EU Taxonomy Alignment, Environmental Ratings, and Financial Performance: Evidence from STOXX Europe 600 Firms

LENA HEIDENREICH[1] and SARAH LÖHER[2]

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Abstract

This thesis examines how firm-reported taxonomy alignment relates to environmental ratings, firm performance, and stock returns. Using data from non-financial STOXX Europe 600 firms from financial year 2022 to 2024, we assess whether the EU Taxonomy Regulation provides information beyond established E-scores and whether alignment affects profitability and market-based outcomes. We show that taxonomy alignment is positively but only moderately associated with MSCI and LSEG E-ratings, indicating that taxonomy metrics capture distinct dimensions of environmental sustainability beyond those reflected in E-scores. We find suggestive evidence of a concave relationship between taxonomy alignment and profitability, implying that ROA and ROE are highest at moderate alignment levels. Finally, we show that highly aligned firms earn lower risk-adjusted returns than low-aligned firms. Overall, our findings suggest that the taxonomy metrics provide environmental performance information complementary to E-ratings, however, their financial implications vary in size and direction across performance metrics.

Keywords: EU Taxonomy Regulation, Corporate Environmental Sustainability, E-Ratings, Firm Performance, Stock Returns

Supervisor: Jan Starmans, Associate Professor, Department of Finance, Stockholm School of Economics

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[1] 42499@student.hhs.se
[2] 42890@student.hhs.se

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List of Abbreviations

Capex	Capital Expenditures
CSRD	Corporate Sustainability Reporting Directive
ESG	Environmental, Social, and Governance
EU	European Union
FY	Financial Year
GICS	Global Industry Classification Standard
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
Opex	Operating Expenditures
PP	Percentage Points
PSM	Propensity Score Matching
ROA	Return on Assets
ROE	Return on Equity
SFDR	Sustainable Finance Disclosure Regulation
SME	Small and Medium Enterprises
UN	United Nations

1 Introduction

To meet the environmental objectives set out in the European Green Deal by 2050[1], the European Union (EU) must fundamentally transform its economy towards climate neutrality, resource efficiency, and biodiversity protection (European Commission, 2019). By 2030 alone, the EU faces an estimated funding gap of EUR 742bn to achieve its intermediary objectives (European Environment Agency, 2025). To mobilize private capital and redirect capital flows towards sustainable investments, the EU has introduced several pieces of legislation under its sustainable finance strategy (European Commission, 2025a). In 2014, the Non-Financial Reporting Directive, later the Corporate Sustainability Reporting Directive (CSRD), was adopted, requiring certain EU companies to include sustainability disclosures in their annual reporting (EU, 2014; EU, 2022). In 2019, the Sustainable Finance Disclosure Regulation (SFDR) was introduced to reduce greenwashing in financial products by mandating disclosure of their sustainability (EU, 2019). Among these regulatory initiatives, the EU Taxonomy Regulation represents the central coordinating mechanism and the focus of our thesis. Introduced in 2020, the taxonomy links the CSRD with the SFRD to ensure consistency in sustainability reporting across companies and to help investors identify sustainable investments, ultimately aiming to channel capital towards environmentally sustainable activities (Hummel and Bauernhofer, 2024; Bassen et al., 2025). The EU Taxonomy Regulation constitutes the first standardised, science-based classification system that links financial reporting metrics directly to sustainability criteria for six environmental objectives: climate change mitigation, climate change adaptation, water protection, circular economy, pollution prevention, and biodiversity conservation (EU, 2020). From financial year (FY)[2] 2022 onwards, certain large non-financial companies[3] based in the EU are mandated to report the respective shares of their revenue (turnover), capital expenditure (capex) and operating expenditure (opex) that are covered by the regulation ("taxonomy-eligible") and that qualify as environmentally sustainable, i.e. substantially contribute to at least one of the objectives ("taxonomy-aligned") (EU, 2020).

Despite the taxonomy's central role in the EU's sustainable finance framework, it is unclear whether the regulation provides investors with information distinct from existing third-party

[1] The European Green Deal objectives encompass a reduction of greenhouse gas emissions of 55% compared to 1990 levels and the achievement of climate neutrality by 2050. Furthermore, the Green Deal includes broader policy packages targeting, besides others, industrial reforms, circular economy, and biodiversity efforts (European Commission, 2019).
[2] FY refers to the standard annual reporting period, for simplicity assumed to range from January to December for our analyses.
[3] Similar disclosure requirements apply to financial companies. Financial and insurance companies must report their Green Asset Ratio, Green Investment Ratio, and Green Premium Ratio based on aligned and eligible assets (Hummel & Bauernhofer, 2024).

environmental, social, and governance (ESG) ratings and whether taxonomy alignment creates financial benefits for firms. The first question is of relevance because investors increasingly incorporate sustainability-related information into risk assessments and investment decisions, however, ESG ratings are increasingly criticised for their validity and usefulness (Berg et al., 2022; Bassen et al., 2025). These ratings have been shown to differ substantially due to rater's diverging methodologies and to be sensitive to a firm's disclosure intensity irrespective of the actual performance (Lopez-de-Silanes et al., 2019; Berg et al., 2022; Christensen et al., 2022). Consequently, firms may be incentivised to over-communicate positive information; higher environmental scores (E-scores) may not necessarily reflect superior environmental performance; and investor could derive different conclusions about the ESG performance of the same company depending on which score they use (Lopez-de-Silanes et al., 2019; Berg et al., 2022; Bassen et al., 2025). If the taxonomy provides more credible information on firms' environmental performance, it should meaningfully influence investor decision-making and ultimately be reflected in market valuations and stock returns (Berg et al., 2022; Dumrose et al., 2022). The second question on whether taxonomy alignment is financially beneficial for firms addresses a critical policy concern. If alignment improves firm performance, companies would be incentivised to pursue sustainable activities; if not, stronger regulatory or financial incentives may be required to achieve the EU's environmental objectives.

Our thesis addresses these questions by examining the relationship between taxonomy alignment and E-scores, firm performance, and stock returns, leveraging a sample of 301 non-financial EU-headquartered firms in the STOXX Europe 600 from FY 2022 to FY 2024. Our empirical design follows a multi-method approach tailored to each research dimension. First, we apply contemporaneous ordinary least squares (OLS) regression to assess associations between taxonomy alignment and E-scores. Second, we estimate time-lagged quadratic OLS models to assess the association between taxonomy alignment and firm outcomes. To ensure that these associations are not driven by systematic differences in firm characteristics, we additionally implement propensity score matching (PSM) to match firms with observable similar features but differing degrees of alignment. Finally, we analyse stock return implications of alignment using a long-short portfolio framework and estimate risk-adjusted alphas using Fama-French factor models.

We document three main findings. First, we find a positive yet economically weak association between taxonomy alignment and both MSCI and LSEG E-scores. While LSEG's E-score aligns somewhat more closely with the activity-based nature of the taxonomy, the overlap remains modest. This minor association is supported by correlations below 0.2 between

alignment metrics and E-scores, indicating that taxonomy metrics capture aspects of corporate environmental sustainability that are not fully reflected in E-scores: While E-ratings assess the company's environmental footprint and its efforts to manage this footprint, taxonomy alignment figures express how a company contributes to the achievement of the EU's environmental objectives. We show that E-score providers, especially MSCI, tend to rate companies highly even if these companies do not contribute to any environmental objective, as evidenced by minimal or no alignment. Our findings suggest that investors should consider taxonomy metrics in combination with ESG scores to obtain a more comprehensive and objective view of corporate sustainability performance. Second, we find indicative evidence of a concave association between taxonomy-aligned turnover and Return on Assets (ROA) and Return on Equity (ROE), implying that moderate levels of alignment shares may be optimal for financial performance. However, this relationship is weak, both economically and statistically. For managers, our findings suggest that profitability benefits from taxonomy alignment are modest and may be limited to early-stage alignment levels. Firms should therefore consider the potential trade-off between environmental ambitions and financial outcomes when aligning operations and investments with the taxonomy. For policymakers, the tentative concave patters suggests that existing policy instruments may not provide sufficient incentives for firms to pursue alignment beyond moderate levels, indicating a need for more targeted measures to advance towards European Green Deal's objectives. We do not find a significant association between alignment and Tobin's Q. Finally, we show that highly aligned companies systematically underperform low-aligned firms after controlling for the five Fama-French risk factors. This suggests that investors with strong sustainability preferences may need to accept lower expected returns when allocating capital to highly aligned firms.

Our contribution to the literature is threefold: First, we provide, to the best of our knowledge, the first empirical evidence using reported taxonomy data covering the complete initial mandatory reporting years from FY 2022 to FY 2024, thereby expanding on the main taxonomy literature which predominantly uses proxies for green revenues and expenditures from vendor data such as FTSE Green Revenues (e.g. Dumrose et al., 2022; Bassen et al., 2025). The use of firm-reported taxonomy figures allows us to draw initial conclusions from actual disclosure data, allowing for a more accurate assessment of taxonomy alignment and its implications. In this regard, we confirm and extend the findings by Dumrose et al. (2022) on how alignment relates to E-scores. Second, we extend the literature on the relationship between sustainability performance and firm fundamentals by presenting, to our knowledge, the first evidence of an association between taxonomy alignment and firm performance. Our analysis suggests a non-

linear relationship between alignment and profitability, offering new insights into the economic trade-offs firms face under the current EU environmental policy framework. Finally, we provide first evidence on the relationship between taxonomy alignment and risk-adjusted returns for the post-taxonomy announcement period. Our finding of lower risk-adjusted returns for highly aligned firms confirms expectations on negative sustainability premia (Pástor et al., 2021).

This thesis contributes to the extensive literature on sustainability and financial performance. Despite decades of research, evidence remains mixed on whether ESG performance enhances firm outcomes. While many studies suggest that there is positive association between ESG and accounting- and market-based outcomes, a nontrivial share of research also finds evidence for neutral or negative relationships (for a meta-analysis see Friede et al., 2015). To reconcile these conflicting findings, recent work highlights non-linear dynamics, documenting predominantly U-shaped relationships in which low to moderate environmental engagement initially weaken financial outcomes, but stronger environmental engagement eventually improves these outcomes (Trumpp and Guenther, 2017; for social performance Barnett and Salomon, 2012). The literature on ESG and stock returns is equally inconclusive. While studies such as those of Edmans (2012) and Eccles et al. (2014) find evidence for outperformance of companies with high employee satisfaction or environmental management quality, others find weak and sometimes negative relationship between ESG indicators and stock returns (e.g. Brammer et al., 2006; Vu et al., 2025).

In contrast, empirical research on the EU taxonomy is still emerging. Dumrose et al. (2022) find that an aligned turnover proxy is positively associated with E-ratings from MSCI, LSEG, and Moody's, while eligible turnover proxies are negatively associated with E-scores from S&P and LSEG. Several studies also examine financial implications of taxonomy eligibility and alignment: higher transitional eligibility is associated with lower borrowing costs (Sautner et al., 2025), stronger performance on non-climate environmental criteria improves refinancing conditions (Hoepner et al., 2023), and early voluntary taxonomy alignment disclosures in the utilities sector relate to higher valuations and profitability (Tonnarello et al., 2025). Finally, taxonomy metrics also appear to influence investment and return patters. Lucarelli et al. (2023) find that being taxonomy-eligible does not in itself increase investment, but investment rises significantly in sectors with certainty about eligibility, which depends on industry affiliation. Early market-based evidence shows that proxies for aligned turnover are positively associated with raw and risk-adjusted stock returns (Bassen et al., 2025) and that portfolios of low-carbon

(taxonomy-consistent) energy firms outperform traditional energy portfolios (Cauthorn et al., 2023).

The thesis is structured as follows. Section 2 provides an overview of the EU Taxonomy Regulation. Section 3 develops our hypotheses. Section 4 presents the sample, variables, and summary statistics. Sections 5 to 7 present the methodology and results of the respective analyses. Section 8 discusses key findings, their implications, and limitations of our analysis. Section 9 concludes.

2 The EU Taxonomy Regulation

The EU Taxonomy Regulation, which entered into force in July 2020, provides a classification system for identifying environmentally sustainable activities (EU, 2020). As an EU regulation, the taxonomy directly applies to all 27 EU member states (EU, 2016). Norway, as part of the European Economic Area, has adopted the taxonomy into national law in 2023 (Norwegian Ministry of Finance, 2025).

2.1 Definition of Environmentally Sustainable Activities

The regulation differentiates between eligible and non-eligible activities, and among eligible activities, it further distinguishes between aligned and non-aligned activities (EU, 2020). All activities included in the scope of the regulation are taxonomy-eligible (EU, 2020). The taxonomy regulation initially focused on high-carbon and net zero transition-enabling activities but was gradually expanded by adding activities, such as waste management and disaster risk management, aiming to cover a larger part of the economy and broader environmental objectives (Maier and Bauer, 2023). Currently, the regulation covers more than 150 activities, ranging from air transport ground handling operations to urban wastewater treatment (European Commission, 2025b). A complete list of all activities can be found in Appendix A.

Taxonomy-aligned activities are taxonomy-eligible activities that are classified as environmentally sustainable (EU, 2020). The regulation defines six environmental objectives: (1) climate change mitigation; (2) climate change adaptation; (3) sustainable use and protection of water and marine resources; (4) transition to a circular economy; (5) pollution prevention and control; and (6) protection and restoration of biodiversity and ecosystems (EU, 2020). An activity qualifies as sustainable if it (i) contributes significantly to at least one of the six objectives; (ii) does not harm any of the objectives; and (iii) complies with minimum safeguards and technical screening criteria (EU, 2020). The “do not significantly harm” criterion ensures that the activity does not adversely affect any of the other five environmental

objectives (EU, 2020). The minimum safeguards define that an activity needs to be aligned with the OECD Guidelines for Multinational Enterprises and the UN Guiding Principles on Business and Human Rights, ensuring minimum social and governance requirements for environmentally sustainable activities (EU, 2020). Finally, the technical screening criteria define when an activity can be classified as environmentally sustainable. For each activity, there are specific science-based thresholds and limits, such as certain greenhouse gas emissions levels, that must not be surpassed (EU, 2020; European Commission, 2025b). Qualitative criteria may be used if a definition of quantitative thresholds is not yet possible (Viñes Fiestas, 2023). As an example, Appendix B provides an overview of criteria that need to be fulfilled for the manufacturing of iron and steel to qualify as an environmentally sustainable activity (European Commission, 2025c). Overall, eligibility is largely determined by a firm's sectoral affiliation (Lucarelli et al., 2023) and the activities defined as taxonomy-relevant, while alignment depends on firm-level choices, i.e. how proactively individual firms invest in, expand, or transition toward environmentally sustainable activities.

2.2 Timeline and Scope of Reporting Requirements

The EU Taxonomy Regulation applies to companies operating in the EU (EU, 2020). From FY 2021 onwards, taxonomy disclosures apply to public-interest entities with more than 500 employees (EU, 2014; EU, 2020). From FY 2025, companies that fulfil at least two of the three criteria in two consecutive years (1) total assets of EUR 25m; (2) net turnover of EUR 50m; (3) average number of employees during the financial year of 250 are also mandated to report taxonomy figures (EU, 2020; EU, 2022). From FY 2026, listed small and medium enterprises (SMEs) are obliged to report on the taxonomy; they will, however, be granted a two-year opt out period (EU, 2020; EU, 2022). Finally, the taxonomy will also apply to non-EU companies that generate more than EUR 150m in revenues and have a subsidiary or branch in the EU. The parent companies are required to disclose taxonomy figures starting in FY 2028, while their EU subsidiaries are already mandated to disclose in FY 2025 (EU, 2020, EU, 2022).

All non-financial companies subject to the regulation must report the share of their turnover capex, and opex that is taxonomy-eligible and taxonomy-aligned (EU, 2020). While taxonomy-aligned turnover and opex measure the environmental sustainability of a company's current operations, taxonomy-aligned capex is a forward-looking indicator, capturing firms' commitment to sustainable transformation before such investments materialise in operational performance (Schütze and Stede, 2021; De Oliveira Neves, 2022). The disclosures initially

required limited assurance, but with the implementation of the CSRD, assurance on taxonomy disclosures becomes mandatory from FY 2025 onwards (EU 2020; EU, 2022).

Table 1 Timeline of Taxonomy Reporting Requirements

Period	Scope of Eligibility Reporting	Scope of Alignment Reporting
FY 2021	Reporting for objectives (1) and (2)	Voluntary reporting for objectives (1) and (2)
FY 2022	Reporting for objectives (1) and (2)	Reporting for objectives (1) and (2)
FY 2023	Reporting for objectives (1) to (6)	Reporting for objectives (1) and (2)
FY 2024	Reporting for objectives (1) to (6)	Reporting for objectives (1) to (6)

Note: This table summarises the phased introduction of taxonomy reporting requirements. Objectives (1) and (2) refer to the climate-related objectives; objectives (3) to (6) refer to the remaining environmental objectives.

The specific eligibility and alignment disclosures have been gradually phased in since FY 2021 (Hummel and Bauernhofer, 2024). Table 1 provides an overview of the timeline of taxonomy reporting. Eligibility reporting became mandatory in FY 2021, and alignment disclosure became mandatory in FY 2022 (Hummel and Bauernhofer, 2024). The first two reporting years for each metric may only include reporting on the first two objectives: climate change mitigation and adaptation (EU, 2021). Thus, for FY 2022, reported aligned and eligible figures cover only two out of the six objectives; for FY 2023, reported figures potentially show a mismatch between aligned and eligible metrics based on reported objectives[4]; and only from FY 2024 onwards, both eligible and aligned figures include reporting on all six environmental objectives.

2.3 Limitations

The taxonomy has several limitations. First, the regulation is widely criticized for its binary classification system, which distinguishes only between taxonomy-aligned and non-aligned activities (Schütze and Stede, 2021; Norang et al., 2023). This binary structure can lead to a lack of incentives for incremental improvement, concerning both (1) activities that are already aligned and (2) activities that are too far away to reach the threshold, hindering overall progress toward the achievement of the EU's environmental objectives (Schütze and Stede, 2021).

Second, the taxonomy currently excludes several low-emission sectors, mainly service sectors such as financial services and education (Platform on Sustainable Finance, 2022a). While this exclusion reduces reporting burdens, it also means that a lot of activities remain non-classified. Non-classification may be misinterpreted as a negative fact by investors, which may discourage financing for neutral or moderately sustainable activities (Platform on Sustainable Finance, 2022a).

[4] Companies may already report alignment figures on all six objectives voluntarily ahead of FY 2024.

Third, the taxonomy is limited to environmental objectives and thus, does not address social and governance dimensions of sustainability (Och, 2021). The European Commission has announced plans to introduce a social taxonomy, but its implementation remains uncertain due to the difficulties with defining quantitative metrics for social impact (Platform on Sustainable Finance, 2022b).

Fourth, the taxonomy leads to competitiveness concerns (Brabec and Macháč, 2025). The absence of comparable systems in other major jurisdictions[5] could mean that EU-based firms appear less sustainable compared to global peers due to the stringency of EU criteria (De Oliveira Neves, 2022). If investors would redirect funds to regions with less demanding sustainability regulation, this would undermine both competitiveness and climate objectives (Brabec and Macháč, 2025).

Finally, the taxonomy's complex disclosure requirements of classifying each business activity separately impose high administrative and compliance costs. This is particularly relevant for smaller companies that often lack the resources and expertise for detailed sustainability reporting (Och, 2021). These burdens might discourage voluntary disclosure of SMEs despite potential access to cheaper green financing, which would constrain the taxonomy's effectiveness in mobilizing capital across the broader economy (Platform on Sustainable Finance, 2025).

