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The green economy: The link between corporate social responsibility and financial performance during economic shocks.

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ABSTRACT

A prominent claim within the literature is that 'green' firms are fundamentally more resilient to financial, environmental and social shocks, relative to firms that take no environmental action. To test this, this study compared the financial performance of firms in the UK FTSE4good, and similar firms outside the FTSE4Good through selected financial, environmental and social shocks

Firstly the FTSE4Good indices were compared to the performance of the FTSE All-Share through several shocks. The results of which indicated through average returns, ranking performance and descriptive statistics that the FTSE4good Benchmark did not provide resilience in excess of the FTSE All-Share. The lack of significance was thought to be the consequence of diversification caused by the heterogeneity of each firm's core business. The FTSE4good UK 50 showed neither and advantage nor disadvantage in resilience performance relative to the FTSE All-Share but the higher moments in the distribution of the returns (skewness and kurtosis) shows evidence of decreased risk in producing extreme negative returns. Furthermore, the discrepancies were also thought to be a consequence of the level at which FTSE4good include firms in the index series.

To account for this discrepancy, FTSE4good's ESG ratings were used to identify the best in class firms, eliminating middle ground performance. Only firms classified according to social performance showed conclusive evidence of an advantage for investors who could reduce their risk profile by selecting only firms with relatively high social responsibility ratings.

The results show that the assumption that green firms are more resilient to shocks is too imprecise, at least when analysed in terms of financial performance across the period covered by this study. To become a more effective indicator of environmental, social and governance performance the FTSE4good must demand higher levels of performance from constituent firms and punish any transgressions more severely.

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LIST OF ABBREVIATIONS

BOE	Bank of England
CAPM	Capital Asset Pricing Model
CSR	Corporate Social Responsibility
CFP	Corporate Financial Performance
CU	Cranfield University
EU	European Union
EC	European Commission
EPI	Environmental Performance Indicator
EM	Ecological Modernisation
EMH	Efficient Markets Hypothesis
EU	European Union
ETS	Emissions Trading Scheme
ESG	Environmental, Social, Corporate Governance
EVS	Event Study
FT4GBUK	FTSE4good Benchmark
FT4UK50	FTSE4good UK 50
FTALLSH	FTSE All-Share
GDP	Gross Domestic Product
GVA	Gross Value Added
GHG	Green House Gas
IE	Industrial Ecology
SRI	Socially Responsible Investment
UK	United Kingdom
US	United States of America
UNEP	United Nations Environment Program
UN	United Nations
US Fed	United States Federal Reserve Bank
WB	World Bank

1 Introduction

Environmental and social issues are prominent topics within the global political and economic domain. Consequently a number of solutions have emerged under the banner of a green economy. The main obstacle however is the perceived need to create wealth whilst also managing to protect the environment and increase social equality. Therefore, this study aims to "determine whether financial markets and constituent firms, based on ESG (Environmental, Social, Corporate Governance) performance, are more resilient to associated shock events than their base universe". To achieve this aim a series of questions must be answered. What metrics are appropriate for measuring business resilience? What methods are most appropriate for testing whether "green" firms are resilient during shock events? Does the market value FTSE4good performance across three asset classes during shocks? Does ethical and green production pay?

Initially this research began with the open statement, "the future of the green economy" and subsequently a systematic review was conducted into all meanings of the term green economy (See Appendix A & B). From this review the issues that the green economy aimed to contend with were abundantly clear but the obstacles that prevent widespread acknowledgement and adoption where it's greatest challenge. Emerging from this review was the importance of finance in driving the business-as-usual economy and it would therefore be the source of any major correction. From a research planning perspective, this research followed a deductive approach. However, the contemporary nature of this topic meant that research was in some cases abundant, such as with event study methodology and in others, research was very thin, such as within ethical markets. This reinforced the novelty aspect of the study but meant that progress was initially bound by inductive reasoning to formulate the research aim, questions and methodology. Even once firm objectives were set, results led to new questions on two occasions to confirm the aims of the study. Therefore, overall the study achieved a deductive form but only by means of inductive reasoning. The structure of the methodology is presented in Chapter 4.2.

To provide a thematic link to the research aim and subsequent questions, the following chapter provides a rationale of why society is interested in a green economy and ethical indices, such as FTSE4good, followed by what part financial markets and investments play in the proliferation of externalities and subsequent development of this new economic approach.

1.1 Background to study: The green economy

Measured by Gross Domestic Product (GDP), the twentieth century witnessed an unprecedented increase in living standards within advanced and emerging economies, (Mathews, 2011). A major concern relating to economic growth is the environmental degradation that has occurred to achieve this. There is a strong correlation between economic progress and resource use: where, as population increases and becomes wealthier, demand for basic materials, such as oil and water, increases (Pawlak, 2008). Consequently, risks are being taken to satisfy global demand at the expense of the environment and social welfare (Walsh, 2012). Because of the scale of recent consumption, a number of resources are projected to become depleted within an economically foreseeable timeframe (UNEP, 2011a). As more accessible deposits become depleted attention shifts to less accessible resources with relatively high extraction costs (Morley and Eatherley, 2008). This brings new risks; oil extraction now takes place in environmentally sensitive areas such as the deep and arctic seas (Walsh, 2012); and the extraction of gas through the process of “fracking” has caused environmental concern (Economist, 2011; Jaspal and Nerlich, 2014).

Furthermore, economic growth has caused an increase in externalities, such as air and water pollution (Jackson, 2009). Such effects cause significant damage to the natural environment. The effects of externalities also impact on social welfare and human development, causing long term and widespread social inequality (Stern, 2007). For example, in China, as a result of industrialisation, only 1% of residents breathe air that is considered safe by European Union (EU) standards (Assadourian, 2008). Therefore, many negative impacts on the environment and human welfare are a direct result of economic activity, the costs of which are unlikely to be paid at source (Stern, 2007). Internalising externalities and bringing resource use within sustainable bounds is an increasingly important political goal (OECD, 2011; HM Government, 2011a). A new economic paradigm known as “The Green Economy” captures this aspiration. The idea of a green economy has gathered momentum since the financial crisis of 2008, which provided an opportunity to re-think economic growth and make it more sustainable (Li and Jiang, 2012). Economic reform has been further galvanised by high energy and resource prices, the extraction of which has caused further externalities. For example, the pollution caused by the processing of rare earth minerals to capitalise on unprecedented high prices (Kara et al., 2010).

The UK government has clearly stated that the green economy is a system that is distinct from, rather than a part of, the current economy (HM Government, 2011a). The green economy agenda aims to correct many of the market, economic and social failures that exist within the UK. Among the most pressing issues are energy dependence, inequality between social classes, quality of the natural environment and the potential for new markets that might increase economic growth and social inclusion (Jackson, 2009; HM Government, 2011a; HM Government, 2011b; HM Government, 2011c).

However, there is a lack of theoretical and practical agreement on what constitutes a green economy, and as such the transitional requirements are unclear. Without a consensus it is difficult to imagine whether a green economy is feasible and whether it could provide all the desired benefits. The United Nations Department of Economic and Social affairs addressed the issues around defining the green economy in a publication that sought to understand all meanings within the literature (UNDESA, 2012). The literature implies that the green economy is a progressive system that reconciles the protection of the environment and development of society with economic growth (Gurtowski, 2011; Porfir'ev, 2012) (See Appendices A & B). The UNDESA (2012) publication concluded with the following definition that fits within the context of this study; the green economy is "one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. It is low carbon, resource efficient, and socially inclusive. In a green economy, growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services" (UNDESA, 2012).

1.1.1 Resilience and the green economy

Green economy principles and the characteristics outlined within the definition, are thought to benefit firms and economies, making them relatively more resilient to economic shocks such as the economic crisis of 2007-09 (Jackson, 2009; OECD, 2011; HM Government, 2011a; European Commission, 2013; The Danish 92 Group Forum for Sustainable Development, 2012; Chousa and Castro, 2011; Fiksel, 2006). The UK government believes a UK green economy will be relatively more efficient than the business-as-usual economy, thus decreasing exposure to costly and riskier inputs

(HM Government, 2011a). The green economy is also thought to open opportunities for new markets that will raise employment and, therefore, social inclusion (Environmental Audit Committee, 2012). The principles associated with a green economy are considered complimentary to resilience performance (Chousa and Castro, 2011).

Resilience is a frequently cited advantage of a green economy. Countries and businesses that pursue green growth will develop resilience to shock events, which will give them a competitive advantage over countries and firms who do not (HM Government, 2011b; Aldersgate Group, 2011; UNEP, 2011b). The importance of business resilience has increased, particularly after recent events in the global economy that have manifested in recessionary shocks to volatile oil and energy prices; the prediction of which is in most cases impossible (Simmie and Martin, 2010; Bowen and Fankhauser, 2011; Anand et al., 2013; Ortas et al., 2013). There exists two types of shock; most events fall into a category of “common shocks” that are thought of as business cycles that occur periodically such as oil price surges and talent shortages (Duval and Vogel, 2008). Extraordinary shocks or “black swan” events are those that are unfamiliar and largely unforeseen, such as the first oil shock of 1973 that caused a structural trend break in the output time series (Fukuda, 2012; Hutchins, 2012). These shocks have severely tested the resilience of most businesses, resulting in many failures (Avery and Bergsteiner, 2011).

1.2 The role of financial markets

1.2.1 Finance, the problem and solution

The allocation of financial capital through markets and investments assumes some responsibility as a significant catalyst of social and environmental externalities due to the inextricable link between economic growth and externalities (Jackson, 2009; UNEP, 2011b; Shieh et al., 2014). The business cycle, which contributes to economic growth, relies on financial capital from investments and consumer spending (Bezemer, 2014). This flow of capital enables firms to invest in their business, a behavioural pattern that in many cases generates externalities (Antoci et al., 2014). In rare cases the externalities develop into a shock that changes the physical and economic environment that firms must continue to operate within (Jackson, 2009; Bezemer, 2014). This change is either detrimental or beneficial to the market players depending on the characteristics’ of their business and whether or not this reflects what is required to be resilient (Chousa and Castro, 2011). The following illustration (Figure 1.1) is an example of this cycle with the inclusion of the intended benefits of the green economy and the resilience it allegedly bestows (HM Government, 2011b; Aldersgate Group, 2011; UNEP, 2011b).

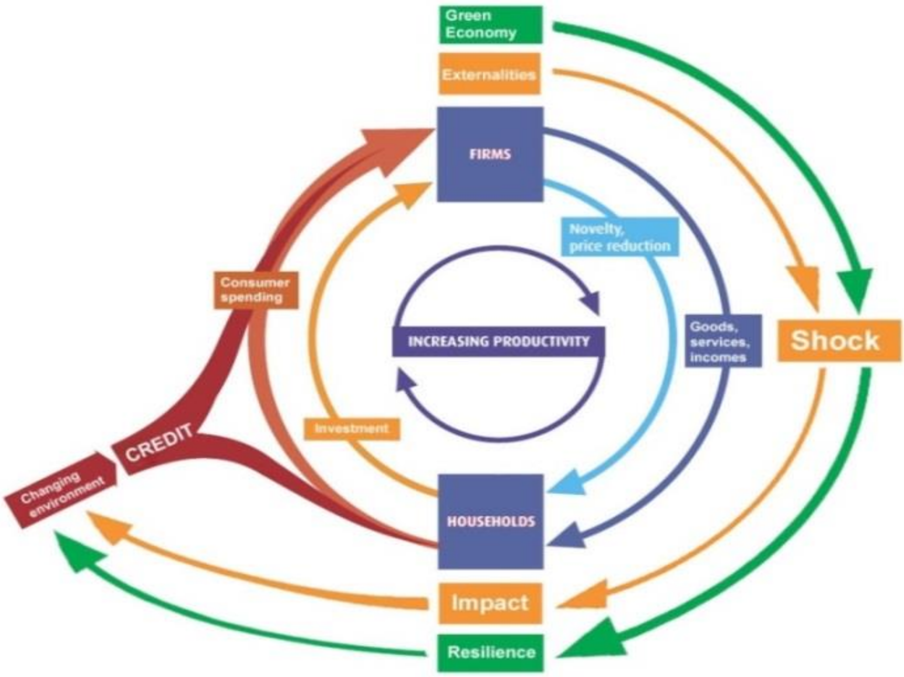

Figure 1.1. The economic and financial cycle, its negative effects and the corrective benefits of green investment (Source: adapted from Jackson (2009) **by Author)**

The cycle presented in Figure 1.1 begins with the objective to broadly increase productivity within the economy. To fuel this demand, products are created to encourage the flow of financial capital in the form of credit and investments. This capital is broadly focused into industrialised activities that for example cause pollution from growing levels of manufacturing; polluting air and water tables due to increased demand for energy. Finally, if these demands continue to grow, then credit continues to flow into the cycle, feeding the complex system of externalities that also risk system failure in the form of shocks. Whilst this model is crude, as it excludes government and not-for-profit organisations, its purpose highlights the connection between finance, non-socially responsible investments and externalities. Therefore, the implications of adopting green economy principles are shown on the outer part of Figure 1.1 in green.

Firms aim to attract investment by demonstrating reduced occurrence of externalities through environmental and social initiatives. These initiatives reduce the likely hood of related shocks, or at least the magnitude of effects, therefore providing resilience to the adopter and stakeholders such as investors (Chousa and Castro, 2011; Fiksel, 2006). Firms are then better placed to attract investment due to the increased demand for ESG values. Consequently, if enough firms adopt these principles, a lasting positive change should be apparent on the entire physical and economic environment. This would then reduce the risk of externalities and shocks such as the financial crisis, climate change and supply chain transgressions (Fiksel, 2003; FTSE, 2011).

