UNIVERSITÀ CATTOLICA del Sacro Cuore

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Abstract

The Security and Exchange Commission (SEC) has considered climate change as a risk issue since 2010. Several emission disclosure initiatives exist aimed at informing investors about the financial risks associated with a zero or low carbon transition. Stricter regulations, particularly in a few sectors, could affect operations costs, ultimately impacting companies financial performances, especially of listed companies. There are two ways these companies can disclose their transition risk exposure and are not alternatives. One is the explicit declaration of exposure to transition risk in the legally binding documents that listed companies must provide authorities. The other is the disclosure of GHG equivalent emissions, which is implicitly associated with transition risk exposure. This paper empirically analyses to what extent US companies stock returns incorporate information about transition risk by using explicit and implicit risk measures and comparing them. In addition, multiple total stock return measures distinguishing dividend payouts from simple stock returns. Results suggest that both explicit and implicit risks are positively related to dividend payouts and not to stock returns, while the overall effect on total stock returns is negative. Evidence supports the view that market operators price negatively the transition risk exposure and, probably as a consequence, boards in carbon intensive companies use dividend policies to attract investment in risky companies.

Keywords: Climate risk, Transition Risk, SEC-10K, Mandatory Disclosure, Text analysis, Dividend Policy
JEL: G35, G32 G38, Q54

Abbreviations: Dividend Policy (DP), Stock Returns (SR), Total Stock Returns (TSR) Return on Equity (ROE), Returns on Total Assets (ROTA), Intergovernmental Panel for Climate Change (IPCC), Green-house Gasses (GHG), Securities and Exchange Commission (SEC)

1. Introduction

Climate Change and its financial uncertainties could affect 93% of the capital markets, or $27.5 trillion of market value, indicating a relevant concern for investors (Sustainability Accounting Standards Board, 2017). Investors expect higher returns from polluting sectors to compensate for their increased transition risk exposure (Bolton & Kacperczyk, 2021a). A solid vulnerability for stringent climate mitigation policies intended to curb CO2 emissions characterises financial markets (Task Force on Climate-related Financial Disclosures, 2017a), which, on the other hand, can foster climate mitigation policies through disinvestment/investment dynamics. Institutional investors are structuring portfolios to be less dependent on carbon intensive activities (Bolton & Kacperczyk, 2021b). A trend of negative stock performances characterized carbon intensive sectors since before the crisis in 2008 (Bressan Bocardo, 2016). Boards might increase the dividend payouts to mitigate the effect of disinvestment due the exposure to transition risk.

Companies' disclosure activity is the primary source of climate information for financial markets. The information about climate-related and transition risks exposure can be disclosed in two different manners. One relates the explicit statements of risk exposure documented in legally binding documents. This information can be used to trace explicit transition risk exposure (Kolbel et al., 2020). Mandatory filings such as the 10-K in the US represent the legally binding channel for explicit transition risk disclosure. Under a regulatory mechanism for compulsory disclosure, omissions in mandatory filings can implicate litigations, and shareholders, associations, and trustees can open lawsuits for climate risks undisclosed in mandatory filings. The Securities and Exchange Commission (SEC) is the agency of US regulatory system that oversees the applications of mandatory disclosures, indicating which risks ought to be revealed to potential investors. Since 2010, the SEC communicated that corporations affected by climate-related impending regulations, taxes, and other physical and financial risks must disclose them (Wang, 2017). In 2021, the number of open court disputes regarding climate change risks amounted to 884 globally, with 654 in the US (Holm & Berardo, 2020). The other way is the disclosure of emitting activities, which is the result of voluntary communication to markets. It implicitly measures the exposure to stricter regulations or other sources of transition risk (Bolton & Kacperczyk, 2020). Described by the Task Force of Climate-Related Disclosure (2017) are scope 1 and 2; respectively direct and indirect emissions. Initiatives like Carbon Disclosure Project (CDP), ESGcook, TruCost and many others are attempting to systematically track firm-specific emissions annually to provide markets and investors reliable and comparable information. Not only direct emissions, which are already found priced in equity returns (Bolton & Kacperczyk, 2020) giving raise to what has been called "carbon premium" but also indirect emissions (Q. Nguyen et al., 2020; Task Force on Climate-related Financial Disclosures, 2017b). Known as Scope 2, indirect emissions represent 73% of global GHG emissions, of which 91% are CO2 (Climate Watch, 2017).

The extent to which transition risk, implicit or explicit, is priced in financial instruments has been the object of multiple studies. Implicit disclosure of transition risk predicated on the cost of abatement. Bolton &

Kacperczyk (2020) used a pooled regression to compare the marginal effect of emission on stock returns across countries and find evidence of a carbon premium that changes according to the country climate policy. Other articles present evidence of financial markets pricing GHG emission in stock price performances (Matsumura et al., 2014; J. H. Nguyen et al., 2020). Implicit measures of transition risk exposure are found to reduce the distance to default (Capasso et al., 2020), increase corporate left-tail risk (Ilhan et al., 2020) and debt cost (S.-Y. Lee & Choi, 2019) and affect asset prices (Liesen et al., 2017). Explicit measures are found to affect financial performances similarly. Albarrak et al. (2019) find that disseminating carbon emissions on social platforms negatively influences the cost of equity. Kölbel et al. (2020) and Jaggi et al. (2017) used text-based indicators to assess the impact of disclosed risk, and their results suggest a positive association of risk exposure explicitly measured with credit default swaps spreads and market to book ratio. Several works noted that after the elections of 2016, volatility in carbon-intensive firms increased, given the reluctance of the US recession from the Paris agreement (Diaz-Rainey et al., 2021; Ilhan et al., 2020; J. H. Nguyen et al., 2020).

In studies that already attempted to estimate the financial impact of transition risk, stock returns have been computed primarily as simple price variation over the considered period (Bolton & Kacperczyk, 2021b; Matsumura et al., 2014; J. H. Nguyen et al., 2020), neglecting dividend payouts. Understanding the effect of transition risk on both sources of total stock returns is crucial because it may help to shed new light on how financial operators price transition risk with their investment and divestment choices and how boards cope with these decisions managing the dividend payouts. A relatively high payout could be, in fact, associated with increased exposure to transition risk. Dividend policies have been studied for a long time (Lintner, 1956; Michaely & Roberts, 2006; Miller & Modigliani, 1961; Perez-Gonzalez, 2002), but there are no studies that assess the link between transition risk indicators and payouts ratio to the author's knowledge. The implications for the transition to a low-carbon society are relevant. If payouts are used to avoid value-destroying activities and reward shareholders during phases of low-investment opportunities, fewer resources are invested where they are needed to boost the transition.

In relation to the mechanism through which risk factors may influence dividend policies, existing empirical evidence suggests diverging evidence (A. W. Cheung et al., 2018; Hail et al., 2014; Michaely & Roberts, 2006; Miller & Rock, 1985), as dividends may either increase or decrease in response to risk shocks. Divedends' increase is in line with the carbon premium hypothesis, as investors expect to be rewarded more to compensate the higher risk, and dividends represent the only option when capital gains are limited. Dividends' decrease, in contrast, may result from the decision to use profits to invest in decarbonisation, increasing investors expectations about future profits at the price of a limited shareholders rewarning in the short term. Thus, if boards and investors alike perceive the relevance of transition risk, it should be possible to find a statistically significant relation between dividends and transition risk measures. Furthermore, the effect should be different in size between stock returns and total stock returns, as the latter incorporate dividend policies.