3 Hypothesis Development

This section outlines the theoretical background underlying our empirical analysis. It first compares the taxonomy metrics with E-scores to explain how both frameworks attempt to quantify corporate environmental sustainability. We then develop expectations for how different levels of taxonomy alignment relate both to accounting-based profitability and market-based firm valuation. Finally, we draw on the efficient market hypothesis and non-pecuniary investor tastes to motivate expectations about the association between taxonomy alignment and stock returns. Building on this exploration, we develop three testable hypotheses.

[5] Five member states of the Association of Southeast Asian Nations (Indonesia, Malaysia, Philippines, Singapore, and Thailand) have implemented national taxonomies for classifying environmentally sustainable economic activities since 2021 (UNEP, 2025). Furthermore, the People's Bank of China together with other Chinese regulators, published the new Green Finance Endorsed Project Catalogue, which took effect in October 2025 and serves as the country's unified green-finance taxonomy (Segal, 2025).

3.1 Conceptual Foundations of Taxonomy Metrics and Environmental Scores

The taxonomy alignment metrics and ESG scores both represent quantitative measures of a firm's sustainability performance (Bassen et al., 2025), with the taxonomy currently only assessing environmental sustainability (EU, 2020).

ESG scores are prepared independently by third-party providers such as LSEG or MSCI (Berg et al., 2022). The environmental component of these ratings measures a firm's performance using quantitative input- and output-based performance indicators as well as qualitative assessment of policies, controversies and other factors (Hummel and Bauernhofer, 2024). However, each provider uses its own proprietary methodology, i.e. they use different sets of attributes which are measured and weighted differently, ultimately leading to different interpretations of sustainability (Berg et al., 2022). For instance, LSEG (2024) focuses its methodology on the assessment of environmental performance by ranking companies among their peers in terms of a company's emissions, innovation, and resource use based on public data points. In contrast, MSCI (2024) assesses different dimensions, such as the product's carbon footprint, based on a company's exposure to business, geographic and company-level risks factors as well as its ability to manage that exposure based on e.g. emission reduction targets in place and level and extent of organizational responsibility attributed to sustainability. MSCI (2024) states specifically that firms operating in environmentally exposed industries must demonstrate substantially stronger environmental risk management practices to achieve the same score as firms with inherently lower exposure.

In contrast to third-party E-ratings, the taxonomy examines environmental sustainability at the economic activity level rather than at the firm level, providing a more granular and directly comparable measurement (Bassen et al., 2025). Notably, the taxonomy does not assess a firm's management of its environmental footprint but instead evaluates whether specific business activities make a substantive contribution to the EU's environmental objectives, such as climate-change mitigation and adaptation (EU, 2020). To ensure scientific robustness, the technical screening criteria incorporate reference points such as climate transition pathways. These criteria are regularly reassessed based on technological and scientific developments, ensuring that the framework remains aligned with evolving expectations of sustainable economic activities (EU, 2020; Bassen et al., 2025). Because the taxonomy is based on regulator-defined definitions of what constitutes an environmentally sustainable activity, and prescribes a standardised classification process, it avoids the methodological discretion that drives divergence in ESG ratings (Bassen et al., 2025).

Overall, while E-scores and taxonomy metrics both aim to measure corporate environmental sustainability, their diverging concepts and methodologies suggest that they may capture different dimensions of environmental sustainability (Hummel and Bauernhofer, 2024; Bassen et al., 2025). Thus, the relationship between firms' reported alignment and E-scores is expected to be positive but modest. Based on these considerations, we develop the following hypothesis:

H1. Taxonomy alignment is positively associated with E-scores, but the magnitude of the association is small.

3.2 Taxonomy Alignment and its Firm Performance Implications

Given the assumed low explanatory power of taxonomy alignment for E-scores, the positive or U-shaped relationships of ESG on firm performance documented in the literature may not extend to taxonomy alignment (Friede et al., 2015; Trumpp and Guenther, 2017; Dumrose et al., 2022). E-ratings may be improved through relatively low-cost managerial actions, such as enhanced disclosure, appointing a Chief Sustainability Officer, or setting emission reduction targets (see LSEG, 2024; MSCI, 2024). However, these measures primarily signal commitment but do not necessarily entail substantial changes to a firm's business activities (Berg et al., 2022). In contrast, the taxonomy measures compliance with strict, science-based and activity-specific environmental criteria directly tied to business operations (Schütze and Stede, 2021; Bassen et al., 2025). Meeting these criteria, i.e. being aligned with European Green Deal targets, often require substantive capital investments to transform production processes or restructure the portfolio of operations towards sustainable activities (McKinsey, 2022; Andersson et al., 2025). Consequently, taxonomy alignment requires genuine operational transformation, which mostly entails higher costs than improvements in ESG ratings (Berg et al., 2022; McKinsey, 2022).

Given the varying transformation costs across alignment levels, we expect economic effects to differ depending on where firms stand in their transition trajectory. At lower or moderate levels of alignment, firms often exploit readily achievable efficiency gains, such as energy efficiency efforts, and benefit from cheaper green financing (Zerbib, 2019; McKinsey, 2021). These effects can reduce operating and financing costs, which would translate into higher ROA and ROE (Berk and DeMazo, 2020). From a valuation perspective, early-stage alignment may signal to investors that a firm faces lower transition risk, that is financial risk arising from the shift to a low-carbon economy such as changing demand and technological changes, and reduced regulatory risk, that is future tightening environmental policies and compliance requirements (Giglio et al., 2021; Ilhan et al., 2021). This perception would lower a firm's

discount rate and raise market valuations, contributing to a higher Tobin's Q (Berk and DeMazo, 2020). At the stage of low alignment levels, the benefits of reduced risk and improved efficiency may surpass the relatively modest transitions costs.

However, as firms progress towards higher alignment levels, the costs-benefit trade-off may change. Achieving high taxonomy alignment requires substantial transformations, including investments in fundamental operational changes and restructuring of supply chains (McKinsey, 2022; WEF, 2024). These measures generate substantial transition costs and temporary operational inefficiencies as new systems are integrated (McKinsey, 2022; WEF, 2024). Therefore, the marginal profitability benefit decreases and may turn negative as transition costs surpass the benefits from the transition. Concerning market valuation, the large, required investments likely depress expected cash flows. Additionally, since benefits of these investments only materialize far in the future, investors may apply higher discount rates which lowers market valuations and, thus, Tobin's Q (Berk and DeMazo, 2020).

Together, these mechanisms imply an inverted U-shaped (concave) relationship between alignment and firm performance across both profitability (ROA, ROE) and market valuation (Tobin's Q). Based on this argumentation, we derive the following hypothesis:

H2. Taxonomy alignment exhibits a concave relationship with firm performance.

3.3 Taxonomy Alignment and its Stock Return Implications

We build on efficient market and market equilibrium theories to assess the link between alignment and stock returns. Under the efficient market hypothesis, new information about a firms' environmental sustainability such as the taxonomy metrics should be reflected in asset prices (Fama, 1970). Thus, if the taxonomy regulation affects investors' perceptions of the risk premia associated with environmentally harmful versus environmentally sustainable firms, these differences should be reflected in required returns (Cauthorn et al., 2023). Low-aligned firms are disproportionately affected by stricter environmental policy and disclosure standards, hence investors should demand higher returns for holding these assets (Bolton and Kacperczyk, 2023). Conversely, aligned firms face lower regulatory and transition risk and should therefore command lower required returns, which in equilibrium implies lower expected returns going forward (Ilhan et al., 2021).

Investor preferences provide a complementary mechanism. According to the non-pecuniary taste framework of Fama and French (2007), investors may value taxonomy-aligned assets for reasons beyond their financial performance and therefore are willing to pay a premium for them (Pedersen et al., 2021). Such preference-driven demand raises realized returns in the short run

but lowers long-run expected returns in equilibrium (Pástor et al., 2021). These predictions are also consistent with recent market development: Despite ESG funds' underperformance in the aftermath of the energy crisis in 2022, European sustainable funds did not experience widespread outflows (Temple-West and Schmitt, 2024; MSCI, 2025), suggesting that preference-driven investors continue to allocate capital to environmentally aligned firms even in periods of weaker financial performance.

Early evidence on the taxonomy is consistent with this adjustment mechanism. Bassen et al. (2025) and Cauthorn et al. (2023) find a positive return premium for taxonomy-aligned companies, but their sample periods span between 2017 to 2020 and 2011 to 2020, respectively, largely coinciding with the announcement and early development of the regulation. During this period, companies did not yet report actual taxonomy data and thus taxonomy information was likely not yet fully incorporated into prices. The short-term outperformance observed during this early period likely reflects a temporary price appreciation as investors learned about firm's alignment status, rather than persistently higher expected returns (Pástor et al., 2021; Pástor et al., 2022).

In contrast, our sample period spans FY 2022 to FY 2024, covering a period after the regulation came into force and firm-reported data became publicly available, taxonomy information should already be largely incorporated into asset prices. In equilibrium, if investors value alignment, either due to lower perceived risk or non-pecuniary preferences, aligned firms should trade at premium valuations (Ilhan et al., 2021; Pástor et al., 2021). This valuation mechanism mechanically lowers forward expected returns and investors who buy at higher prices earn lower subsequent returns (Pástor et al., 2021). Consistent with equilibrium prediction (Pástor et al., 2021), we would expect taxonomy alignment to be negatively associated risk-adjusted returns (alpha), even after for controlling for exposures to standard risk factors (Fama and French, 1993; Fama and French, 2015). Based on the above arguments, we derive our final hypothesis:

H3. Taxonomy alignment is negatively associated with Fama-French risk-adjusted returns.

4 Data

This section outlines the underlying sample used to empirically test our hypotheses and provides an overview of descriptive statistics by year, country, and sector.

4.1 Sample Construction and Variable Definitions

Our sample is constructed based on the STOXX Europe 600 index as of August 4, 2025, to reflect the current composition of major European listed firms. While this static approach ensures comparability and data availability, it may introduce survivorship bias, as firms removed from the index between 2023 and 2025 are not included in the sample (Brown et al., 1992). Out of the 600 firms, we exclude a total number of 299 companies: 197 headquartered outside of the EU (excluding Norway), 84 classified as financial institutions according to the Global Industry Classification Standard (GICS), 11 with fewer than 500 employees, and 7 excluded to ensure independence of observations[6]. The final sample consists of 301 companies. We focus on non-financial companies because reporting requirements for financial firms[7] differ substantially from those for non-financial firms (Hummel and Bauernhofer, 2024).

We obtained financial data, firm-reported taxonomy figures, and LSEG E-rating data were retrieved from LSEG Workspace, and MSCI E-scores from MSCI, for the period FY 2022 to FY 2024. Monthly return data was imported from Yahoo Finance, and monthly Fama-French risk factors and risk-free rates were derived from the Tuck Fama French Data Library, using European three- and five-factor datasets for the period July 2023 to June 2025.

The taxonomy data has only recently been integrated into LSEG Workspace and exhibits data gaps and inaccuracies. 599 missing values were filled in manually using the information from the respective annual or sustainability reports, and identified errors were restated. However, companies may restate previously reported figures in response to changing taxonomy guidelines and these updates may not be fully reflected in the data.

Our taxonomy dataset comprises datapoints for the mandatory reporting years FY 2022 to FY 2024. We exclude FY 2021 due to limited voluntary alignment reporting (KPMG, 2022) and we conduct our analyses only for turnover and capex. We exclude opex for two reasons. Firstly, a smaller data set is available for opex due to companies using the materiality exemption to not report opex (EU, 2021). Secondly, opex, as defined by the taxonomy as non-capitalized, investment-related costs, lacks consistency with the operating expenditure figures reported in the income statement, limiting its meaningfulness for our chosen analyses[8] (European Commission, 2021).

[6] Christian Dior SE (majority owned by LVMH Moet Hennessy Louis Vuitton SE and consolidated reporting with LVMH), Dr Ing hc F Porsche AG (majority owned by Volkswagen AG), Endesa (majority owned by Enel SpA), Hochtief AG (majority owned by ACS Actividades de Construccion y Servicios SA), Sartorius Stedim Biotech SA (majority owned by Sartorius AG), Siemens Healthineers (majority owned by Siemens AG), Var Energi ASA (majority owned by ENI SPA).

[7] Financial and insurance companies must report their Green Asset Ratio, Green Investment Ratio, and Green Premium Ratio based on aligned and eligible assets (Hummel & Bauernhofer, 2024).

[8] Total taxonomy turnover and capex figures can also differ to some extent from reported financial statement metrics. For example, total taxonomy capex includes all additions to tangible and intangible assets before depreciation, amortization, and

Table 2 Variable Definitions: Firm-Level Variables

Variables	Description/Formula
Dependent variables	
MSCI E-Score	MSCI environmental pillar score
LSEG E-Score	LSEG environmental pillar score
ROA	Net income after minority interest / average of last year's and current year's total assets
ROE	Net income after minority interest / average of last year's and current year's shareholders' equity attributable to parent
Tobin's Q	(Total assets - total shareholders' equity - net deferred tax liabilities + end of year market capitalization) / total assets
Independent variables	
Eligible Share	Eligible taxonomy turnover (capex) / total taxonomy turnover (capex)
Aligned Share	Aligned taxonomy turnover (capex) / total taxonomy turnover (capex)
Aligned/Eligible Ratio	Aligned taxonomy turnover (capex) / eligible taxonomy turnover (capex)
Control variables	
Leverage	Total debt / total assets
Size	Logarithm of total assets

Note: This table summarises the definitions and formulas for all firm-level variables. Calculation of Tobin's Q follows Fatemi et al. (2018) and Tonnarello et al. (2025) and assumes fiscal year-end equals calendar year-end. Calculation of leverage follows Aydoğmuş et al. (2022). ROE is not calculated for companies with negative shareholders' equity values to avoid data distortion.

Table 3 Variable Definitions: Portfolio Returns and Risk Factors

Variables	Description/Formula
Dependent variables	
LS_{AT}	Long-short portfolio return based on firms' taxonomy-aligned turnover share
LS_{AET}	Long-short portfolio return based on firms' taxonomy aligned/eligible turnover share
LS_{AC}	Long-short portfolio return based on firms' taxonomy-aligned capex share
LS_{AEC}	Long-short portfolio return based on firms' taxonomy aligned/eligible capex share
Independent variables	
r_{MKT}	Market return (return of the value-weighted (or equal-weighted) portfolio of all sample firms)
r_f	Monthly risk-free rate used to calculate excess returns
SMB	Size factor ("small minus big")
HML	Value factor ("high minus low")
RMW	Profitability factor ("robust minus weak")
CMA	Investment factor ("conservative minus aggressive")

Note: This table summarises the definitions of the long-short portfolio return variables and the asset-pricing factors used in the analyses. Portfolio returns are constructed using quintile sorts and reported as High-Low spreads. The Fama-French factors are included to control for common drivers of stock returns: The market factor r_{MKT} captures broad market movements; SMB reflects the difference between small and large cap firms; HML captures differences between value and growth firms; RMW accounts for return patterns linked to firm profitability; and CMA captures return differences associated with firms' investment intensity (French and Fama, 1993; French and Fama, 2015).

Table 2 provides a summary of all firm-level variables, and Table 3 provides a summary of all portfolio return and risk factor variables. The two main taxonomy variables of interest for

re-measurements, incl. revaluations, impairments, and assets acquired in business combinations, while excluding fair-value changes (EU, 2021).

our analyses are the aligned share and the aligned/eligible ratio, whereas the latter primarily functions as a robustness specification. The aligned share reflects a company's absolute alignment intensity and is therefore most relevant to investors and regulators. The aligned/eligible ratio represents an efficiency indicator assessing whether firms effectively convert taxonomy-eligible activities into aligned ones, independent of the overall scale of eligible activities. This variable can only be calculated if a company has an eligible turnover (capex) that is greater than zero. In contrast, the aligned share variable can be calculated for all firms with available total taxonomy turnover (capex) and thus allows for a higher number of observations.

4.2 Descriptive Statistics

This section provides an overview of the descriptive statistics of our sample. All descriptive statistics are based on equal-weighted firm-level averages to ensure comparability across firms.

4.2.1 Sample Composition and Summary Statistics

Companies in the sample are incorporated in 15 different countries and belong to 10 different GICS sector categories. The sample is dominated by firms active in the industrials (29.2%) and consumer discretionary (12.0%) sectors, as well as French (18.9%) and German (18.6%) companies. Detailed sector-level and country-level composition of the sample can be found in Appendix C and Appendix D.

Table 4 presents summary statistics for the panel dataset from FY 2022 to FY 2024. In line with expectations, coverage of the taxonomy variables is high for mandatory reporting years, with only a few data points missing. Missing data is primarily due to IPOs after FY 2022[9], and Norwegian companies, most of which began to disclose only in FY 2023 after the adoption of the taxonomy into Norwegian law (Norwegian Ministry of Finance, 2025). The aligned shares are considerably lower than the corresponding eligible shares, indicating substantial potential for further alignment. Furthermore, the mean of aligned shares exceeds the median, with the median being zero for turnover and close to zero for capex, indicating a highly right-skewed distribution. Especially for turnover, a small subset of firms accounts for the majority of reported alignment. In contrast, both mean and median values are similar for aligned/eligible ratios; thus, conditional on having eligible activities, firms exhibit, on average, a similar level of conversion efficiency both for current operations and long-term investments. Financial ratios

[9] IPO of Lottomatica Group SpA on 03.05.2023; IPO of Renk Group AG on 10.05.2023; IPO of Svesqo NV on 11.12.2023; and IPO of Puig Brands SA on 05.03.2024. Ferrovial SE and Iveco Group NV also became publicly listed in or after 2022 but taxonomy reporting is available for FY 2022 to FY 2024.

ROA and ROE show moderate dispersion, while Tobin's Q exhibits high variability because of extreme market valuations in certain firms. Supplementary summary statistics for portfolio return and risk factor variables are provided in Appendix E.

Table 4 Summary Statistics: Firm-Level Variables

Variable	N	Mean	Median	SD	Min	Q1	Q3	Max
Dependent Variables								
MSCI E-Score	889	63.7	61.0	22.1	8.0	48.0	81.0	100.0
LSEG E-Score	882	69.9	73.2	19.0	0.0	60.0	83.8	97.8
ROA (%)	903	5.3	5.0	6.4	-45.7	2.3	7.8	43.5
ROE (%)	901	13.4	13.0	17.7	-175.7	7.6	19.0	140.3
Tobin's Q (%)	896	194.5	142.7	153.4	50.5	108.4	213.2	1328.0
Independent Variables								
Eligible Turnover (%)	886	30.0	9.2	35.9	0.0	0.0	58.1	100.0
Eligible Capex (%)	886	41.3	36.3	33.7	0.0	9.6	70.5	100.0
Aligned Turnover (%)	884	9.4	0.0	19.5	0.0	0.0	9.1	99.8
Aligned Capex (%)[10]	883	14.8	1.7	25.1	-8.7	0.0	17.5	100.0
Aligned/Eligible Turnover (%)	649	30.3	12.2	36.2	0.0	0.0	60.1	100.0
Aligned/Eligible Capex (%)	828	30.1	11.4	36.1	-12.1	0.0	57.7	100.0
Control Variables								
Size	903	23.3	23.2	1.3	19.3	22.3	24.2	27.2
Leverage (%)	903	27.0	26.4	14.3	0.4	16.3	36.4	76.5

Note: This table summarises descriptive statistics for all firm-level variables used in the analysis, reporting observations, central tendencies, and dispersion measures for dependent, independent, and control variables. Statistics are computed on the pooled panel dataset spanning FY 2022 to FY 2024, with 903 firm-year observations from 301 unique firms.