Therefore, avoiding and reducing further harms requires an equally substantial amount of financial capital (Jackson, 2009). Indications are that the finance required to drive the green economy along with the desired benefits will largely come from private sector investments (UNEP, 2011b; Jackson, 2011). Consequently, the assets under management that incorporate Environmental, Social and Corporate Governance (ESG) into investment decisions have increased globally from $2.6trillion in 2002 to $3.6trillion in 2006 and $10.1trillion in 2010 (FTSE, 2011). This highlights the growth in ethical investment and its importance in not only protecting the environment and society but as a fundamental aspect of the investment and finance domain (Schmidt, 2010). Despite this level of growth, Ernst & Young (2010) highlight that the UK needs to reduce a £370 billion gap in low-carbon investment in energy infrastructure, renewable sources and government backed initiatives to increase adoption of new technologies; it is not clear if this figure includes R&D.

These investments are provided in return for income in the form of dividends, which means green business must perform well relative to other businesses to attract investors (Jackson, 2009). Therefore, highlighting the advantages that green investments bring through increased resilience could serve to raise awareness of such investments, thus closing the gap in funding and driving the green economy and its associated benefits. Green or socially responsible investments (SRI) reflect the corporate social performance of a firm that is often broken down into components, namely environmental, social, and corporate governance. Therefore, corporate social responsibility (CSR) is a lagging indicator of businesses practices that is promoted or imposed by an institution, and ESG or corporate social performance (CSP) is a leading indicator that investment decisions are based upon (Lu et al., 2014). Furthermore, CSR is considered a multi-dimensional construct that despite its name contends with ecological, social and economic systems (Sheehy, 2014). Despite this interest in protection and enhancement, a comparison of socially responsible investment (SRI) and non-SRI fund managers beliefs' and attitudes to SRI points to significant evidence that investment decisions are primarily based on financial returns rather than environmental and social concerns. Respondents were rated on a seven point scale according to their attitudes towards a range of values within the investment domain; for example: wealth and success, or environmental protection and social justice (Jansson and Biel, 2014). Therefore, an equitable financial return must be realised for SRI/ESG based investments to be accepted within the market place.

To attract funding, markets must be shaped in a way that investors can differentiate between green and less green investments. Globally a range of sustainability indices have been developed to guide investors to more socially responsible investments (World Federation of Exchanges, 2009); and among the most recognised is the FTSE4good Indices (FTSE, 2010b), which has been running since 2001. The FTSE4good index aligns with the principles of the green economy and the definition proposed by UNDESA (2012) (FTSE, 2011). If green investments are more resilient then this should be apparent in the financial performance of sustainability indices, otherwise referred to as the relationship between corporate social responsibility and corporate financial performance (CSR-CFP) (Cavaco and Crifo, 2014)

1.2.2 Identified area of research

There are two major research needs identified by the literature. Whilst not explicitly requested, a lack of evidence infers the need to test whether a green economy will increase business resilience at the firm level and for an investor (HM Government, 2011a; Aldersgate Group, 2011; UNEP, 2011b). Secondly, Ortas et al. (2013) highlight the need to test the relative advantages of socially responsible investment (SRI) based portfolios during times of crisis. Answers to these questions have the potential to highlight the effectiveness of ESG markets and consequently what is needed to make them more effective and ultimately attractive for investment.

Evidence of such benefits would serve to drive the green economy agenda forward and close the gap in green funding (Ernst & Young, 2010). Therefore, this study will attempt to fill this research gap by determining whether green actions make firms more resilient and whether benefits are also transferred to the investor. To focus issues, this study will look at practices within the UK because HM Government (2011b) have expressed a specific interest in the green economy and resilience, and despite this need, no research linking financial performance with Environmental, Social and Corporate Governance (ESG) performance exists in the UK. A positive relationship between ESG performance and financial performance (the CSP and CFP link) would potentially motivate the reallocation of capital to firms that demonstrate these relatively higher green credentials. This in-turn will also motivate firms to achieve higher Environmental, Social and Corporate Governance (ESG) standards so that they can attract investment and sell products or services more effectively (Jackson, 2009).

2 Literature review

The introduction initially framed the issues that are present within the current business-as-usual economy, linking the theories and the emerging green paradigm that aims to correct these market failures. This chapter therefore examines the literature in search of research that supports these ideas of a connection between corporate social responsibility and corporate financial performance during a shock event. This potentially reinforces the claims of resilience in the model for a green economy. In subsequent chapters, the system used to test these assumptions (FTSE4good) and the findings are used to scrutinise the ESG/SRI model.

2.1 Resilience and the green economy

2.1.1 The meaning of resilience

The concept of resilience has many meanings as it is applied to multiple disciplines and risks. From a "management" perspective, Hyslop (2013) uses the term "hardened institutions" to refer to business resilience as firms are able to withstand shocks without sustaining damage. Duval and Vogel (2008 p.203) add to this by stating that "economic resilience may be loosely defined as the ability to maintain output close to potential in the aftermath of a shock". These definitions all point to the organisational resilience definition from McDonald (2006 p.157) that highlights the "ability to adapt to environmental requirements while managing its variability". Therefore, the common denominator is that a resilient firm will function effectively and profit in the face of a changing operative climate that would otherwise impact on its business had it not adopted certain principles and procedures.

Resilience can be measured by the extent to which a firm can capitalise on opportunities, maintaining or even increasing output (Goffin et al., 2013), measured by performance metrics that include sales, production levels and profits (Sheffi and Rice, 2005).

Therefore, a resilient firm would organise to:

- Protect its core business operations and resources required to function;
- Gain a competitive advantage through pre-emptive strategies; and
- Protect stakeholder values by overcoming wider risks and vulnerabilities (BRCCI, 2011).

Sheffi and Rice (2005) developed a model (Figure 2.1) that shows the stages that face a firm during a disruptive event.

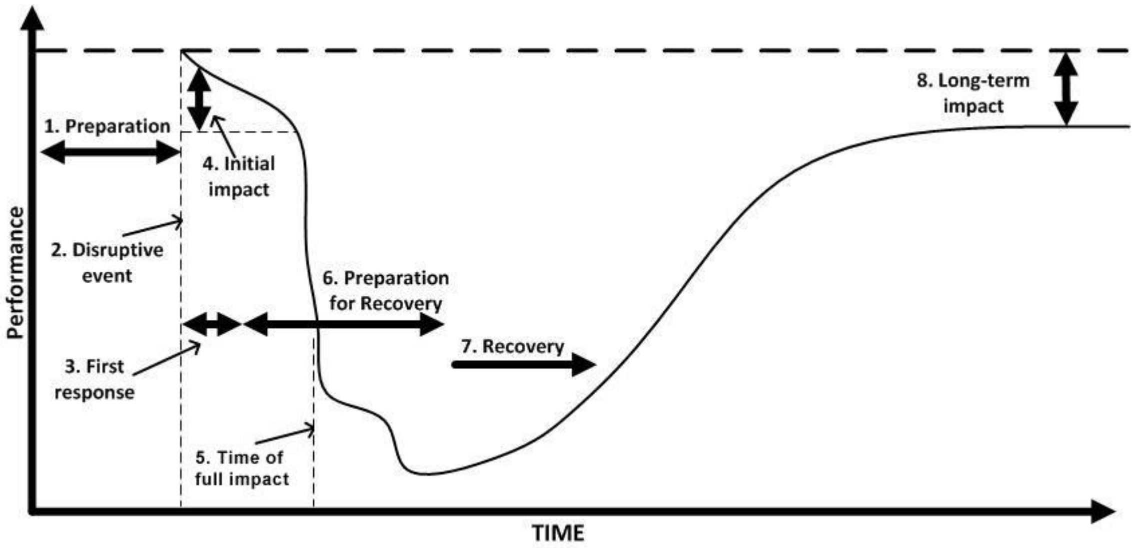

Figure 2.1. The resilience triangle: the eight stages of a disruptive event and its impact on firm performance (Source: adapted from Sheffi and Rice (2005) **by Author).**

Resilience can be inherent within a firm and/or acquired (adaptive). Inherent resilience refers to the existing ability to deal with a crisis or shock event through normal operative activity. Adaptive resilience refers to a firm's ability to adapt to its changing environment through extra effort and novelty created by pre-emptive strategies (Hutchins, 2012; Rose, 2009). Several studies have focused on the characteristics of resilient firms and one study by Ortas et al., (2013) who investigate whether the Spanish FTSE4good fosters adaptive resilience for investors. Another study by Stephenson (2010) found that organisational size and resilience performance are positively correlated. The Harvard Business Review (2012) found that family run firms outperform publicly owned firms during times of recession. Family firms focus on resilience more than performance whereas publicly owned or non-family owned firms focus on performance and, therefore, perform better during periods of economic expansion but poorer during times of economic difficulty, a finding supported by Lampel et al. (2014). An example of a non-family run company that adopts so called family run principles of resilience security is Nestle who again only perform better than competitors during periods of economic downturn (Harvard Business Review, 2012). Ortas et al (2013) looked at the resilience of the Spanish FTSE4good index, during the economic crisis, using multivariate techniques. They found that the FTSE4good index, although limited to one country, showed significant signs of resilience during the financial crisis by outperforming its base-universe of firms, the IBEX35. Conversely, an event study of German firms showed a negative effect on stock value relating to inclusion in the Dow Jones Sustainability Index (DJSI), an index of companies that demonstrate class leading ESG performance (Oberndorfer et al., 2013). Therefore, the characteristics of a firm can determine resilience performance before any strategy has been employed.

2.1.2 Linking resilience with corporate social responsibility

As noted in Chapter 1.1, UNEP and other organisations claim that the green economy will be inherently resilient and able to withstand shocks and even turn them into opportunities (HM Government, 2011a; HM Government, 2011b; UNEP, 2011b). Other organisations state the importance of building resilience is to protect vital aspects of the economy such as food supply through adaptive capacity (OECD, 2011; European Commission, 2010). The overall assumption is that if firms and economies become progressively sustainable in the face of economic, natural and man-made shocks, then productivity will also increase (Chousa and Castro, 2011). In turn resilience is also thought to foster competitiveness as collectively these benefits provide a compelling business case (Stephenson, 2010).

All firms and the industry they operate within carry inherent risks. Therefore they attempt to avoid exposure to economic and environmental risks by proactively enhancing their “business resilience” (Avery and Bergsteiner, 2011). An example of inherent resilience from a green economy perspective is that of Kenco (2013), who have established significant partnerships with coffee growers under the Rainforest Alliance (2013) programme, which promotes sustainable and ethical methods of farming while securing a direct supply of product at the local level. This initiative has social, economic and environmental benefits throughout the supply-chain, bringing resilience to shocks in the supply of Kenco's coffee and ultimately revenue (Hutchins, 2012). An example of adaptive resilience comes from Rio Tinto (2012) who state that there are a range of potential incidents that continually threaten their business, and to combat this they have adopted an adaptive approach under their Business Resilience Recovery Programme (BRRP) that recognises the presence of risk (plan); assess the level of risk and implements plans (execute); establish a tangible means to mitigate and respond (check); and review the programme for weakness. It is evident that Rio Tinto's (2012) BRRP is geared to the context of their business and any event that may impact upon it. These are examples of behavioural changes that green markets aim to foster for effective resilience performance through normal inherent activity and pre-emptive adaptive capacity (UNDESA, 2012).

Limited research exists linking environmental, social and governance performance with resilience performance. Lampel et al. (2014) found a direct relationship between governance and business performance; adding that employee involvement (that constitutes social performance) is necessary to develop higher levels of organisational resilience. Furthermore, Chousa and Castro (2011) identify corporate social responsibility and resilience as being complimentary tools that propagate the constant process of business model renewal in order that firms remain competitive beyond their products and services. Due to these synergies and benefits, CSR is thought to be a highly resilient concept in itself (Harwood et al., 2011). Porter and Kramer (2006b) highlight that CSR should not be viewed as a costly burden but a source of innovation and opportunity that provides a competitive advantage. This implied relationship between CSR and CFP is the primary driver behind this thesis.

The literature clearly intimates that firms and investors have a significant interest in swift recovery following a shock event (Anand et al., 2013; Rose, 2004). This is achieved in part through the inherent and adaptive resilience concepts (Rose, 2009). Both concepts are central to this study with the capacity for ESG based indices, portfolios and firms to resist shocks and return to normality as quickly as possible through the creation of novelty and learning (Bhamra et al., 2011). Does the market place recognise this capacity?

2.2 Does ethical and green production pay?: Evidence of resilience from ethical investments

Chapter 1.2 highlights the importance of financial markets, and the flow of invested capital in correcting market failures and driving the green economy. To address the situation and influence society and businesses, ethical financial markets have been developed. These relatively new markets are designed to give investors a choice of engaging their financial capital in securities with quantifiable environmental, social, and governance performance (Curran and Moran, 2007). Green indices focus on providing value for investors but also help promote and drive organisations to perform better within ESG based practices (Collison et al., 2008; Perez, 2011). Globally, an extensive range of indices have been released to aid in this respect (World Federation of Exchanges, 2009) with the most established being the Dow Jones Sustainability Index (McGraw-Hill, 2013) and the FTSE4good index series (FTSE, 2010b). It has been suggested that the existence of these new markets influences investors in such a way as to indirectly impact on firm capital costs (Perez, 2011). Therefore, exclusion is costly, particularly if competitors are included. Inclusion within ESG based indices and mutual funds follow a screening process that varies across administrative organisations (DJSI, FTSE4good, Domini, MSCI); initially the employment of negative screening eliminates firms from, for example, the tobacco and weapons industry. Screens are then employed to varying degrees of strictness and frequency in the areas of environmental, social or corporate governance performance, and sometimes within all areas (Barnett and Salomon, 2006). The literature indicates, however, that making economic returns on green investments is a significant challenge due to the perceived cost of adhering to environmental and social standards (Chong et al., 2006; Yang and Yao, 2012).