This work examines empirically how explicit and implicit transition risk impacts the multiple Total Stock Returns (TSR). TSR are the sum of stock returns (SR) and dividend payout ratios (DP). Indicators of transition risk used in literature are heterogeneous and often yield contrasting indications about the relationship with financial performance. The novelty of the paper lies in its approach to transition risk measure, which considers both implicit and explicit risk exposure measures and compares them. Explicit measures originate from documents where it is "explicitly" stating the exposure to transition risk in a company. Using text analysis and Natural Language Processing (NLP) algorithms, the repetition of definitions in annual SEC 10-K document filings has been tracked and matched with the International Panel on Climate Change (IPCC) and the Task Force for Climate-related Disclosure (TFCD) glossaries. Implicit measures of transition risk are computed as carbon intensities in revenues. The US market was preferred to others based on a consolidated discipline of implicit and explicit transition risk disclosure that makes the computed indicators comparable across the firms in the sample. The econometric analysis panel includes a sample of firms that disclosed emission intensities and transition risk in 10-K filings between 2011 and 2020.

The work is structured as follows. A brief literature review over the theme of financial consequences of low-carbon transition is presented in Section 2. Section 3 explains the methodology of the analysis and the data used for the estimation and their sources. In Section 4, the estimation results are presented, while Section 5 provides a discussion comparing implicit and explicit disclosure effects on stock returns. Section 6 concludes the work with a discussion on transition risk, its measurement, and its impact on financial markets.

2. Literature

The research objective of the paper draws from two streams of literature on corporate finance. One stream investigates the reasons and factors that push companies to release dividends from net revenues (Divecha & Morse, 2019; Hail et al., 2014; Michaely & Roberts, 2006). The second stream aims at understanding the determinants of total stock returns for shareholders (Abowd, 1990; Bressan Bocardo, 2016; Burgman & Van Clieaf, 2012; Stewart, 2014). Dividend policies have been studied at first by Lintner (1956), who specifically examined the hypothesis that dividends tend to be "sticky" and directed to a long-term target, a phenomenon also called dividend smoothing (Divecha & Morse, 2019; Michaely & Roberts, 2006; Miller & Rock, 1985; Rozeff, 1982). Modigliani and Miller postulated later the irrelevance of dividend policies to corporate performances (Miller & Modigliani, 1961). To which, Corporate finance literature found little evidence in support. It is violated as a consequence of market frictions like information asymmetry (A. Cheung et al., 2018; Miller & Rock, 1985), agency costs (Hail et al., 2014; Rozeff, 1982), tax reforms (Perez-Gonzalez, 2002) and information shocks (Hail et al., 2014). It is however still unanswered the question on why firms pay dividends. Similarly, the relation between dividend policies and transition risk is unclear. Some evidence of dividend payouts policy adjustments has emerged in Australia due to the expectations of stringent policies after the Kyoto protocol (J. H. Nguyen et al., 2020). It is, however, unclear how it reflected on shareholder's gains of exposed firms. Therefore, increased relevance of a transition risk should, in theory, impact dividend policies in the US.

TSR represents the sum of gains obtained by the holder of shares. Increases in dividends and market value per share are the main factors. TSR and SR are related to the earnings yield, capital investment, and changes in profitability and growth opportunities, as well as to changes in the discount rate (Chen & Zhang, 2007). Furthermore, TSR sensitively affects managers compensations (Abowd, 1990). There is no consensus around the TSR drivers as managers would be incentivised to enter strategies to increase it (Burgman & Van Clieaf, 2012; Stewart, 2014). A study regarding the oil sector in the US reported a downward trend for total stock returns from 2004 and 2014, even in the presence of dividend growth (Bressan Bocardo, 2016), but the source of such a downturn is unclear.

Theoretical and applied studies suggest that shareholders and investors price risk by incorporating its information in the investment (and disinvestment) decision (Fama & French, 1992, 2002; Grossman & Stiglitz, 1976). Several research streams have investigated how financial performances incorporate information contained in mandatory and non-mandatory documents. The SEC required listed companies in the US to fairly report climate risk since 2010. Outside weather anomalies, the required risk disclosure is consistent with the definitions presented by the TFCD in 2017. The definitions contained references to exposure to strict carbon regulation, adverse market preferences, damaged reputation; there was no particular link to paradigmatic shifts, which are consider in latter assessments of the transition risk (Ameli et al., 2020; Carney, 2015; Sartzetakis et al., 2012; Task Force on Climate-related Financial Disclosures, 2017b). Financial instruments correctly price-in risk in the absence of information asymmetries (Stiglitz and Grossman, (1976), and indicators that represent risk exposure could be used to assess the impact on financial performances. Evidence in Kolbel et. (2020), for instance, suggest that disclosed climate risk in mandatory documents increases default probability, while Cohen et al. (2020) find that disclosure and data presented in mandatory filings contain information capable of predicting firms' financial performances.

Mandatory disclosure represents an explicit form of risk information. Firms under such regulation are obliged to follow strict language rules in predetermined formats, and this allows using of such information to compare and indicate a genuine set of risks. For the case of 10-K securities from the SEC, the intentional misuse of disclosure represents a legal liability for the firm. Due to this rigidity, several authors have employed mandatory disclosure (in particular the 10-K format) to infer risk indicators: firms explain all factors that their economic activity cannot control and might affect their performances (Campbell et al., 2014). In such a manner, the distance between investor and investee knowledge expectations is reduced, and moral hazard is (better) neutralised in mandatory disclosure frameworks. Disclosure as an instrument to mitigate transition risk is anyway imperfect. Standardised or required forms such as the 10-K of SEC are restricted to dimensions and definitions. A budget of relevant sources of risk emerges in a context of imperfect information. Firms are encouraged to disclose perceived risks to their activity autonomously. Within a limited space of lines, a firm must specify the major risks of the sector and its economic activity to the best knowledge. Lawsuits can emerge when investors are affected by undisclosed risks (Liesen et al., 2017; Litterman et al., 2020). Admittedly, the same information can transpire implicitly from other indicators potentially related to risk factors. This is the example, for instance, of GHG emissions that have been used as an implicit measure of transition risk to estimate the "carbon premium" of polluting firms (Bolton & Kacperczyk, 2021a, 2021b, 2020). Similarly, (Trumpp, C.; Guenther, T., 2017) used emission intensity as a proxy if transition risk exposure and linked it to the market to book ratio of companies. Unfortunately, it is not always possible to employ such implicit measures of risk, as firms are not required to disclose their emissions. In some other cases, disclosure quality and composite indexes related to ESG score have been used in alternative (Fatemi,A.; Glaum, M.; and Kaiser, S., 2018; Friede et al., 2015; Whitelock, 2015), but ESG measures do not necessarily capture a risk. Rather, they are generally considered an ancillary measure for climate performances (Mercereau et al., 2020).

Implicit risk indicators have often been linked to risk premium dynamics within equity prices (Bolton & Kacperczyk, 2020; Thomä & Chenet, 2017) as brown firms' equity transactions implicitly contain the acceptance of a climate-related risk (Giese et al., 2021; Ilhan et al., 2020; Zhang et al., 2016). Mandatory disclosure, on the other hand, is the preferred documentation to elaborate text-based indicators. Disclosure of carbon emissions increases market efficiency in the stock market (Krueger et al., 2020; Liesen et al., 2017). Non-binding disclosure is free from mandatory limits, and no costs of litigation might arise. Nevertheless, reputation could be tarnished by greenwashing accusations (Cooper et al., 2018; Lyon & Maxwell, 2011). Without legal bindings that imply liability risks, it is difficult to compare disclosure documents of different actors. In other words, some firms might focus on some positive aspects and leave out the vulnerabilities, according to unclear preferences. Despite the reputation problem, there are no immediate costs for" elastic" use of the language of non-mandatory reports.