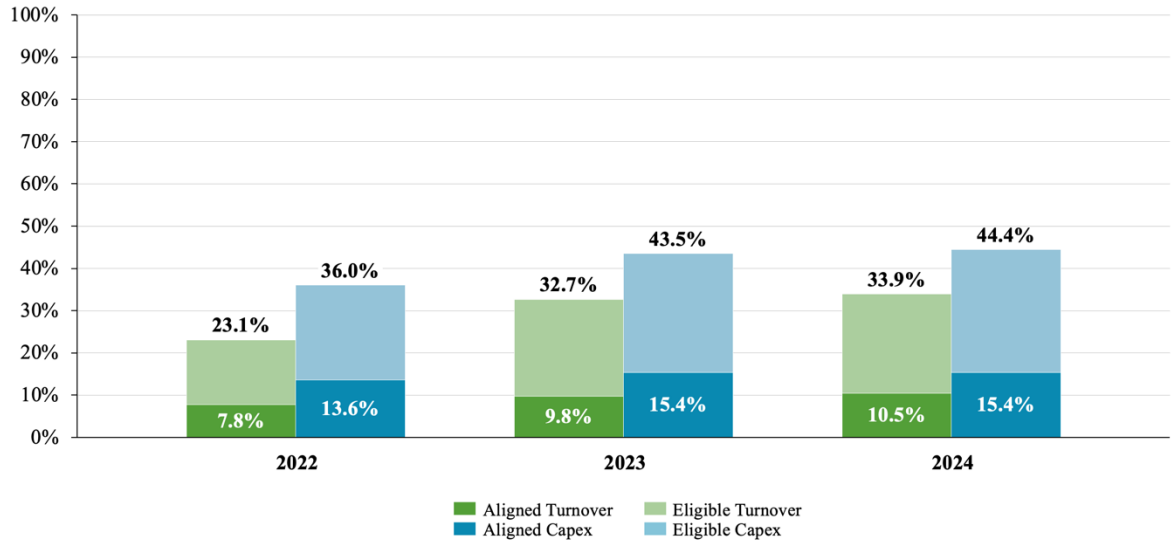
4.2.2 Descriptive Statistics by Year

Figure 1 illustrates the average share of eligible and aligned activities for turnover and capex from FY 2022 to FY 2024. Throughout the sampling period, capex consistently exhibits the highest levels of eligibility and alignment. This suggests that firms are directing more expenditures toward green investments, while their current operations remain less aligned. The share of eligible activities grows significantly more than the share of aligned activities: Over the three-year period, the share of eligible activities increases on average by 9.6 percentage points (pp), while the share of aligned activities grows only by 2.3pp. Furthermore, the eligible share grows continuously for turnover and capex over the three years, while the aligned share only increases continuously for turnover and stagnates for capex from FY 2023 to FY 2024. The increasing share of eligible activities can be attributed to three main factors: (1) the broadening of the taxonomy to all six environmental objectives in FY 2023; (2) the inclusion of more activities; and (3) businesses potentially adjusting their business models towards a

[10] Negative aligned capex figure reported by Thyssenkrupp AG FY 2024 results from a reduction in capex due to a government grant received (Thyssenkrupp, 2024).

higher share of eligible than non-eligible activities (Maier and Bauer, 2023; Hummel and Bauernhofer, 2024). Firms struggle to align their operations as rapidly as the taxonomy is expanded, evident in the growing gap between eligible and aligned shares.

Figure 1 Aligned and Eligible Shares by Year

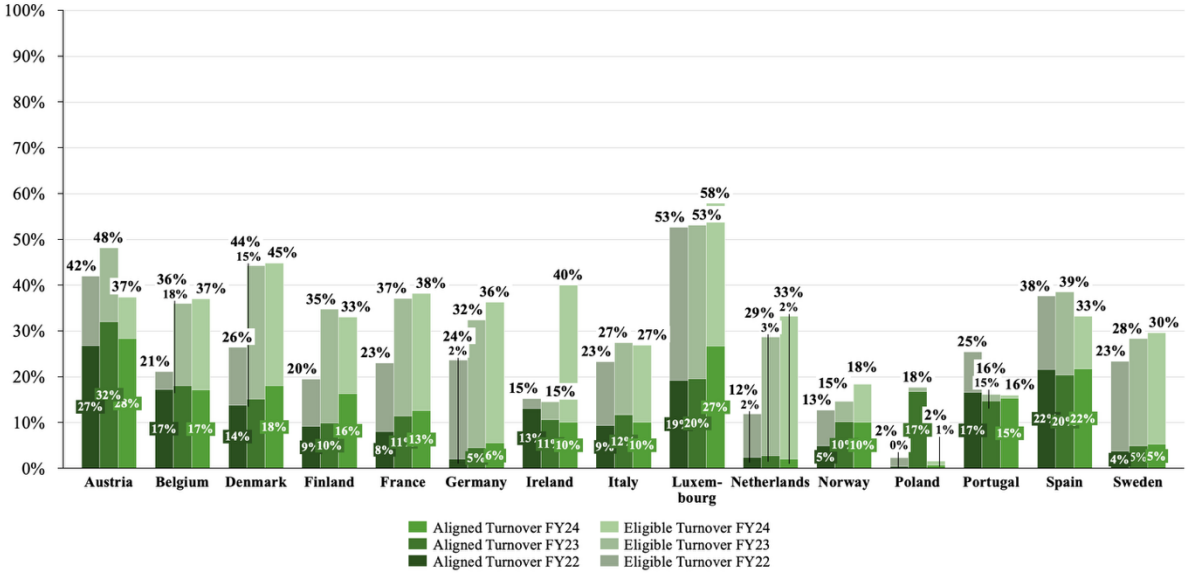


Note: This figure displays the average shares of taxonomy-aligned and eligible turnover and capex from FY 2022 to FY 2024. Values are displayed as percentages of total taxonomy turnover (capex).

4.2.3 Descriptive Statistics by Country of Incorporation

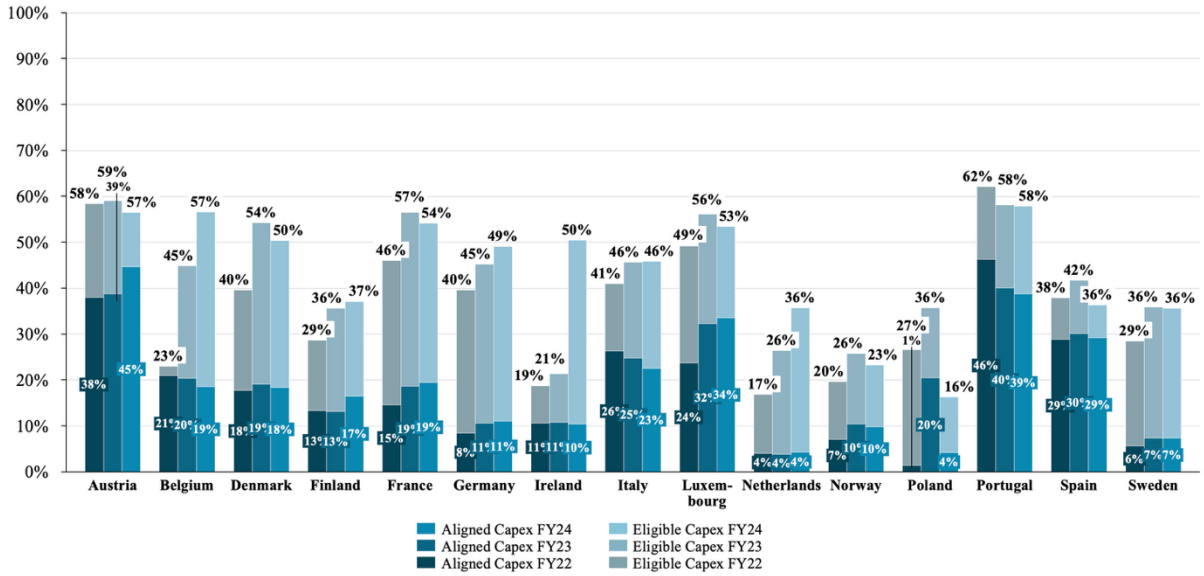
To examine how taxonomy variables evolved over time for firms incorporated in different countries, Figure 2 and Figure 3 show the average share of eligible and aligned turnover and capex, respectively, for each reporting year by country of incorporation.

Figure 2 Aligned and Eligible Turnover Shares by Country and Year



Note: This figure shows the average shares of taxonomy-aligned and eligible turnover from FY 2022 to FY 2024 by country of incorporation. Values are displayed as percentages of total taxonomy turnover.

Figure 3 Aligned and Eligible Capex Shares by Country and Year



Note: This figure shows the average shares of taxonomy-aligned and eligible capex from FY 2022 to FY 2024 by country of incorporation. Values are displayed as percentages of total taxonomy capex.

For FY 2024, Luxembourg exhibits the highest share of turnover eligibility. Portugal shows the highest capex eligibility share, mainly driven by the utilities company EDP SA. Austrian companies disclose the highest share for turnover and capex alignment mainly driven by the utility company Verbund AG and materials company Wienerberger AG. Poland ranks lowest across all metrics[11]. The reason being that included Polish companies all belong to sectors with relatively low taxonomy-eligibility. Generally, it is important to note that for countries with only a few included companies, individual companies can disproportionately affect national averages, making figures easily distorted and less statistically robust (refer to Appendix D).

Compared to other large economies in the sample, Germany exhibits relatively low shares of alignment across all reporting periods. Given that Germany accounts for around a quarter of the EU's GDP (EU, 2025), its economic weight pulls down the EU's overall alignment levels, making it harder to meet European Green Deal objectives.

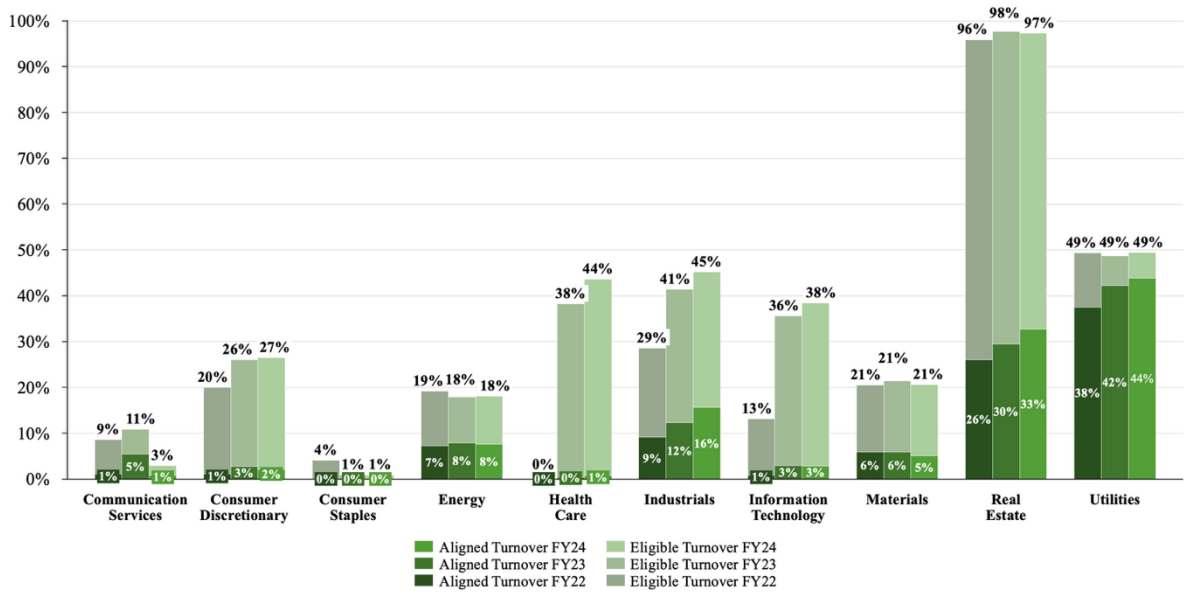
Finally, the Netherlands and Sweden stand out for their large gap between eligible and aligned shares. Several Dutch companies, such as ASML Holding NV and Koninklijke Philips NV, report a 100% eligible share but a 0% aligned share of their turnover, with similar patterns observable in their capex (ASML, 2025; Philips, 2025), highlighting that at least some companies do not translate their high potential for alignment into actual alignment.

[11] The sharp increase of eligible and aligned turnover as well as aligned capex for Poland in FY 2023 is solely driven by CD Projekt SA reflecting changes in their interpretation of EU guidelines for eligibility and alignment (CD Projekt, 2024).

4.2.4 Descriptive Statistics by Sector

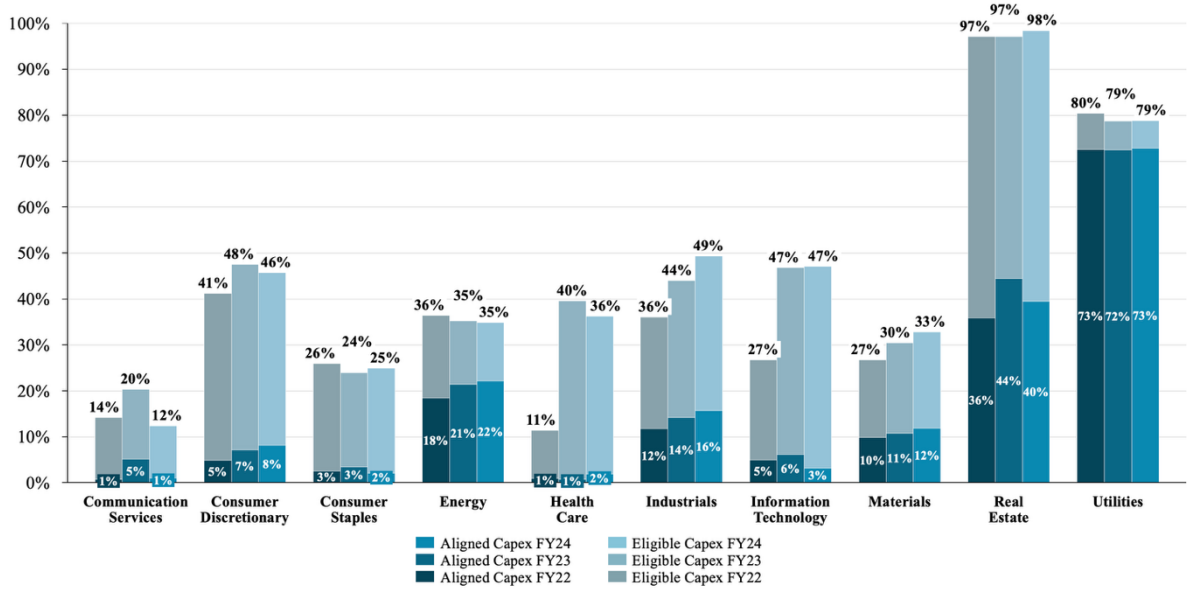
To examine the changes in sector averages across time, Figure 4 and Figure 5 show the average share of eligible and aligned activities for turnover and capex for the period FY 2022 to FY 2024 by sector.

Figure 4 Aligned and Eligible Turnover Shares by GICS Sector and Year



Note: This figure shows the average shares of taxonomy-aligned and eligible turnover from FY 2022 to FY 2024 by GICS sector. Values are displayed as percentages of total taxonomy turnover.

Figure 5 Aligned and Eligible Capex Shares by GICS Sector and Year



Note: This figure shows the average shares of taxonomy-aligned and eligible capex from FY 2022 to FY 2024 by GICS sector. Values are displayed as percentages of total taxonomy capex.

The real estate sector discloses the highest eligibility shares across all reporting periods and both metrics since the sector aligns closely with taxonomy-defined activities such as

acquisition and construction of new buildings and renovation of existing stock. Utility companies disclose the highest alignment shares across both turnover and capex. This finding appears reasonable given that utilities typically engage in activities with inherent sustainability objectives such as renewable energy generation, transmission, and distribution, making it easier for these companies to achieve taxonomy alignment. The consumer staples sector reports the lowest eligible and aligned turnover share, while the communication services sector exhibits the lowest eligible and aligned capex share for the latest reporting year. This is due to the nature of business models in the service and consumer goods sector, for which the taxonomy only lists a few eligible activities with limited alignment potential.

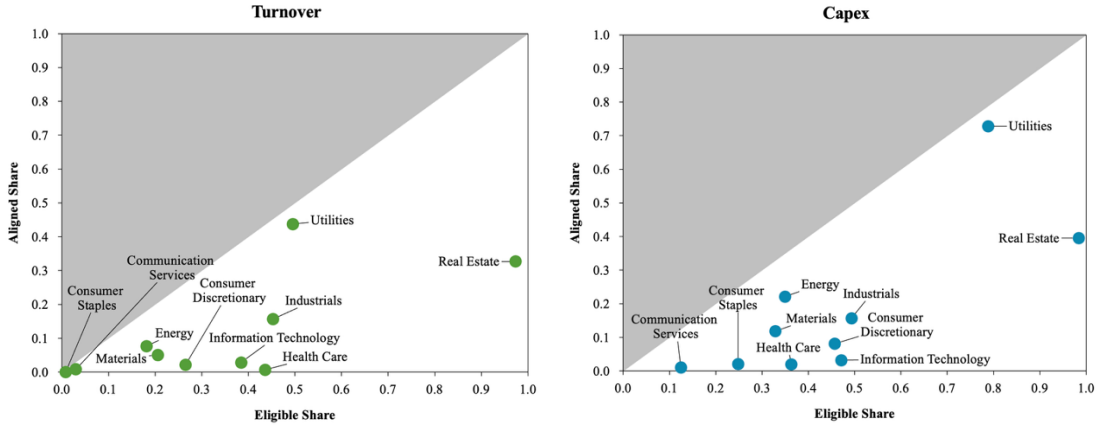
The observed increase in eligible shares across reporting years is shown to be primarily driven by the health care and information technology sectors. For the health care sector, eligibility shares increase significantly from FY 2023 onwards due to revised reporting guidelines, which allow the inclusion of subcontractor revenues and manufacturing of medicinal products within the scope of eligible activities (Argenx, 2024; Novo Nordisk, 2024). Regarding information technology, for example, ASML Holding NV and ASM International NV disclose a significant increase in their eligibility shares stemming from the introduction of activities connected to the circular economy objective (ASM, 2024; ASML, 2024).

While alignment figures generally appear to increase more consistently across years and sectors, a few sectors also exhibit decreasing trends in alignment. Decreasing trends can be attributed to a few companies correcting previously overstated alignment figures or revising earlier reporting practices instead of broad sector-wide reductions in alignment levels. For example, the decrease in aligned turnover for FY 2024 within the communication services sector is entirely attributable to CD Projekt SA's revised interpretation of EU guidelines (CD Projekt, 2025). Likewise, the decline in aligned capex in the information technology sector from FY 2023 to FY 2024 is primarily driven by Dassault Systèmes SE, following lower investments in building acquisitions (Dassault, 2025), and by Bechtle AG, which corrected earlier misinterpretations of guidelines and was unable to report alignment for certain activities due to missing information from its suppliers (Bechtle, 2025).