Fowler and Hope (2007) state that the performance of ESG securities is largely a consequence of diversification and the impact screening strategies have on performance. Barnett and Salomon (2006) support this claim with the conclusion; strategies that employ a relatively high number of social screens eliminate relatively lower performing securities. This enhances the overall performance of an index or fund. Furthermore, they found that strategies that utilised relatively few social screens improved financial performance through increased diversification. Therefore, the strategies that utilize an approach between the high and low intensity screening strategies underperform in comparison. This research was focused on the screening practices of DJSI.

During normal times of trading and considering all types of ethical securities, research suggests that performance variations compared with conventional assets are inconsistent and largely statistically non-significant (Oberndorfer et al., 2013; Collison et al., 2008; Barnett and Salomon, 2006; Chong et al., 2006; Nofsinger and Varma, 2014). Callan and Thomas (2009) found a positive relationship between CSR and financial performance but the choice of sampling interval was not disclosed despite being critical to statistical power (MacKinlay, 1997). Conversely, Oberndorfer et al. (2013) found in an event study of the relationship between inclusion in the DJSI and financial performance of German firms that a strong negative relationship exists. However, this study uses relatively old data between 1999 and 2002. Therefore, whilst there is a plethora of research into the ethical investment domain, inconsistencies are thought to be the consequence of research method variations and the strategies used to screen firms (Fowler and Hope, 2007). Inconsistencies may also be a consequence of the range of products offered by each administrative organisation, such as FTSE4good or DJSI.

For example Ortas et al. (2013) and Belghitar et al. (2014) both use the FTSE4good but their methodologies differ and their findings are contradictory. Ortas et al. (2013) found that markets viewed the Spanish FTSE4good-Ibex as a less risky option in comparison to the Ibex-35 using multivariate techniques; an approach that Belghitar et al. (2014) states misses vital moments in the distributions of the assets returns, namely skewness and kurtosis, statistics that have been proven to be fundamental to investment decisions. Belghitar et al. (2014) found that investment in the FTSE4good UK 50 carries a financial penalty. A conclusion that was made using the higher moments of index returns distributions, skewness and kurtosis. Furthermore, the majority of research is focused on mutual funds (Fowler and Hope, 2007), and the strategies used to formulate portfolios differ drastically according to the subjective view of the researcher and the available service of the index provider (FTSE4good).

The UK FTSE4good index series consists of two indices that are constructed on a bi-annual basis using ratings of every FTSE All-Share firm across the three E, S and G pillars. Within each rating category are sub-ratings that provide greater detail on each firm’s performance. The performance across the three ESG (and sub categories) pillars equates to an absolute score (FTSE, 2013a). The evidence and consequential gap in the knowledge implies that using FTSE4good offers an opportunity to test for the presence of resilience within the market place between FTSE4good constituents and non-constituents; relative to ESG performance; eliminating the subjectivity of CSR performance, using up to date data, and specifying the model accurately by using daily asset price data

2.3 FTSE4good index series

The FTSE4good index series comprise a range of regionally focused indices that cover the UK, USA, European and Global markets along with a number of benchmark only indices in Australia, Spain and Japan (FTSE, 2013b). These indices are linked to a base universe. For example the FTSE All Share Index is the base universe for the FTSE4good UK index series. All firms in the base universe, including those already in FTSE4good, are assessed by FTSE according to their predefined ESG criteria. Depending on the assessment result, firms are included in or excluded from the FTSE4good index series until the following assessment. FTSE calculates two types of index, a benchmark and tradable index. The FTSE4good Benchmark Index (FT4GBUK) is calculated to include all constituents from the base universe that meet the ESG inclusion criteria. The tradable FTSE4good UK 50 index (FT4UK50) is a published instrument that consists of the best performing firms included in the benchmark index but based on the same metrics used to assess performance in their base universe, namely market capitalisation and, therefore, may not include the best performing ESG firms from the all-inclusive benchmark population (FTSE, 2010b; FTSE, 2013a; FTSE, 2013b). FTSE4good publish the bi-annual ratings for all firms regardless of inclusion and exclusion. This data-set is central to this study.

2.3.1 FTSE4good history and performance

The FTSE4good Index Series was introduced in 2001 by FTSE with the aim of providing a resource for investors to measure the effectiveness of their investments against a recognised ESG benchmark, directing financial resources to firms and industry sectors that indicate social, economic and environmental performance and finally to motivate business to employ socially and environmentally responsible operative systems (FTSE, 2013a). The FTSE4good business model is designed to progressively challenge companies to improve their operational practices. Since launch the inclusion criteria have been revised several times, causing a number of controversial casualties (FTSE, 2011). For example, Tesco were excluded from the index because of poor environmental policy. However, given that their main competitor, Sainsbury's was included, they were determined to work with FTSE to achieve the targets required for inclusion. This was granted a year later in 2002. Since its launch, the UK index series has deleted 288 firms, added 793, with over 1000 engagements regarding the addition of new inclusion and exclusion criteria. Of the firms that have not met the inclusion criteria, FTSE has had a 60% success rate for successfully supporting companies in meeting their inclusion criteria (FTSE, 2011).

The vast majority of literature investigating the link between corporate social responsibility (CSR) and corporate financial performance (CFP) focuses on portfolios constructed on the subjective perception of corporate social performance (CSP), or other sustainability indices such as the Dow Jones Sustainability Index (DJSI) (Lu et al., 2014). Therefore, specific research into the performance of FTSE4good is sparse and largely inconsistent, as some find they perform at least as good as conventional investments (Ortas et al., 2013; Curran and Moran, 2007; Collison et al., 2008; Brzeszczynski and McIntosh, 2013); another study by Nofsinger and Varma (2014) found that while not significant, conventional mutual funds outperformed socially responsible funds by 0.67-0.95%. However, during crisis periods, socially responsible funds outperformed their conventional counterparts by 1.61-1.7%. The inconsistencies may reflect the challenges of testing the wide range of products that FTSE4good offer.

Most evidence seems to indicate that investment in ESG based indices perform as well as investment in normal indices, but rarely better (UNEPFI, 2007). Brzeszczynski and McIntosh (2013) found that returns from a portfolio composed of "Global-100" (Corporate Knights, 2013) stocks exceeded those of the FTSE4good and FTSE100 indices. Curran and Moran (2007) focused on events that influence firm value and this was centred on the impact of positive and negative announcements and public endorsement. This again showed no significant relationship between the two variables and FTSE4good firm value.

Most previous studies were conducted pre-FTSE4good and some more recent using old FTSE4good data. Furthermore, research in this area and within the UK is thin, particularly relating to FTSE4good. This is partly due to the restricted availability of FTSE4good's ratings data and access to financial markets prices because of the high subscription cost. However, FTSE4good have made this data available solely for use by the author in the current study. The lack of research and the availability of this vast dataset provide a clear opportunity to test the performance of FTSE4good firm ratings history against the very shocks it is designed to mitigate. This research will consequently use FTSE4good as a proxy to green economic performance and identify if the proposed resilient benefits are actually present within constituent firms and perceived by the market.

2.3.2 FTSE4good inclusion and exclusion criteria

Central to the aim of this research is to detect the impact of resilience, as expressed through movements in the FTSE4good indices. All companies that are included in the FTSE All-Share Index are subject to evaluation according to the FTSE4good rating framework that is based on performance within ESG (Environment, Social and Governance) criteria (FTSE & EIRIS, 2011). Inclusion in the index series is determined by an independent committee of experts that meet bi-annually to review the results of the assessment (FTSE4Good, 2012). Initially negative screening automatically excludes those companies whose business interests are primarily focused on producing tobacco, connected to the manufacturing of weapon systems, mining of uranium, and nuclear power.

Those firms that remain eligible are voluntarily scrutinised through their annual reports, websites, publicly available material and questionnaires. FTSE4good includes firms based on their scores during the assessment and only includes those that surpass an absolute score threshold (Perez, 2011). The criteria by which firms are assessed have evolved over time according to developments within corporate responsibility and policy; making inclusion progressively more difficult. This is reflected by the periodic strengthening of environmental and human rights criteria as well as the introduction of new standards (FTSE, 2010a). Each ESG criteria has two subcategories within which firms are assessed and scored (FTSE, 2010a).

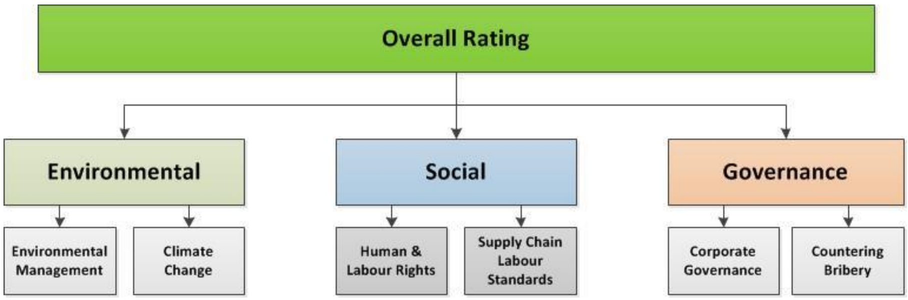

Figure 2.2. Schematic of the ESG assessment for each firm within the FTSE All-Share

The assessment aids investors in understanding the performance of firms' ESG practices as firms are rated from 0 to 5 within each area of assessment. 0 denotes no record of achievement up to the highest possible score of 5.

2.3.2.1 Environmental criteria

The first area assessed is the environment with the sub-categories environmental management, and climate change where firms are classified as high, medium or low impact according to their environmental footprint. The higher the impact, the more rigorous the inclusion criteria are. The classification process has particular nuances in that firms, such as those in financial services, might appear to be low impact but significant holdings or loan provision within certain sectors will impact on their classification. To be included in the FTSE4good all classified firms must meet a standard referred to as "good practice", which is represented by a score of 3. To score higher than 3, firms must meet additional standards referred to as "best practice". For example, with environmental management criteria, the classified firms are assessed on their 1) public policy, 2) management systems such as ISO14001 (ISO, 2014), and 3) public reporting. Therefore, the scoring framework is particular to the classification of the firm (high, medium or low). See the following table for details of the scoring framework.

Table 2.1. The environmental management scoring framework for inclusion in FTSE4good indices (FTSE & EIRIS, 2011)

	Risk Level 3 - High	Risk Level 2 - Medium	Risk Level 1 - Low
5	Meets Best Practice for all • Policy • Management Systems • Reporting	Meets Best Practice for all • Policy • Management Systems • Reporting	Meets Best Practice for all • Policy • Management Systems • Reporting
4	Meets two at Best Practice and one at Good Practice • Policy • Management Systems • Reporting	Meets two at Best Practice and one at Good Practice • Policy • Management Systems • Reporting	Meets one at Best Practice and one at Good Practice • Policy • Management Systems
3	Meets Good Practice for all • Policy • Management Systems • Reporting	Meets Good Practice for all • Policy • Management Systems	Meets at Good Practice • Policy
2	Meets one at Good Practice • Policy • Management Systems • Reporting	Meets at least one underlying indicator	Does not meet any underlying indicator
1	Meets at least one underlying indicator	N/A	N/A
0	Does not meet any underlying indicator	Does not meet any underlying indicator	N/A

Table 2.1 shows that firms classified as high risk level 3 have more requirements to achieve the same score as firms of a lower classification. Each assessment criterion follows a similar framework with minor differences that suit the challenges in question.

The next area of interest within the environmental criteria assessment is the level of risk associated with their current greenhouse gas emissions. Again, firms are organised into a risk classification and assessed accordingly. Assessments within the two environmental criteria are centred on strategies and targets for improving impacts related to their business activities. For example, within the climate change requirement for management and strategy, firms are required to make publicly available the quantifiable strategic goal for the reduction of their GHG emissions. This requirement follows a consistent theme across all other areas of assessment, namely a quantifiable measure of the firms' actual strategic activities in mitigating the issues in question.

2.3.2.2 Social criteria

Social responsibility is the second area of interest within the ESG assessment with sub-categories, human and labour rights, and supply chain labour standards. Firms are again initially assessed for risk based on their business activities and country of operation. FTSE4good have identified a list of countries that are of primary concern and highlight that the resource sector carries the highest risk of human rights abuse. Therefore, risk is classified in this regard, with level 3 or high risk being all resource based firms, and level 2 or medium risk being firms with significant operative involvement in the list of countries of concern. All others are placed in level 1 or low risk. The subsequent scoring is based again on areas pertaining to this theme such as equal opportunities, employee relations and scoring is more difficult or easier depending on the level of risk.

Connected to the issue of human rights is that of supply chain labour standards where firms are classified and assessed according to 1) the products they sell, 2) where they are sourced from, and 3) over-exposure threshold. High risk, level 3 firms fit into all three categories and include agricultural goods such as sugar, tea, and coffee; as well as consumer goods that include clothing and electronics. To be classified as medium risk a firm must fit into a combination of two risk areas identified within the high risk class. Examples of products from firms that are automatically included in the medium risk sector are bed linen, watches and electrical components. Over-exposure is determined if more than £100million is generated in sales, or a third of firms profits come from a high risk product such as sugar or tea. Once classified, the thematic metrics are then used to assess the firm's level of performance. Within this area, employment rights, working hours and wages are assessed.

