EXCESS RETURNS OR EXCESSIVE RISK?
ENVIRONMENTAL IMPACT IN THE AGE OF NEWS OVERLOAD

A Thesis

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Cale Steven Harrison

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ABSTRACT

If the impact of positive environmental announcements on corporate valuations is positive markets can provide a vital mechanism through which to address climate change, plastic pollution, and fertiliser runoff. Thus, this thesis looks at this impact of positive environmental actions on large UK corporations 2011-2019, via several event studies. There is also analysis of the likely role of institutional investors, selection bias and new entrants to the FTSE 100. The key finding is that the announcement of new environmental initiatives leads to a positive, statistically significant, and economically material 0.6% abnormal weekly return. Several other types of positive environmental news are found to be undistinguishable from non-events. This provides a more nuanced and asset pricing consistent understanding than much of the existing literature.

BIOGRAPHICAL SKETCH

Cale Harrison was born in King's Lynn, Norfolk and is the oldest of 13 siblings. He graduated from Royal Holloway, University of London in 2016. After several years of working in finance he decided to pursue a master's at Cornell to be able to produce his own research and experience American culture.

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1 Introduction

The past decade has seen a global shift towards Environmental, Social and Governance based investing (ESG), which in this thesis is used interchangeably with environmental factors more specifically. This thesis looks to quantify the impact of this newfound interest in ESG investments by impartially and empirically evaluating the stock market response to four different types of positive ESG news, in this case environmental news specifically. Environmental news is important as it is how companies signal their commitment to the environment and it is closely followed by investors.

This thesis improves upon the existing UK literature by better reflecting the informational content of news stories, which enables a more nuanced understanding of the impact of positive environmental actions.

This paper clearly identifies that there is a robust stock market response to the release of environmental news, dependent on the type of news. Previous literature which does not distinguish by type is likely underestimating the impact of, and market response to, positive environmental news. Once this result has been positioned in the literature and these implications discussed, there is then analysis on the likely robustness of this result and how to further strengthen it.

In addition, the paper adds to the literature by incorporating institutional ownership as a variable, which thereby demonstrates the ESG impact of the shift to passive investing over the past decade.

In addition to the academic contribution, there is a broader conversation to which this thesis contributes. By establishing the valuation impact of different types of ESG behaviours, this paper hints at where policy can have the greatest impact and shows several counterintuitive aspects of ESG outcomes.

Overall, this paper adds to the literature about two of the biggest changes in investing over the past decade and has the social benefit of showing the impact of environmental actions on firm valuation.

2 Literature review

2.1 ESG impact on returns

A common way to find the causal impact of an event on stock returns is an event study, which compares the actual result (treatment) with an estimated counterfactual. In this case the treatment is an environmental action by a firm and the time periods are fixed length intervals before and after the treatment. Although various methodological improvements have been made since, much of this literature relies upon (MacKinlay, 1997). Most of the following papers build upon their methodology.

The dependent variable is usually the residual compared to a factor based regression, such as Fama & French (2015)**.** This approach reduces omitted variable bias by incorporating firm characteristics. The rest of this section discusses papers which take this approach.

Let it be taken as a given that corporations make environmental decisions for ethical and moral reasons as well as potentially aiming to maximise share price. This flows naturally into the question of whether information about and actions driven by ESG do impact share price.

The literature looks at this from several different angles, including both positive changes, like the ESG awards and initiatives discussed by Lo and Kwan (2017) and negative changes, like the lethal chemical spills discussed in Cappelle-Blancard and Laguna (2010).

Lo and Kwan (2017) call out the diverse ways to classify ESG innovations and it is instructive to briefly review some of the papers they mention when doing so. Gilley et al (2000) split ESG actions into "process" driven and "product" driven, where product is specific to a product line and process is across the entire business. They go on to argue that process changes have no stock impact, but product changes have much more of an impact.

Given the modern shift to a more service-based economy, one could argue that this more manufacturing based split is no longer as appropriate. It seems arbitrary as to whether, for example, a bank changing their lending criteria is a process or a product change.

A more replicable way of classifying actions can be seen in Jacobs et al (2010), which utilize two categories, one being what they call "environmental awards and certifications" and the other "corporate environmental initiatives." This is a clear and replicable way to partition the sample and they subdivide further as well, but not explicitly by newness of information. This variable is omitted from their paper and is most likely why they find few statistically significant results, as this is a vital methodological improvement to improve the statistical power of the estimator. This paper also used one tailed statistical tests, which reduces the threshold to find statistical

significance in the direction of interest, but requires deciding which way the event will impact returns.

There is also an entire subgenre of papers focussed solely on the impact of corporate disclosures such as Clarkson et al. (2013), Cong et al. (2020) and Metcalf et al. (2016). They skew towards being sector-specific and using US returns data, and as such there seems to not be the level of data sharing needed to do these studies with E.U. data. The focus of this subgenre is usually on high polluting sectors, such as paper companies, which is logical given the data is from regulators but reduces their generalisability to other sectors. It is also questionable whether this approach works for CO2, given that it is currently almost impossible to attribute indirect emissions (so called scope III) at a company level, especially in the U.K.

One innovative aspect of this sub-genre, however, is the success with which these papers link ESG performance to cost of capital. This seems a fruitful approach pertinent to the perennial divestment versus engagement debate. It seems there is potentially a clear mechanism linking cost of capital with ESG decisions, which has the potential to be explored further in future research.

Homing in on broader firm valuation, there are different dependent variables, which can be used. Tobin's Q is popular amongst the broader ESG literature, as seen in Li et al. (2018) and Albitar et al. (2020). This variable is defined as the "simplified market-to-book ratio" by (Bartlett & Partnoy, 2018) and, taken at face value, seems a reasonable way to value the intangibles of a firm. However, given the recent debate around the use of Tobin's Q as a variable it is somewhat surprising that there is still a literature around this metric. There are concerns that Tobin's Q is "mean reverting" and

"likely to produce biased estimates" (Bartlett & Partnoy, 2018). Most papers attempt to overcome this by adding many controlling variables, but this approach does not necessarily address the mentioned omitted variable bias. The argument that this leads to the oversampling of firms which choose to report is rarely rebutted. Li et al. (2018) use a 2SLS to control for endogeneity, but this does not necessarily control for the relationship between Tobin's Q and return of a firm being mean reverting, as mentioned.

Therefore, another approach is to build portfolios based around differences in ESG ratings, as done in Humphrey et al. (2012). Empirically this is a well-established methodology, as there are a variety of well-known methods to control for the biases of the portfolio, e.g. factor-based investing, as per Fama and French (2015). The issue with this approach is that ESG ratings tend to focus more on disclosure than impact, especially during the sample period of Humphrey et al, which is 2002-2010. As such this research design is best viewed as focussing on third party recognition and reports rather than future focussed statements. More generally portfolio-based papers struggle to deal with events which happen at different points in time and of different types of magnitude.

Nonetheless, it is a notable addition to the literature that the paper "find[s] no evidence of a difference in the risk-adjusted performance of portfolios comprising firms with high and low [ESG]" (Humphrey et al., 2012).This strongly hints that a different identification strategy is needed to find the causal impact of ESG, if any and this is a paper which will be further discussed.

Whilst much of the scholarship discussed thus far examines 'positive' ESG actions, it is essential to briefly compare these theories with 'negative' ESG outcomes

and see if the same research design works. Papers which assume a positive or negative impact often use a one-tailed test statistic, thereby changing their identification strategy and to some extent eliminating the possibility of counter-intuitive findings.

Capelle-Blancard and Laguna (2010) look at some rather negative environmental outcomes, namely workplace chemical explosions. As to be expected, there is a detrimental stock market impact following such an extreme event, with the study finding "shareholders suffer a significant loss of about -1.3% over the two days following a disaster" (Capelle-Blancard & Laguna, 2010). This paper was innovative at the time, but there is one area in which it could be improved: The authors use a T distribution as their test statistic and thus are implicitly assuming normality of returns, which likely skews their results given the well-known conditional kurtosis of stock returns. However, one aspect of Capelle-Blancard and Laguna's paper that has aged well is their insistence on including information from the news reports, e.g. deaths. There are many modern papers which neglect to capture additional aspects of news events, beyond simply their having occurred.

Hoang et al. focus on how institutional owners react to negative ESG incidents and identify that "institutional investors are responsive to and informative of" negative ESG incidents (2019). The main contribution of this paper is showing how to run an event study including institutional ownership as an independent variable. Their use of the Ancerno dataset is a unique advantage, as it means that the authors analyse trades as they happen rather than relying on somewhat quarterly filings. This dataset also enabled them to calculate a more useful metric than the overall institutional ownership level, institutional ownership flow.

By comparison, the next paper is counterintuitive, in that it empirically shows that "Voluntary carbon disclosures are deemed by investors to have a negative value" (Alsaifi et al., 2020). There is also some discussion of whether this constitutes 'greenwashing' or using disclosure to moderate/hide negative or lacklustre ESG outcomes. The data for this paper is innovative but including the 2008 data somewhat weakens their overall argument. They state that the impact of the 2008 recession is picked up by the statistical tests, but that is a contentious statement. The simulation based approach in Chen (2014) shows that for a 2008 scale crisis the conventional modelling approach overestimates significance and, as such, Alsaifi et al. (2020) should have used more sophisticated statistical tests or simply excluded that portion of the sample, as done in Wang et al. (2019). Alsaifi's not doing so makes the paper's extensive discussion around ESG in times of crisis less convincing than it otherwise could be, had it addressed concerns around shifting variance.

More qualitatively, the way Alsiaifi et al positioned their findings as being a clash between the Porter vs Friedman hypotheses clearly positioned their finding against the broader literature. These hypotheses on the financial impacts of ESG, referenced later in the thesis, are particularly meaningful in the context of information disclosure, as they provide a lens through which to interpret managers decisions as to whether to release ESG information or not.

Lastly, Wang et al. (2019) contributed to the literature by splitting positive ESG decisions into four different types. This overcomes the issues around newness of information identified in Lo and Kwan (2017), and also enables the use of multiple test statistics to overcome potential econometric issues. As is often the case in the equities

literature the paper uses US data which raises the question of whether the results hold more generally, especially given the lack of survivorship bias free data outside of the US. This means that there is a clear gap in the literature around the UK impact of ESG and especially when it comes to studies which also focus on the new information content of ESG news releases.

2.2 Impact of institutional ownership on returns

There is a lively debate on the likely impact of institutional ownership, going at least as far back as Keynes (1936). The literature gives the impression that prior to the 90s there was not sufficiently granular data for the impact on returns to be an empirical question, such that was more of a theoretical slant, as seen in Nalebuff and Stiglitz (1983), or they only looked at the largest institutional holdings, such as Klemkosky (1977) or Demsetz and Lehn (1985), which is likely the case due to the wave of corporate takeovers at that time. These takeovers often seemed to hinge on large shareholder votes. There is probably a generational difference here in that contentious boardroom votes are more or less a thing of the past, being more skewed in the board's favour now. As seen in Bach and Metzger (2019), one would expect the impact of the largest shareholder to be similarly dampened.