To assess the conversion from eligibility to alignment, Figure 6 presents scatter plots of each sector's taxonomy-aligned share against its taxonomy-eligible share for turnover and capex in FY 2024. This overview is particularly interesting for FY 2024 as it is the first year where eligible and aligned shares are directly comparable and cover all six objectives. A sector's position close to the 45-degree line indicates an almost perfect conversion rate. The utilities sector plots closest to the line in the upper portion of the graph, demonstrating its high

conversion of a major number of eligible activities, especially for capex. While real estate shows the highest eligibility shares of close to 100%, it plots the furthest away from the 45-degree line, showing the largest eligible-aligned gap. In practice, this gap can likely be explained by the challenge of meeting energy-efficiency thresholds and "top-15%" benchmarks for building performance (Buschbeck and Teubler, 2025). All other sectors cluster in the lower-left quadrant, meaning both eligibility and alignment are low. Consumer staples and communication services are the most pronounced trailing firms, and industrials, information technology, consumer discretionary, energy, and materials show modest eligibility and alignment but remain far from the 45-degree line. The capex plot exhibits slightly greater dispersion for the lower left quadrant, suggesting that companies may find it easier to align new investments than existing revenue streams.

Figure 6 Scatter Plots of Aligned and Eligible Shares for Turnover and Capex



Note: This figure presents scatter plots comparing sector-level aligned and eligible shares for turnover and capex in FY 2024. Each point represents the sectoral average based on GICS classification. The 45-degree line indicating full alignment, where the aligned share equals the eligible share.

5 Taxonomy Alignment and Environmental Scores

In the following subsections, we present the methodology and results of our analyses regarding the relationship between taxonomy alignment and E-scores.

5.1 Methodology

To assess how taxonomy alignment relates to E-scores, we first generate a correlation matrix for an initial indication of the relationship between eligible share, aligned share, and E-ratings. We then estimate the following contemporaneous panel OLS regression model (1):

$$\text{E-Score}_{i,t} = \alpha + \beta\,\text{Align}_{i,t} + \gamma_1 \text{Elig}_{i,t} + \gamma_2 \text{Size}_{i,t} + \text{Country}_i + \text{Sector}_i + \text{Year}_t + \varepsilon_{i,t}$$

E-Score$_{i,t}$ denotes the environmental pillar score of firm *i* in year *t*, obtained from either MSCI or LSEG. The MSCI E-score is scaled from the initial range of 0 to 10 to a range from 0 to 100 by multiplying each score by 10 to ensure direct comparability with the LSEG E-score. The model is estimated separately for turnover-based and capex-based taxonomy metrics and for both variables of alignment. Hence, in the first specification, *Align*$_{i,t}$ represents the aligned share, and in the second specification, it reflects the aligned/eligible ratio. Taxonomy ratios are scaled to percentages for consistency and comparability with E-scores. All variables are mean-centred to improve the interpretability of the coefficients. We control for the eligible share to ensure that the estimated effect of alignment captures the distinct effect of taxonomy alignment, independent of the firm's exposure to taxonomy-eligible activities. Following Dumrose et al. (2022), we control for *Size*$_{i,t}$ using the logarithm of total assets. To capture unobserved heterogeneity, we include country, sector, and year fixed effects in the model and estimate it using country-clustered standard errors.

To mitigate potential selection bias related to firm characteristics, we additionally employ a PSM approach using firm-year observations from FY 2022 to FY 2024. We construct comparable treatment and control groups by matching on eligibility, size, sector, and year, using 1:1 nearest-neighbour matching. The treatment indicator equals one for firm-year observations above the pooled median of the respective taxonomy variable. After matching, we estimate the treatment effects using OLS regression of the treatment indicator on E-scores, rather than simple difference-in-means to improve estimation efficiency. We include year fixed effects and cluster standard errors at the firm-level to account for within-firm correlation across time:

$$\text{E-Score}_{i,t} = \alpha + \beta \cdot \text{High}_{i,t} + \sum_{t} \gamma_t + \varepsilon_{i,t}$$

This approach complements our regression analysis by addressing potential selection bias arising from systematic differences between high- and low-aligned firms. Because taxonomy alignment could be driven by structural characteristics, OLS estimates may capture cross-industry heterogeneity rather than alignment effects. In contrast, PSM allows us to assess whether the associations identified in the regression persist when firms are evaluated against similar peers.

5.2 Results

Table 5 shows the correlation between MSCI and LSEG E-scores and the taxonomy variables. For the taxonomy alignment variables and the two E-ratings, we find positive but low correlations that are statistically significant at the 1% level. These correlations range from 0.12

to 0.17, suggesting that firms with higher taxonomy alignment exhibit slightly higher E-ratings on average. The scatter plots in Appendix F further illustrate this low correlation, showing a positive but highly dispersed pattern in which many firms record high E-scores despite very low or zero taxonomy alignment. Similarly, the aligned/eligible ratios show only small positive correlations with both E-scores. Eligibility appears to be negatively correlated with the MSCI E-score but marginally positively correlated with the LSEG E-score. The correlation among the respective eligible (aligned) turnover and eligible (aligned) capex variables is high, with 0.77 (0.83), suggesting firms reporting eligible (aligned) turnover tend to exhibit similar patterns in eligible (aligned) capex. The correlation between eligible and aligned turnover (capex) is moderate with 0.54 (0.59), indicating that mere eligibility does not directly translate into alignment. MSCI's and LSEG's E-scores show a low correlation of 0.15, revealing a substantial divergence between the assessment criteria of these two rating providers, confirming findings by Berg et al. (2022).

Table 5 Pooled Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Eligible Turnover	1.00***							
(2) Eligible Capex	0.77***	1.00***						
(3) Aligned Turnover Share	0.54***	0.51***	1.00***					
(4) Aligned Capex Share	0.45***	0.59***	0.83***	1.00***				
(5) Aligned/Eligible Turnover	0.03	0.16***	0.66***	0.66***	1.00***			
(6) Aligned/Eligible Capex	0.16***	0.21***	0.60***	0.76***	0.78***	1.00***		
(7) MSCI E-Score	-0.08**	-0.01	0.14***	0.17***	0.22***	0.15***	1.00***	
(8) LSEG E-Score	0.17***	0.19***	0.12***	0.17***	0.12***	0.19***	0.15***	1.00***

Note: This table presents Pearson correlation coefficients between taxonomy metrics and environmental ratings, pooled across financial years FY 2022 to FY 2024. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 6 displays the results of model (1) regressing the respective E-scores from MSCI and LSEG on our independent variables and control variables. The regression results with turnover variables are shown in panel A, and those using capex variables in panel B.

For the MSCI E-score, we find a positive relationship that is significant at the 1% level with all independent variables: *Aligned Turnover Share, Aligned/Eligible Turnover, Aligned Capex Share,* and *Aligned/Eligible Capex.* This confirms the results from the correlation matrix, indicating that firms with higher taxonomy alignment tend to achieve higher MSCI E-scores. For the LSEG E-score, only the coefficients on *Aligned/Eligible Turnover* and *Aligned/Eligible Capex* are significantly positive. This result suggests that the LSEG E-score may reward companies only if they align a considerable share of their eligible activities. Since LSEG's methodology for E-score is already peer-adjusted and the aligned/eligible ratio removes sector-driven variations, only firms with higher alignment than their peers experience a measurable

increase in the LSEG E-score. Despite their statistical significance, the associations between alignment and E-scores are economically small. For instance, a 1pp increase in a firm's taxonomy-aligned turnover share is associated with a 0.269-point increase in its MSCI E-score, holding other factors constant; and similar effect sizes can be observed for LSEG's ratings. The association between alignment and E-scores is stronger for turnover, evident in the magnitude of coefficients compared to the capex specifications. This may suggest that the rating providers primarily evaluate the environmental profile of a firm's current operations and place less weight on future-oriented investment measures captured by aligned capex.

Table 6 Relationship between Taxonomy Alignment and E-Scores

Panel A: Turnover Alignment				
	MSCI E-Score		LSEG E-Score	
Intercept	93.698***	99.797***	62.784***	68.681***
	(3.149)	(2.671)	(2.419)	(3.562)
Aligned Turnover Share	0.269***		0.050	
	(0.048)		(0.057)	
Aligned/Eligible Turnover		0.118***		0.047*
		(0.034)		(0.027)
Eligible Turnover Share	-0.161***	-0.065**	0.017	0.018
	(0.027)	(0.027)	(0.027)	(0.027)
Size	2.508***	1.718**	6.830***	6.949***
	(0.957)	(0.729)	(0.828)	(0.993)
Adj. R^2	0.362	0.389	0.351	0.364
Observations	878	648	870	642
Panel B: Capex Alignment				
	MSCI E-Score		LSEG E-Score	
Intercept	96.379***	99.118***	63.240***	64.833***
	(2.945)	(3.063)	(2.196)	(2.127)
Aligned Capex Share	0.174***		0.045	
	(0.049)		(0.046)	
Aligned/Eligible Capex		0.068***		0.054**
		(0.024)		(0.022)
Eligible Capex Share	-0.084***	-0.029*	0.023	0.016
	(0.019)	(0.016)	(0.037)	(0.034)
Size	1.695**	1.369	6.894***	6.834***
	(0.829)	(0.851)	(0.798)	(0.902)
Adj. R^2	0.332	0.345	0.354	0.360
Observations	876	825	868	816

Note: This table reports OLS regression results examining the relationship between taxonomy alignment and firms' E-scores, using data from FY 2022 to FY 2024. Panel A uses turnover-based alignment measures, and panel B uses capex-based alignment measures. For each alignment measure and E-score, the first column shows the aligned specification, and the second column presents the aligned/eligible specification. Continuous variables are mean-centred. Coefficients are shown with standard errors clustered at the country level (in parentheses). All specifications include country, sector, and year-fixed effects (not reported). R^2 has been adjusted for degrees of freedom. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

For our control variables, *Eligible Turnover Share* and *Eligible Capex Share*, we find significant negative coefficients for the MSCI E-score, but no significant association for the LSEG E-ratings. This may be explained by MSCI's focus on assessing a company's environmental risk exposure and management (MSCI, 2024). Because high taxonomy-

eligibility frequently corresponds to activities with elevated environmental risk (Platform on Sustainable Finance, 2022a), these firms may obtain lower E-scores, unless they demonstrate strong risk management, e.g. through alignment. To explore this mechanism, we conduct an explorative descriptive analysis by filtering for companies that achieve a very high E-score of equal or above 90 but disclose zero taxonomy alignment, see Appendix G. We find that such firms appear far more frequently under MSCI than LSEG. Many of these firms operate in service-oriented industries such as health care and communication services whose business models naturally have low direct environmental impacts. This suggests that E-ratings, predominantly MSCI, may reward firms with low environmental exposure rather than those actively contributing to environmental objectives. This discrepancy shows that conceptual differences between rating frameworks and taxonomy metrics can lead to different conclusions about a firm's environmental performance. Our control variable *Size* shows a positive association with both E-ratings, confirming prior findings of Drempetic et al. (2020). All results remain significant after winsorizing 1% of outliers.

The results of the PSM analysis are presented in Table 7. For the MSCI E-score, none of the alignment measures remain significant once firms are matched on sector, size, year, and eligibility. This suggests that the positive association found in the regressions in Table 7 is largely driven by structural differences between highly and low-aligned firms, such as industry affiliation, rather than alignment itself. Since MSCI's methodology places substantial weight on exposure to environmental risk (MSCI, 2024) which varies systematically with sectors, matching firms to otherwise similar peers may remove most of the variation that drives the OLS significance. In contrast, the association between *Aligned/Eligible Capex* and LSEG's E-score remains significant in the matched samples. Firms with above-median taxonomy aligned/eligible capex ratio have, on average, a LSEG E-score that is about 6.3 points higher than otherwise low-aligned firms, after matching on sector, size, year, and eligibility. This indicates that LSEG's rating framework captures environmental performance dimensions that are more closely related to the taxonomy's activity-based measures. The significance of *Aligned Capex Share* for LSEG only emerges in PSM because matching removed cross-sectoral noise in capex intensity. LSEG's E-score is peer-adjusted and once firms are compared with structurally similar peers, the environmental information embedded in aligned capex becomes visible and statistically significant. The more limited dispersion of aligned turnover compared to aligned capex may reduce the ability of the matched sample design to identify meaningful differences between treated and control firms which may explain why only the capex-based specification results in significant effects. Overall, the findings show that the

observed MSCI relationship is driven by confounding structural characteristics rather than alignment itself, whereas the LSEG relationship is more robust and consistent with taxonomy-related environmental performance.

Table 7 Treatment Effect of High versus Low Alignment on E-Scores

	MSCI E-Score	LSEG E-Score
Aligned Turnover Share	5.485	4.606
	(3.742)	(3.557)
Aligned/Eligible Turnover	2.545	2.709
	(2.786)	(2.431)
Aligned Capex Share	2.488	5.997***
	(2.786)	(2.109)
Aligned/Eligible Capex	4.444	6.317***
	(2.885)	(2.230)

Note: This table reports propensity score matching results examining differences in E-scores between firms with higher taxonomy alignment and matched control firms between FY 2022 and FY 2024. Treatment firms are firms with above-median alignment, and control firms are firms with below-median alignment. Firms are matched based on eligibility, size, sector, and year. Estimated average treatment effects are shown with standard errors in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Overall, our results confirm *Hypothesis 1*, showing that taxonomy alignment is positively, but economically weakly, associated with firms' E-scores. However, the strength of the association differs between the two rating providers due to underlying conceptual and methodological differences, with LSEG's E-score more closely reflecting the activity-based environmental contributions captured by taxonomy alignment. Our findings confirm the results of the study conducted by Dumrose et al. (2022), who show a positive association between the aligned/eligible ratio and E-ratings and significant divergencies between the ratings. Contrary to our findings of a negative relationship between eligibility and MSCI E-score, they find a negative relationship between LSEG's E-score and eligibility. This discrepancy could stem from differences in sample composition. We expand on their study by confirming their results with actual reported taxonomy data and by providing first explanations for the observed divergence across rating providers, drawing on differences in their underlying methodologies.

6 Taxonomy Alignment and Firm Performance

In the following subsections, we present the methodology and results of our analyses regarding the relationship between taxonomy alignment and firm performance.

6.1 Methodology

We assess the impact of alignment on profitability (ROA and ROE) and firm value (Tobin's Q) using a time-lagged panel OLS regression model. The baseline OLS regression model (2) is specified as follows:

$$\mathrm{Perf}_{i,t} = \alpha + \beta_1\,\mathrm{Align}_{i,t-1} + \beta_2\,\mathrm{Align}^2{}_{i,t-1} + \gamma_1\mathrm{Elig}_{i,t-1} + \gamma_2\mathrm{Size}_{i,t-1} + \gamma_3\mathrm{Leverage}_{i,t-1} + \mathrm{Country}_i + \mathrm{Sector}_i + \mathrm{Year}_t + \varepsilon_{i,t}$$

where *Perf*$_{i,t}$ represents the financial outcome variable. To capture non-linear patterns between taxonomy alignment and financial performance, we introduce *Align*$^2_{i,t-1}$, the squared term of, respectively, the aligned share and the aligned/eligible ratio. To control for effects that may be caused by mere eligibility, we include *Elig*$_{i,t-1}$ as a control variable. For comparability with taxonomy figures, firm performance variables are also scaled to percentages. Following Aydoğmuş et al. (2022), we include *Leverage*$_{i,t-1}$ and *Size*$_{i,t-1}$ as control variables. As indicated by *t-1*, all independent and continuous control variables are lagged by one year to reduce endogeneity concerns. Building on model (2), model (3) incorporates MSCI and LSEG E-scores as additional control variables:

$$\mathrm{Perf}_{i,t} = \alpha + \beta_1\,\mathrm{Align}_{i,t-1} + \beta_2\,\mathrm{Align}^2{}_{i,t-1} + \gamma_1\mathrm{Elig}_{i,t-1} + \gamma_2\mathrm{E-LSEG}_{i,t-1} + \gamma_3\mathrm{E-MSCI}_{i,t-1} + \gamma_4\mathrm{Size}_{i,t-1} + \gamma_5\mathrm{Leverage}_{i,t-1} + \mathrm{Country}_i + \mathrm{Sector}_i + \mathrm{Year}_t + \varepsilon_{i,t}$$

We estimate all models using country-, sector-, and year-fixed effects to control for unobserved heterogeneity across countries, sectors, and time. When calculating the optimum, we adjust mean-centring by adding the uncentered mean of the variable into the optimum formula.[12]

Because highly aligned firms may systematically differ from low-aligned firms, we additionally employ a PSM method to reduce potential selection bias. To account for the hypothesized non-linear relationship, we test whether firms operating near the estimated optima from our quadratic specifications exhibit superior performance compared to firms far from these optima. We define treatment using a distance-based approach: for each estimated optimum, the treatment group comprises the closest 15% of observations (measured by absolute distance in alignment levels at year *t-1*), while the remaining 85%, characterized by either very low or very high alignment levels, serve as the control group[13]. This design allows us to compare firms that differ in their proximity to the estimated optimum but are otherwise similar in observable characteristics. We match treated and control firms on size, leverage, sector, year, and eligibility, using 1:1 nearest neighbour matching. Treatment effects are estimated via OLS with year fixed effects and standard errors clustered at the firm level:

$$\mathrm{Perf}_{i,t} = \alpha + \beta \cdot \mathit{NearOptimum}_{i,t-1} + \sum_t \gamma_t + \varepsilon_{i,t}$$

[12] $\mathrm{Align}^*_u = -\frac{\beta_1}{2\beta_2} + \overline{\mathrm{Align}}_u$

[13] The 15% threshold was selected because lower thresholds yield insufficient observations for reliable inference, while higher thresholds would include firms too distant from the optimum to meaningfully test the concave hypothesis.

6.2 Results

Table 8 shows the results of models (2) and (3) of regressing the financial performance indicators *ROA*, *ROE*, and *Tobin's Q* on our independent variables and control variables. The regression results for the aligned turnover share are presented under panel A, and those for the aligned/eligible turnover ratio are presented under panel B.

For panel A**,** we do not observe a statistically significant effect for the linear alignment term. The coefficient on *Aligned Turnover Share*^{2} is significant at the 10% level and negative for both ROA and ROE. However, the coefficient on the squared terms is only small in size, suggesting that the economic impact is limited. For instance, a 1pp increase in the *Aligned Turnover Share*^{2} reduces *ROE* by around 0.002pp, conditional on the linear term. The relationship remains significant after controlling for the E-scores, indicating that taxonomy alignment has incremental explanatory power for profitability beyond traditional E-ratings. These findings indicate that there is a concave relationship between *Aligned Turnover Share* and *ROA* (*ROE*). Our results further show that the maximum appears at approximately 32% (30%) share of turnover alignment after controlling for E-scores, suggesting that beyond this level, additional increases in alignment are associated with declining profitability.

For panel B, we do find a significant and positive linear effect for *ROA* and for *ROE* when controlling for E-ratings, indicating that aligned turnover has an incremental positive impact on profitability when set in relation to the share of eligible turnover. The relationship remains significant after controlling for E-scores, indicating that the aligned/eligible taxonomy metrics have additional explanatory power for profitability beyond what is captured by E-ratings. The coefficients for the quadratic specifications remain significant and negative for ROE, indicating that the concave relationship also persists for *Aligned/Eligible Turnover* and *ROE*. As in panel A, the coefficient on the quadratic term is close to zero, indicating minimal curvature in the relationship. The maximum occurs at moderately high aligned/eligible levels of about 53% when controlling for E-scores. This higher turning point compared to the 30% optimum observed for the aligned turnover share in panel A suggests that alignment within eligible activities, rather than overall alignment share, allows firms to sustain positive performance effects at higher levels before encountering the diminishing returns and transition costs associated with extreme alignment. This may explain the significantly positive coefficients for the linear terms. However, we do not find significant evidence for a quadratic relationship between *Aligned/Eligible Turnover* and *ROA*. As the coefficient on the linear *Aligned/Eligible Turnover* term is also marginally significant and very small, this indicates that *Aligned Turnover Share* may be a better predictor of *ROA*. We do not find a significant association

between alignment and *Tobin's Q* in either specification, indicating that taxonomy alignment is not associated with cross-sectional differences in the market valuation relative to the asset base during our sample period.