In this study, the explicit climate risk exposure metric is matched with the implicit emissions-based metric. Previous literature suggests investors are currently expecting higher returns from polluting sectors (Bolton & Kacperczyk, 2020; Capasso et al., 2020; Ilhan et al., 2020). The presence of a high carbon footprint is implicitly indicative of a greater future abatement cost under mitigation policies. The pressure to reduce emission intensity should open investment opportunities. There is less evidence from the literature that corporate decision over liquidity is affected by climate risk. Cheung et al. (2018) suggested that increased ratings indicate reduced dividends due to reduced information asymmetry. The lack of studies regarding the impact of implicit and explicit risk exposure opens a clear gap for this study. The novelty hereby proposed of considering both implicit and explicit transition risk metrics and analysing their impact on the different strands of TSR intends to increase the understanding of dividend payouts' relation with climate-related disclosure and the implications for investors.

3. Empirical Framework and Data

The statistical model used to link returns with transition risk metrics is expressed by equations 1, 2, and 3 for DP, TSR, and SR. Regression models follow the framework of cross-sectional stock returns analysis in Fama and French (2002), with explanatory variables lagged by one time period to avoid simultaneity bias. For each company i=1,…,N in the sample, target variables at a given period t=2011,…,2020 are explained by explicit (Risk) and implicit (CI) risk indicators. The framework is meant to incorporate the information shock rather than a correlation. Thus, it is hereby captured the influence that past information has on current dividend policies and shareholder returns. A similar approach has been used regarding the controls for stock returns by Bolton and Kacperczyk (2020). Each equation is estimated three times using a different indicator of emissions (by scope) while keeping the other variables.

$$DP_{i,t} = \beta Risk_{i,t-1} + \gamma CI_{i,t-1} + Z_{i,t-1}\delta + \varepsilon_{i,t} \quad (1)$$

$$TSR_{i,t} = \beta Risk_{i,t-1} + \gamma CI_{i,t-1} + Z_{i,t-1}\delta + \varepsilon_{i,t} \quad (2)$$

$$SR_{i,t} = \beta Risk_{i,t-1} + \gamma CI_{i,t-1} + Z_{i,t-1}\delta + \varepsilon_{i,t} \quad (3)$$

The β and γ coefficients measure the impact risks, measured explicitly and implicitly respectively, on the specific type of return. Matrix Z condensates the firm-specific control variables and includes information regarding cash and liabilities that could influence financial performances (A. W. Cheung et al., 2018; Fama & French, 2002; Wong & Hasan, 2021). Each equation is estimated twice, firstly using scope1 emission intensities and then scope2. In each equation, the inclusion of time-specific and firm-specific effects has been assessed: LM tests for time and firm fixed effects have been conducted, and results suggest the inclusion of time effects only. In such regard, political events that occurred between 2011 and 2020, including the Paris Agreement and the pull-out of US from it, constituted significant structural breaks that need to be accounted for in the regression (Berkman et al., 2019; Diaz-Rainey et al., 2021; Fan et al., 2020). As for firm effects, the literature suggests that industry-specific fixed effects incorporate sufficiently the exogenous characteristics of firms that cannot be estimated otherwise (Ilhan et al., 2020). Matching the statistical test results with theoretical arguments resulted in the choice to include time-specific and industry-specific fixed effects in the pooled regression model.

The target variables investigated by the study are three: SR, TSR, and DP. The first one represents the total price variation perceived by investors and is commonly employed in the climate finance literature as a general measaure of return (Bolton & Kacperczyk, 2020; Liesen et al., 2017). The second one includes, in addition to the final price, the dividend paid during the year and its definition is outlined in equation 5. TSR incorporates the net value variation enjoyed by shareholders rather than a casual investor. The last one represents the ratio of paid dividends and reinvested shares against net revenues.

$$SR_{i,t} = 100\frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \tag{4}$$

$$TSR_{i,t} = 100\frac{P_{i,t} + D_{i,t} - P_{i,t-1}}{P_{i,t-1}} \tag{5}$$

$$DP_{i,t} = 100\frac{Shares * Dividends\ per\ share}{Net\ Revenues} \tag{6}$$

As presented in figure 1, dividends payouts (DP) in the sample are generally varying between 0% to the 75 percentiles of 25% circa. This aligns with other studies regarding dividend policies (Michaely & Roberts, 2006; Perez-Gonzalez, 2002; Wong & Hasan, 2021). However, the dividend payout ratio is higher for more polluting firms: those with emissions above the 75 percentiles have a higher median dividend payout ratio.

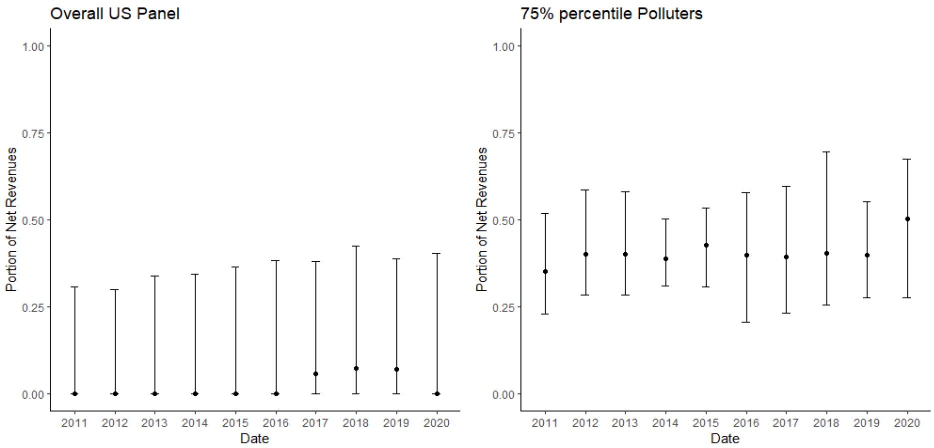

Figure 1: Dividend's payouts over the entire panel of firms (left) and firms with emissions above the 75th percentile (right)

The independent variables are the explicit (text-based) and the implicit (emission-based) risk exposure indicators. We scrapped information solely from 10-K filings, which are uploaded annually. To have an implicit measure of transition risk, we employed the revenue intensity of CO2 emission equivalents according to scope 1, 2, and their sum. Finally, we collected control variables for firm market performance that could affect target variables annually.

Our explicit risk measure grounds on the assumption that the frequency of appearance of some risk-related words in documents indicates the relative importance assigned by the document writers to the risk. The more frequent these words appear, the higher is the risk exposure and the need to declare it accordingly. The 10-K documents risk section, where all risks are reported, is used for this purpose. After cleaning annual documents from redundant expressions such as articles, the remaining text is a sparse set of words that gets matched with a vocabulary intended to represent risk-related information. The higher the occurrence of matching, the more relevant is the risk. Corporations are expected to disclose risks at the best of their knowledge to avoid liability exposure (S. Y. Lee & Choi, 2019; Loughran & McDonald, 2011; Matsumura et al., 2014) and, as a consequence, the information reported in 10-K filings can be considered complete.

The structure of 10-K filings is fixed for all firms. All relevant risk factors are contained in section 1A. The total length of this section provides a gross dimension of a firm's riskiness: the more risk factors are reported, the thicker the Item1A will be. Furthermore, definitions of risks are often similar across firms, which makes the documents more easily comparable. After cleaning text from redundant words, NLP algorithms are applied to the remaining text to retrieve risk measures. The technical procedure involves several steps of data cleaning. At first, a machine-learning process must be read to transform each line into a data entry. Proper packages with neural networks are trained to capture English words and drop out irrelevant words such as articles or other reiterated expressions. Indexes are generated matching words or groups of words with a benchmark library, and a Boolean process assigns 0 or 1 to each group of words of each document. Afterwards, repetitions are weighted by the dimension of the entire text. The weighted average of term frequency is used as a proxy of risk relevance. This is computed as the product of term frequency (tf), that is the number of matches, and the inverse document frequency (idf), that weights the relative importance of the climate risk over total risk. The benchmark bigrams are extracted with a similar procedure but do not present assigned values. Previous works have employed IPCC glossary and definition for climate negativism and effective scientific presentations on media (Rogova & Aprelkova, 2020; van der Geest & Warner, 2020).