In the 90s, as the proportion of assets owned by institutions increased so did the volume of empirical literature on institutional ownership. Particularly impactful to the subsequent literature were Lakonishok et al. (1992) and Gompers and Metrick (1998).

Lakonishok et al. (1992) focus on two phenomena: herding and positive feedback trading (elsewhere called momentum trading). Positive feedback trading "implies that market participants buy (sell)… in response to previous price increases

(decreases)" (Salm & Schuppli, 2010). It could be argued this is more of a corollary that follows from liquidity constraints requiring the unwinding of positions, rather than being a phenomenon in and of itself, this view being informed by both Brunnermeier and Pedersen (2009) and the various fire sales of 2008, which were of course negative feedback trading.

Regardless, Lakonishok et al. (1992) contribute to the literature in several ways. They specifically examine the impact of pension funds, with the argument that by comparing the same type of institution one is more likely to find evidence of correlated behaviour (herding). Note that this argument was also advanced in Ashok et al. (2013), who demonstrated a large correlation in the percentage change of allocation to stock of pensions across OECD countries. Lakonishok, et al. report the opposite conclusion by arguing that there was little to no evidence of either herding or feedback trading. Though they do find an inconclusive price impact of institutional trades, which they characterise as "no consistent evidence of a significant positive correlation between changes in institutional holdings and contemporaneous excess returns, except… small stocks" (Lakonishok et al. 1992). Given this, the key contribution of this paper can be seen as methodological, as it provides models through which to identify the existence of herding and/or positive feedback trading by institutions. Their finding against price impact has been since challenged as shown below with more recent papers.

It is perhaps worth noting that the paper above is implicitly assuming that either institutional investors all behave the same as pensions or as a whole they display enough heterogeneity that their overall price impact cancels out. Is this accurate? Probably not, as pensions have fairly unique concerns around longevity risk, duration risk, stricter

regulations[1] than other institutions and comparatively less of a focus on stock-picking/active investing. There is also a broader philosophical question around whether this is an assumption trivial enough to make without evidence, although they are not unique in doing so. A second question that then follows is do institutions desire different asset characteristics to individual investors? Individual investors are at times closer to gamblers than rational participants as shown in Kumar (2009) and more colloquially by the emerging trend of Robin Hood 'traders'.

Gompers and Metrick (1998) argue that there is a difference in desired characteristics by investor type and it leads to a price impact, directly contradicting Lakonishok et al. (1992). In contrast with Lakonishok, the size/breadth of their dataset (all institutional asset holders over $100M assets under management, for 1980-1986) enables them to provide more conclusive evidence than those only considering one type of institution. Gompers and Metrick show that institutional ownership "forecasts future returns … evidence suggests that inflows to institutions increase the demand for stocks with preferred characteristics, and that this increased demand drives up prices and returns."

They identify this by taking a weighted least squares with returns as the dependent variable and then using one of the previously mentioned genre of market model papers to control for correlation of residuals, in this case Fama and MacBeth (1973). This enables the authors to tease out predictive power in a way that otherwise would not be feasible. There are also various regressions to attempt to determine whether the effect is due to "smart institutions" or a more general flow of funds impact,

[1] At least in the UK and Europe, one would assume in at least some US states as well

such as that observed when a stock is added to an index. There is not a compelling result in either direction, so this debate instead informed the subsequent search for papers.

Overall the paper is fairly exhaustive in examining implications and counterarguments against their findings. Perhaps their most cursory defense is their argument against short sellers having an impact, although overall there is little systematic coverage of the impact of short sellers on the returns of institutions so far within the literature reviewed. This is a clear gap, as there are applied papers showing short sellers have an impact, especially in developing markets per Bohl et al. (2012) and Sobaci et al. (2014), but also in the U.S., as seen in Huszár et al. (2017). It also seems like an oversight that there is little literature around the transition of mutual funds from being long only (no shorting) to a growing proportion taking a hybrid approach, where they take both long and short positions.

This gap aside, Metrick and Gompers' influence on this strand of literature is hinted at by how regularly their paper is cited in subsequent studies. Having examined some of these older papers, it is logical to now show that this is not merely some transitory effect from the explosion in institutional ownership last century.

Firstly at the international level there is some evidence that institutions can shift the importance of the relative factors which determine returns, between sector effects and country level effects. This at least is the argument made in Faias and Ferreira (2017). Looking at a sample of 1300 firms across 46 countries and 17 aggregated industries, the authors then estimate a dummy model for the relative importance on returns of both sector and country, with institutional ownership as an independent variable. They also hint at a need to consider the proportion of foreign vs domestic institutional ownership.

As appears to be the standard trade-off, because the authors are using an international panel they use annual ownership data, meaning these results are perhaps marginally less conclusive than those derived at a domestic level, although as ever there is an opposite impact from the increased sample size. Perhaps due to these data issues, they also fail to establish causality, which seems to be a trend with these more macro type papers, which get as far as establishing correlation, but are often short of causality.

In general, whilst this Faias' paper is well justified by the existing literature, the overall research design seems to be flawed. It raises the question more generally if multi country regressions are an effective tool for this area of economics, especially given the extensive economic linkages between the stock markets of different countries. Perhaps a better experiment design would have been a metastudy, as done for Ricardian equivalence in Stanley (2001) or, perhaps more relevantly, for firm size and stock returns in Astakhov et al. (2019).

A paper which looks at a more micro level for identification is Gao et al. (2015), who examine if returns are predictable for firms which are "from different industries with no customer-supplier linkages (economically unrelated stocks)" but which share institutional owners. Given there is an unexplained returns anomaly they are implicitly saying institutional behaviour is leading to excess returns. They demonstrate this by constructing portfolios according to this principle and are able to show excess returns, although it is difficult to see how, as they argue, this is "not a pairs trading strategy."(Gao et al., 2015)

To predict returns they then use an event study approach, e.g. looking at the cumulative abnormal returns before and after an event and then attributing the difference

to the event. That is a prevalent approach, but the key contribution of their paper is to add an additional layer of sophistication. The authors regress these returns against those of the unrelated stocks to then show that there is a degree of predictability between them, based on the shared institutional ownership. This is an interesting approach, because it combines micro foundations, a large amount of data and an intuitive model. One nonobvious aspect of the paper is whether this is primarily driven by similarities around earnings season, or a more general relationship due to homogeneity of individual institutions investment strategy. Quantitatively they find more evidence of there being an end of month/quarter effect, suggesting a link to earnings season.

Looking further back in the literature, Dasgupta et al. (2011) used similar data to show an impact in the opposite direction, but did not account for economic linkages. They found that "persistent institutional trading negatively predicts long-term returns," which contradicts many other studies who have found the opposite. In what seems to be a theme throughout the literature, they saw an effect most concentrated in smaller stocks, which it is worth noting were excluded in Gao et al. (2015), therefore the two studies do not necessarily directly contradict each other, in that Dasgupta et al. (2011) are using a broader sample. Regardless this shows potential sensitivity of findings to the research design.

Lastly, many of the papers examined use quarterly data. This is due to SEC rules requiring institutions with over $100M AUM to file a quarterly 13F form of their ownership holdings. This is the data source for almost every American centric paper in this review, whether noted explicitly, e.g. where they reference 13Fs or implicitly, which is where they have mentioned using Thomson Reuters or the Factset datastream.

Given the potential concerns around data frequency, it is useful to evaluate what using monthly ownership data looks like. A paper which does so for the Taiwanese stock exchange is Chuang (2020), who builds upon the model of Dasgupta et al. (2011) to study both the short and long term impact of institutional ownership on prices. Lakonishok et al. (1992) is also used as a heuristic way to provide a control variable for herding behaviour. Notably, Chuang uses their findings around ownership to construct a portfolio outperforming a momentum strategy in that market, which presumably is a fair comparison to a strategy taking advantage of price impacts.

Thus, the general sense from the literature is that institutional ownership demonstrably has an impact on asset returns. In which direction depends on which areas the research design controls for and which market is being examined. The impact at a global level is less clear due to the data frequency being too low to have any statistical power.

Taken together the two subsections of the literature demonstrate both evidence for an ESG impact on returns and an evidence base for the inclusion of institutional ownership, if not a firm steer for the preferred model specification. This lends itself to the argument that institutional ownership is an omitted variable. Furthermore, there is a clear absence of literature doing so in a UK context, suggesting a need for further literature in this area.

2.3 Hypotheses generation

Based on the literature, several gaps emerge, which this paper aims to address in a British context. Much of the existing literature does not sufficiently condition on

the new information content of ESG actions, which is in effect an omitted variable bias, if a latent one. This thesis will build upon the information-based approach used in Wang et al. (2019), which entails dividing ESG actions into four different types, based on the likelihood of said ESG actions containing new information. These four types will be discussed further in the methodology section.

This paper will also build upon the analysis of institutional ESG investing in Hoang et al. (2019), although instead of looking at negative ESG incidents, this thesis will look solely at positive ESG news.

This is being done to test four hypotheses:

H1: We hypothesise that for positive ESG news overall, only new information influences stock price.

From the efficient market hypothesis (EMH) one would expect all readily available information about a firm to be incorporated in the stock price- especially for the large firms this thesis looks at. This is as "smaller firms tend to be less closely followed by analysts" (Jacobs et al., 2010). As such it would be paradoxical if ESG news with little new information was sufficient to lead to an excess return, as some existing papers assume.

H2:Announcements, which consist of new information and have a large financial impact have the strongest market response of the four types of ESG news.

The argument for this is that reducing environmental impact can often reduce costs and announcements are by definition new information. Recognitions also consist of new information, however they reward past performance instead of future plans and

as such likely have less of an impact. Recognitions having little impact is in line with the existing literature, such as Lorraine et al (2004).

H3: Institutional ownership is an omitted variable, which when included will lead to a more statistically significant market reaction to ESG news

This controls for inattention from retail investors, which is widely documented, see for example discussion in Barber and Odean (2008). The argument that institutional investors are more engaged with ESG issues is informed by the observation that "institutional investors are actively involved with companies in combatting the problems from climate change." (Krueger et al., 2020). The same survey goes on to state that "55%" of institutional owners responded, "already today" there is a "material Regulatory climate risk". It therefore follows that an increase in the proportion of a company's shares owned by institutional investors impacts the response to ESG news. Given the model specification the expectation is that this will lead to an increase in significance.

H4: ESG reports[2] have a positive market response, as more ESG data is rewarded by the market.

This hypothesis is primarily driven by ESG reports now being more standardised. As a result it is likely that there is now less greenwashing of the type seen with optional/bespoke reports such as Metcalf et al (2016) for the US and Alsaifi et al (2020) for the UK. From a more applied standpoint, the UK has mandated environmental disclosure for the companies in this sample since 2013, "Quoted[3]

[2] Report as in the release of an ESG report, not reporting on ESG news as in H1
[3] Same meaning as listed

companies… are also required to report on environmental matters" (HMG, 2019). It stands to reason that this would change the UK response to environmental reporting compared to both the previous literature and the US.