Table 8 Effect of Taxonomy-Aligned Turnover on Firm Performance

Panel A: Aligned Turnover						
	ROA		ROE		Tobin's Q	
Intercept	5.224***	5.372***	14.345***	14.951***	161.906***	157.098***
	(1.367)	(1.516)	(4.507)	(4.586)	(24.292)	(28.571)
Aligned Turnover Share	0.036	0.028	0.088	0.071	-0.346	-0.230
	(0.025)	(0.027)	(0.066)	(0.068)	(0.852)	(0.869)
Aligned Turnover Share^2	-0.001**	-0.001*	-0.002*	-0.002*	0.003	0.002
	(0.000)	(0.000)	(0.001)	(0.001)	(0.009)	(0.009)
Eligible Turnover Share	-0.000	-0.001	-0.040	-0.044	0.058	0.056
	(0.014)	(0.016)	(0.051)	(0.058)	(0.285)	(0.285)
MSCI E-Score		0.005		0.012		-0.182
		(0.020)		(0.076)		(0.218)
LSEG E-Score		0.029		0.095**		-0.971**
		(0.021)		(0.048)		(0.493)
Leverage	-0.090***	-0.093***	-0.005	-0.003	-1.842***	-1.772***
	(0.015)	(0.019)	(0.077)	(0.096)	(0.603)	(0.675)
Size	-1.347***	-1.554***	-2.481***	-3.149***	-48.805***	-41.266***
	(0.344)	(0.273)	(0.981)	(0.727)	(9.624)	(9.191)
Adj. R^2	0.188	0.190	0.085	0.088	0.305	0.309
Observations	582	571	581	570	582	571
Panel B: Aligned/Eligible Turnover						
	ROA		ROE		Tobin's Q	
Intercept	6.168***	5.897***	14.956***	14.299***	147.482***	141.573***
	(1.044)	(1.057)	(3.198)	(2.765)	(15.335)	(17.482)
Aligned/Eligible Turnover	0.023	0.023*	0.072*	0.066**	0.033	0.073
	(0.014)	(0.013)	(0.039)	(0.033)	(0.345)	(0.359)
Aligned/Eligible Turnover^2	-0.000	-0.000	-0.002**	-0.002**	0.005	0.004
	(0.000)	(0.000)	(0.001)	(0.001)	(0.008)	(0.008)
Eligible Turnover Share	0.016	0.015	-0.005	-0.000	0.377	0.437
	(0.011)	(0.012)	(0.034)	(0.037)	(0.277)	(0.295)
MSCI E-Score		0.013		0.036		0.046
		(0.023)		(0.082)		(0.286)
LSEG E-Score		0.014		0.106		-1.136*
		(0.030)		(0.082)		(0.643)
Leverage	-0.095***	-0.098***	-0.060	-0.065	-1.120***	-1.235***
	(0.011)	(0.013)	(0.076)	(0.086)	(0.425)	(0.424)
Size	-1.464**	-1.577***	-2.541**	-3.293***	-43.860***	-36.088***
	(0.573)	(0.433)	(1.295)	(0.881)	(9.892)	(7.860)
Adj. R^2	0.233	0.231	0.116	0.118	0.323	0.335
Observations	408	403	407	402	408	403

Note: This table reports OLS regression results examining the relationship between taxonomy alignment and firm performance (ROA, ROE, and Tobin's Q), estimated with and without environmental score controls. Observations for independent variables and continuous control variables are from FY 2022 and FY 2023 and are lagged by one year and mean-centred. Observations for dependent variables are from FY 2023 and FY 2024. For each independent variable, the first column shows the results without E-score controls, and the second column presents the results with E-score controls. Panel A shows the regression using the aligned share specification, and panel B shows the regression using the aligned/eligible ratio. Coefficients are estimated using OLS with standard errors clustered at the country level (in parentheses). All specifications include country, sector, and year fixed effects (not reported). R^2 has been adjusted for degrees of freedom. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

The control variable *Leverage* is negatively associated with *ROA* and *Tobin's Q*, supporting prior research of e.g. Hirdinis (2019) and Dao and Ta (2020). While existing literature shows mixed findings for the relationship between *Leverage* and *ROE* (e.g. Herciu and Ogrean, 2017; Dao and Ta, 2020), we do not find a significant association, potentially due to the heterogenous composition of our sample. *Size* is negatively associated with all dependent variables, indicating that, among large firms such as in the STOXX 600 Europe, further increases in *Size* may decrease profitability and valuation, e.g. due to organisational complexity (e.g. Canback et al., 2006; Lee, 2009). Our results for panel A and panel B become partly less statistically significant after winsorizing 1% of outliers, indicating sensitivity to outliers.

We conducted analogous regressions as shown in panel A and panel B using capex specifications for the independent variables. The full regression table can be found in Appendix H. Overall, capex alignment shows a smaller and statistically weaker effect on financial outcomes, with a significant result at the 5% level only appearing for *Aligned/Eligible Capex*^{2} and *ROE* specification. This result is not robust when including E-scores as control variables or to 1% winsorization. Our 1-year lag and sample length over three years may be too short to capture more significant effects as capex alignment may require multi-year investment cycles before translating into improved profitability or valuation.

Table 9 shows the results of the PSM analysis, with the matching being conducted based on the detected maxima of around 30% for aligned shares and around 55% for aligned/eligible ratios. However, the PSM reveals limited evidence that alignment near these optima translates to superior performance. Out of four specifications tested, only the *Aligned/Eligible Turnover* ratio shows a significant difference between treated and control firms for *ROE*. The curvature detected in the OLS regression may partly reflect structural differences between firms such as asset intensity or technological maturity that may be correlated with both alignment and profitability, rather than being driven by alignment alone. While fixed effects account for average differences across categorical control variables in the OLS models, matching imposes much stricter comparability by pairing firms with highly similar observable characteristics. Once these differences are absorbed through matching, little variation in alignment remains. However, the matching procedure also significantly reduces the usable sample size which could also explain the insignificant results. Given that the original sample is already limited, the matched sample has even lower statistical power, making it more difficult to detect economically small effects. Still, the PSM results suggest that the inverted U-shaped patterns found in the OLS should be interpreted with caution.

Table 9 Treatment Effect of Proximity to Estimated Optima on Firm Performance

	ROA	ROE
Aligned Turnover Share	-0.527	2.467
	(0.907)	(2.187)
Aligned/Eligible Turnover	-	4.339**
		(2.027)
Aligned/Eligible Capex	-	2.418
		(2.222)

Note: This table reports propensity score matching results assessing differences in firm performance (ROA, ROE) between firms with taxonomy alignment around the maximum of ca. 30% for aligned share and at around 50% for aligned/eligible ratio and matched control firms at low or very high alignment levels. Observations for independent variables and continuous control variables are from FY 2022 and FY 2023 and are lagged by one year. Observations for independent variables are from FY 2023 and FY 2024. We estimate propensity score matching results only for those specifications that document a statistically significant quadratic term in the relevant OLS models. Estimated average treatment effects are shown with standard errors in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

The thesis presents, to the best of our knowledge, the first empirical evidence for an association between taxonomy alignment and firm performance outcomes. Given the conceptual differences in taxonomy alignment, which captures a firm's contribution to environmental objectives, and ESG ratings, which assess firm's environmental performance, the concave relationship we identify stands in contrast to the predominantly U-shape effects reported in the ESG literature (e.g. Barnett and Salomon, 2012; Trumpp and Guenther, 2017). Our findings provide tentative support for *Hypothesis 2*, suggesting that taxonomy alignment is non-linearly associated with both ROA and ROE, but not significantly associated with Tobin's Q. While the findings for ROA and ROE remain statistically significant after controlling for E-scores, the economic magnitude of these effects is very small, and the results are not consistently robust across models.

7 Taxonomy Alignment and Stock Returns

In the following subsections, we present the methodology and results of our analyses regarding the relationship between taxonomy alignment and stock returns.

7.1 Methodology

We perform a Fama-French alpha analysis to test for abnormal risk-adjusted stock returns among highly aligned firms. Value-weighted and equal-weighted monthly returns are used to create dynamic portfolios, i.e. portfolios are rebalanced yearly based on the current alignment ranking of firms. We introduce a six-month lag between taxonomy alignment disclosures and the return observations to ensure that alignment information is known at time *t* (following Cauthorn et al., 2023); accordingly, the return analysis covers the period from July 2023 to June 2025. Portfolios are sorted into quintiles based on firms' alignment share or

aligned/eligible ratios. Given the substantial proportion of firms with zero alignment, we employ a hybrid portfolio formation approach where the lowest quintile consists of all with zero and near-zero (<0.001%) alignment share or aligned/eligible ratio, and the remaining four portfolios consist of firms with different levels of positive alignment. The portfolio excess returns are regressed against standard Fama-French risk factors to investigate whether a potential underperformance persists after accounting for conventional risk-factor loadings (Fama and French, 1993; Fama and French, 2015). As our baseline analysis, we employ the five-factor model, which is described by model (4):

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_{i,MKT}(r_{MKT,t} - r_{f,t}) + \beta_{i,SMB}SMB_t + \beta_{i,HML}HML_t + \beta_{i,RMW}RMW_t + \beta_{i,CMA}CMA_t + \varepsilon_{i,t}$$

The dependent variable describes the return of each portfolio in excess of the risk-free rate r_f. r_{MKT} is the return of the value- or equal-weighted portfolio of all sample firms, *SMB* the size factor, *HML* the value factor, *RMW* the profitability factor, and *CMA* the investment factor (Fama and French, 2015). Portfolios are constructed on a non-sector-neutral and sector-neutral basis. The former captures how investors price alignment overall, including sector differences, while the latter isolates the pure alignment effect by removing sector composition influences. As a robustness test, we run the standard three factor model for the non-sector neutral specification, which only includes the r_{MKT}, *SMB,* and *HML* factors (Fama and French, 1993).

7.2 Results

Table 10 shows the results of model (4) which estimates the alpha obtained from a long-short portfolio based on taxonomy alignment. Panel A presents the non-sector-neutral analysis and panel B shows the sector-neutral analysis for both value-weighted and equal-weighted portfolios.

Across the value-weighted portfolios, our analysis shows consistently negative and significant alphas for nearly all taxonomy variables, for both the non-sector neutral and the sector-neutral analysis. This means that highly aligned firms systematically underperform low-aligned firms even after controlling for the Fama-French five factors, indicating that this underperformance cannot be explained by traditional factor exposure. Importantly, this finding does not contradict the non-significant result for Tobin's Q, as the two metrics capture different dimensions of market outcomes: Tobin's Q reflects cross-sectional valuation levels at specific points in time, whereas risk-adjusted returns measure the dynamic performance of stock prices relative to expected returns given their systematic risk exposures. The effect is notably smaller in the capex specifications and often not significant when using equal-weighted portfolios,

suggesting that these effects are mainly driven by larger aligned companies whose influence dominates the value-weighted portfolios. Sector-neutral portfolios exhibit even stronger and more significant alphas, indicating that once sector biases are removed, the underperformance of highly aligned firms becomes more pronounced.

Table 10 Five-Factor Adjusted Returns to Taxonomy Alignment Long-Short Portfolios

Panel A: Non-sector neutral								
	Value-Weighted				Equal-Weighted			
	LS_{AT}	LS_{AET}	LS_{AC}	LS_{AEC}	LS_{AT}	LS_{AET}	LS_{AC}	LS_{AEC}
Alpha	-0.454	-1.579***	-0.976**	-1.257***	-0.300	-1.190**	-0.358	-0.613*
	(0.368)	(0.474)	(0.423)	(0.462)	(0.409)	(0.472)	(0.347)	(0.342)
r_{MKT}-r_f	0.302***	0.304***	0.244***	0.119*	0.271***	0.216**	0.212***	0.201***
	(0.105)	(0.094)	(0.062)	(0.070)	(0.071)	(0.084)	(0.057)	(0.073)
SMB	0.495**	0.615***	0.572***	0.335	0.250	0.276**	0.422***	0.311***
	(0.201)	(0.172)	(0.137)	(0.214)	(0.156)	(0.132)	(0.116)	(0.073)
HML	0.091	0.388	0.379*	0.692***	-0.144	0.116	-0.037	0.321***
	(0.196)	(0.309)	(0.195)	(0.205)	(0.119)	(0.107)	(0.106)	(0.112)
RMW	-0.703**	-0.747*	-0.629**	-0.398	-0.567***	-0.070	-0.278	0.413
	(0.336)	(0.430)	(0.250)	(0.253)	(0.183)	(0.312)	(0.223)	(0.266)
CMA	1.136***	1.041**	0.684**	0.990***	0.943***	0.966***	1.002**	1.065***
	(0.432)	(0.485)	(0.292)	(0.300)	(0.260)	(0.229)	(0.253)	(0.205)
Adj. R^2	0.509	0.554	0.621	0.688	0.453	0.463	0.680	0.689
Panel B: Sector-neutral								
	Value-Weighted				Equal-Weighted			
	LS_{AT}	LS_{AET}	LS_{AC}	LS_{AEC}	LS_{AT}	LS_{AET}	LS_{AC}	LS_{AEC}
Alpha	-1.458***	-2.102***	-1.342***	-1.539***	-0.710*	-0.984*	-0.486	-0.458
	(0.376)	(0.682)	(0.359)	(0.355)	(0.403)	(0.504)	(0.342)	(0.357)
r_{MKT}-r_f	0.407***	0.227***	0.098*	0.163**	0.279***	-0.232**	0.133**	0.184***
	(0.099)	(0.088)	(0.055)	(0.064)	(0.069)	(0.103)	(0.061)	(0.067)
SMB	0.451*	0.183	0.406***	0.172	0.157	0.089	0.385***	0.325**
	(0.251)	(0.429)	(0.135)	(0.220)	(0.156)	(0.186)	(0.126)	(0.128)
HML	0.155	0.360	0.345*	0.650***	-0.032	0.199	0.074	0.308***
	(0.185)	(0.224)	(0.202)	(0.146)	(0.130)	(0.147)	(0.139)	(0.090)
RMW	-0.438	-0.204	-0.532	-0.453	-0.197	0.277	0.083	0.435
	(0.324)	(0.531)	(0.464)	(0.402)	(0.222)	(0.344)	(0.254)	(0.283)
CMA	1.059**	0.702***	-0.620**	0.410*	0.665***	0.793***	0.341**	0.525***
	(0.453)	(0.264)	(0.247)	(0.217)	(0.220)	(0.287)	(0.145)	(0.156)
Adj. R^2	0.471	0.147	0.275	0.551	0.352	0.163	0.290	0.385

Note: This table reports monthly Fama-French five-factor regression results for long-short portfolios sorted on taxonomy alignment. The results are shown in percentages. Panel A presents non-sector-neutral portfolios, and panel B presents sector-neutral portfolios. Results are shown for value-weighted and equal-weighted specifications. To ensure that alignment information was available to investors at the time returns were realised, a six-month gap between the reporting year of the taxonomy data and the return measurement period is imposed. The return data covers July 2023 to June 2025. Alpha represents the monthly risk-adjusted abnormal return, and the remaining coefficients measure portfolio sensitivities to the Fama-French factors. Coefficients are reported with standard errors in parentheses. R^2 has been adjusted for degrees of freedom. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

The size and significance of the coefficients of the different Fama-French risk factors allow us to draw conclusions about the underlying risk profile of highly taxonomy-aligned

companies. Firstly, the coefficient on the market factor is modest, but positive and significant for all almost all specifications. This indicates low systematic risk, naturally arising from the construction of long-short portfolios which hedges out market exposure and therefore reduces sensitivity to overall market movements. Secondly, the *SMB* coefficient is positive and significant for most specifications, indicating that the return of highly aligned forms resembles that of smaller firms. Thirdly, the *HML* coefficient is frequently positive and significant for capex specifications, implying that highly aligned firms display value-like return characteristics. This is consistent with aligned activities being concentrated in asset-intensive capital-based sectors. Fourthly, the *RMW* coefficient is negative and significant across nearly all regressions, implying that the return behaviour of aligned firms resembles that of firms with weak profitability. Finally, the *CMA* coefficient is strongly positive and significant in nearly all specifications, indicating that highly aligned firms exhibit return patterns consistent with low-investment firms.

The results of the non-sector-neutral three-factor model in Appendix I broadly confirm the five-factor findings. Across all taxonomy variables, alphas remain negative, and several specifications show statistically significant underperformance of highly aligned firms. Although size and significance levels partly weaken once the *RMW* and *CMA* factors are excluded, the overall pattern persists, indicating that the underperformance is robust across specifications.

Our analysis extends the existing taxonomy literature on stock returns by providing first evidence for a period after the formal introduction of the taxonomy. While Bassen et al. (2025) and Cauthorn et al. (2023) find a positive return premium for taxonomy-aligned firms during earlier, pre-implementation phases, we find negative risk-adjusted performance of highly aligned companies based on actual reported data, thereby confirming *Hypothesis 3*. This result is in line with theoretical predications that taxonomy-aligned firms trade at premium valuations either due to lower perceived regulatory risk (Ilhan et al., 2021) or preference driven demand (Pástor et al., 2021). However, we acknowledge that standard Fama-French factors may not fully capture environmental risk exposures, and what appears as negative alpha in our model could partly reflect appropriately lower returns for lower systematic environmental risk (Bolton and Kacperczyk, 2023; Hsu et al., 2023).

8 Discussion

In the following subsections, we summarize the key findings of our analyses and discuss their implications for investors, managers, and policymakers. We then reflect on the limitations of our study.

8.1 Key Findings and Implications

First, we find a positive yet economically small association between taxonomy alignment and both MSCI and LSEG E-scores. While LSEG's E-score aligns somewhat more closely with the activity-based nature of the taxonomy, the overlap remains modest. We show that there is significant number of companies for both providers that achieve very high ratings but disclose zero or near zero alignment. These findings confirm that the taxonomy metrics offers additional informational value beyond E-scores and support the view that E-ratings and activity-based alignment measure distinct dimensions of sustainability.

Second, our results suggest a non-linear yet economically small association between taxonomy alignment and profitability. Both ROA and ROE regressions display a concave pattern, with peak financial performance occurring at approximately 30% aligned turnover share, suggesting that moderate levels of alignment may be optimal for balancing environmental with financial performance. Importantly, this effect persists even after controlling for E-scores, indicating that taxonomy metrics convey incremental economic information for profitability differences beyond that captured by ESG ratings. However, the profitability effects disappear in the PSM analysis, highlighting that the OLS results may not be robust and may partly reflect structural differences across firms rather than alignment itself.

Third, we find that companies with higher levels of taxonomy alignment significantly underperform low-aligned firms in risk-adjusted stock returns. This effect is consistent across different long-short alignment portfolios and remains robust after controlling for Fama-French three- and five-factors. This systematic underperformance is in line with theoretical predications that taxonomy-aligned firms trade at premium valuations either due to lower perceived regulatory risk or preference-driven demand (Ilhan et al., 2021; Pástor et al., 2021).

