (Arvidsson, 2024). Support for H1 is less robust when examining the integration of biodiversity and climate change into governance structures compared to into integration into business strategies, see Table 3. There is some indication that larger firms are more inclined to assess managers based on climate-related performance measured and to implement incentive programs tied to climate change outcomes. However, this pattern does not extend to biodiversity integration. This discrepancy might be attributed to the limited number of firms that evaluate managers or operate incentive programs specifically for biodiversity, see Section 4. The small subset of firms that reported affirmative or ongoing efforts regarding climate change seem to be influenced by having board members with sustainability expertise, aligning with H2. This further suggests that initiatives related to biodiversity are often spearheaded by board members equipped with relevant competences. In contrast, such a correlation is not observed with climate change initiatives. There is no major support for H3 or H4. Differences among the firms are related to size and board competence. Where the size matters most for climate change and board composition matters most for biodiversity integration.

5. Conclusions

Our findings provide four main conclusions. First, climate change is clearly higher up on the firms' agenda than biodiversity. This result is manifested throughout the whole analysis. This is unsurprising given the greater attention placed to climate change in the global political agenda. Firms are responding to, but not driving, the environmental sustainability agenda. Clearly firms require external pressures from, e.g., regulations and their customers to integrate various environmental considerations business strategies and governance structures.

Secondly, although biodiversity has begun to move higher up on the political agenda (IPBES, 2019; European Commission, 2023b) it is still early days. In our results, this is manifested in that the competence of the board is still a critical factor for the probability of firms' advancing the integration of biodiversity into their business strategies. For climate change board competence is not a critical factor for this advancement. Potentially this is due to the fact that the integration process related to climate change has advanced further due to external pressures.

Thirdly, our results also suggest not only that climate change comes before biodiversity but also that there is a sequence in the integration process; firms integrate environmental sustainability first into strategies and plans and thereafter into governance structures. For climate change, the integration generally included both business strategies and governance structures, however for biodiversity the integration process has still not reached governance structures. It is likely that halting and reversing biodiversity loss will require, similar to climate change, more than updating strategies and plans. Thus, ensuring continued and accelerated external pressures on the firms to continue their integration process related biodiversity is of vital concern.

Fourth, the tendency to weaken the CSRD during the consultation phase, by making all standards being subject to (subjective) materiality assessments by the individual firms, is problematic. It reduces the vital external pressures and may slow down or even halt the biodiversity integration process, which in turn may impair the advancement of the EU's policy agenda of decoupling resource use from economic growth. Perhaps the most important implication of our results is the necessity to not further weaken launched and upcoming environmental sustainability regulations but rather to acknowledge the important role these regulations have in promoting and fostering firms' integration of biodiversity and climate change into their business strategies and governance structures.

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Appendix A. List of firms

Firm	GICS classification	Our industry classification
AAK	Consumer stable	Downstream
Addtech	Capital goods	Upstream
Alfa Laval	Capital goods	Upstream
Alimak Group	Capital goods	Upstream
Alligo	Consumer durables	Downstream
Assa Abloy	Capital goods	Upstream
Atlas Copco	Capital goods	Upstream
Avanza	Bank	Financial
Axfood	Consumer stable	Downstream
Beijer Alma	Capital goods	Upstream
Berman & Beving	Capital goods	Upstream
Bergs Timber	Material	Upstream
Besqab	Consumer durables	Downstream
Bilia	Consumer durables	Downstream
Björn Borg	Consumer durables	Downstream
Bonava	Consumer durables	Downstream
Boozt Fashion	Consumer durables	Downstream
Brorson	Material	Upstream
Bufab	Capital goods	Downstream
Bure Equity	Diversified financial	Financial
Catell	Bank	Financial
Clas Ohlson	Consumer durables	Downstream
Collector Bank	Bank	Financial
Duni Group	Consumer durables	Downstream
Duroc	Capital goods	Upstream
Dustin	Consumer durables	Downstream
Eolus Vind	Capital goods	Upstream
EQT	Diversified industrial	Financial
Fagerhult Group	Capital goods	Upstream
Fenix Outdoor International	Consumer durables	Downstream
FM Mattson	Capital goods	Upstream
Gränges	Material	Upstream
H&M	Consumer durables	Downstream
Hexatronic Group	Capital goods	Upstream
Holmen	Material	Upstream
Husqvarna	Consumer durables	Downstream
Industrivärlden	Diversified financial	Financial
Indutrade	Capital goods	Upstream
Instalco	Capital goods	Upstream
Investment Latour	Diversified financial	Financial
Inwido	Capital goods	Upstream
JM	Consumer durables	Downstream
KABE Group	Consumer durables	Downstream
Kinnevik	Diversified financial	Financial
LE Lundberföretagen	Diversified financial	Financial
Lifco	Capital goods	Upstream

Lindab	Capital goods	Upstream
MEKO	Consumer durables	Downstream
Midsona	Consumer stable	Downstream
Midway Holding	Capital goods	Upstream
Mips	Consumer durables	Downstream
Momentum Group	Capital goods	Upstream
Munters	Capital goods	Upstream
NCC	Capital goods	Upstream
Nederman Holding	Capital goods	Upstream
New Wave Group	Consumer durable	Downstream
Nilörngruppen	Consumer durable	Downstream
Nolato	Capital goods	Upstream
Nordea	Bank	Financial
Nordic Waterproofing Group	Capital goods	Upstream
Nordnet	Bank	Financial
OEM Internatinoal	Capital goods	Upstream
PE Teknik & Arkitektur	Capital goods	Upstream
Resurs Holdin	Bank	Financial
Rottneros	Material	Upstream
SCA	Material	Upstream
Scani Standard	Consumer stable	Downstream
SEB	Bank	Financial
Serneke Group	Capital goods	Upstream
Skanska	Capital goods	Upstream
SKF	Capital goods	Upstream
SSAB	Material	Upstream
Stora Enso Oyj	Material	Upstream
Svedbergs Group	Capital goods	Upstream
Svenska Handelsbanken	Bank	Financial
Sweco	Capital goods	Upstream
Swedbank	Bank	Financial
Systemair	Capital goods	Upstream
Thule Group	Capital goods	Upstream
Trelleborg	Capital goods	Upstream
Troax Group	Capital goods	Upstream
VBG Group	Capital goods	Upstream
VNV Global	Diversified financial	Financial
Volati	Diversified financial	Financial
Volvo Cars	Consumer durable	Downstream
Xano Industri	Capital goods	Upstream