3 Data collection

This thesis looks at the impact of positive ESG news on FTSE 100 firms 2011-2019. The data collected covers both firms which were in the FTSE 100 in 2011 and those which were in the FTSE 100 in 2019.

The FTSE 100 is an index comprising of the largest 100 firms listed on the London Stock Exchange by market cap[4]. Firms enter and exit based on their market cap ranking on a quarterly basis, which leads to some churn around inclusion in the index. The list of firms in the sample are the same as those that were in the index in 2011 (for section 5.1) and the firms which were in 2019 (5.2& 5.3). Positive ESG news is defined as news about a company's Environmental behaviour/plans, Social and Governance news items were not collected.

3.1 Qualitative data collection process

To gather qualitative data on news events, one followed broadly the same data collection process as (Wang et al., 2019), however using a different software due to it having a greater number of British stories. The events were collected on "Newsbank" a software which is similar to LexisNexis, but seems to have better UK sources and as such gives both more and more relevant results for UK companies.[5]

For each firm in the sample, data collection consisted of searching for all three of:

[4] Not referenced, as common knowledge/discussed elsewhere in paper

[5] For each results page collection stopped on page three as this often seemed to be the point where results became irrelevant. It is also worth noting that for some firms the stories duplicated, e.g. for BP there was extensive coverage of the Deepwater Horizon incident and the resulting legal cases. This meant that if one would have reviewed the full search results it would entail reading several hundred headlines mostly on the same incident and with no information content.
Using a concrete stopping rule also means that one can go back and gather more news stories if needed, which is now relevant for collecting the survivorship bias free data sample.

{Company name} +environmental stewardship

{Company name}+environmental responsibility

{Company name}+environment AND sustainability

Once a relevant news story was found, it was allocated one of four types, by newness of information and expected financial benefit as per Wang et al (2019).

Table 1 Types of news

Type	**Newness of information**	**Expected financial benefit**	**Working definition**
Announcement	High	High	A firm announces forward looking ESG plans
Action	Low	Low	A firm provides an update on progress towards a previous ESG announcement
Report	Low	High (Differing from Wang et al)	A firm reports on their ESG on a firm-wide basis
Recognition	High	Low	A firm receives a third-party award or certification due to their ESG performance

3.2 Quantitative data collection process

Several data sources were combined and compiled to enable the testing of the hypotheses provided.[6] Yahoo finance[7], Eikon[8] and Bloomberg[9] were the main data sources. Given the extensive amount of data needed, Yahoo Finance was the primary source for the daily returns data, the benefit of doing so is that they have no limit on the amount of data one can gather. The limit on taking data from Bloomberg is around 250k datapoints and the amount needed was close to that number. Eikon returns were used where the firms being looked at were now delisted, this is because Yahoo does not retain data on delisted firms, Eikon does.

It is noteworthy that the market return discussed throughout currently refers to the equal weighted FTSE100 index, not the standard FTSE 100 which is weighted by stock value. The reason for this is discussed further in the methodology section.

This paper also utilises Bloomberg for the institutional ownership data, which is on roughly a weekly basis, but with some evidence for quarterly filings in addition. This measures institutional ownership as a percentage of outstanding shares. [10]

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[7] Yahoo finance provides London Stock Exchange data, which is sourced from ICE Data services, per (*Yahoo Help*, 2021). In addition to the standard suite of stock trading data they also provide news, financial reports, and company profiles. Their primary focus is equities, with a limited offering in fixed income.

[8] Formerly Reuters 300, Eikon provides point-in-time data as experienced by market participants. Several million assets are covered across a range of asset classes and countries, including: "equities, bonds, commodities and mutual funds" (*Refinitiv® Datastream®*, 2020)

[9] The Bloomberg terminal is hardware/software which provides access to a broad range of asset data, news and industry research. It covers "fixed income to equities, to foreign exchange, commodities and derivatives" (Bloomberg Terminal, 2021). It also provides tools for back testing, portfolio creation and algorithmic strategies.

[10] It has the rather disconcerting property of often adding up to over 100%, mainly because short selling can be counted for both participants, once for the short institution and once for the long institution.

3.3 Returns data availability

Next, this paper will examine missing stock returns datapoints. These can exist due to several reasons, stocks can be delisted, trading in a stock may be temporarily suspended, or the stock ticker may have changed.

This is a slight overestimate as this estimate is not yet controlling for survivorship bias- this has a documented price impact implying the need for a control variable. This is because inclusion in the index can change quarterly, essentially in a manner similar to a football club moving down a league. This means that we still have price data for them, but they are more accurately a FTSE250 firm once they have fallen out of the FTSE100. This is different to the US as the UK calculates indexes only by market capitalisation FTSE (2020). It is therefore odd that there is a price impact to entering/leaving the FTSE 100, as seen in Fernandes and Mergulhão (2016), given it really is not difficult to calculate who is about to exit and enter the index. This is therefore a clear example of rational expectations not being reflected in pricing.

Regardless, we have full daily returns data for over 80% of firms currently in the index for the Yahoo data. For the Eikon data a similar amount of data was available. In the Yahoo instance, some firms only have data from when they entered the index, for Eikon the only firm which had no data was RBS, due to some sort of ticker clash.

3.4 Selection bias

There is a degree of selection bias in parts of this thesis, due to what is commonly called “look ahead bias” (Daniel et al., 2008). This is because the sample in parts is based off membership in the FTSE 100 at the end of the sample period.

There are two ways in which this is mitigated. For section 5.1, Eikon data is survivorship bias free. Returns data on the 40% of companies which left the FTSE 100 over the ~9 year period is included in section 5.1. When these two actions are combined it is shown in the robustness checks section that this effectively completely eliminates any selection bias in the sample and by extension the regression.

Therefore, the rest of this section solely concerns section 5.2 and 5.3, both of which include a fixed effect for new entrants to the index. 60% of the sample were in the FTSE 100 throughout the entire sample period, such that there needs to be a fixed effect added for new entrants to mitigate any upward bias due to entering the index. The fixed effect controls for any selection bias in missing data for institutional ownership. The reasons why this is a reasonable approach will be explained below.

If we were looking at S&P 500 companies this approach would be inadvisable, however there is a vital distinction between S&P 500 and FTSE 100 companies: objectivity. Being added/demoted to the S&P 500 is fundamentally a commentary on the underlying company as the inclusion committee considers the likely prospects of the company, which means there is likely a greater selection bias when using the S&P 500 index, or some subset thereof.

By comparison, FTSE 100 inclusion (exclusion) just means that the firm's market cap has reached (fell below) ~100th place in the London Stock Exchange[11]. There is a similar criteria to be included in the next 250 smaller companies (the FTSE 250) as

[11] It is slightly more complex in practice, but this is the basic idea. In reality there is a relegation and promotion 'zone' similar to a football/soccer league, but it is still based around market cap. There are also some minor disclosure requirements to prevent illicit entrants, but they are negligible for companies who respect basic human rights.

well. As such inclusion in the FTSE 100 should induce less of a survivorship bias than what one would see in a similar research design using the S&P 500.

Lack of data availability for deletions and inclusions from indexes is such an issue that even papers on the bias, such as Daniel et al. (2008) use proxies in lieu of the actual S&P 500 data.

This view that FTSE 100 inclusion or otherwise should not be material long term is discussed by papers such as (Mase, 2007) who state "As a result, these changes should have absolutely no information content." Given they ultimately conclude otherwise, this bias needs to and is controlled for, here with both a fixed effect and, separately, survivorship free data.

In general this is a common issue in the literature, given the reliance on Bloomberg data, as Bloomberg often does not retain data on delisted firms and 'recycles' tickers. This bias is therefore likely present in papers such as Liu et al. (2012) who use a similar research design, use Bloomberg data and do not explicitly mention any type of control for this bias

Also, if there ever was a long run index effect, one would reasonably expect it to now be arbitraged out of existence. In line with the EMH, there is extensive evidence for equity market anomalies either reducing/vanishing once published in the academic literature, papers on this topic are many, but include: Mclean and Pontiff (2016) for US, Becchetti and Cavallo (2000) for small-cap UK and Chordia et al (2014) who focus more on "the decline in anomaly profits," but by relying on published anomalies are effectively discussing the same. This means that one would have to argue that an

anomaly has been known for 20 years, but can still be effectively traded on, which seems unlikely.

If this thesis looked at smaller firms it is distinctly possible that these types of anomalies could persist as detailed in (Lamont & Thaler, 2003). The argument against that being the case here is that the sample consists of some of the largest companies on the London stock exchange e.g. not thinly traded and there are no short selling restrictions, which seem to increase the odds of persistent anomalies per Lamont and Thaler. The sample of firms is also large enough that individual firm level anomalies are less of a concern.

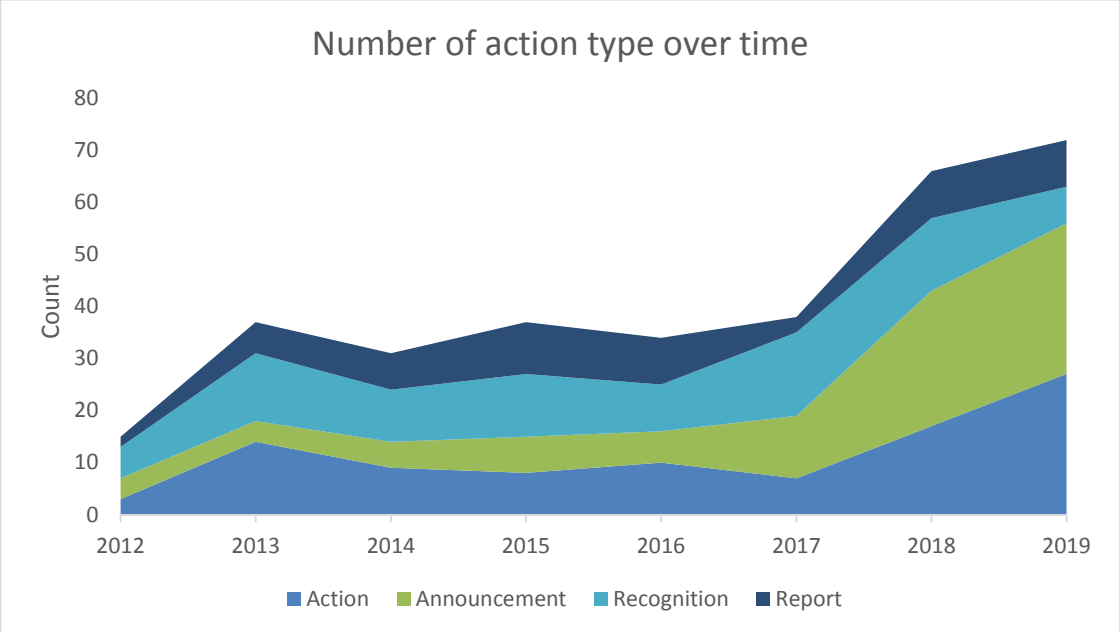
Furthermore given the overall complexity of this topic, one is inclined to agree with those who argue that "there is a serious limitation to studies that suggest a long-short strategy involving trades between the portfolios of additions and deletions."(Afego, 2017). The authors argue this due to the pretty inescapable issues around trading in firms which, in some instances, are about to go bankrupt.