The frequency of a term that occurs in a document is simply proportional to the term frequency Luhn, (1957). The latter refers to the logarithm difference of the total number of documents under control and the number of documents that contain the bigram itself. As reported in equation 7, we adjusted this index according to the dimension of the documents: the variable is labelled "Risk" and represents the product of term frequencies and inverse document frequencies. This standardisation is extremely relevant due to the text structure changing over time. Securities 10-K registered two major evolution patterns. One is the increase in the spread in terms of complexity. The number of bigrams per document increased each year and the difference between the richest document and the poorest one. In figure 2. A appears evident that the distribution of bigrams per document is negatively skewed, tending to 2000 within the section of risks. Furthermore, the use of disclosure has induced an increase of definitions since 2010.

$$Risk_{i,t} = tf_{i,t} idf_{i,t} = \frac{1}{B_{i,t}} \sum_{\forall b} \left(tf_{b,i,t} * idf_{b,t} \right) \tag{7}$$

Figure 2 shows the yearly average number of bigrams on the left panel (A) and the risk indicator on the right one (B) with the respective 95% intervals in shaded grey. The average number of bigrams in panel A represents raw data on how wide the space of definitions of risk is reported within the filings. The figure has grown over time considerably. In addition, documents have become more homogenous in their size, and the variance has decreased over time accordingly. Notwithstanding, the distribution of the number of bigrams appears very skewed on the right tail, tending to 2000 within the section of risks. There are two possible explanations for an observed increase in the number of bigrams. One relates to the increased use of the section reduce the likelihood of litigation. Companies may prefer to specify more in detail this section to prevent litigation, even when the risk is low, leading to over-specification. The other is the actual intention to highlight the emergence of risk factors. The *Risk* indicator in panel B, in contrast, declines over time.

Thus, while the mandatory disclosure risk section size has increased between 2011 and 2020, the role of climate risk remained relatively minor compared to other factors.

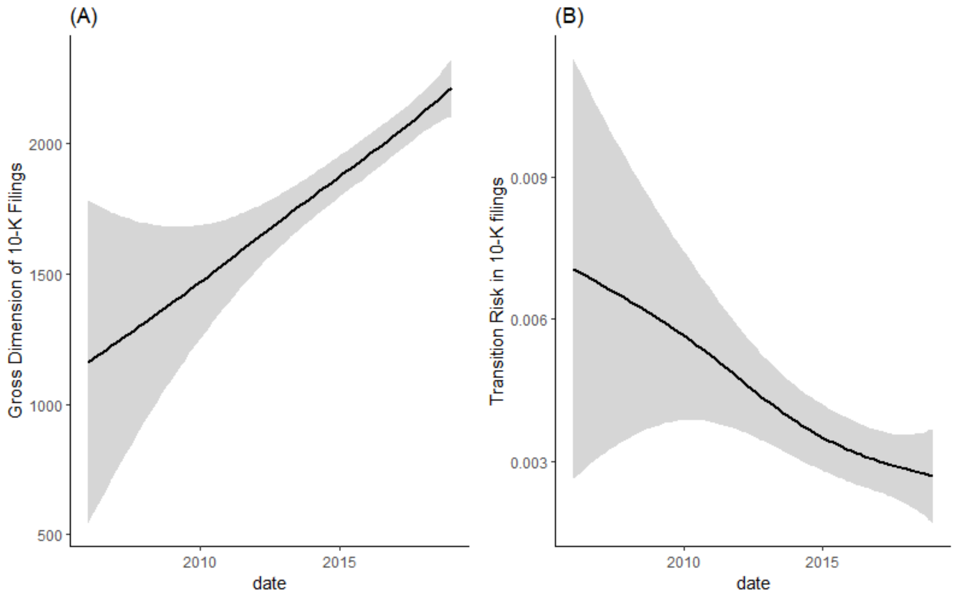

Figure 2: Text-Based Indicators. (A) is the plot of the total number of bigrams per 10-K Filings; (B) tf*idf adjusted to bigrams, using a confidence interval of 95%

In this paper, the explicit measure of risk also vary significantly across industries. Using the four-digit Global Industry Classification Standard (GICS), we clustered firms into 24 major sectors. Table 1 provides summary statistics by industry. Banks, Capital Goods, and Financial Services organisations are among the most prominent groups. Overall, the observed panel registers a low median risk index for climate change (0.246), and the distribution appears positively skewed with fat tails in all industries. Hence, the expected disclosure contains a minimal reference to the IPCC glossary with some cases of large exposure. For instance, companies in the Food, Transport, and Commercial & Professional Services industries are characterised by very high indexes. Contrary to expectations, companies in the Utilities, Energy, and Insurances industries show a lower-than-average risk exposure.

Comparing this evidence with the gross amount of bigrams in risk disclosure, hence weighting the overall risk exposure, it emerges that firms in industries that do not perceive climate as one of their main priorities disclose as much or even more than other industries. As for risk patterns, distributions are often positively skewed, with fat tails. The average risk disclosure section presents on average 933 bigrams. The panel presents a high variance of mandatory disclosure, with some empty values due to late participation.

Table 1: Sectorial Distributions of 10-K bigrams of 1A Item and tfidf risk

	Bigrams							Risk						
GICS	NxT	Missing	Ratio	Mean	SD	25 perc	75 perc	NxT	Missing	Ratio	Mean	SD	25perc	75perc
Automobiles & Components	66	17	26%	1518,245	838,981	988	1845	66	17	26%	0,003	1.688	0,002	0,004
Banks	216	43	20%	1716,566	881,0407	1126	2199	216	43	20%	0,003	1.950	0,002	0,003
Capital Goods	352	104	30%	1433,78	725,9424	880,25	1762,75	352	104	30%	0,003	1.906	0,002	0,004
Commercial &Professional Services	84	9	11%	1347,267	741,3702	771	2028,5	84	9	11%	0,005	5.533	0,002	0,004
Consumer Durables & Apparel	123	39	32%	1873,75	703,366	1354,75	2315	123	39	32%	0,002	1.116	0,002	0,003
Consumer Services	97	29	30%	1444,577	548,1983	970,5	1844,5	97	29	30%	0,003	1.763	0,002	0,004
Diversified Financials	201	54	27%	2743,134	2031,961	1536	3540	201	54	27%	0,002	1.605	0,001	0,002
Energy	162	36	22%	2275,675	1002,289	1671,5	2630	162	36	22%	0,002	1.627	0,001	0,002
Food & Staples Retailing	42	16	38%	1429,276	1088,611	479	2037	42	16	38%	0,004	2.272	0,002	0,007
Food, Beverage & Tobacco	111	29	26%	1217,585	567,4194	1037,25	1463,5	111	29	26%	0,021	39.319	0,002	0,004
Health Care Equipment & Services	165	50	30%	2485,348	1362,281	1444	3270,5	165	50	30%	0,004	1.212	0,001	0,002
Household & Personal Products	44	12	27%	1680,438	611,702	1304,25	1871	44	12	27%	0,002	1.360	0,002	0,003
Insurance	77	17	22%	2826,9	1288,259	1678	3308	77	17	22%	0,002	1.122	0,001	0,002
Materials	119	39	33%	1473,863	1025,412	928,75	1798,25	119	39	33%	0,003	2.020	0,002	0,004
Media & Entertainment	105	20	19%	2038,8	780,532	1454	2579	105	20	19%	0,002	2.028	0,001	0,003
Pharmaceuticals, Biotechnology & Life Sciences	187	43	23%	3166,743	1717,09	1704,75	3982	187	43	23%	0,002	1.291	0,001	0,002
Real Estate	145	37	26%	1785,778	849,4394	1203,75	2329,75	145	37	26%	0,003	1.595	0,002	0,003
Retailing	151	52	34%	1708,545	971,4556	1130	2164	151	52	34%	0,003	1.631	0,002	0,003
Semiconductors & Semiconductor Equipment	72	31	43%	1777	579,9458	1374	2079	72	31	43%	0,002	1.173	0,002	0,002
Software & Services	170	46	27%	1619,476	767,9374	991	2159,25	170	46	27%	0,003	1.556	0,002	0,004
Technology Hardware & Equipment	122	37	30%	2467,859	2535,956	1725	2587	122	37	30%	0,002	1.995	0,001	0,002
Telecommunication Services	21	1	5%	1355,9	436,3632	1211,25	1553,5	21	1	5%	0,003	1.708	0,002	0,003
Transportation	31	8	26%	783,4783	402,3764	677,5	1062	31	8	26%	0,009	6.558	0,003	0,006
Utilities	61	21	34%	2771,525	1128,3	1897	3622,25	61	21	34%	0,002	0.973	0,001	0,002