2.3.2.3 Corporate governance criteria

The criteria for corporate governance measure each firm's success in countering bribery and administering a range of corporate responsibilities. Again FTSE4good classifies firms according to the risk associated with their sector and country they primarily operate in. Firms are then assessed according to the transparency of their policies, ethical codes of practice regarding equality and remuneration.

The systems used to assess the six areas of interest are consistent in their application, with classification of firms, an assessment through clearly defined good and best practice, followed by a scoring framework that is fundamentally the same throughout the assessment criteria. To the author's knowledge there is no literature that assesses the structure and validity of the inclusion criteria. Therefore, differences between the FTSE4good indices and their base universe will be in part a result of the method and criteria used to include and exclude firms.

With respect to the aforementioned concepts and the application to ESG based investment there is a significant gap in the knowledge of which there is a clear interest (Anand et al., 2013; Ortas et al., 2013; Agrawal, 2010; Scholtens and Boersen, 2011).

2.4 The efficient markets hypothesis (EMH)

The aims, objectives, research question, and subsequent event study methodology assume rationality and efficiency in the market place. This principle is central to the efficient market hypothesis (EMH) and for the event study method to hold, through significant returns, the assumption is that stock prices always reflect the information that is available to investors (Mcwilliams and Siegel, 1997). Therefore, new, unanticipated events provide new information that is incorporated into the market place. It is however reasonable to assume that on some occasion information is released to investors over an extended period, causing a delayed response, and in some cases information is not available (Hayes, 2012).

This effect is accounted for in EMH through three concepts that determine the level of efficiency. The strong form of EMH states that markets are efficient if all "privately" held relevant information is quickly and accurately reflected into the market place. The semi-strong form states that markets are efficient if all "publically available" and relevant information is priced into the market quickly. The weak form of EMH implies that future prices cannot be predicted from historic prices and as such they follow a type of random walk, independent of past prices. This does not however imply that markets are priced in constant equilibrium where no advantage is possible or that prices are even correct, it actually refers to the fact that prices accurately reflect available information (Brown, 2011). This concept is central to the success of the FTSE4good and ultimately, the part of financial markets in driving the green economy.

The empirical intuition behind the concept is that if the value of a stock or index is below or above what available information suggests it should be (inefficient), then the market would take advantage of the situation by either buying or selling the security for profit. This increased demand then alters the value of the security and accurately reflects the available information that moved it there (Hayes, 2012). In the context of this study the event generates new information for investors that is priced into the market according to relevance to the stocks and indices in question. Therefore, if FTSE4good’s screening process is effective and the market interprets FTSE4good’s “private” ratings as relevant in the valuation of stock values then a detectable and significant difference should be apparent.

3 Research aim and objectives

Given the identified gaps in the knowledge base, the aim of this research is to:

"Determine whether financial markets and constituent firms, based on ESG performance, are more resilient to shock events than their base universe."

To achieve this aim the following questions must be answered (sub-paragraphs summarise and point to the answers for each question):

- What metrics are appropriate for measuring business resilience?
    - The meaning and rationale for measurement are outlined in **chapter 2.** Resilience aims to protect firm value and financial performance is therefore a core metric.
- Given the identified metrics, what methods are most appropriate for testing whether "green" firms are resilient during shock events?
    - The method used for testing FTSE4good performance (**chapter 4**) and achieving the research aim (**chapter 3**) follows the quantitative event study approach to determine the impact of exogenous shocks on FTSE4good indices and constituent firms.
- How does the market value the FTSE4good index series during shocks?
    - **Chapter 5** compares the actual against the expected returns of the FTSE4good and FTSE All-Share during a range of shock events.
- How does the market value ESG portfolio performance during shocks?
    - **Chapter 6** compares firms that scored highest in FTSE4good respective E, S, & G assessment against those with the lowest respective scores across a range of shocks.
- How does the market value ESG performance at the sector/firm level during shocks?
    - **Chapter 7** compares firms included in FTSE4good against excluded firms, across a range of shocks but from the same industrial sector.
- Are they an attractive investment prospect? Does ethical and green production pay?
    - **Chapter 8** is a synthesis of what the results mean for green investment and what is needed to make ESG indices more effective?

4 Methodology

Chapter 4 presents the rationale behind the methodology followed by an explanation of the structure of an event study; then the event study overview that relates to the current analyses; followed by the asset selection process; and finally, the steps and calculus required to generate statistically robust results for the analysis of indices and firms.

4.1 Rationale

This study aims to determine whether FTSE4good fosters characteristics in associated firms that result in heightened performance during shock events compared with firms that are excluded or with relatively lower ESG performance. This follows the importance of resilience in protecting firm value (chapter 2); the importance of financial markets in driving a green and sustainable economy (chapters 2 & 2.2); and that event study methodology as the dominant means of testing whether FTSE4good performance results in a favourable abnormal return for investors (MacKinlay, 1997; Mcwilliams and Siegel, 1997; Aggarwal et al., 2012b). The event study market model tests whether an abnormal return in excess of an expected return is significant and therefore attributable to the event in question (section 4.7). The following figure is an illustration of the methodological design:

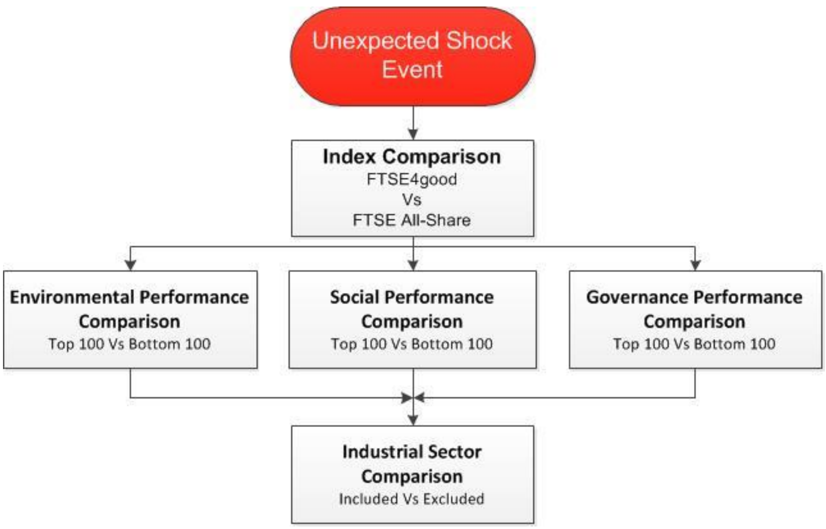

Figure 4.1. Conceptual work flow schematic of the 5 outputs derived from this research

Figure 4.1 shows the steps taken to investigate the aim starting with the UK stock market index analysis in Chapter 5 where the FTSE4good Benchmark and FTSE4good UK 50 returns are compared to the returns of the FTSE All-Share; this leads into a decomposition of the firms within the index through a financial performance comparison of portfolios organised according to environmental, social and corporate governance performance in chapter 6; lastly in chapter 7, firms are further decomposed according to industrial sector and categorised by inclusion or exclusion from FTSE4good using for example, financial services for the financial crisis. At the industry sector level, each analysis utilises firms that are specific to the event in question and some events are only analysed in one area. For example, the Deep Water Horizon explosion utilises oil and gas industry firms and the horse meat scandal is used only at the food processing and retail sector firm level. Details of these models are outlined in associated chapters. The majority of studies define their own measures of CSR performance raising issues of subjectivity (Lu et al., 2014). This is not an issue within the current study due to the adoption of FTSE4good' own assessment criteria that is empirically tested and available to stakeholders.

4.2 The event study methodology structure

A range of approaches were considered for this study, such as risk factor analysis (Fama and French, 1993), productivity, accounting measures (Choi et al., 2010) and variations of event study methodology (Sorokina et al., 2013). Risk factor measures focus on drivers of change to determine the value of the firm (Scholtens and Boersen, 2011) and Mackinlay (1997) states that productivity measures require significantly longer periods of observation and are generally ineffective in event studies owing to the risk of capturing confounding effects from other unrelated events. Accounting and Capital Asset Pricing Model (CAPM) methods were explored in-depth (see appendices C1, C2 and C3) but this approach proved inappropriate because of insufficient data, such as yearly and quarterly prices. Infrequent data diminishes accuracy and potentially captures confounding effects caused by other unknown events (Davidson and Worrell, 2003).

In the context of this study the dominant method for testing the financial impacts of specific events is the event study method (Brown, 2011). The event study method utilises stock prices to reflect the market value of a firm because the market is assumed to incorporate all relevant information and future cash flows (Sorokina et al., 2013). Event studies test for significance in the market response to an event (Anand et al., 2013; Ortas et al., 2013; Curran and Moran, 2007; MacKinlay, 1997; Mcwilliams and Siegel, 1997; Erol et al., 2010). In the current research, event studies are used to substantiate a causal link between a firm's market value and the extent to which it conforms to FTSE4good's ESG ratings. The event study methodology is useful in the application of multiple investigations as it is flexible and transcends many disciplines (MacKinlay, 1997; Graca and Masson, 2012; Krivin et al., 2003). Event studies follow a systematic procedure that can be altered according to the field of enquiry and characteristics of the event. The general process of a typical event study is to determine if the event has generated an abnormal return above or below its expected return value. Therefore, the method measures the deviation in the value of a firm or index away from its expected return as a result of an unforeseen event. In this respect the most common technique for calculating expected returns is the 'market model'.

4.3 Event study overview

4.3.1 Event selection

An event study begins by identifying key events of interest (Oberndorfer et al., 2013; Mcwilliams and Siegel, 1997); events were initially identified through a literature search of related studies the authors of which had outlined and rationalised the related timeline; the event dates were then cross-referenced with market values of the included assets to make a qualitative determination that an effect was present. Once identified, the indices were tested using the event study method to determine if any significance was present around the event. A number of events were tested and eliminated from the study (see appendices D). The remaining events used to test the FTSE4good are outlined in Table 4.1, showing the event title, start date, FTSE4good product tested, and the publications used as guidance.

Table 4.1. List of events used to test performance of the FTSE4good indices and firms

Event	Event Date	Product	Source
Financial crisis	09/08/2007	Index/ESG/Sector	(Anand et al., 2013; Ortas et al., 2013; The Guardian, 2012)
Deep Water Horizon oil spill	20/04/2010	Index/ESG/Sector	(Sabet et al., 2012; Fodor and Stowe, 2010)
Iceland Volcanic Eruption	15/04/2010	Index/ESG/Sector	(Mazzocchi et al., 2010)
Japan earthquake	11/03/2011	ESG/Sector	(Gianfreda and Scandolo, 2013; Betzer et al., 2013)
Oil price shocks	Multiple	Index	(Cunado and Perez de Gracia, 2013)
Horse meat scandal	15/01/2013	Sector	(Food Standards Agency, 2014; Kong, 2012)
US Presidential Election Results	06/11/2012	ESG	(Goldenberg, 2012)
EU ETS Prohibition Act, US (announcement)	07/06/2011	Sector	(Leggett et al., 2012; GreenAir, 2014)
EU ETS Stop the Clock on Aviation	12/11/2012	Sector	“

Events were selected based initially on the assumed magnitude of impact. Literature (shown in source column of Table 4.1) on the events in question was sought as guidance in defining the event window and interval period. Therefore, some adaptations to length of sampling periods and frequency of interval period measurements were necessary to complete an effective analysis that was consistent with the characteristics of each event. Beyond the current, general explanation of the event study methodology, the nuances associated with each event in relation to the tested variable; index, portfolio or sector/firm(s) are outlined in sections 4.4.1 to 4.4.8.

After selection, events were tested for a significant response and those non-responsive events were excluded from the analysis, the results of which can be found in appendix D. This is based on guidance from Mcwilliams and Siegel (1997), and MacKinlay (1997) who state that an event must show signs of significance to robustly determine causality with the chosen assets.

4.3.2 Estimation window and event window design

Estimating a response to an economic event requires comparison against a counterfactual scenario. The counterfactual scenario is derived by a regression between the asset in question and a reference asset throughout estimation window, which precedes the event window by up to 252 days (MacKinlay, 1997; Scholtens and Boersen, 2011; Aggarwal et al., 2012a; Aslam and Kang, 2013; Ye et al., 2013). Figure 4.2 shows the relationship between the event window and the estimation window across a time-series dataset.

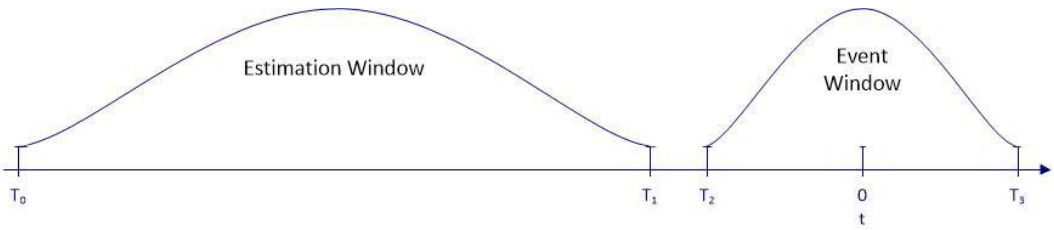

Figure 4.2. Time-line for the event study showing estimation and event window

The event window centres on the event day (t=o) with the surrounding days of T_2 to T_3. The estimation window T_0 to T_1 precedes T_2 so as not to be influenced by the event. The estimation window is used to estimate the typical stock price movements relative to a reference index (FTSE 100). These estimations are then used to forecast expected returns during the event window. The difference between the expected returns and actual returns, known as abnormal returns, are the basis of determining the degree to which the event has impacted on the respective asset.