As such this thesis is cautious and takes an agnostic view. Survivorship free data is used to be certain there is no selection bias. Given this requires not considering any new entrants to the FTSE 100 over the past decade, a fixed effect is used on a different sample of firms, which allows for the paper to also include new entrants to the index. Furthermore, this approach allows for the inclusion of institutional ownership as a variable, because there is limited survivorship free data on institutional ownership.

3.5 News data

Next, it is best to look at the simple count of news items by year, as shown in the below graph. This gives an idea of the distribution in time of the events and shows that the number of events per year has almost quintupled since 2012.

Figure 1 Actions over time



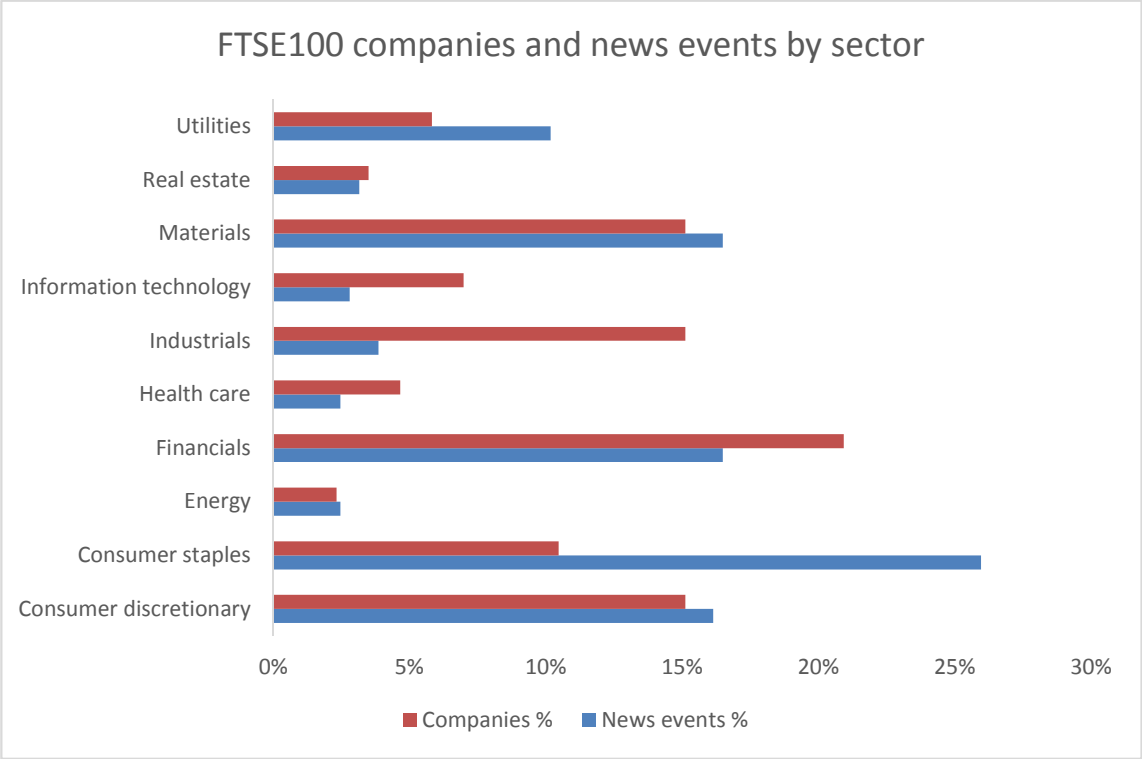
Clearly, the uptick in numbers has been driven primarily by an increase in actions (blue) and announcements (green). This intuitively makes sense given the dramatic rise of ESG investing and the overall increase in attention to climate change in particular.

On the topic of consumers, is it possible that there is some skew in coverage of these events, for example towards consumer-focussed companies? There is some evidence of this in the chart below, but it is important to note that for banks in particular the word "environment" tends to bring up discussions of the interest rate environment, this likely accounts for their slightly underrepresentation of 'financials' in the sample.

The skew towards 'consumer staples' is mostly due to the excellent environmental actions of the major UK supermarkets and drinks companies. In particular Sainsbury's who invested over a billion dollars in green initiatives over the course of the sampled decade IEMA (2011).

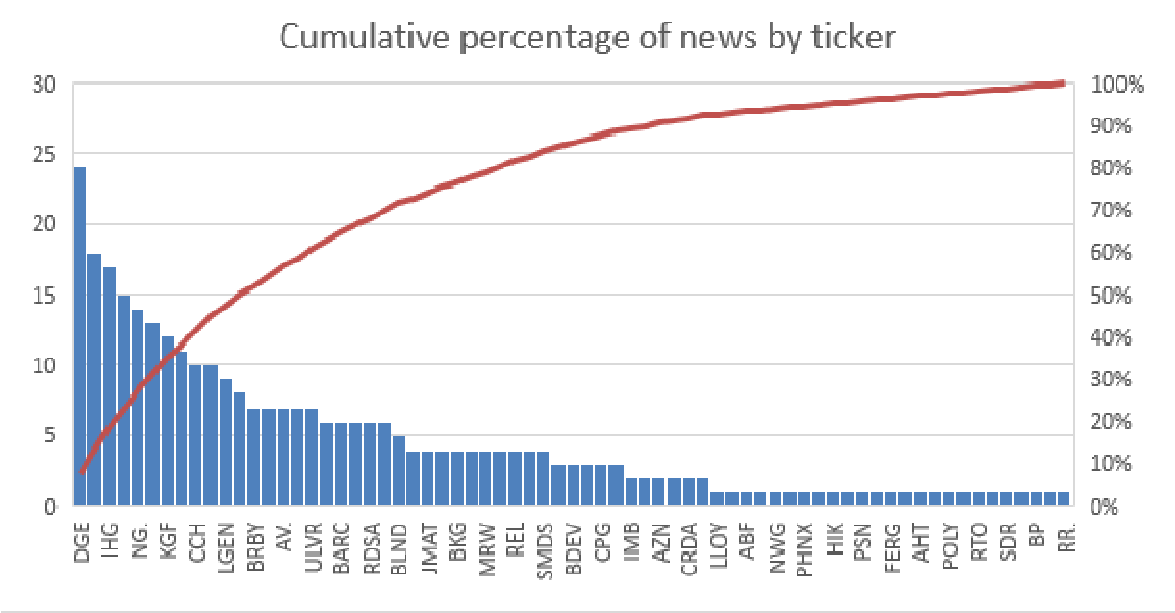
Ex ante, one would expect there to be more of a showing from the consumer discretionary sector as they are likely more conscious of consumer preferences than non discretionary/ non consumer facing sectors. This was unexpected but agrees with evidence from the other sectors, that in general number of news events is proportionate to the number of companies in that sector.

Figure 2 Sector analysis



Lastly, the below graph shows the distribution of news by company. This graph gives some support to the idea of using a company fixed effect, in that there does seem to be different levels of news release. Ultimately this was decided against due to concerns around sample size, especially for those companies which had fewer news events.

Figure 3 Cumulative percentage by ticker



The way to read this graph is that DGE (Diageo) has 24 news articles over the course of 2010-2019. Meanwhile, LLOY (Lloyd's banking group) has 1. Clearly there is some clustering by firm, which is to be expected in the context of non-mandatory corporate actions. If this paper was evaluating the impact of mandatory changes, as for example Alexander et al (2011) who look at the impact of mandatory tax code changes, than this would be more of a concern.

4 Methodology

In the simplest terms, the underlying methodology here is an event study of abnormal stock returns after the announcement of positive environmental news.

Historically this has been done by modelling the relationship between the overall index and its component stocks, e.g. "the market model" from Wang et al. (2019) and

MacKinlay (1997). The methodology equations below are an augmented version of Wang et al (2019). This thesis builds upon their methodology by adding a fixed effect to account for changes in index composition and including the impact of institutional ownership. In addition, there will be both parametric and non-parametric tests run on the results as robustness checks.

Note that the below may change for the IOF variable, as there is an extensive literature around mixed frequency regressions, see for example Andreou et al. (2010) and Armesto et al. (2010). This is relevant as returns are daily and institutional ownership data is weekly, with some evidence of quarterly effects. As such there is an argument to be made for using a rolling average and the below currently assumes that has been done without specifying the length of the rolling average window.

4.1 Regression model

So, what is referred to as the "market model" is captured as follows:

For the survivorship free data, section 5.1:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it}, \quad t \in [-135, -16], \ N = 1,2, \dots, N$$

For the sample including new entrants, section 5.2:

$$R_{it} = \alpha_i + \beta_i R_{mt} + FE_{new} + \epsilon_{it}, \quad t \in [-135, -16], \ N = 1,2, \dots, N$$

For the sample including new entrants and institutional ownership, section 5.3:

$$R_{it} = \alpha_i + \beta_i R_{mt} + Inst_{it} + FE_{new} + \epsilon_{it}, \quad t \in [-135, -16], \ N = 1,2, \dots, N$$

As in Wang et al (2019) R_{it} is "the estimated return of the stock i on day t", theoretically alpha is the risk adjusted return of a risk free asset (e.g. zero), but it is included to control for market distortions, as discussed more fully in Linton (2019). Beta is then the relationship between the stock and the market return. Inst is the level of

institutional ownership of outstanding shares, included to determine if there is a causal impact on returns of increased trading of the stock by institutional investors. FE_{new} is the fixed effect for if a stock entered the sample during the sample period, e.g. is a new entrant to the index.

It is of note that Alpha and Beta are recalculated for each estimation window, such that the Alpha and Beta of a given stock can vary over time, which may be non-obvious from the notation. This is the key reason for not including a company level fixed effect, as it could potentially confound the estimation

The next step treats the estimation of the returns induced by the event as the returns after the event in excess of the market models returns. In essence, for each stock and estimation period assume parallel trends between the behaviour of the stock in the [-135,-16] trading days window before the event and between the week post the event [0,7].

This is defined econometrically as:

$$\mathrm{AR}_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i * R_{mt} - (IOF_{it}) - (FE_{new}) \,, \mathrm{t} \in [\tau_1, \tau_2]$$

Where AR stands for Abnormal Returns. Tau now refers to the start and end period of the estimation windows, as will be seen later these are varied to capture the full dynamics of the entire week following a news item. The variables in brackets are included or excluded depending on whether they were included in the market model for that version.

The cumulative abnormal return (CAR) is captured as follows:

$$CAR_i(\tau_1, \tau_2) = \sum_{t=\tau_1}^{\tau_2} AR_{it}$$

There is then some disagreement in the literature over how to proceed next, given that in practise there is always some degree of correlation between stocks, although often spuriously so. To give a sense MacKinlay (1997) argues for clustering, Linton (2019) argues for assuming "a sparse overlap" and Wang et al (2019) assumes "abnormal returns are independent across securities".

This last assumption is credible in that the sample is the whole of the FTSE100 and covers all industries. It would be less defensible if one were looking at the shared risk of a single sector, for example the rather uncomfortable topic of shareholder response to mass shootings as seen in Gopal & Greenwood (2017) for example.