The second transition risk indicator is the implicit one. Emission intensity, particularly over revenues, indicates the total burden that carbon cost might have over liquidity, greater intensities implicitly carrying higher abatement costs. Firms can disclose three types of emissions. The "scopes" terminology identifies the direct and indirect emissions of CO2 equivalent quantities. Scope1 registers fugitive emissions and fuel combustion of company vehicles. Scope2 represents part of the indirect emissions, especially those "bought" to continue di activity: purchased electricity, heat and steam. Finally, Scope3 emissions account for all the externalities produced by the supply chain of corporate activity: purchased goods and services, business travels, employee commuting, waste disposal, use of sold products, transportation and distribution (upstream and downstream), investments, leased assets and franchises. Estimates of Scope3 are rare to find as they require significant investment to be computed on an annual basis. Thus, previous studies considered mainly Scope1 (Bolton & Kacperczyk, 2021b, 2020; Ilhan et al., 2020; King & Lenox, 2001; Wang, L.; Li, S.; and Gao, S., 2014). Furthermore, industry-level values have often been preferred to firm-specific ones. Ilhan et al. (2020) compared industry level and firm-level emissions in regression models and found that using firm-level values rather than industry values does not improve the model fit, suggesting that the use of firm level values does not add informatiove content when industry values are already accounted for. In the appendix, a report of this evidence is portrayed using our sample and the result in Ilhan et al. (2020) is confirmed. For these reasons, sector-specific emissions are used in the empirical model as a measure of implicit risk factors.

Table 2: Summary Table

Statistic	NxT	Mean	St. Dev.	Pctl(25)	Pctl(75)
Assets	3,562	13.737	1.923	12.534	14.919
CAPEX	4,166	4.665	6.711	1.140	6.128
CORP_LEV	4,343	26.325	42.495	7.930	38.680
MTBV	4,206	3.343	37.086	1.290	3.690
EBIT_ASS	3,513	0.228	0.570	0.074	0.426
DIV_PAY	2,051	34.660	21.598	18.885	47.315
TSR	4,229	19.548	180.183	-7.820	33.720
SR	4,163	17.828	51.059	-7.509	33.913
Risk	4,400	-2.507	3.038	-6.0	-1.12
SCOPE_1_REV	998	0.229	0.728	0.002	0.086
SCOPE_2_REV	972	0.064	0.293	0.009	0.043
SCOPE_1_REV_IND	4,204	0.104	0.180	0.001	0.126
SCOPE_2_REV_IND	4,204	0.028	0.029	0.012	0.031

We summarised the variables used in this work in table 2. The study's timeframe reflects the timespan successive to the SEC adjustment to the presence of regulatory risk due to climate change. Observations represent a match of firms that disclosed climate-related risks and those disclosing emissions between 2011 and 2020. Independent variables are emissions (implicit risk) and disclosure risk (explicit risk). The former is the ratio of CO2 equivalents tons over one million dollars of revenues for Scopes 1 and 2. Control variables collected in the Z matrix of equations 1,2,3 are in percentage points Capital expenditure over assets (CAPEX), corporate leverage (CORP_LEV) and earnings before interest and taxes over Assets (EBIT_ASS). Firms' dimension was controlled by the logarithm of assets book value, while market to book ratio (MTBV) indicates the ratio between market value over book value of assets. We used a logarithmic scale for text-based indicators to the distribution more similar to a normal distribution and have comparable estimates with emissions intensities and total quantities. Risk presents the relevance of climate risk within the disclosure. According to our analysis, most firms did not disclose climate risk according to relevant bigrams of the IPCC glossary. The number of bigrams has a comparable standard deviation to Risk (3.038). The indicator has not shown drastic evidence of change, indicating a leptokurtic distribution. Moreover, disclosing firms use similar complexity of language due to strictness of regulation formats.

4. Results

Equations 1, 2, and 3 have been estimated using OLS. Two rounds of estimates per model have been made using Scope1 and Scope2 emissions, respectively, alongside the *Risk* variable. Matching the 10K filings with the IPCC vocabulary resulted in a large group of companies not reporting climate risk. These observations have a null value of the Risk variable and are dropped from the estimation panel accordingly. The estimates are presented in table 3.

Explicit transition risk, measured by the text-analysis indicator *Risk*, shows a positive and statistically significant impact on DP, in contrast to the effect on SR, which is not statistically significant, albeit positive. The estimated *Risk* effect is equal to 0.647 with respect to DP. This value indicates an increase of net revenues directed to dividends of 0.647 base points according to an increase in risk measure. Implicit transition risk, measured by either Scope1 or Scope2 intensities, is also found to affect returns: in all models the coefficients are statistically significant, but the direction of the effect depends on the target variable. Intensity is associated positively with DP and negatively with SR. The impact of Scope1 and Scope2 was equivalent respectively to 13.897 and 35.613 base points of DP. For SR, the effects were respectively -8.203 and -85.328 base points. Similarly, TSR is affected by Scope 1 and 2, with estimates indicating an impact of -9.230 and -83.086 base points from a percentage increase of Scope1 and Scope2. The main difference between the explicit and implicit is the standard deviations, which will be discussed in the next section.. The results of control variables are consistent with previous literature and corroborate the pecking order hypothesis: CAPEX expenditure is negatively related to dividend payout ratios. On the other hand, growth opportunities (defined as Tobin's q), corporate leverage, and systemic risk are not statistically significant. The firm dimension operationalised by assets is overall significant. The estimation of the TSR model revealed a lack of significance concerning the text-based indicators. Overall, total stock returns are negatively affected by carbon footprint over the revenues: -11.865 base points for each percentage increase of Scope1 intensity and -86.588 base points for each percentage variation of Scope2 intensity. The controls reflected low significance, except corporate leverage and EBIT percentage over the assets or ROTA. In terms of statistical significance, the models regressing TSR are overall less significant. Their F statistics is around 2.5, compared to 42 for the dividend payout ratio. This systematic difference is present furthermore in the Adjusted R squares.