The length of the event window and the interval periods are critical to the design of an event study so as to accurately capture all price movements caused by the event (Brown and Warner, 1985). The use of long event windows can reduce the power of certain test statistics, leading to false inferences as to the significance of an event (Karafiath, 2009). The main issue with using a relatively long window is the risk of capturing unrelated, confounding effects that may add to or diminish the investigation (MacKinlay, 1997). However, in some cases confounding effects are related to the event, and therefore a longer event window can be included to capture these known effects, as is the case with a number of studies (Ortas et al., 2013; Sabet et al., 2012; Kong, 2012). The interval periods must be designed on an *ad hoc* basis that either reflects the stages of an event or designed to capture unknown significant effects within the event window (Krivin et al., 2003). Regardless of event window length, a robust estimation of impacts can be established through short interval periods that reflect different stages of an overall event. The event window can include days before the event in circumstances where the event is not entirely unexpected, such as class action law suits for insider trading. Where an event is considered to be entirely unexpected, such as a terrorist attack, then the event window usually begins with the event day [0] as they are unexpected and thus exogenous to investment decisions (Scholtens and Boersen, 2011; Krivin et al., 2003). Therefore, in accordance with the literature the event window time frequencies vary according to the characteristics of the shock as per the literature identified in Table 4.1. Interval period estimations are calculated within the event window to determine when the impact is priced into the market. For example, an event window of 0 to 15 days may consist of intervals [0, 2], [3, 9], [10, 15] (Ortas et al., 2013; Sabet et al., 2012).

The investigations focus on a comparison of multiple assets, where, during each event the testing framework remains the same for each index, portfolio of firms, and industry grouped firms. For example, the testing framework for the financial crisis uses the same market model, estimation window, event window, and intervals for the index, portfolio and industrial sector analysis. The following sections outline the estimation and event window lengths that are unique to each event. Below is an overview (Table 4.2) of the time frame for each event that includes an event identifier, estimation window and event window length; the timeframes reflect the event characteristics from the identified literature outlined in Table 4.1.

Table 4.2 Event study time frames for estimation and event windows

Event	Estimation Window (days)	Event Window (days)
Financial Crisis	252	50
Deepwater Horizon Oil Spill	252	50
Japan Earthquake & Tsunami	252	10
Iceland Volcanic Eruption	252	6
Oil Price Shocks	241	5
Horse Meat Scandal	252	50
US Presidential Elections	252	6
EU ETS Prohibition Act	115	15
EU ETS Stop the Clock	115	4

The tests of significance are central to the aims of this study (chapter 4.7) therefore, only periods with at least one significant abnormal return are ranked. The collection of ranked periods provides a performance classification between the indices, portfolios and sector based firms. The rankings are then tested for significance using Friedman's Chi-squared test (see chapter 4.8). Given that ranking return performance will miss information relating to magnitude and volatility, descriptive statistics are generated to provide greater insight and potential differentiation between the included assets.

4.4 Event description and design

Event window and estimation window days reflect working days only, therefore weekends and holidays are excluded as is the case in the financial price data for all asset classes.

4.4.1 The financial crisis of 2007/2008

With guidance from Ortas et al (2013), Agrawal (2010) and the financial crisis time line published by The Guardian (2012), it was possible to configure an event window and interval periods that reflect the land mark occasions of the financial crisis. The first confirmation of the crisis started with the announcement by BNP Paribas of significant liquidity issues. This confirmation was reinforced by actions from the European Central Bank (ECB), United States Federal Reserve Bank (US Fed), and the Bank of England (BOE) as they injected liquidity into capital markets and cut interest rates in an effort to boost the economy (The Guardian, 2012). The restrictions on interbank lending also indicated significant difficulty in the financial environment reinforced by the run on UK bank, Northern Rock at which point the BOE stepped in with financial support. These events are all indicative of the crisis as a whole and integral to the design of the event window and interval periods. The event window covered 50 days from the BNP Paribas announcement on 9/8/2007 and consists of the following periods and associated characteristics:

Table 4.3. Financial crisis periods with corresponding dates and description

Period	Date	Description
[0, 50]		Event window – accumulation of all events
[0]	09/08/2007	Event start - BNP Paribas announce significant liquidity issues
[0, 5]	09/08/2007	ECB liquidity injection in capital markets
[6, 16]	17/08/2007	US FED cuts rates – seen as warning of threat to growth
[17, 24]	04/09/2007	Interbank lending rate at highest since 1998
[25, 28]	14/09/2007	Run on Northern Rock – first in 150 years as BOE steps in.
[29, 50]	18/09/2007	FED cuts rates and BOE injects capital

A 50 day window was used to capture the different stages of the crisis. Within the event window, the impact of landmark occasions is captured through relatively shorter interval periods. Despite being a financial event with an element of predictability it is well publicised that the crisis was globally unexpected and, therefore, the event window begins with the event day [0]. The response to the financial crisis was tested using the event study abnormal returns of FTSE4good indices against the returns of the FTSE All-Share, the base universe from which firms are selected; followed by an analysis of portfolios of the top and bottom 100 firms classified according to their FTSE4good based Environmental, Social, and Corporate Governance performance; finally a sector analysis of 50 Financial services firms included in FTSE4good compared to the financial performance of 31 excluded firms.

4.4.2 Deep Water Horizon oil spill in the Gulf of Mexico

The unexpected oil spill caused by the BP plc owned Deep Water Horizon rig explosion was taken as an environmental event. The works of Sabet et al. (2012) follow a case wise event study analysis of individual firms directly linked to the incident (almost entirely US based firms and their inclusion is therefore not applicable to a UK based study). They also provide a detailed timeline of the event, and this provides the framework for the design of the event window and subsequent periods. The study by Sabet et al. (2012) highlights the delayed response to the incident due to a shortage of information. Consequently, financial markets did not comprehend the magnitude of the event until 29/04/2010, seven days after the announcement of the incident by BP on 22/4/2010. The delayed response was blamed on the location of the rig and the initial curtailment of information. However, as time went on and the magnitude of the event grew, information via the US government then took precedence in the valuation of financial markets. At the time of the event, BP was included in the FTSE4good, and therefore BP's value may have had an impact on the value of the assets. The timeline given in Table 4.4 also includes a government moratorium on drilling in the Gulf of Mexico and statements of intent by US president, Barak Obama; both of which threaten to alter the operative and subsequent economic environment of the industry:

Table 4.4. BP oil spill event window and interval periods with corresponding dates and impact description

Period	Date	Description
[0, 50]		Event window
[0]	20/04/2010	Rig explosion
[2, 6]	22/04/2010	BP announcement 2 days after the incident
[7, 25]	29/04/2010	Recognition of the incident by financial markets
[26, 34]	27/05/2010	First moratorium on oil drilling in Gulf of Mexico
[35, 50]	09/06/2010	President Obama statement on responsibility for incident

The intervals shown in Table 4.4, aim to prove that firms included in FTSE4good, with relatively higher ESG credentials, are favourable to investors in light of the issues associated with this event. For example, it could be expected that the severity of the statements by president Obama would be considered a negative for non-FTSE4good-firms relative to the value of firms included in FTSE4good. Therefore, if the aforementioned is found then FTSE4good and derived portfolios/firms would provide resilience against an unexpected shock of this type. The estimation window for this event was 252 days immediately preceding the event window. The Deep Water Horizon event was used to compare the returns of the FTSE4good indices against the returns of the FTSE All-Share index; portfolios of the top and bottom 100 firms in terms of FTSE4good Environmental, Social, and Corporate Governance performance; followed by an analysis of firms from the oil and gas (with and without BP plc), and alternative energy sectors that were included and excluded from FTSE4good.

4.4.3 Japan earth quake of 2011

The Japan earth quake and subsequent nuclear disaster generated a number of widespread impacts in the supply of goods and services as well as a political sea-change on the risks associated with nuclear power generation in Germany and Europe (Betzer et al., 2013). Many of the studies that focus on localised impacts use an event window of up to +30 days, but because of the distance between Japanese and UK markets, associations are diminished relative to firms that are more localised to Japan; furthermore there is a risk of detecting other events so a short event window of [0, 10] was used, as is the case in the short window scenario study by Gianfreda and Scandolo (2013). The aforementioned studies and works of Herold and Muck (2012), and Lopatta and Kaspereit (2014) were used to develop the time line for the event window periods that begin with the earthquake and tsunami that caused substantial damage to Japan’s eastern coastline and nuclear power facilities. The subsequent nuclear reactor leak caused Germany to announce that they were cancelling their nuclear energy programme. The time-line is outlined in Table 4.5.

Table 4.5. Japan earth quake event window and interval periods with corresponding dates and impact description

Period	Date	Description
[0, 10]		Event window
[0]	11/03/2011	Event day – Earth quake & nuclear reactor damage
[0, 3]	11/03/2011	Event day and following week (excludes weekend)
[1, 5]	14/03/2011	Monday and the first full week of trading
[6, 10]	21/03/2011	Second trading week following disaster

The event was tested for a significant impact using the indices but only the portfolios and relevant sectors showed evidence of an effect, therefore the index analysis is not included in this study but the results are available in appendix D. The portfolios were classified using FTSE4good ESG ratings history, comparing the financial performance of the top and bottom 100 in each respective pillar; for the sector based analysis 2 included firms from the power utilities sector were compared to 3 excluded firms due to the impact relating to the reactor leak and the subsequent announcement by Germany; for the technology hardware and equipment sector 6 included firms were compared to 5 excluded because of Japan’s prominence in the technology manufacturing field.

4.4.4 The 2010 eruption of the Eyjafjallajökull volcano in Iceland

The eruption of the Icelandic volcano, Eyjafjallajökull, generated an unexpected cloud of ash that moved over Europe causing widespread disruption to UK and EU airspace (Miller, 2011). The impacts this event had on the European airline industry have been tested using event study methodology by Mazzocchi et al (2010); who tested the effect the event had on the share price of European airlines and a counterfactual group of land based travel firms who were thought to have gained from the event. This study and news reports provide the basis for developing a timeline needed for the event window. The event window and periods that match the characteristics of the event are outlined in the Table 4.6:

Table 4.6. Iceland volcanic eruption event window and interval periods with corresponding dates and impact description

Period	Date	Description
[0, 6]		Event window
[0]	15/04/2010	Event day – Eruption of volcano
[0, 1]	“	Eruption to closure of airspace
[2, 6]	19/04/2010	Re-opening of EU Airspace - Recovery period

The reasons for the length of the event window were twofold; firstly the literature suggests that the value of effected firms returned to normality within a week of the disaster as EU airspace reopened on 19/04/2010 (Mazzocchi et al., 2010; Miller, 2011); secondly, the BP oil spill in the Gulf of Mexico occurred soon after the event with its effects showing up in financial markets 14 days after the volcanic eruption in Iceland. Therefore, a larger event window would include an un-associated confounding event. The Iceland volcanic eruption event was used to test the FTSE4good indices against the FTSE All-Share index; and portfolios of the top and bottom 100 firms in terms of FTSE4good’ Environmental, Social, and Corporate Governance performance; followed by a sector comparison between 2 included and 2 excluded travel and tourism firms with the inclusion of 6 land based travel firms that Mazzocchi et al (2010) found to benefit significantly from the event.

4.4.5 Oil price shocks

Fuel usage and efficiency are a fundamental aspect of the green economy. Therefore, oil price movements were used to determine if FTSE4good performance was relevant in the valuation of constituent firms. To account for an event, daily changes in the price of Brent Crude oil ($/brl) that exceeded 5% (40 events) and -5% (34 events) since the start of FTSE4good (2001) were classified as shocks in-line with studies by Aggarwal et al. (2012a) and Mohanty et al. (2013), an approach that was taken to clearly distinguish between extreme positive and negative price movements. To account for a lagged response between the event and the assimilation of information by markets, an event window of [0, 5] and interval periods [0], [1], [0, 1], [0, 2], [1, 3], [2, 4] and [2, 5] were used to determine a mean effect across positive and negative oil price movements. The estimation window of 241 days preceded the date of the first oil price shock, which was positive on 16/12/2002. Theoretically, firms included in FTSE4good should be viewed as less risky than excluded firms due to their environmental, climate change performance in reducing CO_2 emissions that is consequently related to increases in multiple fuel efficiencies (Chen and Hu, 2012).

4.4.6 Horse meat scandal of 2013

During January 2013, the Food Standards Authority of Ireland (FSAI) found evidence of horse DNA in unrelated food products (Food Standards Agency, 2014). This prompted the UK Food Standards Agency (FSA) to conduct investigations that also revealed evidence of horse DNA in unrelated food products. The presence of unidentified food ingredients raised questions regarding the origin and safety of the ingredients and whether they posed a risk to consumers. The impact of this event on firm value remains untested and therefore is useful in testing the markets perception of FTSE4good performance and whether it is relevant in valuing firms accordingly. A similar study by Kong (2012) looked at the impact of melamine contamination in the Chinese food chain and whether markets valued firms with Corporate Social Responsibility (CSR) attributes favourably during this period. Findings from this study indicates that interest in the level of CSR activity increased compared to pre-event levels; suggesting that CSR can influence investor behaviour. This study and the timeline by the Food Standards Agency (2014) align with the framework required to test the value of FTSE4good over the horse meat scandal. An index response was tested but eliminated from the study due to insignificance and inverse trending (see appendix D). The interval periods are presented below in Table 4.7

Table 4.7. Horse meat scandal event window and interval periods with corresponding dates and impact description

Period	Date	Description
[0, 50]		Event window – 50 working days
[0, 1]	15/01/2013	FSAI & FSA announce possible horse DNA contamination
[18, 21]	08/02/2013	FSA announces risks associated with possible presence of Bute
[22, 24]	14/02/2013	Arrests made by police & Bute test results published
[25, 26]	19/02/2013	FSA publishes report on scandal
[27, 31]	21/02/2013	Test results published & firms withdraw food from sale
[32, 37]	28/02/2013	Details of FSA sampling programme revealed
[38, 50]	08/03/2013	FSA lifts ban on major slaughter house and test results revealed

The interval periods reflect the major landmark findings and characteristics of the event (Food Standards Agency, 2014). This framework should allow for accurate tracking of firm price movements. The estimation window for this event is 252 days before the event window. The horse meat scandal was used to compare the FTSE4good indices against the FTSE All-Share index and the portfolios but without the presence of a significant return. Therefore, the event was used only at the firm level where the financial performance of 7 included food producing and retail firms was compared to that of 6 excluded firms.