As such, this thesis assumes independence of abnormal returns. From this one then calculates the average CAR:

$$\overline{CAR}(\tau_1, \tau_1) = \frac{1}{N} * \sum_{i=1}^{N} CAR_i(\tau_1, \tau_2)$$

One then makes assumptions about its normality, which allows the average CAR to be transformed into a test statistic, testing against the null that the news stories have no impact. Assuming that it is symmetrically distributed around 0, with its sample variance, the test statistic theta can be defined as:

$$\theta = \frac{\overline{CAR}(\tau_1, \tau_2)}{VAR\left(\overline{CAR}(\tau_1, \tau_2)\right)^{(1/2)}} \sim N(0,1)$$

Due to the inclusion of fixed effects there is currently a greater focus on the sign test Z_G, this looks at the difference in proportion of negative and positive ARs between the estimation (before) and event (after) window.

First, the measure of skew either way (rho hat) is measured:

$$\hat{p} = \frac{1}{N} * \sum_{i=1}^{N} \frac{1}{120} * \sum_{t=-135}^{-16} S_{it}$$

S_{it} is a binary variable, which tests whether the AR for that prediction is positive or not. The value found for Rho is then used to construct the test statistic Z_G as follows:

$$Z_g = \frac{w - N\hat{p}}{(N\hat{p}(1-\hat{p}))^{1/2}} \sim N(0,1)$$

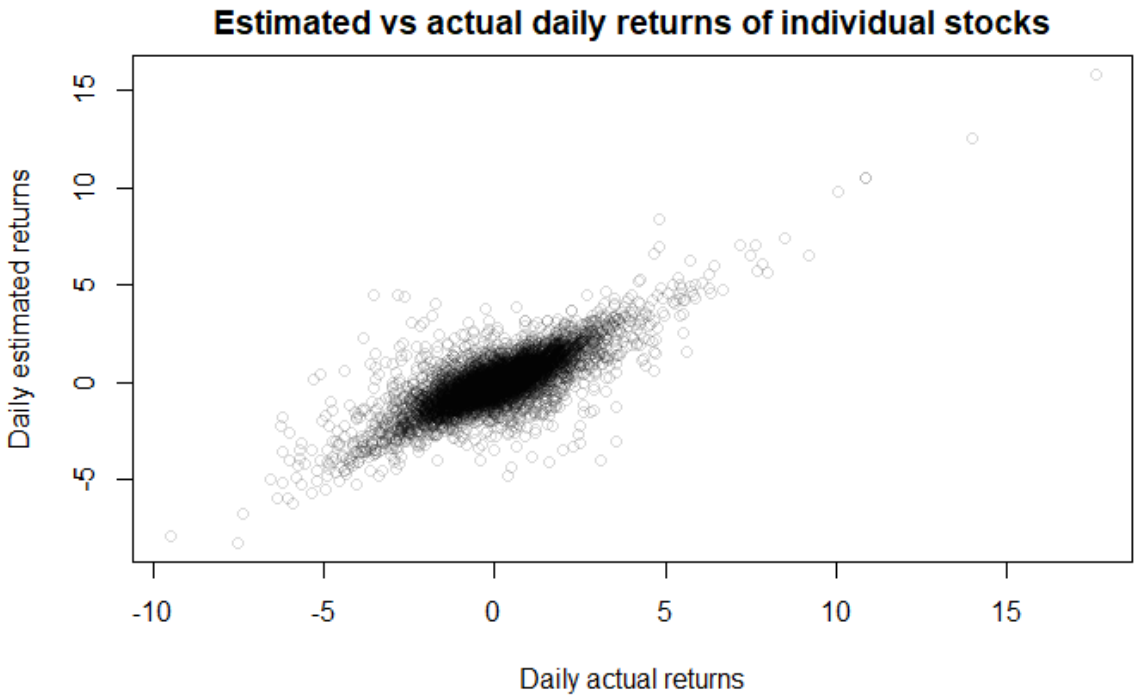
This time w is the binary variable, again taking one value (1) if the CAR is positive and another (0) if it is not. This is currently the test statistic reported in the results table. Whilst these test stats are slightly different, they broadly align.

This is the stage the methodology design has reached, the clear next step is to add in alternative test statistics, there are a couple of routes possible on this and Linton (2019) gives a good sense of the tradeoffs so will broadly guide the next steps here. As such the rest of the methodology section at present covers the current performance and diagnostics of this approach.

4.2 Market model accuracy

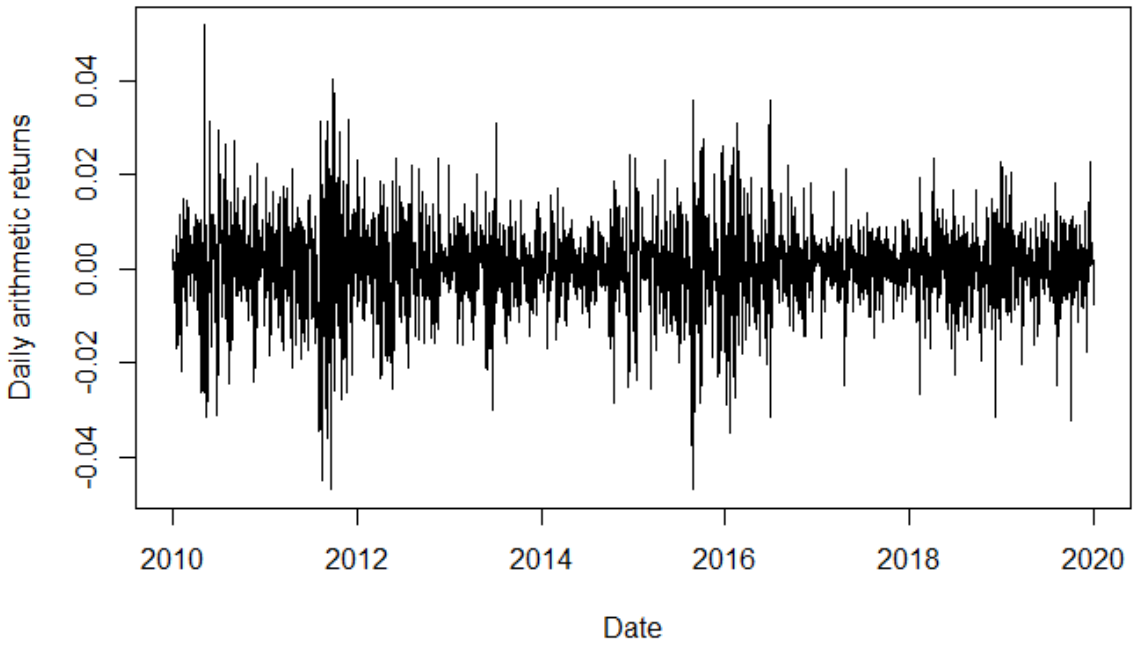
It is instructive to plot the estimate of the daily return by stock against the actual daily return by stock. Theoretically one would expect a linear relationship, due to this being a simplified version of CAPM. The current overall R-squared is 0.53, which suggests this is a sufficient estimator for this model and broadly a linear relationship.

Figure 4 Model vs market



It is also worthwhile to look at the daily returns of the FTSE100 and address a concern around the market model raised in the broader literature, for example by Chen (2014). As can be seen from the daily returns documented below, there is considerable volatility. The concern around this is that it can lead to an inefficient estimator and provide spuriously high t-values due to shifting market variance leading to abnormal returns.

Figure 5 Daily returns



The explanation behind this is that if the market model is fitted on a time of low volatility and then the estimator is applied to a period of high volatility, a large amount of stocks will have spuriously high returns as they themselves are components of the market model.

This is explained well by Chen (2014) who ran 400 million spurious event studies, with the aim of showing the impact volatility has on the validity of the event study estimator. The key finding was that whilst the overall figure is around 5% (as one would hope), there are periods of time where the average spurious regression had far higher significance. Whilst this can be a notable risk, it is negligible for this paper as we are looking at a far longer estimation window, which means that ultimately it would average out.

4.3 Choice of index

From a close reading of the literature, a clear preference for using equally-weighted indexes emerged, with multiple papers irrespective of country agreeing on this point. As such, this paper solely uses the value weighted. Nonetheless it is interesting to note that this assumption is material as using the 'normal' value-weighted index, leads to a weaker estimator and a materially different result.[12]

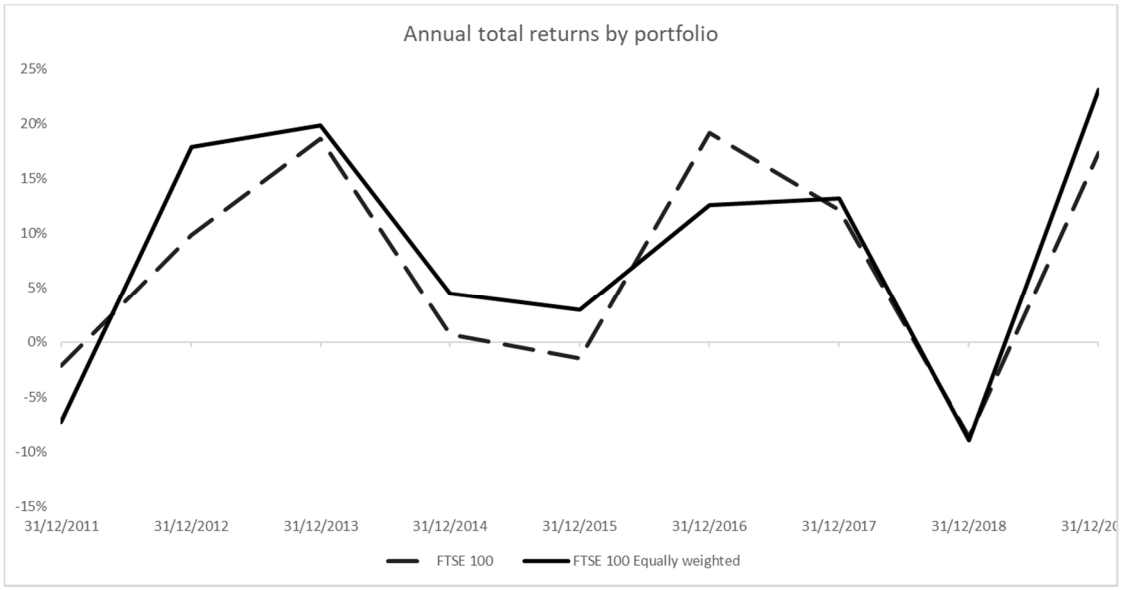
This decision to use the equal weighted index is corroborated by papers such as Plyakha (2014), Corrado and Truong (2008) & Campbell and Wesley (1993) all of whom argue both that the difference matters and that equally weighted is the correct decision.

The graph below shows this difference in returns between the equal weighted and value weighted FTSE 100 indices. As discussed above this is an important decision to make for the research design. This importance is reinforced by looking at the 2016 points, where there was a 10% difference between the indices, which are composed of the exact same stocks, just weighted differently. Note that the dashed line is the value weighted FTSE 100 and the equal weighted is the unbroken line.