Table 3: Explicit and implicit transition risk impact on Dividend Payouts, Stock Returns, and Result Total Stock – summary estimation results

	Dependent Variables:					
	Dividend Payouts		SR		TSR	
Risk	0.647***	0.630***	0.279	0.266	0.045	0.036
	(0.209)	(0.210)	(0.306)	(0.306)	(0.315)	(0.315)
SCOPE_1_REV_IND (CI)	13.897***		-8.203*		-9.230**	
	(2.813)		(4.205)		(4.322)	
SCOPE_2_REV_IND (CI)		35.613*		-85.328***		-83.086***
		(19.672)		(26.475)		(27.260)
log(Assets)	0.171	0.141	-0.537	-0.569	-0.623	-0.648
	(0.341)	(0.344)	(0.445)	(0.444)	(0.457)	(0.457)
CORP_LEV	0.016	0.020	-0.003	-0.006	0.155***	0.151***
	(0.026)	(0.026)	(0.038)	(0.038)	(0.039)	(0.039)
ROTA	-1.780	0.227	5.846***	5.447***	-4.082**	-4.557**
	(1.750)	(1.714)	(1.750)	(1.724)	(1.798)	(1.772)
MTBV	0.009	0.008	0.008	0.007	0.038	0.036
	(0.024)	(0.025)	(0.026)	(0.026)	(0.026)	(0.026)
CAPEX	-0.254*	-0.305**	-0.305**	-0.257*	-0.413***	-0.372**
	(0.147)	(0.150)	(0.153)	(0.154)	(0.157)	(0.158)
Observations	2,927	2,927	2,927	2,927	2,927	2,927
R^2	0.161	0.148	0.006	0.008	0.013	0.015
Honda LM (Time), Normal	2.194** [0.016]	1.834** [0.014]	66.404*** [0.000]	67.161*** [0.000]	78.386*** [0.000]	79.316*** [0.000]
Honda LM (Indiv.), Normal	1.112 [0.266]	1.016 [0.309]	-1.181 [0.237]	-1.159 [0.246]	-1.196 [0.231]	-1.164 [0.244]
Adjusted R^2	0.150	0.136	0.0005	0.003	0.008	0.010
F Statistic	28.353***	25.605***	2.484**	3.429***	5.636***	6.320***
Note:	*p<0.1; **p<0.05; ***p<0.01, robust standard errors in paratheses, p-values in brakets					

5. Discussion

The explanatory variables of interest in our models, *Risk*, *Scope1*, and *Scope2*, are measured in different scale, and this prevents a direct comparison of their effects. To make results comparable, we consider the effect a SD change of each explanatory variable on the SD change in the respective target variable. Each coefficient associated with *Risk*, *Scope1*, and *Scope2* is multiplied by the SD of the respective variable and divided by the SD of the dependent variable the estimate refers to.

Table 4: Comparison of SD effects on dependent variables' SD

	DP	SR	TSR
Risk	8.359%		
Scope1/Net Revenues	11.582%	-2,892%	-0,922%
Scope2/Net Revenues	4.781%	-4,846%	-1,337%

One standard deviation of the variable Risk represents 8.359% of the standard deviation of DP. This variability could be explained in such a manner. Increases of relevance for transition risk in its 10-K filings from the first to the 25 percentiles (equivalent in this case to one standard deviation) generate an expectation of a dividend payout ratio increase of 0.783%. The direct emission footprint reflects a more significant impact over revenues, where one standard deviation is reflected on 10.653% of dividend payouts variations: it indicates a payout gap between polluters of almost 8%. The effect exerted over TSR, and SR is relatively modest. One standard deviation of direct emission increase negatively affects SR for a 2.89% of standard deviation reduction, while indirect emissions account for a reduction equivalent to 4.864% of the SD. Dividend policies reduce the negative effect of disinvestment on stockholders. It is possible to see that for scope 1 emissions, the reduction is 0.922%, while indirect is 1.337%. A summary of impact variation is presented in table 6. It is possible to see that intense over revenues has a greater impact on the dependent variable than the variation on assets.

The results might potentially present evidence colliding with recent works of carbon premium and the effect of climate risk disclosure (Bolton & Kacperczyk, 2021a; Jaggi et al., 2017). For instance, Bolton & Kacperczyk (2021a, 2020) present the carbon premium as originated from a pooled panel data. These results corroborate the expectations of investors for premium. The evidence gathered here suggests that this premium could be presented directly as immediate liquidity from the board's decision. It is possible to see this from the differences in TSR and SR results. Simple equity trading is negatively related to emissions. However, shareholders that do not disinvest are partially compensated. This indicates that boards are incentivising asset managers to keep more intensive firms against minor exporters. The positive relation between DP and risk factors corroborates this outcome. As suggested by Jaggi et al. (2017), climate disclosure influence investors' decisions: in our case, implicit information gathered by sectorial intensity is the main driver. The signs of estimates match a less recent branch of literature regarding the negative effect of carbon-intensive activities on financial performances directly. (Chava, 2014; Matsumura et al., 2014).

Previous works noticed that the discharge of dividends was often related to endogeneity (A. Cheung et al., 2018). Such a problem could be overcome by adding the Inverse Mills' Ratio in the estimation process. Such value is calculated using Heckman's statistical model presented in the appendix. The estimate is reported; however, it is non-significant, indicating that the selection bias is irrelevant. To control for heteroscedasticity, the estimator involved robust errors.

Payout policies are prone to compensate for the presence of transition risk due to the implicating policy uncertainty. The evidence here portrayed is in line with previous works. The acknowledgment of transition risk generates uncertainties and therefore requires increased dividends due to agency cost (Hail et al., 2014; Harakeh et al., 2019; Michaely & Roberts, 2006). However, these results collide with the emerging literature regarding payouts and corporate social performances. Several articles have found that well-performing firms tend to pay higher dividends (A. Cheung et al., 2018; Hendijani Zadeh, 2020; Limkriangkrai et al., 2017; Verga Matos et al., 2020). It is unclear, therefore, the use of dividends in case of non-mandatory disclosure concerning mandatory.

Regarding transition risk, the pecking order hypothesis indicates that investments and dividends are negatively correlated (Agrawal & Jayaraman, 1994). If companies hold potential stranded assets, they do not have growth opportunities (rather liabilities). This is potentially indicated by the negative relation between TSR and corporate leverage and corroborated by carbon footprint. In contrast, they might be forced to pay higher dividends due to the downturn. The impact for total stock returns opened space for further investigation. The reasons of the long-term decrease in shareholder gains overall unclear. While this study presents evidence regarding transition risk relations, a long-term bearish trend predates the changes in SEC regulations in US Oil sector (Bressan Bocardo, 2016). Therefore, there could be external factors from the paradigmatic shifts that indicate the negative relation between total stock returns and carbon footprint.

6. Conclusion

The paper analysed the effects of explicit and implicit transition risk disclosure on DP, SR, and TSR in a sample of US listed companies. Explicit measure of transition risk are built applying text-analysis to mandatory disclosure documents, matching the risk section of 10-K filings with the IPCC vocabulary. Implicit measures of transition risk consider Scope1 and Scope2 emission intensities measured at the industry level. The results underlined an overall statistical significance of the dividend payouts model, while the total stock returns and stock returns models proved to be less fitting. However, a negative relation between the shareholder gains and emission intensities was found. The explicit measure positively affected dividend payouts, indicating that increased relevance of transition risk for US firms meant future higher payouts. The effect of implicit indicators was similar, indicating that exposure to transition risk under both form drive net revenues to be dischared to shareholders rather than to other directions. Explicit indicator was unrelated to both total stock return and stock returns. On the other hand, both indicators were negatively affected by increased carbon footprint indicators. A relevant difference in impact was registered between the total and simple stock returns. When dividends per share are considered, the effect of one standard deviation of implicit measure impact relatively less the capital gain loss.

The evidence in this paper have substantial implications concerning the long-term investments capabilities of carbon-intensive firms. Exposure to transition risk drives dividends payout upward. The result is that total gains from carbon intensive equity holding is far less damaged from disinvestment. While both measure of transition risk exposure sustain such explanation, the main effect comes from the implicit risk disclosure rather than the explicit one. This is an indication that carbon performance (Climate Walk) outpases mandatory disclosure (Climate Talk) in providing signals for boards and investors alike. In such sense, the paper presents results in line with the carbon premium hypothesis, according to which investors are increasingly expecting to be compensated from the exposure to transition risk. Boards responded in US with an aggressive dividend payout policies to boost total shareholder gains.