Based on the above results, we derive several implications for investors, corporate managers, and policymakers. For investors, the low explanatory power of taxonomy alignment for E-scores suggests that investors should not solely rely on traditional E-ratings but consider taxonomy metrics in combination with ESG scores to obtain a more comprehensive and objective view of corporate sustainability performance. Overall, the taxonomy metrics offer investors a financially grounded, standardized, and auditable dataset, which is particularly

valuable for quantitative investment models in the age of data-driven decision-making. We argue that the taxonomy metrics will be especially important for debt investors in both regulated and private credit markets. For instance, in sustainability-linked bonds or loans, using taxonomy-aligned turnover or capex as loan covenants could provide credible and auditable sustainability targets (Loumioti and Serafeim, 2022). With the increasing importance of private credit markets in Europe (Gilmore, 2025), we further believe that the taxonomy could emerge as a key benchmark for evaluating sustainability performance, as ESG scores are rarely available for private companies (OECD, 2025). Furthermore, our finding of systematic underperformance of highly aligned firms suggests that taxonomy information is increasingly incorporated into asset prices. For investors with strong sustainability preferences this implies that allocating capital towards highly aligned firms entails accepting lower expected returns.

For managers, our results tentatively indicate that moderate levels of taxonomy alignment are associated with small improvements in accounting-based profitability. Firms may therefore benefit from integrating environmental objectives into strategic decision-making, but the effects will be incremental rather than substantial. However, taxonomy alignment should still be considered a factor amongst many when it comes to optimising financial outcomes. Additionally, the fact that taxonomy metrics are based on standardised, regulator-defined framework of environmental sustainability makes them a potentially more suitable basis for executive compensation targets than ESG scores. Berg et al. (2022) argue that due to the divergence in the ratings it is difficult to link the compensation to ESG scores as executives might try to optimize one rating but miss improving the firm's overall performance. Given the clear objective orientation, i.e. contribution to the EU's environmental objectives and lower methodological discretion, taxonomy metrics could provide a more transparent and less gameable benchmark for designing the environmental dimension of sustainability-linked executive compensation.

For policymakers, our indicative finding of a concave relationship between taxonomy alignment and a firm's profitability, with the maximum occurring at moderate alignment levels, highlights a potential misalignment between current corporate incentives for alignment and the European Green Deal's long-term objectives. If alignment beyond moderate levels leads to declining profitability, most firms are unlikely to voluntarily increase their alignment, beyond what is already mandated through policy instruments such as the EU's Emission Trading System. Bridging this gap will require reduced policy uncertainty for businesses as well as targeted incentives such as transition financing instruments to make higher levels of alignment economically viable (Friday et al., 2022). Furthermore, our findings underscore the importance

of continuing to expand and refine the scope of the taxonomy. Investors still depend heavily on ESG ratings to assess a firm's overarching non-financial performance, but these ratings remain heterogeneous (Berg et al., 2022; Dumrose et al., 2022). Extending the taxonomy to cover additional social and governance dimensions would enable a more complete and consistent view of corporate sustainability performance and, consequently, could increase investors' adoption of the taxonomy metrics in their investment processes.

8.2 Research Limitations

Our thesis is subject to several limitations that should be acknowledged when interpreting the findings. First, since our analysed period coincides with the first reporting years, the analyses are constrained by the evolving nature of taxonomy reporting. Company disclosures for FY 2022 to FY 2024 reflect a period of gradual introduction of requirements, thereby limiting comparability across different financial years. Moreover, during this period, the European Commission provided updated guidelines on disclosures, resulting in firms having to restate their previous reporting and, thus, in some year-over-year inconsistencies. These dynamics introduce measurement noise and reduce comparability across firms and time.

Second, sample size and composition constitute another important limitation of our sample. Our sample of 301 companies, combined with the limited time horizon of three years, results in a limited number of firm-year observations. The sample length of three years was unavoidable, as mandatory taxonomy alignment disclosures are only available for this period. Necessary lagging of taxonomy variables results in even fewer firm-year observations, which further reduces the statistical power of analysis on firm performance. Furthermore, the nature of taxonomy metrics allows for zero values. Due to the stringency of criteria for sustainable activities, many companies indeed report close to zero alignment, resulting in right-skewed distributions and limited within-sample variation in alignment values. Overall, these sample characteristics reduce the statistical power of the analyses and constrain the extent to which our findings can be generalized.

Third, the period of the return analysis from July 2023 to June 2025 coincides with macroeconomic volatility, including high energy prices, high inflation rates, and geopolitical uncertainty (Armstrong, 2025; Eurostat, 2025a; Eurostat, 2025b). These macroeconomic shocks may dominate return variation and temporarily overshadow pricing signals related to taxonomy alignment. As a result, return patterns during this period should be interpreted with caution as they may not reflect long-run market reactions.

Finally, endogeneity and causality concerns need to be considered as well. Our thesis identifies associations rather than causal effects, as the empirical design does not allow us to disentangle whether taxonomy alignment influences firm performance or whether financially stronger firms are simply more capable of improving their alignment. Reverse causality is therefore a plausible concern. In addition, unobserved firm characteristics such as management quality and innovation capabilities may simultaneously affect both alignment and performance, giving rise to omitted variable bias.

9 Conclusion

This thesis provides early empirical evidence on the relationship between taxonomy alignment, environmental ratings, firm performance, and stock returns, using reported data for non-financial STOXX Europe 600 firms from FY 2022 to FY 2024. We analyse whether the taxonomy offers information beyond E-scores, whether alignment is linked to profitability, and whether markets price alignment.

Our results reveal three central insights. First, taxonomy alignment is positively associated with MSCI and LSEG E-scores, but the effect size is economically small. Thus, this finding indicates that alignment captures information that is not fully reflected in existing ratings. Second, our results provide tentative evidence of a non-linear association between alignment and profitability: ROA and ROE reach the highest levels at moderate alignment levels, however, the economic magnitude of this association is modest and not fully robust across methods. Third, firms with higher taxonomy alignment earn lower risk-adjusted returns after controlling for Fama-French risk factors, consistent with the prediction that environmentally stronger firms command lower expected returns due to preference-driven investor demand and reduced regulatory and transition risk (Ilhan et al., 2021; Pástor et al., 2021).

Several open questions remain regarding the effectiveness of the taxonomy regulation. The divergence between alignment and E-scores gives rise to the question of whether the two measures will gradually converge as reporting practices mature and ratings providers may include taxonomy metrics in their scoring methodologies. It remains open whether our results concerning profitability show real economic value created by taxonomy alignment or if the observed effect is driven by other factors. Furthermore, it remains to be seen whether a larger dataset including a longer time period could reveal an economically and statistically stronger relationship. The negative return premium for aligned firms may reflect genuine pricing of reduced environmental risk and investor preference premia for aligned assets, or simply

temporary macroeconomic conditions. It remains unclear whether this pricing effect will continue, or whether future shifts in market sentiment or increasing climate policy uncertainty within the EU will lead to a repricing of aligned firms (e.g. Hancock, 2025; Reuters, 2025).

Further research on the taxonomy should examine longer reporting time horizons to determine whether alignment-related investments eventually translate into improved operational or market outcomes. Analyses using multi-year lags and longer time horizons could provide clearer evidence on how aligned capex affects future profitability and valuation. Future studies should also investigate whether the negative return premium persists across different market environments, whether alignment and E-scores converge as reporting matures, and whether results extend beyond STOXX Europe 600 firms by examining reporting of smaller firms, private companies, or firms in transition-critical sectors that are underrepresented in public indices. A broader research agenda could also investigate the firm-level determinants of alignment, such as board composition, innovation capacity, or exposure to carbon-pricing regimes, to identify which types of firms are best positioned to increase alignment over time. Comparative work across jurisdictions with emerging frameworks in Australia, Cananda, India, and China would help determine whether the taxonomy's observed impact on firm performance represents a universal pattern or reflects EU-specific institutional factors. (Department of Finance Canada, 2024; Australian Sustainable Finance Institute, 2025; Government of India, 2025; Segal, 2025).

Overall, this thesis provides first evidence on whether taxonomy alignment provides information that is economically meaningful and distinct from environmental ratings, and whether aligning business activities is financially advantageous for firms. By documenting the additional information content of the taxonomy, the indicative non-linear association of alignment with profitability, and the negative return premium for aligned firms, the thesis contributes to understanding how the regulation functions both as a disclosure instrument and as an emerging signal in capital markets.

Bibliography

Andersson, Malin, Petra Köhler-Ulbrich, and Carolin Nerlich, 2025, Green investment needs in the EU and their funding, ECB Economic Bulletin 2025(1). Available at: https://www.ecb.europa.eu/press/economic-bulletin/articles/2025/html/ecb.ebart202501_03~90ade39a4a.en.html. Accessed on 03.12.2025

Argenx SE (Argenx), 2024, Annual Report 2023. Available at: https://argenx.com/content/dam/argenx-corp/media-documents/Annual_Report_2023_argenx.pdf. Accessed on: 30.09.2025

Armstrong, Ashley, 2025, Political and economic volatility wipes $320bn off global profits. Available at https://www.ft.com/content/34b387e4-ea54-419c-a4b6-b6f9f72cd9d0. Accessed on: 13.11.2025

ASM International NV (ASM), 2024, Annual Report 2023. Available at: https://www.asm.com/media/1fcpm1px/asm-annual-report-2023.pdf. Accessed on: 30.09.2025

ASML Holding NV (ASML), 2024, Annual Report 2023. Available at: https://www.asml.com/en/investors/annual-report/2023#2023-annual-report. Accessed on: 30.09.2025

Australian Sustainable Finance Institute, 2025, Australia launches its sustainable finance taxonomy: a major milestone for green investment. Available at: https://www.asfi.org.au/asfi-news/australia-launches-its-sustainable-finance-taxonomya-major-milestone-for-green-investment. Accessed on: 20.11.2025

Aydoğmuş, Mahmut, Güzhan Gülay, and Korkaz Ergun, 2022, Impact of ESG performance on firm value and profitability, Borsa Istanbul Review 22, 119-127.

Barnett, Michael L. and Robert M. Salomon, 2012, Does it pay to be really good? addressing the shape of the relationship between social and financial performance, Strategic Management Journal 33 (11), 1304-1320.

Bassen, Alexander, Othar Kordsachia, Kerstin Lopatta, and Weiqiang Tan, 2025, Revenue alignment with the EU taxonomy regulation in developed markets, Journal of Banking & Finance 170, 107339.

Bechtle AG (Bechtle), 2025, Annual Report 2024. Available at: https://reports.bechtle.com/annual-report/2024/. Accessed on: 29.11.2025

Berg, Florian, Julian F. Kölbel, and Roberto Rigobon, 2022, Aggregate Confusion: The Divergence of ESG Ratings, Review of Finance 26(6), 1315-1344.

Berk, Jonathan, and Peter DeMarzo, 2020, Corporate Finance, 5th edition, Pearson Education.

Bolton, Patrick, and Marcin Kacperczyk, 2023, Global Pricing of Carbon-Transition Risk, Journal of Finance 78(6), 3677-3754.

Brabec, Jan, and Jan Macháč, 2025, Impacts of the EU Taxonomy implementation: A systematic literature review, Climate Policy, 1-13.

Brammer, Stephen, Chris Brooks, and Stephen Pavelin, 2006, Corporate Social Performance and Stock Returns: UK Evidence from Disaggregate Measures, Financial Management 35 (83), 97-116.

Brown, Stephen J., William Goetzmann, Roger G. Ibbotson, and Stephen A. Ross, 1992, Survivorship Bias in Performance Studies, The Review of Financial Studies 5 (4), 553-580.

Buschbeck, Christian, and Jens Teubler, 2025, Estimating future thresholds for the 15% eligibility criteria of the EU taxonomy with limited data availability, SN Business & Economics 5, 36.

Canback, Staffan, Theodor Samouel, and David Price, 2006, Do diseconomies of scale impact firm size and performance? A theoretical and empirical overview, Journal of Managerial Economics 4(1), 27-70.

Cauthorn, Thomas, Christian Klein, Leonard Remme, and Bernhard Zwergel, 2023, Portfolio benefits of taxonomy orientated and renewable European electric utilities, Journal of Asset Management 24(7), 558-571.

CD Projekt SA (CD Projekt), 2024, CD PROJEKT Group Sustainability Report 2023. Available at: https://www.cdprojekt.com/en/accounting-year/2023/. Accessed on 17.09.2025

CD Projekt SA (CD Projekt), 2025, Sustainability Statement 2024. Available at: https://www.cdprojekt.com/en/esg/download-center/. Accessed on 22.09.2025

Christensen, Dane M., George Serafeim, and Anywhere Sikochi, 2022, Why is Corporate Virtue in the Eye of The Beholder? The Case of ESG Ratings, The Accounting Review 97(1), 147-175.

Clark, Gordon L., Andreas Feiner, and Michael Viehs, 2015, From the Stockholder to the Stakeholder: How Sustainability Can Drive Financial Outperformance, SSRN Electronic Journal.

Dao, Binh Thi Thanh, and Tram Dieu Ngoc Ta, 2020, A Meta-Analysis: Capital Structure and Firm Performance, Journal of Economics and Development 22(1), 111-129.

Dassault Systèmes SE (Dassault), 2025, 2024 Universal Registration Document. Available at: https://investor.3ds.com/news-releases/news-release-details/dassault-systemes-2024-universal-registration-document-annual/. Accessed on: 29.11.2025

De Oliveira Neves, Riu, 2022, The EU Taxonomy Regulation and Its Implications for Companies, In: Câmara, Paulo, and Filipe Morais (eds) The Palgrave Handbook of ESG and Corporate Governance, Palgrave Macmillan, Cham.

Department of Finance Canada, 2024, Government advances Made-in-Canada sustainable investment guidelines to accelerate progress to net-zero emissions by 2050, Government of Cananda. Available at: https://www.canada.ca/en/department-finance/news/2024/10/government-advances-made-in-canada-sustainable-investment-guidelines-to-accelerate-progress-to-net-zero-emissions-by-2050.html. Accessed on: 20.11.2025

Drempetic, Samuel, Christian Klein, and Bernhard Zwergel, 2020, The influence of firm size on the ESG score: Corporate sustainability ratings under review, Journal of Business Ethics 167 (2), 333-360.

Dumrose, Maurice, Sebastian Rink, and Julia Eckert, 2022, Disaggregating confusion? The EU Taxonomy and its relation to ESG rating, Finance Research Letters 48, 102928.

Eccles, Robert G., Ioannis Ioannou, and George Serafeim, 2014, The Impact of Corporate Sustainability on Organizational Processes and Performance, Management Science 60(11), 2835-2857.

Edmans, Alex, 2012, The Link Between Job Satisfaction and Firm Value, With Implications for Corporate Social Responsibility, Academy of Management Perspectives 26(4), 1-19.

European Commission, 2019, The European Green Deal: Striving to be the first climate-neutral continent. Available at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en. Accessed on: 10.11.2025

European Commission, 2021, FAQ: What is the EU Taxonomy Article 8 delegated act and how will it work in practice? Available at: https://finance.ec.europa.eu/document/download/af6e560f-842c-4ea9-ba5f-ef4a97246f88_en. Accessed on: 05.10.2025

European Commission, 2025a, Overview of sustainable finance - The EU sustainable finance framework. Available at: https://finance.ec.europa.eu/sustainable-finance/overview-sustainable-finance_en#the-eu-sustainable-finance-framework. Accessed on: 11.11.2025

European Commission, 2025b, EU Taxonomy Navigator - All Activities. Available at: https://ec.europa.eu/sustainable-finance-taxonomy/activities. Accessed on: 30.09.2025

European Commission, 2025c, EU Taxonomy Navigator - Manufacture of iron and steel. Available at: https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/274/view. Accesses on: 18.11.2025

European Environment Agency, 2025, Annual investment gap until 2030 to meet Green Deal environmental objectives. Available at: https://www.eea.europa.eu/en/europe-environment-2025/thematic-briefings/circular-economy-and-other-enablers-of-transformative-change/financing-the-transition-towards-sustainable-activities/annual-investment-gap-until-2030-to-meet-green-deal-environmental-objectives. Accessed on: 10.11.2025

European Union (EU), 2014, Directive (EU) Directive 2014/95/EU mending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups (NFRD), Official Journal L 322, 15-80.

European Union (EU), 2016, Consolidated version of the Treaty on European Union and the Treaty on the Functioning of the European Union, Official Journal C 202, 1-388.

European Union (EU), 2019, Regulation (EU) 2019/2088 on sustainability-related disclosures in the financial services sector (SFDR), Official Journal L 330, 1-9.

European Union (EU), 2020, Regulation (EU) 2020/852 on the establishment of a framework to facilitate sustainable investment (EU Taxonomy Regulation), Official Journal L 198, 13-43.

European Union (EU), 2021, Commission Delegated Regulation (EU) 2021/217 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by specifying the content and presentation of information to be disclosed by undertakings subject to Articles 19a or 29a of Directive 2013/34/EU concerning environmentally sustainable economic activities, and specifying the methodology to comply with that disclosure obligation, Official Journal L 443, 9-67.

European Union (EU), 2022, Directive (EU) 2022/2464 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting (CSRD), Official Journal L 322, 15-80.

European Union (EU), 2025, Germany. Available at: https://european-union.europa.eu/principles-countries-history/eu-countries/germany. Accessed on: 04.11.2025

Eurostat, 2025a, Harmonised Index of Consumer Prices (HICP) - monthly data (annual rate of change). https://ec.europa.eu/eurostat/databrowser/view/prc_hicp_manr/default/table Accessed on: 13.11.2025

Eurostat, 2025b, Domestic producer prices – energy (TEIIS030) https://ec.europa.eu/eurostat/databrowser/view/teiis030/default/table?lang=en Accessed on: 13.11.2025

Fama, Eugene F., 1970, Efficient Capital Markets: A Review of Theory and Empirical Work, The Journal of Finance 25(2), 383-417.

Fama, Eugene F., and Kenneth R. French, 1993, Common risk factors in the returns on stocks and bonds, Journal of Financial Economics 33(1), 3-56.

Fama, Eugene F., and Kenneth R. French, 2007, Disagreement, tastes, and asset prices, Journal of Financial Economics 83(3), 667–689.

Fama, Eugene F., and Kenneth R. French, 2015, A five-factor asset pricing model, Journal of Financial Economics 116(1), 1-22.

Fatemi, Ali, Martin Glaum, and Stefanie Kaiser, 2018, ESG performance and firm value: The moderating role of disclosure, Global Finance Journal 38, 45-64.

Friday, Catherine, Meghan Mills, and Julie McQueen, 2022, Six ways that governments can drive the green transition. EY. Available at https://www.ey.com/en_gl/insights/government-public-sector/six-ways-that-governments-can-drive-the-green-transition. Accessed on 13.11.2025

Friede, Gunnar, Timo Busch, and Alexander Bassen, 2015, ESG and Financial Performance: Aggregated Evidence from More Than 2,000 Empirical Studies, Journal of Sustainable Finance & Investment 5(4), 210-233.

Giglio, Stefano, Bryan Kelly, and Johannes Stroebel, 2021, Climate Finance, Annual Review of Financial Economics 13, 15-36.

Gilmore, Aysha, 2025, BlackRock: Europe's private credit market to double by 2030, Alternative Credit Investor. Available at: https://alternativecreditinvestor.com/2025/11/10/blackrock-europes-private-credit-market-to-double-by-2030/. Accessed on: 12.11.2025

Government of India, 2025, Framework of India's Climate Finance Taxonomy (Draft). Available at: https://static.pib.gov.in/WriteReadData/specificdocs/documents/2025/may/doc202557551101.pdf. Accessed on: 20.11.2025

Hancock, Alice, 2025, EU countries weaken 2040 climate plan in eleventh-hour deal, Financial Times. Available at: https://www.ft.com/content/01238ed6-3a8f-44eb-92c7-f640b33293fe. Accessed on: 07.12.2025

Herciu, Mihaela, and Claudia Ogrean, 2017, The relationship between firm performance and capital structure: Empirical evidence from emerging markets, Studies in Business and Economics 12(3), 92-99.

Hirdinis, M., 2019, Capital Structure and Firm Size on Firm Value Moderated by Profitability, International Journal of Economics and Business Administration 7(1), 174-191.