Additionally, there is an important data concern. If one instead chooses to use the value weighted index, there is a limited data on the market cap of non-surviving firms, in practise this means it would not have been possible to measure survivorship bias against the value weighted index, even if one decided it was the correct way to proceed.

[12] Not included in this paper because it only included a few statistically significant findings which overall contradicted each other, consistent with the literature discussed in the following paragraph.

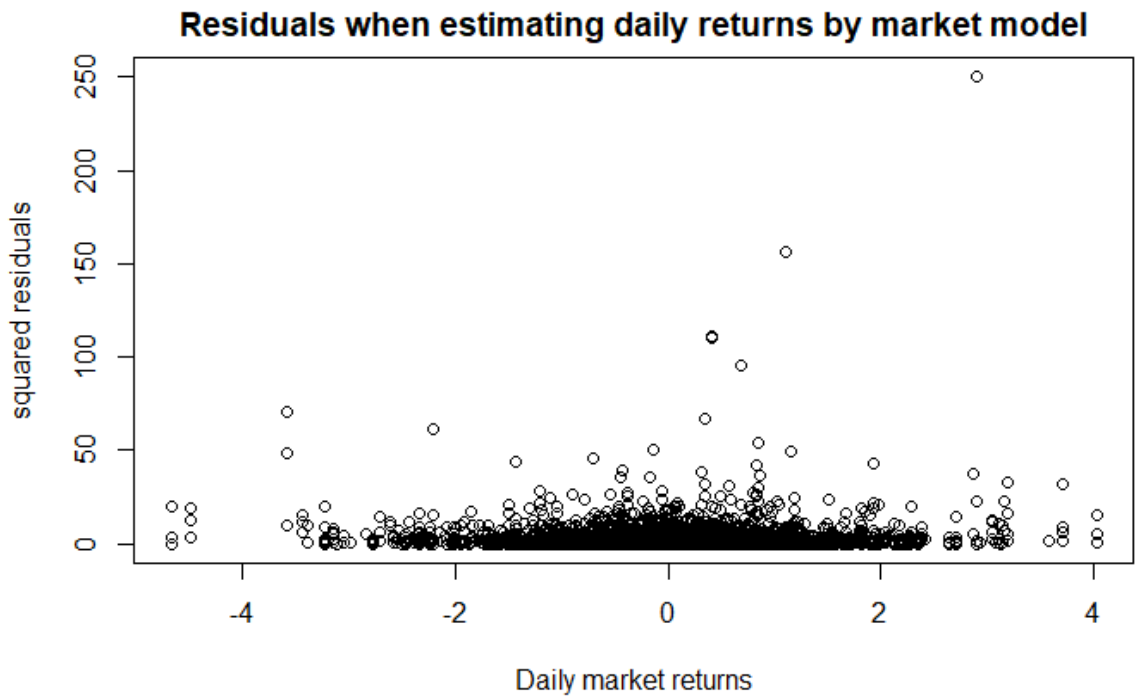
Figure 6 Comparison of indices



4.4 Diagnostics

A key concern when working with returns is heteroskedasticity. So let us plot squared residuals against the independent variable to informally check for heteroskedasticity. If there were currently heteroskedasticity we would expect the diagnostic plot to have a cone shape, along the dependent variable (x axis) which clearly it does not, despite some outliers.

Figure 7 Squared residual plot



5 Empirical results

Having discussed the literature, hypotheses and methodological underpinnings of this approach, the clear next step is to examine how it performs in practise. As such, the below shows abnormal returns in the days following the announcement of a green news item. As mentioned, it is captured by employing an event study, looking for the excess returns over (or under) the market model.

5.1 Equal weighted index, survivorship bias free

Table 2 Equal weighted index, survivorship bias free

Trading day after event	Action type	Average CAR	Number of actions	Z_G
0 (day of)	**All**	**0.0%**	**218**	**-0.35**
	Action	-0.2%	56	-0.59
	Announcement	0.0%	57	0.74
	Recognition	-0.1%	59	0.20
	Report	0.0%	46	-1.15
1	**All**	**0.0%**	**218**	**-0.62**
	Action	-0.2%	56	-1.39
	Announcement	0.2%	57	0.48
	Recognition	0.0%	59	0.46
	Report	0.0%	46	-0.86
2	**All**	**-0.1%**	**218**	**-0.35**
	Action	-0.1%	56	-0.06
	Announcement	0.2%	57	1.27
	Recognition	-0.2%	59	-1.1
	Report	-0.4%	46	-0.86
3	**All**	**0.0%**	**218**	**0.20**
	Action	0.1%	56	-0.59
	Announcement	0.4%	57	2.33**
	Recognition	-0.1%	59	-0.06
	Report	-0.3%	46	-1.45
4	**All**	**0.0%**	**218**	**1.01**
	Action	-0.3%	56	0.21
	Announcement	0.4%	57	2.86***
	Recognition	-0.3%	59	0.20
	Report	0.1%	46	-1.45
5	**All**	**-0.1%**	**218**	**0.87**

	Action	-0.5%	56	-0.86
	Announcement	0.4%	57	1.80*
	Recognition	-0.2%	59	-0.06
	Report	0.1%	46	0.91
6	**All**	**-0.1%**	**218**	**1.01**
	Action	-0.8%	56	-1.39
	Announcement	0.5%	57	2.86***
	Recognition	-0.2%	59	0.20
	Report	0.3%	46	0.32
7	**All**	**-0.2%**	**218**	**0.60**
	Action	-1.1%	56	-1.93**
	Announcement	0.6%	57	3.13***
	Recognition	-0.3%	59	-0.58
	Report	0.2%	46	0.62

*=10% significance level, **=5% significance level, ***=1% significance level, all two tailed

Removing survivorship bias leads to a result which emphasises the importance of the newness of information. This emphasis is best explained by and corroborates the EMH. This is the argument that "securities prices at any time 'fully reflect' all available information" (Malkiel & Fama, 1970). A corollary of this is that abnormal returns only occur in the presence of an informational innovation, or more colloquially "new news", such as announcements.

In terms of significance, almost the only significant results are for announcements, which consist entirely of new information. This suggests that 'stale news' such as reports and updates on previous announcements are already reflected in share price, as one would expect from the EMH. This clearly suggests that dividing news types by informational content is the correct identification strategy. If one were to simply look at the impact of overall ESG news (the bold rows) one would falsely conclude that ESG news has no impact. This clearly provides evidence for this paper more having a more effective identification strategy than many of the papers covered in the literature review.

Furthermore, it suggests that the asset markets for FTSE 100 companies are paying attention to and incorporating ESG innovations/news from companies as they occur. It is rather surprising that Recognition events had no impact on share price, as the informational content from third party awards in theory is high, therefore this likely reflect the lack of business impact rather than informational content. It is also possible that not all awards are equal and a more significant result would be found if subdividing by the level of award as done in Lo and Kwan (2017), which was not done here due to sample size.

Similarly, one would have expected reports to have a larger impact, given that they are often the main venue for companies to share their environmental data, especially at the start of the sample period, prior to the introduction of mandatory reporting. Indeed, this was why H3 was that reports induce a positive abnormal return, which seems to be incorrect.

The lack of valuation impact calls into question some of the justification for an increased focus on environmental reporting as a regulatory strategy. Cong et al (2020) argue that "information as regulation" is sometimes a regulatory strategy, one where regulators assume that disclosure of information has a disciplining effect due to market or customer response. The results of this regression provide no evidence for the existence of this mechanism. This perhaps implies that ESG reporting may be being encouraged for other social or political purposes.

In a different vein there are methodology implications to the report results also. Note that the Z_g estimate of report oscillates between positive and negative values, this undermines the argument for using a one tailed test statistic, which would be a valid

identification strategy for subsequent research if it were clearly leaning one way throughout. The same logic applies to recognition also. This undermines the methodological argument made in Laguna and Cappelle-Blanchard (2010)[13] for the one tailed test statistic.

There are also no statistically significant results for the 'all' category (bold). It is of note that there has not once been a statistically significant finding for the all category during this thesis, even in the value-weighted regressions, which were ultimately excluded. As such, H0 should be considered as having been not rejected- there is no statistically significant impact to ESG news unless the informational content of said news is considered.

Having discussed significance, it is now germane to discuss the direction of the market response. An interesting result observed prior to controlling for selection bias is negative response to action, once one adds non surviving firms to the sample this mostly disappears. There is a clear sampling reason for this, which is based on ESG behaviour and as such is an especially pertinent finding.

From the literature one would expect those leaving to only be doing so due to a fall in share price. However, several firms had left the FTSE 100 due to well-publicised poor ESG behaviour, such as involvement in human rights violations against environmental activists.

This has asset pricing implications. Studies which look at the differences between ESG overperformers and ESG underperformers often do so by constructing portfolios of both groups and then comparing the difference in performance, as in

[13] Amongst others, prevalent especially in the negative ESG news literature.

Humphrey, et al (2012). However, when collecting the data for the survivorship bias free regression, the data differed from the literature and in a way which many of the asset pricing papers appear not to have mitigated using a control variable.

This means that unless portfolio-based studies continue to include these firms once they have relocated to more 'hospitable' stock exchanges, the portfolio's estimation is biased, especially where they subdivide by sector, as it is mostly mining/extraction companies which have these types of issue. It is likely this is also an acute concern for the estimation of ESG ratings, for the exact same reason as in asset pricing.

The finding of negative response to actions is still present on the 7th trading day but seems to have less evidence in support now that non survivor firms are included. This is an unexpected shift but shows overall that given almost the only statistically significant findings are those consisting of 'new news', the EMH correctly describes market response. Furthermore, the market response to announcements is positive, reaching a cumulative abnormal return over the week of 0.6%, which is a large amount, as can be seen by the 99% statistical significance.

This firmly agrees with the Porter hypothesis (positive reaction) and refutes the Friedman hypothesis (negative reaction). In addition, it strongly suggests a gap in much of the existing literature. Using event studies for ESG factors without considering the newness of information can lead to erroneous inferences. This is because the release of old information is essentially a non-event, as per the EMH the information is already incorporated into the share price.

Lastly, given the inspiration for this approach was largely Wang et al (2019) it is worth briefly comparing findings. A key difference is the finding of no statistical significance for the 'All' category. This suggests a potential difference in the informational content of ESG news between the two markets. By contrast, the finding of positive significance for announcements is consistent between the two papers and again is consistent with the EMH.