According to the results, it appears that the hypothesis of information shock hold for a carbon premium linked to dividends. In other words, boards use excess liquidity to repay the negative expectations from investors. It is possible however that expectations of low investment opportunities are driving boards of such firms to destroy liquidity. They would pursue such strategy to avoid wasting resources in projects characterized by negative net present value while compensating investors. The hypothesis of low investment opportunities is more in line with a disbelieve or even a bet from "carbon boards" against the green transition. Such disbelieve could be driven by the perception of uncertainty surrounding policies of carbon neutrality and emission reduction. A reliable planning from policymakers could clarify the potential investment opportunities and therefore move excess liquidity from dividends to projects for the carbon transition.

7. Appendix: controls for text analysis

7.1.SEC 10-K Structure

We hereby reported the main feature of a generic SEC 10-K document. Instead of parsing the entirety of each one, we simply focused on item 1A. Other sections might contain useful information such as item 7A. On the other hand, they are usually either empty or too heterogeneous to use. In particular, the Item 1A is similar across all firms in terms of structure and in terms used.

Part 1

Item 1 – Business

Item 1A – Risk Factors

Item 1B – Unresolved Staff Comments

Item 2 – Properties

Item 3 – Legal Proceedings

Item 4 – Mine Safety Disclosures

Part 2

Item 5 – Market

Item 6 – Consolidated Financial Data

Item 7 – Management's Discussion and Analysis of Financial Condition and Results of Operations

Item 7A – Quantitative and Qualitative Disclosures about Market Risks, Forward Looking Statements

Item 8 – Financial Statements

Item 9. Changes in and Disagreements with Accountants on Accounting and Financial Disclosure

Item 9A. Controls and Procedures

Item 9B. Other Information

Part 3

Part 4

7.2. Risk references in SEC 10-K

Mandatory disclosure comes in different formats and requirements. In this research, 10-K was employed within the text analysis. As recalled in the text-analysis sections, the main concern of the work relates to the disclosed risks. Therefore, it was mined within Part I, in particular within item 1A. This section does not vary in a significant manner among actors, and risk description too. A reference using a bigram could be related to a certain element of risk reflected by the company within the section. For instance, we can see risks related to" climate change" are perceived as regulation changes. These are for instance the references to two different companies. The first relates the Agilent Manufacturing[1] in 2019:

[1] Agilent Technologies, Inc. is an American analytical instrumentation development and manufacturing company

“...in the the event that any future **climate change** legislation would require that stricter standards be imposed by domestic or international environmental regulatory authorities, we may be required to make certain changes and adaptations to our manufacturing processes ...”

Indexes applied in this paper do not commensurate with the risk outside its frequency. In some cases, the explanation is more specific. This means the disclosure contains for the same risk more than one bigram related to climate change. This is for instance a reference from Arconic[2] of 2018:

“...Increased concern over **climate change** has led to new and proposed legislative and regulatory initiatives, such as **cap-and-trade** systems and additional limits on emissions of **greenhouse gases**. New laws enacted could, directly and indirectly, affect Arconic’s customers and suppliers (through an increase in the cost of production or their ability to produce satisfactory products) or business (through an impact on Arconic’s inventory availability, cost of sales, operations, or demand for Arconic products), which could result in an adverse effect on our financial condition, results of operations and cash flows.

Compliance with any new or more **stringent laws** or regulations, or stricter interpretations of existing laws, could require additional expenditures by the Company or its customers or suppliers. Also, Arconic relies on natural gas, electricity, fuel oil, and transport fuel to operate its facilities. Any increased costs of these energy sources because of new laws could be passed along to the Company and its customers and suppliers, which could also have a negative impact on Arconic’s profitability. ...”

The use of a specific term from the climate change glossary within the risk section captures disclosed risk. The tf-idf index provided a relative weight of its relevance. The reported cases referred to manufacturing companies that could evidently face transition risks. The general climate-related risks vary greatly among the sectors. Nevertheless, the magnitude of glossary use is influence according to the number of risk factors. For instance, a reason why Food, Beverages and Tobacco industry faces higher damages reflection is related to the number of stress factors considered. While factories of automotive are relatively immune to climatic effects, crops are dependent on predictable and safe weather. Furthermore, reputation risk related to meat dependency on carbon emissions is usually criticised by non-corporate organisations, such as Peta. In terms of the market shift, new vegan-based products constantly appear on market, with often cheaper alternatives. Policy changes could affect livestock acquisition, due to the greater impact of methane emissions from the cattle population. Looking at these trivial examples, it is reasonable to infer why the climatic risk of such a sector appears to be higher than the Energy one.

7.3. Correlation table

Firm characteristics are controlled by, Corporate Leverage, capital expenditure over assets, dimension (logarithm of assets), EBIT over assets, and market to book value or Tobin’s Q. Finally, we reported the correlation table 4. Financial instruments have a low correlation with each other. On the other hand, the

[2] Arconic Corporation is an American industrial company specializing in lightweight metals engineering and manufacturing

correlation between emission data is highly correlated. Firms with greater assets at disposal have higher emissions too. In the next section, we will explain which econometric model has been used and which tests have been made for robustness.

Table X1: Correlation table

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Assets (1)	1	-0.177	-0.091	0.123	-0.275	0.033	0.051	-0.002	0.123	-0.145	-0.188	-0.171	-0.062
CAPEX (2)	-0.177	1	0.018	-0.026	0.326	-0.046	-0.087	-0.013	0.016	0.234	0.116	0.325	0.308
CORP_LEV (3)	-0.091	0.018	1	-0.042	0.234	0.097	-0.051	-0.065	-0.142	0.091	0.099	0.107	0.085
MTBV (4)	0.123	-0.026	-0.042	1	-0.028	0.073	0.066	0.082	-0.058	-0.058	-0.005	0.006	-0.016
EBIT_ASS (5)	-0.275	0.326	0.234	-0.028	1	0.020	0.010	0.037	-0.017	0.174	0.060	0.540	0.401
DIV_PAY (6)	0.033	-0.046	0.097	0.073	0.020	1	0.017	-0.194	0.011	0.038	0.068	0.063	0.011
TSR (7)	0.051	-0.087	-0.051	0.066	0.010	0.017	1	-0.088	0.040	0.025	0.012	-0.034	-0.048
SR (8)	-0.002	-0.013	-0.065	0.082	0.037	-0.194	-0.088	1	0.112	0.067	-0.005	0.020	-0.065
tf_idf (9)	0.123	0.016	-0.142	-0.058	-0.017	0.011	0.040	0.112	1	-0.050	-0.084	-0.041	-0.128
SCOPE_1_REV (10)	-0.145	0.234	0.091	-0.058	0.174	0.038	0.025	0.067	-0.050	1	0.186	0.495	0.304
SCOPE_2_REV (11)	-0.188	0.116	0.099	-0.005	0.060	0.068	0.012	-0.005	-0.084	0.186	1	0.041	0.166
SCOPE_1_REV_IND (12)	-0.171	0.325	0.107	0.006	0.540	0.063	-0.034	0.020	-0.041	0.495	0.041	1	0.626
SCOPE_2_REV_IND (13)	-0.062	0.308	0.085	-0.016	0.401	0.011	-0.048	-0.065	-0.128	0.304	0.166	0.626	1