4.4.7 US Presidential elections of 2012

After the BP oil of 2010 and its ongoing economic impact, environmental protection was high on the electoral agenda within these elections (Goldenberg, 2012). The results were announced on 6 November 2012 to which markets responded globally to differing degrees. Therefore, the event window for this study is dictated by a preliminary investigation to the market response following the announcement. An investigation showed that a majority of markets hit a post announcement low after two days followed by a full recovery in 4/5 days. Therefore the event for the event study was [-1, 5] with internal periods of [-1, 1], [0, 1], [0, 2], [0, 3], [0, 5] and [2, 5] with an estimation window of 252 days. Presidential candidate Mitt Romney was cited as losing the election to Obama because of his stance against climate change (Zelman, 2012) and consequently the markets perception that a win for Obama may bring a relatively stronger environmental policy stance; particularly in light of the events surrounding the Deepwater Horizon Oil spill (Semeniuk et al., 2012; Humphries et al., 2012).

4.4.8 The EU Emissions Trading System

The European Union Emissions Trading System (EU ETS) was introduced in 2005 to reduce the level of greenhouse gas emissions from European industry through a “cap-and-trade” based system. The system was introduced in three stages with increasing degrees of stringency starting with Phase I (2005 – 2007), Phase II (2008 – 2012), and Phase III (2013-2020) (Zhang and Wei, 2010). Jong et al (2014) used an event study approach to determine if the EU ETS compliance announcement was relevant in the valuation of firms that participate within the system. This study focused only on a single period in 2006 and found that share prices increased as a result of falling allowance prices and increasing allowance holdings. Therefore, this study provides a useful framework and comparison for testing the impact of the EU ETS on the value of FTSE4good firms over the three EU ETS phases and the US Prohibition ACT of 2011 (passed into law by US President Obama on 27/11/2012). No significant returns were detected around the three phases of the EU ETS. Therefore, these events were excluded from the study. Furthermore, only sector based returns were significant in response to the EU ETS Prohibition ACT and the EU ETS “Stop the Clock” event.

The Prohibition ACT of 2011 was passed to prohibit US aircraft from participating in the EU ETS and subsequently prompted the exclusion of aviation from the EU ETS under the “stop the clock” agreement (Leggett et al., 2012). To understand if the market recognised the event in valuing firms differentiated according to inclusion and exclusion within FTSE4good, an event study was conducted testing market response to the announcement by the Air Transport Association of America (ATA) to propose government backed legislation, prohibiting American airlines from participating in the EU ETS on 06/07/2011 (GreenAir, 2014). For the prohibition act event study the event window [0, 15] included the day before the event to determine accuracy. A longer event window was inappropriate as this would impact on statistical robustness owing to the risk of detecting other firm specific events because of the small sample size of firms. The estimation window was 115 days before event window.

Following the Prohibition Act and global disagreement against paying the EU ETS aviation charges, the European Commission announced intention to only include intra-European flights within the system. Informally referred to as ‘stop the clock’, all flights originating from and landing outside of the EU are excluded until 2016. The announcement was made on 12/11/2012 and was viewed as weakness by the administrators that may affect the entire scheme (Buyck, 2014). A four day event window was used to mitigate the impact of confounding effects in line with jong et al (2014). The event window includes the previous trading day to determine if the market prices the announcement in earlier than the event day, identifying potential leaks of information. The event window was defined as [-1, 3] with interval periods [-1, 0], [0], [0, 1] and [1, 3]. This event was used to test firms classified by FTSE4good under the industrial sector with a sample of 58 included firms and 39 excluded.

4.5 Firm and index selection criteria

The two FTSE4good indices used for analysis consist of a tradable index (FTSE4good UK 50) and benchmark index (FTSE4good UK Benchmark). Constituents are only added to the FTSE5Good if they pass the predetermined environmental, social and governance (ESG) criteria set by FTSE4good. Therefore, the FTSE4good Benchmark index includes all FTSE All-Share firms that meet the required ESG criteria and the FTSE4good UK 50 comprises the top 50 performing (in terms of market capitalisation) firms that have passed the criteria (FTSE, 2010a). The difference between the two FTSE4good Indices and the FTSE All-Share should therefore represent the difference in performance of firms that meet FTSE4good inclusion standards and those that do not.

Data for all indices and constituent firms were collected from 2001 (the launch of The FTSE4good index series), to 2013 (most recent available data). Daily market prices were downloaded from Thomson Reuters (2013) DataStream service.

4.6 Normal and abnormal return measurement

The measure of abnormal returns (AR) is central to event study methodology. The abnormal return is the difference between the return within the event window for a given index or firm (daily/actual return) minus the expected return of a counterfactual scenario, which is determined using a regression model (known as 'the market model') during the estimation window. The expected return must be defined during the event window through an out of sample estimation. The price data for all indices and firms can be found in appendix E and F.

Price Index (PI) was used as an indicator to calculate returns, as this is the standard data type for equities and represents the price of the equity or asset as a percentage of its value set at 100 percent on the base date that is set by the exchange and remains constant for all data. Productivity measures, such as return on assets (ROI), sales or value added, are an alternative to the use of financial securities. However, Mackinlay (1997) states that productivity measures require significantly longer periods of observation and are generally ineffective in event studies. Price index is calculated as follows:

$$I_t = I_{t-1} * \frac{\sum_1^n (P_t * N_t)}{\sum_1^n (P_t - 1 * N_t * f)} \quad \textbf{(4-1)}$$

Where:
I_t = index/firm value at day t
I_{t-1} = index/firm value on previous working day (of t)
P_t = unadjusted share price on day t
$P_t - 1$ = unadjusted share price on previous working day (of t)
N_t = number of shares in issue on day t
f = adjustment factor for a capital action occurring on day t
n = number of constituents in index

After collecting PI data it was possible to calculate **Daily Returns (DR),** which is the percentage change in the Price Index (PI) between the close of the current day minus the close of the previous day using the following calculation:

$$(R_{i,t}) = [(\frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}})]*100 \quad \textbf{(4-2)}$$

Where:
$R_{i,t}$ = daily return of an index/firm
$P_{i,t-1}$ = previous day value of an index/firm
$P_{i,t}$ = current day value of an index/firm

Using the daily returns it is then possible to calculate **Abnormal returns (AR),** which is the difference between the daily percentage changes (previous equation) in the Price Index (PI) between two indices, portfolios, or a constituent firm and market:

$$AR_{i,t} = R_{i,t} - E[R_{i,t}|\Omega_{i,t}] \quad \textbf{(4-3)}$$

Where:
$AR_{i,t}$ = abnormal return of an index/firm
$R_{i,t}$ = actual daily return of an index/firm
$E[R_{i,t}]$ = expected daily return of an index/firm
$\Omega_{i,t}$ = standard error of an index/firm

Where: $R_{i,t}$ is the daily return for index/firm i_i on day t and $E[R_{i,t}]$ is the expected return generated from the market model on day t using ordinary least square parameters (α_i and β_i) of the regression between $R_{i,t}$and $RM_{i,t}$ during the preceding estimation window. The expected return or otherwise known as the normal return is unconditional to the event but conditional to the off sample regression parameters of the estimation window.

Following the calculation of the AR for each index or firm it is also useful to aggregate the abnormal returns to gain an overall assessment of the impact throughout the event window rather than just single days. This requires the calculation of Cumulative Abnormal Returns (CAR) for each period of interest within the event and the event window as a whole. For multiple observations the abnormal returns and cumulative AR can be averaged across the sample to produce average abnormal returns (AAR) for each day and cumulative average abnormal returns (CAAR) for periods with multiple days. The following section highlights the calculations required to complete the event study in-line with this framework.

4.7 Event study using the Market Model

The first step in an event study is to calculate the daily returns for the included indices and firms using the equation (4-2). Next, the estimation of how the expected returns vary according to changes in the daily returns of a benchmark market was calculated using the market model. The counterfactual index for the market model was the

FTSE100, applied during the estimation window, using ordinary least square (OLS) parameters that include the intercept (α) and slope (β).

The regression parameters of the following regression model were applied to each day in the event window to generate the expected return:

$$[E]R_{i,t} = \alpha_i + \beta_i R_{i,t} RM_{i,t} + \varepsilon_{i,t} \qquad \textbf{(4-4)}$$

Where:
$E[R_{i,t}]$ = expected daily return of index/firm
α_i = intercept of index and return model
β_i = slope of index/firm and return model
$R_{i,t}$ = daily return of an index/firm
$RM_{i,t}$ = daily returns of return model index
$\varepsilon_{i,t}$ = error term of index/firm

The expected return $E[R_{i,t}]$ is derived from the regression of index $R_{i,t}$ and market model index $RM_{i,t}$ (benchmark) daily returns on day t with $\varepsilon_{i,t}$ as the error term. The linearity of the model assumes daily returns are normally distributed. This method is seen as the best way to assess market response as other proposed methods that assess volatility, such as GARCH models, are focused more on determining drivers of an event (Scholtens and Boersen, 2011). From the estimates of the market model, daily abnormal returns $\mathrm{AR}_{\mathrm{i,t}}$ for the index/portfolio are calculated using the equation (4-3). Using the daily abnormal returns, the cumulative abnormal returns (CAR) during each interval (i.e. [0, 20]) within the event window are then estimated as follows:

$$\mathrm{CAR}_{\mathrm{i(T1,T2)}} = \sum_{t=T1}^{T2} \mathrm{AR}_{\mathrm{I,t}} \qquad \textbf{(4-5)}$$

Where:
$\mathrm{CAR}_{\mathrm{i(T1,\,T2)}}$ = cumulative abnormal return of index/firm
$T1$ = return of an index/firm at start of interval
$T2$ = return of an index/firm at end of interval
$\mathrm{AR}_{\mathrm{i,t}}$ = abnormal return of index/firm at time t

The sum of abnormal returns $\mathrm{AR}_{\mathrm{i,t}}$ over the start of the interval ($T1$) to the end of the interval ($T2$) generates the cumulative abnormal returns (CAR) for the interval within the event window. When multiple events/indices/firms are accumulated then the following estimation is required for average abnormal returns (AAR):

$$AAR_{i,t} = \frac{1}{N}\sum_{i=1}^{N} AR_{i,t}$$ **(4-6)**

Where:
$AAR_{i,t}$ = daily average abnormal return of portfolio
$\mathrm{AR_{it}}$ = abnormal return of index/firm at time t

Then, to calculate the cumulative average of the abnormal returns (CAAR) across time yields the following estimation is required:

$$CAAR_{i,}(t_1, t_2) = \frac{1}{N}\sum_{i=t_1}^{t_2} AAR_{i,t}$$ **(4-7)**

Where:
$CAAR_{i,t}$= daily average abnormal return of portfolio
$AAR_{i,t}$ = daily average abnormal return of portfolio

To test the significance of the AR values a parametric t-statistic or z-statistic was utilised along with the event study specific, non-parametric Corrado rank test (Corrado, 1989) and Boehmer et al. (1991) cross sectional test for each day surrounding the event and the cumulative abnormal returns, at a significance of 1%, 5% and 10% in-line with other event studies (Scholtens and Boersen, 2011; Graca and Masson, 2012). Significance is determined by the assumption that under the efficient markets hypothesis (Hayes, 2012; Salameh and AlBahsh, 2011) an unanticipated event will be priced into the market either immediately at the time of the event or soon after representing the strong and semi-strong interpretation of the efficient markets hypothesis. The t-statistic is the preferred measure of significance when there are fewer than 30 observations (n=<30) such as in the index analysis (Gujarati, 2011). The t-test for abnormal returns is calculated as follows:

$$AR_{i,t}\mathrm{t-Statistic} = \frac{AR_{i,t}}{\sigma_{\epsilon}}$$ **(4-8)**

Where:
$AR_{i,t}$ = abnormal return of index/portfolio/firm
σ_{ϵ} = standard deviation of estimation window abnormal returns

The t-test for cumulate abnormal returns is based on the following:

$$CAR_{i,t}\text{t} - \text{Statistic}(t_1 t_2) = \sum_{t=t_1}^{t_2} \frac{AR_{i,t}}{\sigma_\epsilon} \quad \textbf{(4-9)}$$

Where:
$CAR_{i,t}$ = cumulative abnormal return of index/portfolio/firm interval
σ_ϵ = standard deviation of estimation window abnormal returns

The standard deviation is calculated from the abnormal returns derived from the estimation window and are calculated as follows:

$$\hat{\sigma}^2_{ARi} = \frac{1}{M_i - d} \sum_{t=Est_{min}}^{Est_{max}} (AR_{it})^2 \quad \textbf{(4-10)}$$

Where:
$AR_{i,t}$ = abnormal return of index/portfolio/firm
σ_{ARi} = standard deviation of estimation window abnormal returns

M_i refers to the number of observed returns within the estimation window and d are the degrees of freedom within the market model.