5.2 Equal weighted index, with fixed effects

Table 3 Equal weighted index, with fixed effects

Trading day after event	Action type	Average CAR	Number of actions	Z_G
0 (day of)	**All**	**0.00%**	**253**	**0.78**
	Action	-0.07%	75	0.64
	Announcement	0.17%	76	1.31
	Recognition	-0.11%	58	0.66
	Report	-0.03%	44	-1.44
1	**All**	**-0.04%**	**253**	**-1.11**
	Action	-0.24%	75	-1.44
	Announcement	0.27%	76	0.16
	Recognition	-0.26%	58	-0.39
	Report	0.07%	44	-0.54
2	**All**	**-0.13%**	**253**	**-0.60**
	Action	-0.31%	75	-0.52
	Announcement	0.31%	76	1.77*
	Recognition	-0.44%	58	-1.70*
	Report	-0.16%	44	-1.14
3	**All**	**0.02%**	**253**	**-0.10**
	Action	-0.01%	75	-0.75
	Announcement	0.37%	76	1.54
	Recognition	-0.35%	58	-0.39
	Report	-0.03%	44	-0.84
4	**All**	**-0.09%**	**253**	**0.91**
	Action	-0.08%	75	0.18
	Announcement	0.29%	76	1.77*
	Recognition	-0.71%	58	0.40
	Report	0.08%	44	-0.84
5	**All**	**-0.15%**	**253**	**0.28**
	Action	-0.25%	75	-0.29
	Announcement	0.37%	76	0.62
	Recognition	-0.85%	58	-0.39
	Report	0.07%	44	0.67
6	**All**	**-0.16%**	**253**	**-0.10**
	Action	-0.39%	75	-1.90*
	Announcement	0.39%	76	1.77*
	Recognition	-0.80%	58	-0.65
	Report	0.14%	44	0.67
7	**All**	**-0.25%**	**253**	**0.28**
	Action	-0.69%	75	-2.13**

	Announcement	0.50%	76	2.45**
	Recognition	-0.91%	58	-0.12
	Report	0.09%	44	0.37

*=10% significance level, **=5% significance level, ***=1% significance level, all two tailed

The above regression takes a slightly different tack and uses the FTSE 100 as at the end of the sample period. A fixed effect is used to control for any survivorship bias which this induces. The reason for doing so is that otherwise the research design excludes the new entrants, which are 40 of the largest companies in the UK over the past nine years. They are therefore added into this sample, in addition to the 60 companies which were in the previous sample at the start and at the end.

These results for the most part corroborate the previous regression and there are three key points to highlight, before we dive into an analysis based on both the theoretical and empirical literature. Firstly, as before there is no statistically significant impact from environmental reporting, as will be analysed further below this is a surprising departure from the literature.

Secondly, there is a different response to action and announcement and this relationship holds in all of the significant results. In effect the finding is that announcing new green initiatives increases stock price, but successfully finishing them/ updating the market on their progress decreases the stock price. This was somewhat the case in the previous regression but is more pronounced here. This is difficult to explain through solely an EMH approach, so the below analysis relies upon the corporate finance literature. This is appropriate as the question centres around the direction not the statistical significance of the result.

There are two different ways to think about this result which is much in line with how papers in this genre of literature, e.g., Alsaifi et al. (2020) and Fatemi et al. (2018),

discuss the field. One, the "shareholder maximisation hypothesis", beloved by Friedman and co, which argues against any concern for the environment, in the aptly titled "The Social Responsibility of Business Is to Increase Its Profits" (Friedman, 2007). Through this lens, one could argue that new involvement in environmental initiatives (e.g. announcements) is detrimental to share price, whilst completing them (e.g. actions) is good as it enables managers to go back to maximising corporate profits/buybacks etc.

This is the opposite of our finding and therefore the Friedman hypothesis appears not to apply in this case.

Alternatively, there is the Porter hypothesis, which takes the opposite tack, arguing that ESG "can be a source of opportunity, innovation and competitive advantage" (Porter, 2007). If one were of this view, it could be argued that there is a "past is past" dynamic, where firms are rewarded for announcing new environmental actions, but punished for reporting completed ones. This implies that firms should be more ambitious in their environmental ambitions and that there is appetite from investors for more radical change. Again, this does not contradict the previous regression, it does however provide stronger evidence for this argument.

These results somewhat gently agree with the idea that ESG initiatives can increase profits by reducing resource intensity, which is essentially a corollary of the Porter viewpoint. It would be easier to make this argument if the response to both announcement and action were positive, but there is clearer evidence for increased valuation based on positive environmental announcements.

Given the regression results, this study empirically agrees with the Porter hypothesis, that positive environmental decisions can be share price maximising. Of

note is that the other types of news such as recognition is still publicised, including by the companies themselves. This implies that they are not doing so for share price reasons, rather due to cultural, signalling, and organisational factors. This is again consistent with the Porter hypothesis.

It is important to note that whilst by definition most announcements turn into actions, that transition may not necessarily be captured in the sample. This could be due to several reasons, but in particular that at the start and end of the sample the dataset captures initiatives starting or ending, e.g. it is not necessarily longitudinal data. This is consistent with the majority of papers in the literature, but it does mildly complicate the interpretation of the results. During the literature review no paper which took this approach was found and doing so would go a large part towards establishing causality for a firm's overall ESG strategy. This likely has not been done due to econometric concerns around the independent and identically distributed assumption, but it would be an innovative addition to the nature, as this linkage does not appear to have been analysed econometrically at any length.

As in the previous sub-section, given the inspiration for this paper was in large part Wang et al (2019), it is instructive to compare findings.

At this stage, the comparison will just be made based on the Z_g test statistic, as that is the part which both papers have in common. For announcements, Wang et al found a positive impact on share price and for actions effectively no impact. The regression above corroborates the positive impact of announcements but found a negative impact for actions.

This implies that the UK stock market reacts differently to corporate environmental behavior and most likely in a more nuanced way. This is an illuminating result given there is such a close linkage between the two. In fact, given that there are British listed companies on the NYSE (secondary listings so US investors can invest), there is a slim possibility there are one or two companies which are captured in both samples.

It is also important to note that this close linkage extends to ownership, with for example "35% of the FTSE 100 being held by North American investors as of end of June 2020" (Factset, 2020), which is greater than the corresponding E.U. ownership percentage (15%). There is clearly an avenue for further research here, centred on the differences in environmental approach between the two countries. The studies differ by both sample selection and time period, an interesting addition to the analysis here would be to add fixed effects by year to see if there is a change in trend over time, this was however decided against due to concerns over confounding the estimator given the small sample size.

5.3 Equal weighted index, with fixed effects and institutional ownership

Table 4 Equal weighted index, with fixed effects and institutional ownership

Trading day after event	Action type	Average CAR	Number of actions	Z_G
0 (day of)	All	**-0.02%**	**252**	**0.70**
	Action	-0.09%	75	0.13
	Announcement	0.16%	75	1.44
	Recognition	-0.11%	58	0.39
	Report	-0.08%	44	-0.83
1	All	**-0.07%**	**252**	**-1.06**
	Action	-0.26%	75	-1.71*
	Announcement	0.25%	75	0.28
	Recognition	-0.26%	58	0.13
	Report	-0.04%	44	-0.83
2	All	**-0.18%**	**252**	**-0.56**
	Action	-0.34%	75	-1.02
	Announcement	0.28%	75	2.82***
	Recognition	-0.45%	58	-1.71*
	Report	-0.32%	44	-1.73*
3	All	**-0.04%**	**252**	**0.45**
	Action	-0.04%	75	-1.02
	Announcement	0.32%	75	2.59***
	Recognition	-0.35%	58	-0.40
	Report	-0.24%	44	-0.53
4	All	**-0.17%**	**252**	**0.07**
	Action	-0.12%	75	-0.79
	Announcement	0.22%	75	1.67*
	Recognition	-0.72%	58	-0.13
	Report	-0.19%	44	-0.83
5	All	**-0.25%**	**252**	**0.07**
	Action	-0.31%	75	-1.02
	Announcement	0.29%	75	1.44
	Recognition	-0.85%	58	-0.40
	Report	-0.25%	44	0.08
6	All	**-0.28%**	**252**	**0.32**
	Action	-0.45%	75	-0.79
	Announcement	0.26%	75	1.67*
	Recognition	-0.80%	58	-1.18
	Report	-0.23%	44	0.98

7	All	**-0.40%**	**253**	**0.38**
	Action	-0.79%	75	-1.02
	Announcement	0.34%	76	2.00**
	Recognition	-0.90%	58	-0.66
	Report	-0.32%	44	0.38

*=10% significance level, **=5% significance level, ***=1% significance level, all two tailed

Including institutional ownership as a variable leads to a somewhat different story. Firstly, note that a fixed effect is still used for firms which entered the sample during the sample period. This is used to account for any heterogeneity around missing data. As such any remaining data gaps are quasi-random. This is an important addition to the literature, as many existing papers just omit missing data without any control variable. The modal approach seems to be to simply "exclude observations with missing values" (Chung & Zhang, 2011).

Regardless, including institutional ownership as a variable leads to a more nuanced story. By doing so there appears to be some short-lived negative effect of recognition and reports, but only in day two. This is in line with the view of Hoang et al (2019) that institutional investors trade on ESG information. In addition, there is some evidence for a negative impact of action, but only in the first day.

Overall, this suggests that there is some additional role played by institutional ownership, but it appears to be fairly limited. There is an argument to be made that they appear to be more closely examining the release of ESG information and are perhaps incorporating some of the limited amount of new information captured in these other action types. This somewhat seems to lead to an increased significance in results by including institutional ownership, e.g. we fail to reject hypothesis three.

Consistent with both previous regressions, there is a statistically significant market response to the announcement of new ESG policies, which as before is consistent

with the EMH. The statistical significance for this finding is again notably high, suggesting even further that focussing on the release of new information is the clearest way to causally demonstrate the impact of positive ESG news. It is worth reemphasising that this provides further circumstantial evidence that studies which do not consider the newness of information are likely underestimating the impact of ESG news.

6 Robustness checks

Robustness checks are a major focus of and the main next steps for this thesis. It has already been demonstrated that several of the key findings of this paper are robust to several different regression specifications. A key requirement in this type of study is an in depth analysis of potential selection bias. There are also a second and potentially third set of institutional ownership regressions, using monthly and then quarterly data, which can be found in the appendix.

In addition, it would also be innovative to see if the firms ESG reputation impact the response to their actions. Using the direct emissions of companies in the firms characteristics would potentially be misleading in that the incentive is to not report if one's company is a major polluter, as such a more representative variable to include is, as mentioned, the ESG score of the company, which is a reasonable proxy.

6.1 Selection bias

The clearest way to measure selection bias in a sample comes from Brown et al. (1995), who are paraphrased in Amin and Katz (2002) as "the differences in average return between the portfolio of all funds existing at the start of the sample period and a portfolio containing all funds in the sample." This is the definition which will be used for the below analysis.

Measuring the impact of selection bias has proved to be unexpectedly involved. The issue is that there are two possible data sources to do so, but both have an underlying issue that is not ideal.

Using Bloomberg or Yahoo Finance means there is little to no returns data on non-surviving firms, even during the points at which they had yet to fail. This is because their data policy is to remove non-current firms from their databases, as discussed in Daniel et al (2008) and confirmed by experience of using both products. Clearly, this means the data is unusable when looking at survivorship bias as it simply does not include the non-survivors.

If this thesis looked at American stocks, it would simply use the same survivorship bias free data available from CRSP as Daniel et al. (2008). Unfortunately, there does not seem to be a British equivalent of this stock database and as such the author must look to the Thomson-Reuters product Eikon.