Hoepner, Andreas G. F., Johannes Klausmann, Markus Leippold, and Jordy Rillaerts, 2024. Beyond Climate: The impact of biodiversity, water, and pollution on the CDS term structure, Swiss Finance Institute Research Paper No. 23-10, Michael J. Brennan Irish Finance Working Paper Series Research Paper No. 23-4, SSRN Electronic Journal.

Hsu, Po-Hsuan, Kai Li, and Tsou, Chi-Yang, 2023, The Pollution Premium, The Journal of Finance 78(3), 1343-1392.

Hummel, Katrin, and Karina, Bauernhofer, 2024, Consequences of sustainability reporting mandates: Evidence from the EU taxonomy regulation, Accounting Forum 48(3), 374-400.

Ilhan, Emirhan, Zacharias Sautner, and Grigory Vilkov, 2021, Carbon Tail Risk, The Review of Financial Studies 34(3), 1540-1571.

Koninklijke Philips NV (Philips), 2025, Annual Report 2024. Available at: https://www.results.philips.com/publications/ar24. Accessed on: 12.10.2025

KPMG, 2022, Setting the baseline towards transparency - Insights into the first EU Taxonomy disclosures of 275 European non-financial undertakings. Available at: https://kpmg.com/dk/en/esg/setting-the-baseline-towards-transparency.html. Accessed on 05.11.2025.

Lee, Sang-Hoon, 2009, Does size matter in firm performance? Evidence from U.S. public firms, International Journal of Economics and Finance 1(1), 130-140.

Lopez-de-Silanes, Florencio, Joseph A. Mccahery, and Paul C. Pudschedl, 2019, ESG Performance and Disclosure: A Cross-Country Analysis, Singapore Journal of Legal Studies, 217-241.

Loumioti, Maria, and George Serafeim, 2022, The Issuance and Design of Sustainability-linked Loans, SSRN Electronic Journal.

LSEG Data & Analytics (LSEG), 2024, Environmental, Social and Governance scores from LSEG. Available at: https://www.lseg.com/content/dam/data-analytics/en_us/documents/methodology/lseg-esg-scores-methodology.pdf. Accessed on: 28.11.2025

LSEG Workspace, 2025a, EU Taxonomy data 2022 - 2024. Retrieved on 04.08.2025

LSEG Workspace, 2025b, Company Financials and E-Scores 2022 - 2024. Retrieved on 30.09.2025

Lucarelli, Caterina, Camilla Mazzoli, Michela Rancan, and Sabrina Severini, 2023, The Impact of EU Taxonomy on Corporate Investments, Journal of Financial Management, Markets and Institutions 11(01), 2350004.

Maier, Christian, and Bernadette Bauer, 2025, EU Taxonomy: New delegated acts expand the scope of covered sectors and activities, Rödl & Partner. Available at: https://www.roedl.com/insights/esg-news/2023-3/eu-taxonomy-new-delegated-acts-expand-scope-sectors-activities. Accessed on 18.11.2025

McKinsey, 2021, Net zero or bust: Beating the abatement cost curve for growth. Available at: https://www.mckinsey.com/capabilities/operations/our-insights/net-zero-or-bust-beating-the-abatement-cost-curve-for-growth. Accessed on 03.12.2025

McKinsey, 2022, The net-zero transition - What it would cost, what it could bring. Available at: https://www.mckinsey.com/capabilities/sustainability/our-insights/the-net-zero-transition-what-it-would-cost-what-it-could-bring. Accessed on: 03.12.2025

MSCI ESG Research LLC (MSCI), 2024, ESG Ratings Methodology. Available at: https://www.msci.com/documents/1296102/34424357/MSCI+ESG+Ratings+Methodology.pdf. Accessed on: 05.11.2025

MSCI, 2025, E-Scores 2022 - 2024. Retrieved on 15.10.2025

Norang, Hilde, Marit Støre-Valen, Nina Kvale, and Alenka Temeljotov-Salaj, 2023, Norwegian stakeholder's attitudes towards EU taxonomy, Facilities 41(5/6), 407–433.

Norwegian Ministry of Finance, 2025, Taksonomien for bærekraftig økonomisk aktivitet. Available at: https://www.regjeringen.no/no/tema/okonomi-og-budsjett/finansmarkedene/taksonomien-for-barekraftig-okonomisk-aktivitet/id2924859/. Accessed on: 30.09.2025

Novo Nordisk A/S (Novo Nordisk), 2024, Annual Report 2023. Available at: https://www.novonordisk.com/content/dam/nncorp/global/en/investors/irmaterial/annual_report/2024/novo-nordisk-annual-report-2023.pdf. Accessed on: 30.09.2025

Och, Marleen, 2021, Sustainable Finance and the EU Taxonomy Regulation - Hype or Hope?, Jan Ronse Institute for Company & Financial Law Working Paper No. 2020/05 (revised), SSRN Electronic Journal.

OECD, 2025, Behind ESG Ratings, Unpacking sustainability metrics. Available at: https://www.oecd.org/content/dam/oecd/en/publications/reports/2025/02/behind-esg-ratings_4591b8bb/3f055f0c-en.pdf. Accessed on: 13.11.2025

Pástor, Ľuboš, Robert F. Stambaugh, and Lucian A. Taylor, 2021, Sustainable investing in equilibrium, Journal of Financial Economics 142(2), 550-571.

Pástor, Ľuboš, Robert F. Stambaugh, and Lucian A. Taylor, 2022, Dissecting green returns. Journal of Financial Economics 146(2), 403-424.

Pedersen, Lasse Heje, Shaun Fitzgibbons, and Lukasz Pomorski, 2021, Responsible investing: The ESG-efficient frontier, Journal of Financial Economics 142(2), 572-597.

Platform on Sustainable Finance, 2022a, The Extended Environmental Taxonomy: Final Report on Taxonomy extension options supporting a sustainable transition. Available at: https://finance.ec.europa.eu/system/files/2022-03/220329-sustainable-finance-platform-finance-report-environmental-transition-taxonomy_en.pdf. Accessed on: 12.11.2025

Platform on Sustainable Finance, 2022b, Final Report on Social Taxonomy. Available at: https://commission.europa.eu/system/files/2022-03/280222-sustainable-finance-platform-finance-report-social-taxonomy.pdf. Accessed on: 02.10.2025

Platform on Sustainable Finance, 2025, Streamlining Sustainable Finance for SMEs. Available at: https://finance.ec.europa.eu/document/download/0d8e5199-44c2-4a17-affc-0f398443e603_en?filename=250321-sustainable-finance-platform-report-smes_en.pdf. Accessed on 12.11.2025

Reuters, 2025, Six member states push EU to water down 2035 ban on internal combustion engine cars. Available at: https://www.reuters.com/business/retail-consumer/six-countries-push-eu-allow-hybrid-cars-other-technologies-beyond-2035-2025-12-05/. Accessed on 07.12.2025

Sautner, Zacharias, Jing Yu, Rui Zhong, and Xaoyan Zhou, 2025, The EU Taxonomy and the Syndicated Loan Market, Journal of Financial Services Research.

Schütze, Franziska, and Jan Stede, 2024, The EU sustainable finance taxonomy and its contribution to climate neutrality, Journal of Sustainable Finance & Investment 14(1), 128-160.

Segal, Mark, 2025, China Releases New Green Finance Taxonomy, ESG Today. Available at: https://www.esgtoday.com/china-releases-new-green-finance-taxonomy/. Accessed on: 20.11.2025

Temple-West, Patrick, and Will Schmitt, 2024, Investors pull cash from ESG funds as performance lags, Financial Times. Available at: https://www.ft.com/content/cf9001ab-e326-4264-af5e-12b3fbb0ee7b. Accessed on: 09.11.2025

Thyssenkrupp AG (Thyssenkrupp), 2024, Annual Report 2023/2024. Available at: https://www.thyssenkrupp.com/en/investors/reporting-and-publications/archiv. Accessed on 04.11.2025

Tonnarello, Federica, Carlo Vermiglio, Carlo Migliardo, and Valeria Naciti, 2025, The Impact of EU Taxonomy for Sustainable Activities on European Utilities' Performance, Business Strategy and the Environment 34(3), 2848-2862.

Trumpp, Christoph, and Thomas Guenther, 2017, Too Little or too much? Exploring U-shaped Relationships between Corporate Environmental Performance and Corporate Financial Performance, Business Strategy and the Environment 26(1), 49-68.

Tuck Fama French Data Library, 2025a, Monthly Fama French Three Factors July 2023 - July 2025. Retrieved on: 06.11.2025

Tuck Fama French Data Library, 2025b, Monthly Fama French Five Factors July 2023 - July 2025. Retrieved on: 06.11.2025

United Nations Environment Programme (UNEP), 2025, How are ASEAN Member States approaching sustainable finance taxonomies? New analysis reveals trend towards regional harmonization. Available at: https://www.unepfi.org/regions/asia-pacific/asean-taxonomies-analysis/. Accessed on 12.11.2025

Viñes Fiestas, Helena, 2023, The EU Taxonomy: Financing the Transition through Sustainable Investing, ICE Revista de Economía 932.

Vu, Thanh Nam, Heikki Lehkonen, Juha-Pekka Junttila, and Brian Lucey, 2025, ESG investment performance and global attention to sustainability, The North American Journal of Economics and Finance 75, 102287.

World Economic Forum (WEF), 2024, Net-Zero Industry Tracker 2024. Available at: https://www.weforum.org/publications/net-zero-industry-tracker-2024/. Accessed on: 03.12.2025

Yahoo Finance, 2025, Monthly Stock Returns July 2023 - July 2025. Retrieved on 06.11.2025

Zerbib, Oliver David, 2019, The effect of pro-environmental preferences on bond prices: Evidence from green bonds, Journal of Banking & Finance 98, 39-60.

Appendices

Appendix A Activities Covered by the EU Taxonomy

- Acquisition and ownership of buildings
- Afforestation
- Air transport ground handling operations
- Airport Infrastructure
- Anaerobic digestion of bio-waste
- Anaerobic digestion of sewage sludge
- Clore to market research, development and innovation
- Cogeneration of heat/cool and power from bioenergy
- Cogeneration of heat/cool and power from geothermal energy
- Cogeneration of heat/cool and power from renewable non-fossil gaseous and liquid fuels
- Cogeneration of heat/cool and power from solar energy
- Collection and transport of hazardous waste
- Collection and transport of non-hazardous and hazardous waste
- Collection and transport of non-hazardous in source segregated fractions
- Composting of bio-waste
- Computer programming, consultancy and related activities
- Conservation forestry
- Conservation, including restoration of habitats, ecosystems and species
- Construction and safe operation of new nuclear power plants, for the generation of electricity and/or heat, including for hydrogen production, using best-available technologies
- Construction of new buildings
- Construction, extension and operation of waste water collection and treatment
- Construction, extension and operation of water collection, treatment and supply systems
- Consultancy for physical climate risk management and adaptation
- Creative, arts and entertainment activities
- Data processing, hosting and related activities
- Data-driven solutions for GHG emissions reductions
- Demolition and wrecking of buildings and other structures
- Depollution and dismantling of end-of-life products
- Desalination
- Distract heating/cooling distribution
- Education
- Electricity generation from bioenergy
- Electricity generation from fossil gaseous fuels
- Electricity generation from geothermal energy
- Electricity generation from hydropower
- Electricity generation from ocean energy technologies
- Electricity generation from renewable non-fossil gaseous and liquid fuels
- Electricity generation from wind power
- Electricity generation using concentrated solar power (CSP) technology
- Electricity generation using solar photovoltaic technology
- Emergency services
- Engineering activities and related technical consultancy dedicated to adaptation to climate change
- Flood risk prevention and protection infrastructure

- Forest management
- Freight rail transport
- Freight transport services by road
- High-efficiency co-generation of heat/cool and power from fossil gaseous fuels
- Hotels, holiday, camping grounds and similar accommodation
- Infrastructure enabling low carbon water transport
- Infrastructure enabling low carbon road transport and public transport
- Infrastructure enabling road transport and public transport
- Infrastructure for personal mobility, cycle logistics
- Infrastructure for rail transport
- Infrastructure for water transport
- Inland freight water transport
- Inland passenger water transport
- Installation and operation of electric heat pumps
- Installation, maintenance and repair of charging station for electric vehicle sin buildings (and parking spaces attached to buildings)
- Installation, maintenance and repair of energy efficiency equipment
- Installation, maintenance and repair of instruments and devices for measuring, regulation and controlling energy performance of buildings
- Installation, maintenance and repair of renewable energy technologies
- Landfill gas capture and utilization
- Leasing of aircraft
- Libraries, archives, museums and cultural activities
- Low carbon airport infrastructure
- Maintenance of roads and motorways
- Manufacture of active pharmaceutical ingredients (API) or active substances
- Manufacture of aluminium
- Manufacture of anhydrous ammonia
- Manufacture of automotive and mobility components
- Manufacture of batteries
- Manufacture of biogas and biofuels for use in transport and bioliquids
- Manufacture of carbon black
- Manufacture of cements
- Manufacture of chlorine
- Manufacture of electrical and electronic equipment
- Manufacture of energy efficiency equipment for buildings
- Manufacture of equipment for the production and use of green hydrogen
- Manufacture of hydrogen
- Manufacture of iron and steel
- Manufacture of low carbon technologies for transport
- Manufacture of medical products
- Manufacture of nitric acid
- Manufacture of organic basic chemicals
- Manufacture of other low carbon technologies
- Manufacture of plastic packaging goods
- Manufacture of plastics in primary form
- Manufacture of rail rolling stock constituents

- Manufacture of renewable energy technologies
- Manufacture of soda ash
- Manufacture, installation and associated services for leakage control technologies enabling leakage reduction and prevention in water supply systems
- Manufacture, installation and servicing of high, medium and low voltage electrical equipment for electrical transmission and distribution that result in or enable a substantial contribution to climate change mitigation
- Manufacturing of aircraft
- Marketplace for the trad of second-hand goods for reuse
- Material recovery from non-hazardous waste
- Motion picture, video and television programme production, sound recording and music publishing activities
- Nature-based solutions for flood and drought risk prevention and protection
- Non-life insurance: underwriting of climate-related perils
- Operation of personal mobility devices, cycle logistics
- Passengers and freight air transport
- Passenger interurban rail transport
- Phosphorus recovery from waste water
- Pre-commercial stages of advances technologies to produce energy from nuclear processes with minimal waste from fuel cycle
- Preparation for re-use of end-of-life products and product components
- Product-as-a-service and other circular use- and result-oriented service models
- Production of alternative water resources for purposes other than human consumption
- Production of heat/cool from bioenergy
- Production of heat/cool from fossil gaseous fuels in an efficient distinct heating and cooling system
- Production of heat/cool from geothermal energy
- Production of heat/cool from renewable non-fossil gaseous and liquid fuels
- Production of heat/cool from solar thermal heating
- Production of heat/cool using waste heat
- Professional services related to energy performance of buildings
- Programming and broadcasting activities
- Provision of IT/OT data-driven solutions
- Provision of IT/OT data-driven solutions for leakage reduction
- Recovery of bio-waste by anaerobic digestion or composting
- Rehabilitation and restoration of forests, including reforestation and natural forest regeneration after an extreme event
- Reinsurance
- Remediation of contaminated sites and areas
- Remediation of legally non-conforming landfills and abandoned or illegal waste dumps
- Renewal of waste water collection and treatment
- Renewal of water collection, treatment and supply systems
- Renovation of existing buildings
- Repair, refurbishment and remanufacturing
- Research, development and innovation for direct air capture of CO2
- Residential care activities
- Restoration of wetlands

- Retrofitting of inland water passenger and freight transport
- Retrofitting of seas and coastal freight and passenger water transport
- Sale of second-hand goods
- Sale of spare parts
- Sea and coastal freight water transport, vessels for port operations and auxiliary activities
- Sea and coastal passenger water transport
- Software enabling physical climate risk management and adaptation
- Sorting and material recovery of non-hazardous waste
- Storage of electricity
- Storage of hydrogen
- Storage of thermal energy
- Sustainable urban drainage systems (SUDS)
- Transmission and distribution networks for renewable and low-carbon gases
- Transmission and distribution of electricity
- Transport by motorbikes, passenger cars and light commercial vehicles
- Transport of CO_2
- Treatment of hazardous waste
- Underground permanent geological storage of CO_2
- Urban waste water treatment
- Urban and suburban transport, road passenger transport
- Use of concrete in civil engineering
- Water supply

Note: This figure shows all activities currently covered by the taxonomy regulation (European Commission, 2025b).

Appendix B Example: Assessing Climate Mitigation in Iron and Steel Manufacturing

Substantial contribution criteria (technical screening criteria)		The activity manufactures one of the following iron and steel where GHG emissions, reduced by the amount of emissions assigned to the production of waste gases in accordance with point 10.1.5(a) of Annex VII to Regulation (EU) 2019/331 do not exceed the following values applied to the different manufacturing process steps: ▪ hot metal = 1,331 tCO2e/t product; ▪ sintered ore = 0,163 tCO2e/t product; ▪ coke (excluding lignite coke) = 0,144 tCO2e/t product; ▪ iron casting = 0,299 tCO2e/t product; ▪ electric Arc Furnace (EAF) high alloy steel = 0,266 tCO2e/t product; ▪ electric Arc Furnace (EAF) carbon steel = 0,209 tCO2e/t product. ▪ steel in electric arc furnaces (EAFs) producing EAF carbon steel or EAF high alloy steel, as defined in Commission Delegated Regulation (EU) 2019/331 and where the steel scrap input relative to product output is not lower than: - 70 % for the production of high alloy steel; - 90 % for the production of carbon steel.
Do not significantly harm criteria	**Climate adaptation**	The physical climate risks that are material to the activity have been identified from those listed in the table in Section II of this Appendix by performing a robust climate risk and vulnerability assessment with the following steps: (a) screening of the activity to identify which physical climate risks from the list in Section II of this Appendix may affect the performance of the economic activity during its expected lifetime; (b) where the activity is assessed to be at risk from one or more of the physical climate risks listed in Section II of this Appendix, a climate risk and vulnerability assessment to assess the materiality of the physical climate risks on the economic activity; (c) an assessment of adaptation solutions that can reduce the identified physical climate risk. The climate risk and vulnerability assessment is proportionate to the scale of the activity and its expected lifespan, such that: (a) for activities with an expected lifespan of less than 10 years, the assessment is performed, at least by using climate projections at the smallest appropriate scale; (b) for all other activities, the assessment is performed using the highest available resolution, state-of-the-art climate projections across the existing range of future scenarios320 consistent with the expected lifetime of the activity, including, at least, 10 to 30 year climate projections scenarios for major investments. The climate projections and assessment of impacts are based on best practice and available guidance and take into account the state-of-the-art science for vulnerability and risk analysis and related methodologies in line with the most recent Intergovernmental Panel on Climate Change reports, scientific peer-reviewed publications, and open source or paying models.