Where samples are greater than 30 (n=>30), such as in the firm level analysis, then the z-statistic is used. The calculation for the z-statistic is based on the following equation:

$$z = \frac{1}{\sqrt{n}} \sum_{j=1}^{N} \left[\sum_{t=t_1}^{t^2} \frac{AR_{i,t}}{\sqrt{Var \sum_{t=t_1}^{t^2} AR_{i,t}}} \right] \quad \textbf{(4-11)}$$

Where:
t_1 = first day of the interval period
t_2 = last day of the interval period
N = number of observations

The z and t statistics assume that the data are independently sampled and normally distributed. The data was tested in this respect and the results are shown in Appendices C3. If samples depart from the assumptions of independently sampled and normal distribution but sizes are large enough, then both tests will be robust (Gujarati, 2011). Significance is based on confidence intervals, and extent to which the AR, AAR, CAR and CAAR can be attributed to the event (Rumsey, 2003).

Table 4.8. Confidence intervals for z & t test of significance in the abnormal returns

Percentage Confidence	t & z-statistic confidence levels	p-values	Significance identifier
90%	1.64	p<0.1	*
95%	1.96	p<0.05	**
99%	2.58	p<0.01	***

For non-parametric testing, the Corrado rank test allows for non-symmetry in the distribution of the returns and has proven power over the parametric tests for single-day and short-term daily abnormal returns (Kolari and Pynnonen, 2011). Its inclusion allows for a robust estimation of the significance in the AR values beyond parametric testing and was formulated specifically for use in event studies (Bailey et al., 2006; Fidrmuc et al., 2006)

$$CORRADO\ RANK = \sum_{i=1}^{N} K_{it}/(m+1) \qquad \textbf{(4-12)}$$

Where:
K_{it} = rank of the excess return
N = number of included securities
m = number of non-missing returns

The Corrado rank test tests whether the average abnormal returns are equal to zero. The ranking of returns is determined asset by asset during the estimation and event windows, the time series of which are transformed into their respective ranks. Within the sector based analysis there is a risk of cross-sectional dependence in clustered market-model returns around the event date because the firms originate from the same industry (Brown and Warner, 1985). However, Boehmer et. al (1991) find that their standardised cross-sectional test is robust for clustering caused by same sector firms and is therefore useful in testing the significance of the sector and firm level returns in chapter 7. The specification of the test is as follows:

Initially the returns are standardised under the following specification:

$$S(CSAR_i) = \sqrt{(t_2 - t_1 + 1)\frac{M_i - d}{M_i - 2d}} \qquad \textbf{(4-13)}$$

Where:
$S(CSAR_i)$ = Standardised cross-sectional abnormal return
t_1 = First day of the interval period
t_2 = Last day of the interval period
M = Characteristics of i observation (regression)
d = Degrees of freedom

The cross-sectional average of the CSAR must then be calculated as follows:

$$\overline{CSAR}_{(t_1,,t_2)} = \frac{1}{N}\sum_{j=1}^{N} CSAR_i(t_1, t_2) \quad \textbf{(4-14)}$$

Where:
$\overline{CSAR}$ = Cross-sectional abnormal return abnormal return
t_1 = First day of the interval period
t_2 = Last day of the interval period
N = Number of included securities
d = Degrees of freedom

The standard deviation of $\overline{CSAR}$ must then be estimated from the cross section of the event window abnormal returns, shown in the following specification:

$$S(\overline{CSAR}) = \sqrt{\frac{1}{N(N-1)}\sum_{j=1}^{N}[CSAR_i(t_1, t_2) - \overline{CSAR}_{(t_1,,t_2)}]^2} \quad \textbf{(4-15)}$$

Where:
$S(\overline{CSAR})$ = Standardised cross-sectional abnormal return
t_1 = First day of the interval period
t_2 = Last day of the interval period
N = Number of included securities

Finally the standardised cross-sectional test statistic for the null hypothesis that the CAAR are equal to zero is calculated as follows:

$$T_{Boehmer\ et.al} = \frac{\overline{CSAR}_{(t_1,,t_2)}}{S(CSAR)} \quad \textbf{(4-16)}$$

Where:
$T_{Boehmer\ et.al}$ = Standardised cross-section test
$S(\overline{CSAR})$ = Standardised cross-sectional abnormal return
$\overline{CSAR}$ = Cross-sectional abnormal return abnormal return
t_1 = First day of the interval period
t_2 = Last day of the interval period

The test statistics are applied to the returns of each index, portfolio or sector to verify whether the event has a statistically significant and therefore causal impact on the assets. Large values do not automatically qualify as significant as the test relies on historical variance within the estimation window to determine if the abnormal return within the event window is significant

4.8 Performance ranking and descriptive statistics

To gain an overall indication of FTSE4good performance, periods that contain at least one statistically significantly abnormal return was selected. Then, the abnormal returns during each period and for each counterpart asset (index, portfolio, and sector) were ranked according to their deviation away from the expected return. The rank for each asset across all periods was then aggregated to determine the number of times each asset was placed in a particular position. The following table is an example of the process for ranking periods with significant returns within a single asset class and before significance testing and descriptive statistics are generated.

Table 4.9 Example of environmental portfolio ranking using returns for each portfolio

Abnormal Returns		**Portfolio Ranking**	
TOP 100	BOTTOM 100	TOP 100	BOTTOM 100
-11.42%	-5.21%	2	1
-1.08%	0.61%	2	1
2.42%	0.30%	1	2
0.14%	-0.44%	1	2
-0.70%	-0.15%	2	1
-1.49%	-2.41%	1	2
-0.97%	-1.44%	1	2
2.41%	1.17%	1	2

Rank Descriptive Statistics		
	TOP 100	BOTTOM 100
1st	5	3
2nd	2	6
Mean	1	2
Count	8	8

Using the ranking results, a Friedman test (Friedman, 1937) was conducted to determine the asymptotic significance (Xr^2 = Chi-squared) of the rankings. A Friedman test is a non-parametric test for a significant difference between random variables and is calculated through the following specification:

$$Xr^2 = \frac{12}{np(p+1)} \sum_{j=1}^{p} (\sum_{i=1}^{n} rij)^2 - 3n(p+1) \qquad \textbf{(4-17)}$$

Where:

p = Number of columns

n = Number of rows

r_{ij} = rank in row i and column j

The significance of the ranking confirms if the difference in performance, indicated by significant abnormal returns (AR, CAR), is the result of the markets recognition of FTSE4good ESG performance. The ranking method highlights consistency in performance but does not accommodate for the magnitude and distribution of each assets abnormal returns and the use of descriptive statistics accounts for this limitation. Also, where rankings are non-significant, the use of descriptive statistics provides deeper insight into the performance of each respective asset, as the ranking method fails to identify periods with substantially different returns. The descriptive statistics explain the distribution and main characteristics of the returns that provided either an increase or decrease in valuation. In line with Belghitar et al. (2014) the kurtosis and Skewness statistics are highlighted as important moments as investors have a preference for assets with positive Skewness and high kurtosis, and an aversion to negative skewness coupled with high kurtosis (Post et al., 2008; Dittmar, 2002). The following three points focus the aim of the study in determining the final conclusion; firstly the assets are tested across each event using the event study market model; secondly, each assets return (AR, AAR, CAR, CAAR) is ranked across all events; lastly the characteristics of the returns are defined using descriptive statistics.

A complete set of the ranking and descriptive statistics can be found in appendix G.

4.9 Limitations

Event studies assume the rationality of the market, in-line with the efficient markets hypothesis (EMH) (Hayes, 2012). This assumes that the information arising from an event in relation to the information from FTSE4good is reflected promptly in the price of the asset (MacKinlay, 1997). However, if private information held by FTSE4good is unavailable to the extent that it is able to generate a significant difference in the market, the market would be inefficient in the strong EMH form as private information is not accurately and fully priced into the market (Hayes, 2012; Fama, 1965).

Event studies use abnormal returns above or below the expected return in a counterfactual scenario, this takes into account, market, and idiosyncratic (firm specific) risk (MacKinlay, 1997; Scholtens and Boersen, 2011). This may not happen in reality for the index and portfolio analysis owing to the effects associated with diversification and the EMH. Diversification theory applies to portfolios and indices, where risk is reduced in-line with the level of diversification or mixture of firms across a range of industries (Sharpe, 1994). The theory behind diversification is that negative returns in one asset are balanced by a positive response in another, for example, the asymmetry between fossil fuel and clean energy firms.

The data relating to the classification of firms, either within their respective sector based case study or by ESG score portfolio, dates back only to 2007. Therefore, the events appropriate for firm level analysis must fall within 2007 to 2013 for an effective analysis; this discounts a substantial number of possible events. Furthermore, some industries contain a limited number of firms for an robust analysis of cumulative average abnormal returns (average returns across a population sample) and therefore, where firms are limited in number, a case wise analysis is used as is common within event studies (Curran and Moran, 2007; Sabet et al., 2012; Kong, 2012).

5 Does FTSE4good index provide resilience to ethical investors?

This chapter presents the event study results of a financial performance comparison between two FTSE4good indices and the FTSE All-Share (See Appendix H). The index comparisons follow the event study framework presented in chapter 4. The structure of this chapter starts with the results for each event; followed by a discussion of the index analysis results. Table 5.1 shows the index ticker symbols used within this study

Table 5.1 Index series and corresponding ticker identifiers

Index Name	Index ticker	N
FTSE4good Benchmark	FT4GBUK	278
FTSE4good UK 50	FT4UK50	50
FTSE All-Share	FTALLSH	672

5.1 Results

5.1.1 The 2007/08 financial crisis and FTSE4good index performance

During the financial crisis the FT4GBUK underperformed the FTALLSH in all periods, reinforced by a significant event window [0, 50] cumulative abnormal return (CAR) of -1.9%, 82% below the FTALLSH at -1.04%. The FT4UK50 outperformed the FTALLSH with returns in line with expectations with a non-significant -0.55%. Figure 5.1 shows each indices CAR for the event window [0, 50], relative to their expected returns.

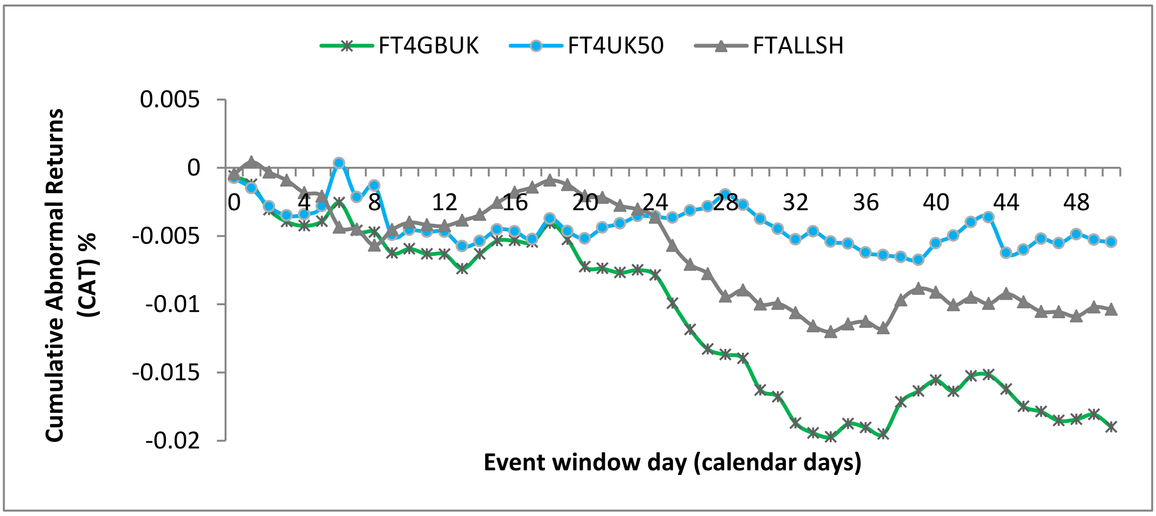

Figure 5.1. Index abnormal returns during the financial crisis event window [0, 50]

The returns in Figure 5.1 show the departures from each indices expected returns during the event window [0, 50]. Differentiation is most evident from day 25, which coincides with the run UK bank Northern Rock. The following Table 5.2 shows the abnormal returns and statistical test results for the event window and interval periods.