Eikon data is better quality, but has a different issue, Thomson Reuters own Eikon and are excellent for survivorship-bias free data, they use 'point in time' data, which means one sees the market as a participant at that point would have done. However, Eikon' portfolio creation tools are lacking. To overcome this 10 portfolios were manually created, a portfolio for each year in the sample. The return for the first year of each portfolio was captured as the return of the reference portfolio for that year. A limitation of this approach is that the reference portfolio is rebalanced annually rather than quarterly like the actual equal weighted FTSE 100 index, which likely introduced some slight drift.

In addition, Eikon also do not have the equally weighted index, so to compare the differences between the reference portfolio and the value weighted FTSE 100 one has used total returns from the FTSE website, FTSE (2021).[14]

For the survivorship bias free sample, the list of companies in the FTSE 100 is gathered at the start of the sample period 2011. An equal weighted portfolio is constructed and rebalanced annually, firms leave the portfolio once they are no longer listed on the London stock exchange, which is the same approach taken in the data collection process. The FTSE 100 equally weighted index is rebalanced quarterly, so as mentioned this is a slight difference in rebalance frequency between the sample and index portfolio[15].

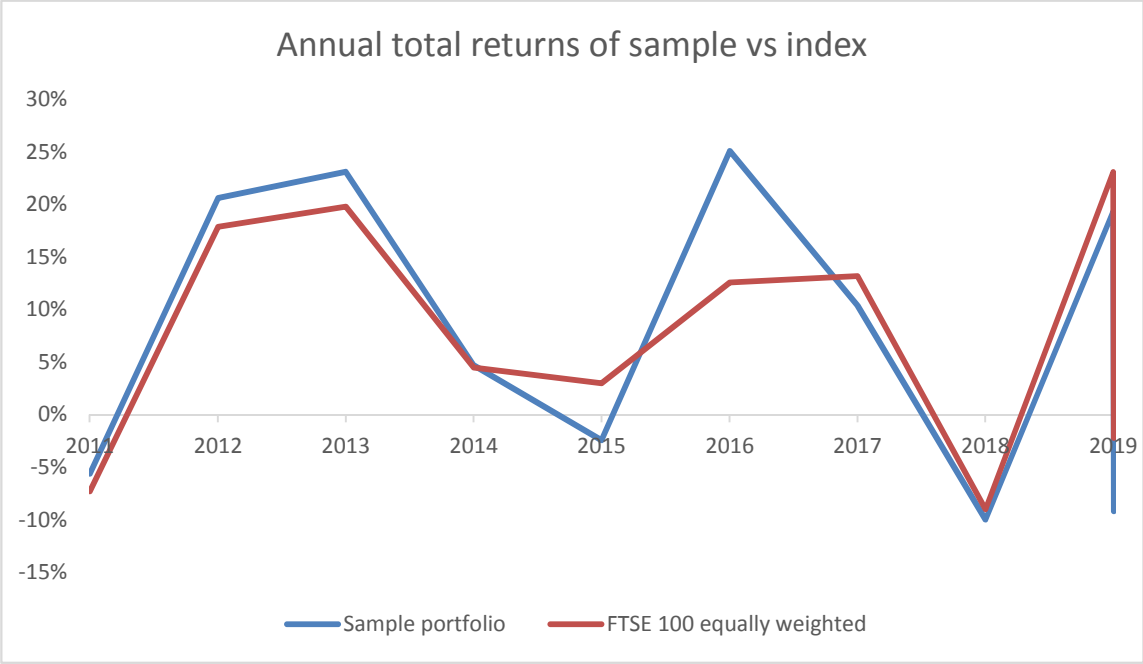
Regardless, using the Katz definition the selection bias of the survivorship free sample is 0.05% per year, this is a minimal annual amount- on a daily basis it is completely negligible.

As can be seen from the below graph, the main difference between the two are the 2015/2016 period. The clear explanation for this is the run-up to and fall out from the 2016 Brexit referendum. The argument against using a year fixed effect to correct for this is that the average selection bias is already indistinguishable from 0, such that the fixed effect would be capturing political noise rather than an overall difference between the samples. This means that the fixed effect would add a Brexit effect on ESG, which is not a coherent addition to this model.

[14] The figures were the exact same across the sources for the FTSE 100 value weighted, which was available on both sources. As such whilst somewhat convoluted this is a demonstrably correct data usage.

[15] Rebalancing quarterly would require manually creating 40 portfolios and downloading a report for each, annual only required creating 10. Doing so is unlikely to lead to any change in findings

Figure 8 Selection bias plot



7 Conclusion

This thesis shows a clear yet nuanced effect from releasing ESG news. It strongly demonstrates a positive stock market response to the announcement of new green policies whilst also showing somewhat of a negative response to existing ones. This corroborates the existing literature, but in a new context. The results are robust to three different regression specifications. Further robustness checks, statistical tests and slight modifications to the data cleaning will likely further strengthen this case.

Furthermore, this thesis provides a compelling addition to the literature by describing a decade of British corporate ESG behaviour in several innovative ways, enabling comparison with the US market, incorporating the impact of institutional investors and capturing the newness of information. It both corroborates and adds to the existing literature, enabling a more nuanced discussion with significant causal inference around the drivers of market response to ESG innovations and especially ESG announcements.

From having done this there is a better sense of how the market reacts to ESG news and how it differs from what one would expect based off the literature. By building upon a US study this thesis also provides an understanding of how to mitigate non-US data gaps and what the cultural differences are, even in a fundamentally similar market and legal system. Of particular interest is the key role of announcements of new information for understanding company's ESG behaviours, which differs significantly from how many existing ESG scores are calculated.

Lastly, it is often taken as a given that the free market is the best way to allocate resources. Given the magnitude of the environmental issues facing us this is a

vital assumption to check. This thesis directly demonstrates a mechanism by which the market is rewarding positive ESG behaviours and also show several mechanisms by which the market is not, this is an urgent contribution to the discourse around climate change.

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8.1 Appendix: Equal weighted index, with fixed effects and institutional ownership (monthly average)

Table 5 Equal weighted index, FE and monthly IO

Trading day after event	Action type	Average CAR	Number of actions	Z_G
0 (day of)	All	**0.00%**	**252**	**1.24**
	Action	-0.08%	75	0.65
	Announcement	0.20%	75	1.89*
	Recognition	-0.08%	58	0.66
	Report	-0.09%	44	-1.12
1	All	**-0.04%**	**252**	**-0.65**
	Action	-0.26%	75	-1.89*
	Announcement	0.33%	75	0.74
	Recognition	-0.20%	58	0.66
	Report	-0.06%	44	-0.82
2	All	**-0.13%**	**252**	**-0.27**
	Action	-0.34%	75	-1.20
	Announcement	0.38%	75	2.59**
	Recognition	-0.35%	58	-0.91
	Report	-0.35%	44	-1.42
3	All	**0.02%**	**252**	**0.36**
	Action	-0.06%	75	-1.20
	Announcement	0.47%	75	2.36**
	Recognition	-0.22%	58	-0.12
	Report	-0.27%	44	-0.52
4	All	**-0.10%**	**252**	**0.36**
	Action	-0.15%	75	-0.27
	Announcement	0.41%	75	1.66*
	Recognition	-0.56%	58	0.40
	Report	-0.24%	44	-1.42
5	All	**-0.16%**	**252**	**0.99**
	Action	-0.35%	75	-0.27
	Announcement	0.51%	75	1.89*
	Recognition	-0.67%	58	0.14
	Report	-0.34%	44	0.09
6	All	**-0.18%**	**252**	**0.23**
	Action	-0.50%	75	-0.73
	Announcement	0.54%	75	1.66*
	Recognition	-0.59%	58	-1.44
	Report	-0.35%	44	0.99

7	All	**-0.28%**	**252**	**0.36**
	Action	-0.83%	75	-1.43
	Announcement	0.66%	75	2.36**
	Recognition	-0.67%	58	-0.65
	Report	-0.47%	44	0.39

This regression was ran to demonstrate the impact of using monthly rather than weekly data. The institutional ownership data was weekly, such that a rolling average was taken of the past four observations, this is the rolling average over the last trading month. This was then transformed to daily data, where each trading day observation was the latest data at that point in time, e.g. the most recent average.

The primary impact of this seems to be reducing the power of the estimator, compared against section 5.3, which is the same regression but with weekly data. This can be seen especially with reference to the 'announcements' observations. Clearly shifting to monthly data would be an ill-advised empirical strategy, and this is the reason why the weekly data is better advised.

That being the case however, the overall findings do not change having made this switch, such that the findings are still broadly robust to switching to monthly data. This suggests that were the sample size larger this would likely be less of a meaningful decision.

8.2 Appendix: Equal weighted index, with fixed effects and institutional ownership (quarterly average)

Table 6 Equal weighted with FE and quarterly IO

Trading day after event	Action type	Average CAR	Number of actions	Z_G
0 (day of)	All	**0.00%**	**252**	**1.11**
	Action	-0.07%	75	0.64
	Announcement	0.21%	75	2.14**
	Recognition	-0.12%	58	0.40
	Report	-0.08%	44	-1.44
1	All	**-0.04%**	**252**	**0.22**
	Action	-0.23%	75	-0.75
	Announcement	0.34%	75	1.68*
	Recognition	-0.29%	58	-0.39
	Report	-0.03%	44	-0.23
2	All	**-0.13%**	**252**	**-0.41**
	Action	-0.30%	75	-0.98
	Announcement	0.41%	75	2.83*
	Recognition	-0.48%	58	-1.18
	Report	-0.31%	44	-2.04**
3	All	**0.02%**	**252**	**0.35**
	Action	0.00%	75	-0.29
	Announcement	0.50%	75	2.14**
	Recognition	-0.39%	58	-0.39
	Report	-0.24%	44	-1.14
4	All	**-0.10%**	**252**	**0.98**
	Action	-0.07%	75	0.64
	Announcement	0.45%	75	2.14*
	Recognition	-0.77%	58	-0.39
	Report	-0.20%	44	-0.84
5	All	**-0.17%**	**252**	**0.35**
	Action	-0.25%	75	-0.29
	Announcement	0.56%	75	1.22
	Recognition	-0.92%	58	-0.12
	Report	-0.29%	44	-0.23
6	All	**-0.19%**	**252**	**-0.41**
	Action	-0.38%	75	-0.98
	Announcement	0.60%	75	0.99

	Recognition	-0.88%	58	-1.44
	Report	-0.30%	44	0.67
7	All	**-0.29%**	**252**	**-0.66**
	Action	-0.69%	75	-1.67*
	Announcement	0.74%	75	1.22
	Recognition	-0.99%	58	-0.91
	Report	-0.43%	44	0.07

This regression consists of the same data as the previous one, except this time the institutional ownership data has been transformed to be the quarterly averages as opposed to monthly.

These findings are similar to the monthly figures but appears to have reduced statistical significance for several results. Of particular interest is that these results do not appear to converge to the results without institutional ownership, which is what could reasonably be expected given the reduction in informational content when moving from weekly to quarterly data.