	For existing activities and new activities using existing physical assets, the economic operator implements physical and non-physical solutions ('adaptation solutions'), over a period of time of up to five years, that reduce the most important identified physical climate risks that are material to that activity. An adaptation plan for the implementation of those solutions is drawn up accordingly. For new activities and existing activities using newly-built physical assets, the economic operator integrates the adaptation solutions that reduce the most important identified physical climate risks that are material to that activity at the time of design and construction and has implemented them before the start of operations. The adaptation solutions implemented do not adversely affect the adaptation efforts or the level of resilience to physical climate risks of other people, of nature, of cultural heritage, of assets and of other economic activities; are consistent with local, sectoral, regional or national adaptation strategies and plans; and consider the use of nature-based solutions or rely on blue or green infrastructure to the extent possible.
Water	Environmental degradation risks related to preserving water quality and avoiding water stress are identified and addressed with the aim of achieving good water status and good ecological potential as defined in Article 2, points (22) and (23), of Regulation (EU) 2020/852, in accordance with Directive 2000/60/EC of the European Parliament and of the Council and a water use and protection management plan, developed thereunder for the potentially affected water body or bodies, in consultation with relevant stakeholders. Where an Environmental Impact Assessment is carried out in accordance with Directive 2011/92/EU of the European Parliament and of the Council and includes an assessment of the impact on water in accordance with Directive 2000/60/EC, no additional assessment of impact on water is required, provided the risks identified have been addressed. The activity does not hamper the achievement of good environmental status of marine waters or does not deteriorate marine waters that are already in good environmental status as defined in point 5 of Article 3 of Directive 2008/56/EC of the European Parliament and of the Council, taking into account the Commission Decision (EU) 2017/848368 in relation to the relevant criteria and methodological standards for those descriptors.
Circular economy	N/A
Pollution prevention	The activity does not lead to the manufacture, placing on the market or use of: (a) substances, whether on their own, in mixtures or in articles, listed in Annexes I or II to Regulation (EU) 2019/1021 of the European Parliament and of the Council, except in the case of substances present as an unintentional trace contaminant;

	(b) mercury and mercury compounds, their mixtures and mercury-added products as defined in Article 2 of Regulation (EU) 2017/852 of the European Parliament and of the Council; (c) substances, whether on their own, in mixture or in articles, listed in Annexes I or II to Regulation (EC) No 1005/2009 of the European Parliament and of the Council; (d) substances, whether on their own, in mixtures or in an articles, listed in Annex II to Directive 2011/65/EU of the European Parliament and of the Council, except where there is full compliance with Article 4(1) of that Directive; (e) substances, whether on their own, in mixtures or in an article, listed in Annex XVII to Regulation (EC) 1907/2006 of the European Parliament and of the Council, except where there is full compliance with the conditions specified in that Annex; (f) substances, whether on their own, or in mixtures or in an article, in a concentration above 0,1 % weight by weight (w/w), and meeting the criteria laid down in Article 57 of Regulation (EC) 1907/2006 and that were identified in accordance with Article 59(1) of that Regulation for a period of at least eighteen months, except if it is assessed and documented by the operators that no other suitable alternative substances or technologies are available on the market, and that they are used under controlled conditions; In addition, the activity does not lead to the manufacture, presence in the final product or output, or placing on the market, of other substances, whether on their own, or in mixtures or in an article, in a concentration above 0,1% weight by weight (w/w), that meet the criteria of Regulation (EC) No 1272/2008 in one of the hazard classes or hazard categories mentioned in Article 57 of Regulation (EC) 1907/2006, except if it is assessed and documented by the operators that no other suitable alternative substances or technologies are available on the market, and that they are used under controlled conditions. Emissions are within or lower than the emission levels associated with the best available techniques (BAT-AEL) ranges set out in the latest relevant best available techniques (BAT) conclusions, including the best available techniques (BAT) conclusions for iron and steel production
Biodiversity	An Environmental Impact Assessment (EIA) or screening has been completed in accordance with Directive 2011/92/EU334. Where an EIA has been carried out, the required mitigation and compensation measures for protecting the environment are implemented. For sites/operations located in or near biodiversity-sensitive areas (including the Natura 2000 network of protected areas, UNESCO World Heritage sites and Key Biodiversity Areas, as well as other protected areas), an appropriate assessment, where applicable, has been conducted and based on its conclusions the necessary mitigation measures are implemented.

Note: This table shows the substantial contribution criteria, i.e. technical screening criteria, and do not significantly harm criteria for the manufacturing of iron and steel to qualify as aligned under the taxonomy regulation (European Commission, 2025c).

Appendix C Sample Composition by GICS Sector

Industry (GICS Sectors)	Number of Companies	Percentage of Sample
Industrials	88	29.2%
Consumer Discretionary	36	12.0%
Materials	32	10.6%
Health Care	31	10.3%
Consumer Staples	28	9.3%
Utilities	22	7.3%
Information Technology	19	6.3%
Communication Services	18	6.0%
Energy	16	5.3%
Real Estate	11	3.7%
Sum	301	100%

Note: This table summarises the industry distribution of the sample based on GICS sectors, reporting the number and share of firms in each sector. The Financial Institutions sector is excluded from the sample and therefore not reported.

Appendix D Sample Composition by Country of Incorporation

Country	Number of Companies	Percentage of Sample
France	57	18.9%
Germany	56	18.6%
Sweden	45	15.0%
Netherlands	27	9.0%
Italy	23	7.6%
Denmark	19	6.3%
Spain	18	6.0%
Finland	16	5.3%
Norway	10	3.3%
Belgium	8	2.7%
Austria	5	1.7%
Luxembourg	5	1.7%
Poland	5	1.7%
Ireland	4	1.3%
Portugal	3	1.0%
Sum	301	100%

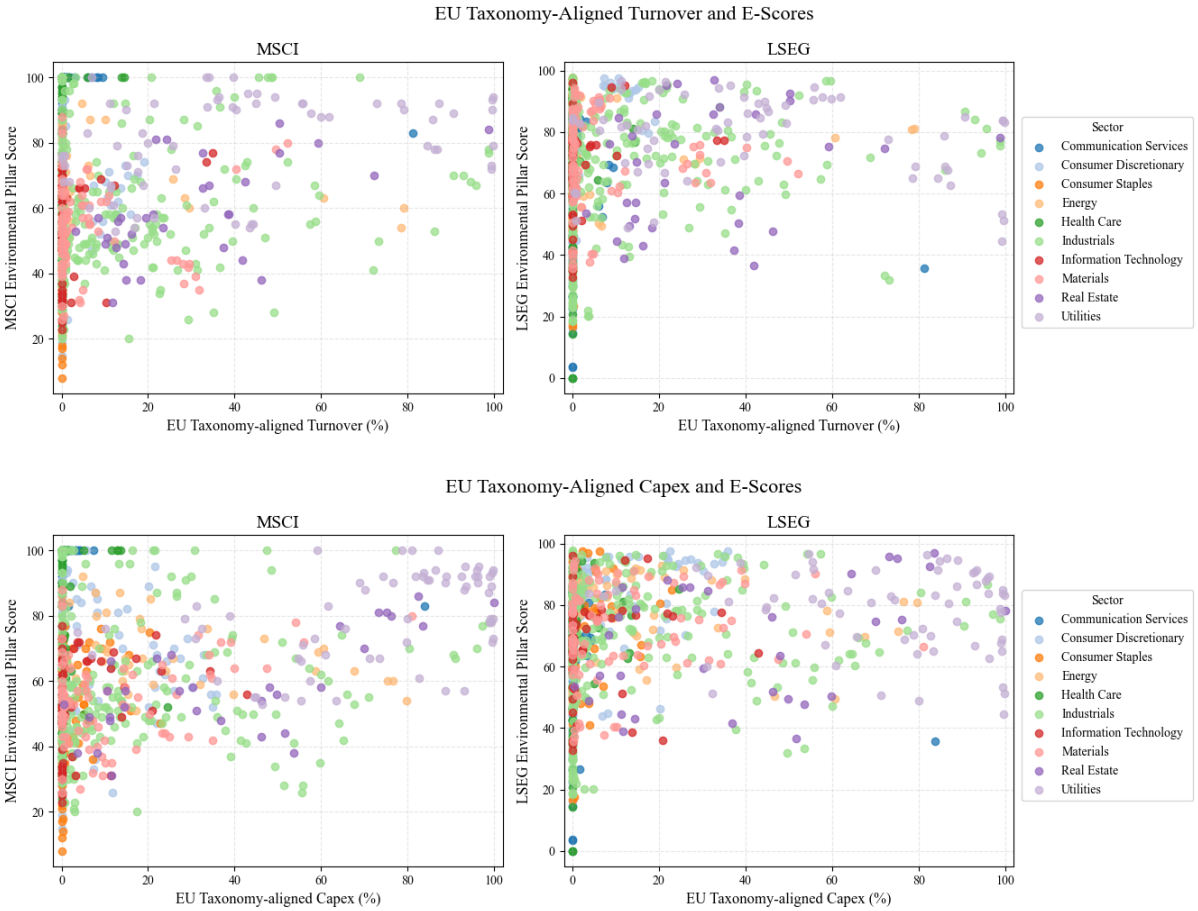
Note: This table summarises the geographical distribution of the sample by country of incorporation, showing the number and percentage of firms from each country. Norway, the only non-EU member state in the sample, is included because it adopted the Taxonomy Regulation into national law in 2023.

Appendix E Summary Statistics: Portfolio Returns and Risk Factor Variables

Variable	N	Mean	SD	Min	Median	Max
Dependent Variables						
Aligned Turnover - P1	24	-0.132	3.733	-9.680	-0.126	6.469
Aligned Turnover - P2	24	0.765	2.952	-3.403	0.608	7.189
Aligned Turnover - P3	24	0.202	3.276	-5.029	-0.560	6.204
Aligned Turnover - P4	24	0.232	3.788	-5.715	0.346	9.596
Aligned Turnover - P5	24	0.459	3.771	-4.855	-0.195	9.223
Aligned Turnover - High-Low	24	0.179	3.540	-5.550	-0.238	9.324
Aligned/Eligible Turnover - P1	24	0.354	3.849	-9.409	0.368	7.224
Aligned/Eligible Turnover - P2	24	0.581	3.698	-4.769	0.206	10.529
Aligned/Eligible Turnover - P3	24	0.297	3.226	-4.401	0.456	5.887
Aligned/Eligible Turnover - P4	24	0.900	3.698	-5.715	-0.207	10.529
Aligned/Eligible Turnover - P5	24	0.139	3.538	-5.924	0.854	9.943
Aligned/Eligible Turnover - High-Low	24	-0.628	3.982	-8.757	-0.962	8.538
Aligned Capex - P1	24	0.294	3.531	-7.449	0.281	9.585
Aligned Capex - P2	24	0.406	3.098	-4.895	-0.374	7.670
Aligned Capex - P3	24	-0.442	4.085	-10.108	-0.163	6.902
Aligned Capex - P4	24	0.107	3.674	-6.916	-0.470	7.637
Aligned Capex - P5	24	0.459	3.551	-5.566	0.376	8.297
Aligned Capex - High-Low	24	-0.248	3.162	-7.896	-0.164	6.626
Aligned/Eligible Capex - P1	24	0.346	3.609	-7.564	0.249	7.935
Aligned/Eligible Capex - P2	24	-0.363	3.787	-9.499	0.453	6.741
Aligned/Eligible Capex - P3	24	-0.249	4.061	-6.803	0.160	7.663
Aligned/Eligible Capex - P4	24	0.491	3.411	-4.106	-0.435	7.653
Aligned/Eligible Capex - P5	24	0.433	2.769	-4.053	0.695	5.130
Aligned/Eligible Capex - High-Low	24	-0.325	3.351	-7.854	0.268	6.720
Independent Variables						
MKT-r_f	24	0.792	4.012	-6.010	1.385	9.210
SMB	24	-0.202	1.907	-3.630	-0.515	3.570
HML	24	1.108	1.933	-2.330	1.065	5.540
CMA	24	0.265	1.476	-2.490	0.330	3.700
RMW	24	-0.652	1.163	-3.300	-0.535	1.090

Note: This table reports summary statistics (N, mean, standard deviation, minimum, median, and maximum) for portfolio returns constructed from taxonomy-aligned and eligible turnover and capex measures, as well as the associated risk factor variables. Values are shown in percentages. Return data ranges from July 2023 to June 2025.

Appendix F Scatter Plots of Taxonomy Alignment and E-Scores



Note: The scatter plots display the relationship between taxonomy alignment (turnover and capex) and environmental pillar scores from MSCI and LSEG for FY 2022 to FY 2024. Observations are coloured by GICS sector.

Appendix G Number of Firms with 0% Taxonomy Alignment and E-Scores ≥ 90

GICS Sector	MSCI E-Score		LSEG E-Score	
	0% Aligned Turnover	0% Aligned Capex	0% Aligned Turnover	0% Aligned Capex
Communication Services	6	5	0	0
Consumer Discretionary	5	2	4	0
Consumer Staples	0	0	3	1
Energy	0	0	1	0
Health Care	11	8	2	0
Industrials	7	6	3	2
Information Technology	0	0	1	1
Total	29	21	14	4

Note: This table reports the number of firms with E-scores ≥ 90 that exhibit 0% taxonomy-aligned turnover or capex in FY 2024, grouped by GICS sector. Sectors without any firms meeting these criteria are omitted.

Appendix H Effect of Taxonomy-Aligned Capex on Firm Performance

Panel A: Aligned Capex

	ROA		ROE		Tobin's Q	
Intercept	5.515***	5.646***	15.469***	15.625***	154.693***	154.341***
	(1.363)	(1.409)	(4.542)	(4.448)	(19.675)	(22.627)
Aligned Capex Share	0.041	0.043	0.094	0.094	-0.009	0.095
	(0.036)	(0.035)	(0.088)	(0.089)	(1.135)	(1.089)
Aligned Capex Share^2	-0.000	-0.001	-0.002	-0.002	0.004	0.003
	(0.000)	(0.000)	(0.001)	(0.001)	(0.013)	(0.013)
Eligible Capex Share	-0.012	-0.015	-0.030	-0.038	-0.155	-0.137
	(0.013)	(0.013)	(0.038)	(0.040)	(0.352)	(0.341)
MSCI E-Score		0.005		0.021		-0.252
		(0.016)		(0.061)		(0.247)
LSEG E-Score		0.031		0.091*		-0.884*
		(0.023)		(0.048)		(0.537)
Leverage	-0.092***	-0.096***	-0.001	-0.010	-1.902***	-1.806***
	(0.016)	(0.018)	(0.083)	(0.098)	(0.584)	(0.672)
Size	-1.354***	-1.570***	-2.702***	-3.349***	-47.757***	-40.884***
	(0.320)	(0.222)	(0.807)	(0.563)	(8.804)	(8.340)
Adj. R^2	0.195	0.198	0.082	0.086	0.298	0.301
Observations	581	569	580	568	581	569

Panel B: Aligned/Eligible Capex

	ROA		ROE		Tobin's Q	
Intercept	5.622***	5.770***	15.439***	15.735***	146.783***	150.325***
	(1.363)	(1.294)	(4.364)	(4.266)	(19.409)	(19.109)
Aligned/Eligible Capex	0.015	0.015	0.045	0.041	-0.079	0.036
	(0.017)	(0.017)	(0.035)	(0.034)	(0.641)	(0.636)
Aligned/Eligible Capex^2	-0.000	-0.000	-0.001**	-0.001**	0.007	0.005
	(0.000)	(0.000)	(0.001)	(0.001)	(0.013)	(0.013)
Eligible Capex Share	-0.005	-0.007	-0.025	-0.030	0.010	0.035
	(0.011)	(0.012)	(0.038)	(0.039)	(0.275)	(0.275)
MSCI E-Score		0.002		0.011		-0.267
		(0.021)		(0.075)		(0.325)
LSEG E-Score		0.020		0.085		-0.888
		(0.025)		(0.066)		(0.718)
Leverage	-0.098***	-0.099***	-0.013	-0.017	-1.897***	-1.835***
	(0.014)	(0.021)	(0.081)	(0.102)	(0.592)	(0.700)
Size	-1.367***	-1.507***	-2.761***	-3.342***	-39.816***	-33.557***
	(0.358)	(0.307)	(0.908)	(0.780)	(6.722)	(6.464)
Adj. R^2	0.190	0.189	0.083	0.083	0.257	0.263
Observations	536	527	535	526	536	527

Note: This table reports OLS regression results examining the relationship between taxonomy capex alignment using the aligned (aligned/eligible) share specification and firm performance (ROA, ROE, and Tobin's Q), estimated with and without environmental score controls. For each independent variable, the first column shows the results without E-score controls, and the second column presents the results with E-score controls. Observations for independent variables and continuous control variables are from FY 2022 and FY 2023 and are lagged by one year and mean-centred. Observations for dependent variables are from FY 2023 and FY 2024. Coefficients are estimated using OLS with standard errors clustered at the country level (in parentheses). All specifications include country, sector, and year fixed effects (not reported). *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Appendix I Three-Factor Adjusted Returns of Taxonomy Alignment Long-Short Portfolios

	Value-Weighted				Equal Weighted			
	LS_{AT}	LS_{AET}	LS_{AC}	LS_{AEC}	LS_{AT}	LS_{AET}	LS_{AC}	LS_{AEC}
Alpha	-0.365	-1.478***	-0.875*	-1.237**	-0.219	-1.262***	-0.375	-0.837*
	(0.621)	(0.570)	(0.519)	(0.597)	(0.535)	(0.488)	(0.441)	(0.459)
r_{MKT}-r_f	0.196***	0.215***	0.196***	0.009	0.181***	0.082	0.088	0.012
	(0.063)	(0.076)	(0.048)	(0.081)	(0.063)	(0.098)	(0.063)	(0.111)
SMB	0.740***	0.849***	0.752***	0.522***	0.468**	0.415***	0.604***	0.388***
	(0.226)	(0.156)	(0.116)	(0.190)	(0.197)	(0.147)	(0.144)	(0.099)
HML	0.859***	1.142***	0.937***	1.285***	0.467***	0.597***	0.539***	0.710***
	(0.308)	(0.318)	(0.189)	(0.149)	(0.172)	(0.120)	(0.095)	(0.064)
Adj. R^2	0.336	0.433	0.522	0.573	0.229	0.304	0.432	0.499

Note: This table reports Fama-French three-factor monthly regression results for long-short portfolios sorted on taxonomy alignment using non-sector neutral portfolios. The results are shown in percentages. To ensure that alignment information was available to investors at the time returns were realised, a six-month gap between the reporting year of the taxonomy data and the return measurement period is imposed. The return data covers July 2023 to June 2025.Alpha represents the monthly risk-adjusted abnormal return, and the remaining coefficients measure portfolio sensitivities to the Fama-French factors. Coefficients are reported with standard errors in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

AI Disclosure

We primarily used OpenAI's ChatGPT and Anthropic's Claude AI during the coding process and to some extent ChatGPT during the writing process. The tools were used to rewrite and debug our code. Using AI was especially helpful when we were stuck with errors in our code. Furthermore, rewriting our code with AI saved a significant amount of time when we made changes to our analyses. For writing, ChatGPT was used to refine wording, enhance clarity, and detect grammar mistakes, thereby improving the language and readability of our thesis.

We acknowledge the risks that arise from using these tools. Regarding coding, AI-generated suggestions could unintentionally change the logic of our analysis when rewriting or debugging our proposed code. Accordingly, we carefully tested and reviewed AI-suggested changes and compared them to our original code. When using the tools in the writing process, hallucination can lead to the inclusion of new or inaccurate content that was not part of our original work. Furthermore, over-reliance on these tools could undermine our independent thinking. To address these concerns, we limited the use of these tools for rewriting to single sentences per prompt and testing the clarity only for selected arguments. All AI suggestions were reviewed and verified to ensure that the meaning and arguments stayed consistent and accurate.

Finally, the use of these tools provided important insights and helped us to improve our AI skills. We realized that effective and detailed prompting, including but not limited to details about the context and a clear formulation of the desired outcome, can significantly improve the quality and accuracy of generated outputs. Furthermore, the use has increased our awareness for the limitations of generative AI tools, such as hallucinations and inconsistencies in reasoning, which showed us the imminent need to verify all outputs.