7.4. CO2 Equivalent Emission, Firm Specific and Industrial Specific

Structural variables could be drivers of emission intensity as well as industry characteristics. To do so, we confronted the fitness levels of models intended to predict emission intensity and total flows at firm level by accounting for industry effects and specific drivers. We reported carbon footprints divided by assets and revenues. These represent the target variables. The null hypothesis regarding footprints is that firm specific factors have no influence in determining the emissions. The alternative hypothesis is that firm specific factors influence firm specific emissions. The implication for the alternative hypothesis have two major negative implications for the principal analysis. The first is the endogeneity problem; it would not be able to use both firm specific controls and carbon footprint if the former is a predictor of the second. Secondly, firms do not often disclose emissions, inducing a great loss of observation which would worsen if matched with the missing data on 10-K climate disclosure. Therefore, if industry specific data are the main driver of firm specific ones, it is possible to overcome both problems. The procedure to assess the relevance hypothesis of firm specific factors involves the comparison with the R squared in models. The main independent variable is the industry specific footprint. If firm specific information does not improve significantly the R2 of the model regressing solely industrial footprints. According to our results, at no carbon footprint scope is possible to see significant difference. This is indicative of the impossibility to reject the null hypothesis. The distinction between firm-specific to industry specific characteristics dictates which emissions should be considered while addressing financial carbon premium. Previous works have investigated the premium that investors require from brown stocks due to the industrial emission intensity (Bolton & Kacperczyk, 2020; Ilhan et al., 2020). If stock correctly price information about firm-specific transition risk and premium dynamics, the sum of scope 1 and 2 emissions should be considered in the regression as well. For intensities, we will employ the firm specific indicator, while for the total emissions, we will indicate the industry GICS 4 reference.

Table X2: Emission drivers

	Dependent variable:											
	SCOPE_1_ASS		SCOPE_2_ASS		GHG_TOT_ASS		SCOPE_1_REV		SCOPE_2_REV		GHG_TOT_REV	
	OLS	panel	OLS	panel	OLS	panel	OLS	panel	OLS	panel	OLS	panel
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
SCOPE_1_ASS_IND	1.406^{***}	1.414^{***}										
	(0.052)	(0.058)										
SCOPE_2_ASS_IND			2.629^{***}	2.482^{***}								
			(0.398)	(0.428)								
GHG_ASS_IND					1.591^{***}	1.652^{***}						
					(0.081)	(0.092)						
SCOPE_1_REV_IND							1.743^{***}	1.918^{***}				
							(0.085)	(0.105)				
SCOPE_2_REV_IND									2.311^{***}	2.069^{***}		
									(0.275)	(0.335)		
GHG_REV_IND											1.689^{***}	1.896^{***}
											(0.090)	(0.110)
log(Assets)		-0.053		-0.100^{**}		-0.158^{**}		-0.002		-0.022^{***}		-0.033*
		(0.038)		(0.048)		(0.063)		(0.017)		(0.008)		(0.018)
CORP_LEV		0.026^{*}		0.066^{***}		0.091^{***}		0.006		0.011^{***}		0.019^{***}
		(0.013)		(0.018)		(0.023)		(0.006)		(0.003)		(0.007)
EBIT_ASS		-0.003^{**}		-0.006^{***}		-0.010^{***}		-0.003^{***}		-0.001^{***}		-0.005^{***}
		(0.001)		(0.002)		(0.002)		(0.001)		(0.0003)		(0.001)
MTBV		-0.005**		0.0002		-0.004		-0.001		0.0001		-0.001
		(0.002)		(0.002)		(0.003)		(0.001)		(0.0004)		(0.001)
BETA		0.0005		0.002		0.003		-0.002**		0.0004		-0.001
		(0.002)		(0.002)		(0.003)		(0.001)		(0.0003)		(0.001)
VOLATILITY		0.140		0.252		0.474		0.159		0.008		0.217
		(0.793)		-1.004		-1.299		(0.351)		(0.166)		(0.382)
TREND		-0.000^{**}		0.000^{***}		0.000		0.000		0.000^{***}		0.000^{**}
		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)
Constant	-0.012		-0.012		-0.014		-0.054^{**}		-0.015		-0.053^{**}	
	(0.086)		(0.076)		(0.096)		(0.024)		(0.013)		(0.027)	
Observations	887	874	861	849	851	839	998	874	972	849	962	839
R2	0.456	0.466	0.048	0.097	0.311	0.350	0.295	0.315	0.068	0.110	0.269	0.314
Adjusted R2	0.449	0.455	0.047	0.077	0.310	0.336	0.294	0.301	0.067	0.091	0.268	0.299
F Statistic	733.594^{***}	93.307^{***}	43.575^{***}	11.152^{***}	382.540^{***}	55.275^{***}	416.225^{***}	49.248^{***}	70.395^{***}	12.855^{***}	352.547^{***}	46.951^{***}
Note:												$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

7.5. Firm Specific Emissions Regression

Table X3: Firm specific Estimations

	Dependent Variables:					
	Lead(Dividend Payouts)		Lead(TSR)		Lead(SR)	
	(1)	(2)	(3)	(4)	(5)	(6)
tf_idf	1.105***	0.951***	0.287	0.228	0.280	0.341
	(0.329)	(0.333)	(0.373)	(0.383)	(0.419)	(0.428)
SCOPE_1_REV	1.288***		0.343		-0.824	
	(0.400)		-1.250		-1.404	
SCOPE_2_REV		10.822*		3.759		-3.314
		-6.202		-3.136		-3.500
log(Assets)	1.090*	0.913	0.549	0.705	0.755	0.462
	(0.650)	(0.631)	(0.720)	(0.738)	(0.809)	(0.824)
CORP_LEV	0.032	0.027	-0.015	-0.020	0.056	0.051
	(0.040)	(0.040)	(0.048)	(0.048)	(0.054)	(0.054)
EBIT_ASS	4.593**	5.708***	6.929***	7.063***	-1.208	-3.290
	-2.193	-2.199	-2.249	-2.419	-2.527	-2.700
MTBV	0.074*	0.070*	0.075**	0.074**	0.055	0.056
	(0.038)	(0.038)	(0.036)	(0.037)	(0.041)	(0.041)
CAPEX	-0.848***	-0.427	-0.548**	-0.563**	-0.727***	-0.460
	(0.272)	(0.269)	(0.241)	(0.264)	(0.271)	(0.294)
Observations	581	569	850	824	850	824
R^2	0.056	0.042	0.023	0.021	0.018	0.013
Adjusted R^2	0.030	0.014	0.004	0.001	-0.001	-0.006
F Statistic	4.818***	3.432***	2.785***	2.457**	2.141**	1.536
Note:						*p<0.1; **p<0.05; ***p<0.01

Variable	Definition	Source
Risk	Tf-idf of risk definition from IPCC as benchmark against SEC 10K Documents	EDGAR.gov and IPCC Glossary, 10-K filings, self-calculated
Bigrams	Sum of non-articles, non- discursive bigrams in 10-K filings	EDGAR.gov, 10-K filings, self-calculated
Emission Intensity of Revenues	Direct (Scope 1) + Indirect (scope 2) Divided by Earnings after taxes and interests	DataStream
Assets	End of the Year total assets	DataStream
CAPEX%	Percentage of Capital Expenditure over end of the Year total assets	DataStream
Corporate Leverage	Ratio of the sum of short-term and long-term debt over Assets	DataStream
Returns on Assets (ROTA)	Ratio of company's earnings before interest and taxes (EBIT) relative to its Assets	Bloomberg
Q Ratio (Tobin's Q)	Difference between common equity and preferred stock capital at the end of the year divided by the equity market value at the end of the year.	Bloomberg
Total Stock Returns	Yearly percentage variation of Equity price while considering dividend payed	DataStream
Dividend Payout Ratio	Percentage of net revenues given to shareholders	DataStream
Stock Returns	Percentage annual variation of stock prices	DataStream

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