Table 5.2. Event window [0, 50] and interval period abnormal returns during the financial crisis

[0, 50] (Event window)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	-1.90%	-2.9	0.00***	-2.45	0.01***
FT4UK50	-0.55%	-0.74	0.46	-0.42	0.67
FTALLSH	-1.04%	-2.13	0.03**	-1.78	0.07*
[0, 5] (09/08/2007 - BNP Paribas Announcement & ECB liquidity injection)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	-0.39%	-1.74	0.08*	-1.72	0.09*
FT4UK50	-0.28%	-1.12	0.26	-1.36	0.17
FTALLSH	-0.21%	-1.25	0.21	-1.5	0.13
[6, 16] (17/08/2007 - FED cuts rates - warning of threat to growth)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	-0.14%	-0.47	0.64	-0.04	0.97
FT4UK50	-0.18%	-0.54	0.59	0.03	0.98
FTALLSH	0.03%	0.12	0.90	0.92	0.36
[17, 24] (04/09/2007 - Interbank lending at highest since 1998)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	-0.25%	-0.97	0.33	-0.82	0.41
FT4UK50	0.11%	0.38	0.71	0.38	0.71
FTALLSH	-0.18%	-0.95	0.34	-1.12	0.26
[25, 28] (13/09/2007 - Run on Northern Rock and BOE intervention)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	-0.58%	-3.17	0.00***	-2.72	0.01***
FT4UK50	0.16%	0.77	0.44	1.10	0.27
FTALLSH	-0.58%	-4.22	0.00***	-3.06	0.00***
[29, 50] (18 & 19/09/2007 - FED cuts rates and BOE injects capital)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	-0.53%	-1.23	0.22	-1.16	0.25
FT4UK50	-0.35%	-0.72	0.47	-0.65	0.51
FTALLSH	-0.10%	-0.30	0.76	-0.60	0.55

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The periods with significant average returns presented in Table 5.2 show that the FT4GBUK suffered the greatest losses relating to the BNP Paribas announcement and ECB liquidity injection [0, 5], and issues with interbank lending [26, 35]. During period [0, 5] the FT4GBUK generated the only significant negative abnormal return at -0.39%. Subsequently, during periods [6, 16] and [17, 24] all three indices generated returns that were non-significant and in line with expectations. However, during period [25, 28] both the FT4GBUK and FTALLSH generated a CAR of -0.58%, both significant at the 1% level. During the same period the FT4UK50 generated a non-significant return of -0.16%. The final period [29, 50] showed all index returns were negative but non-significant despite intervention by the Bank of England' (BOE). Under the circumstances of the time, interventions were viewed as positive within the market place (Labonte, 2011). Northern Rock was not a constituent of any index because it was nationalised and subsequently suspend trading on stock markets.

A full recovery was not realised by any of the included indices over the period of analysis. The periods with significant returns indicate that the FT4GBUK was the lowest performer but the FT4UK50 showed evidence of greater performance above the FTALLSH. Therefore the returns of the event window and subsequent periods highlight the ability for the FTSE4good UK 50 to provide resilience for investors where the FTSE4good Benchmark index did not.

5.1.2 Deep Water Horizon oil spill and FTSE4good index performance

The cumulative abnormal returns (CAR) for the Deep Water Horizon oil spill in 2010 shows no significance for all three indices despite a clear trend over the event window [0, 50]. During this time a negative effect was detected in both FTSE4good indices with a return for the FT4UK50 of -1.17%, marginally significant in the t-test; the FTALLSH however, remained positive throughout but without statistical significance as the effects of the event had diminished and the indices returned to expected levels.

The period including the event day and the announcement of the incident by BP [0, 6] produced no significant returns, which was expected because of the delayed release of information. Despite the statistical insignificance of the event window CAR, the pattern shown in Figure 5.2 shows a deviation from expected returns for both FTSE4good indices around day 35 that coincides with President Obama's statements on drilling restrictions and environmental protection, the results of which are shown in Table 5.3.

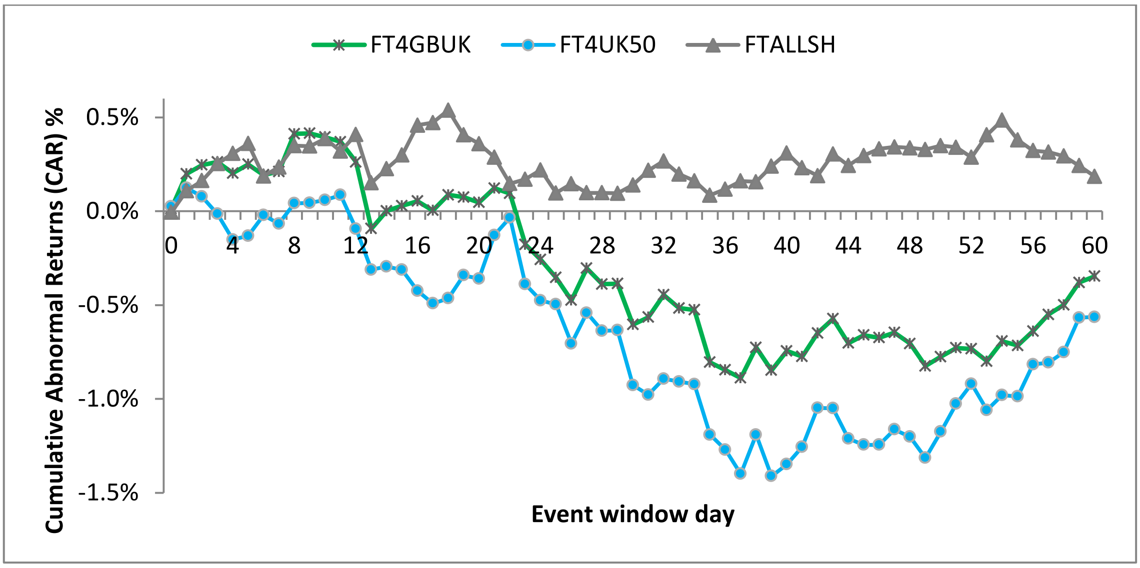

Figure 5.2. Index analysis abnormal returns during the Deep Water Horizon oil spill event window [0, 50]

The recognition of the magnitude of the incident by financial markets during period [7, 25] caused downward pressure in the CAR of all three indices (see Figure 5.2). The FTALLSH was most resistant to these impacts with a CAR return of -0.09% compare to the FT4GBUK at -0.55%. However, none were statistically significant and therefore, did not demonstrate a difference between the indices. The first moratorium period [26, 34] and President Obama's statements [35, 36] also had a minimal and statistically insignificant effect on the three indices as seen below in Table 5.3.

Only the pattern of returns during the event window, as can be seen in Figure 5.2, shows the difference in performance between the three indices. Despite no statistical evidence based on the chosen periods, it is clear that the FTSE4good indices underperformed the FTSE All-Share.

Table 5.3. Index abnormal returns for the event window [0, 50] and all interval periods

[0, 50] (Event Window)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	-0.77%	-0.74	0.46	-0.69	0.49
FT4UK50	-1.17%	-1.53	0.13	-0.93	0.35
FTALLSH	0.35%	0.64	0.52	1.06	0.29
[0] (Event day - Rig explosion)					
Index	AR	t-test	p-value	Corrado rank	p-value
FT4GBUK	0.01%	0.10	0.92	0.24	0.81
FT4UK50	0.03%	0.24	0.81	0.43	0.66
FTALLSH	-0.01%	-0.07	0.94	-0.24	0.81
[0, 6] (Oil rig explosion and BP announcement)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	-0.01%	-0.02	0.99	0.00	1.00
FT4UK50	-0.15%	-0.61	0.54	-0.62	0.54
FTALLSH	0.08%	0.45	0.65	1.03	0.30
[7, 25] (Recognition by financial markets)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	-0.55%	-0.86	0.39	-0.79	0.43
FT4UK50	-0.47%	-1.01	0.31	-0.57	0.57
FTALLSH	-0.09%	-0.27	0.79	0.26	0.79
[26, 34] (First moratorium)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	-0.17%	-0.39	0.69	-0.58	0.56
FT4UK50	-0.43%	-1.32	0.19	-0.97	0.33
FTALLSH	0.06%	0.28	0.78	0.23	0.82
[35, 50] (9-10 June President Obama statements)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	-0.25%	-0.43	0.67	-0.39	0.69
FT4UK50	-0.25%	-0.59	0.56	-0.38	0.70
FTALLSH	0.19%	0.61	0.54	0.54	0.59

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The results therefore indicate that FTSE4good’s screening yielded no benefit in risk mitigation and financial performance. BP was present within all three indices but as the size (diversification) of each index was reduced, the impact of BP’ negative returns increased, meaning that the FT4UK50 was most affected as its level of diversity was smallest.

5.1.3 The Iceland volcanic eruption and FTSE4good index performance

The eruption of the Eyjafjallajökull volcano in Iceland, during 2010 caused considerable unexpected disruption to EU airspace. The market response indicated throughout the event window [0, 6] was positive and significant for both the FTSE4good indices at 0.64% for the FT4GBUK and 0.44% for the FT4UK50. Both indices outperformed the FTALLSH, which traded through the entire event window period with returns close to expected. The event window CAR is shown in Figure 5.3.

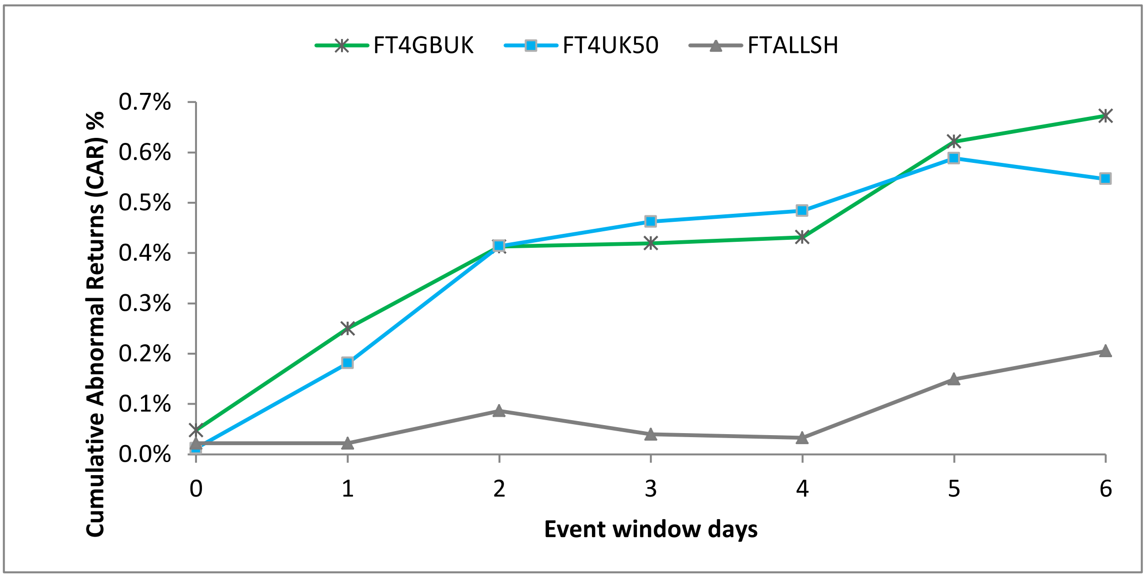

Figure 5.3. The 2010 Iceland volcano eruption event window abnormal returns for two FTSE4good indices (FT4GBUK & FT4UK50) and FTSE All-Share (FTALLSH)

The results in Figure 5.3 and Table 5.4 show the positive response by the market in valuing the two FTSE4good indices throughout the event window and above the FTALLSH which produced returns close to expected values during all periods. However, the market was slow to react to the developing crisis as on the event day only the FT4GBUK generated a positive return at 0.2%, significant at the 10% level in the Corrado rank.

Period [0, 1] (shown in Table 5.4) showed the strongest evidence of differentiation with significant values at 0.4% for the FT4UK50 with a Corrado rank of 0.01 (significant at the 1% level) and the FT4GBUK at 0.36% with a Corrado rank of 0.02 (significant at the 5% level). This coincided with the eruption to the first day of EU airspace closure and therefore covers the weekend between Friday [0] to the following Monday [1]. The results presented in Table 5.4 signify an increased valuation of the FTSE4good indices throughout the periods of EU airspace closure. Overall the results indicate that the market sees the closure of EU airspace as the principle source of information in differentiating between the respective indices.

Table 5.4. Index event window [0, 6] and interval period abnormal returns during the 2010 Iceland volcanic eruption

[0, 6] (Event window)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	0.64%	1.66	0.10*	2.25	0.02**
FT4UK50	0.44%	1.55	0.12*	1.4	0.16
FTALLSH	0.27%	1.29	0.20	1.34	0.18
[0] (Eruption of Iceland Volcano)					
Index	AR	t-test	p-value	Corrado rank	p-value
FT4GBUK	0.2%	1.39	0.16	1.66	0.1*
FT4UK50	0.17%	1.57	0.12	1.47	0.14
FTALLSH	0.00%	-0.01	0.99	0.05	0.96
[0, 1] (Eruption to closure of EU airspace)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	0.36%	1.77	0.08*	2.3	0.02**
FT4UK50	0.4%	2.63	0.01***	2.2	0.03**
FTALLSH	0.06%	0.57	0.57	0.76	0.45
[2, 6] (Re-opening of EU Airspace)					
Index	CAR	t-test	p-value	Corrado rank	p-value
FT4GBUK	0.27%	0.84	0.40	1.21	0.22
FT4UK50	0.04%	0.17	0.87	0.26	0.79
FTALLSH	0.2%	1.17	0.24	1.11	0.27

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

During the re-opening of EU airspace [2, 6] the FT4GBUK and FT4UK50 produced return values of 0.27% and 0.04% respectively. These continue a growth trend above the FTALLSH, which responded with a return of 0.2%. Overall the two FTSE4good indices significantly outperformed the FTALLSH despite the fact that aviation was represented evenly across all three indices. Therefore, FTSE4good screening appeared to provide resilience in the mitigation of risk in this particular event.

5.1.4 Oil price shocks and FTSE4good index performance

The impact of oil price shocks between 2003 and 2011 was determined through 34 shock decreases of at least -5% and 40 increases of at least 5% in the daily returns of Brent Crude Oil. The results show minor evidence of an inverse relationship between the two FTSE4good indices and crude oil returns. The FT4UK50 produced significant returns at the 10% level during period [0, 2] and marginal during period [0, 1]. Despite a negative response, the FT4GBUK showed no statistical significance resulting from positive oil price shocks and the FTALLSH showed significant positive return relationship with crude oil price increases.

As shown in Table 5.5, the FTALLSH outperformed the two FTSE4good indices for the average abnormal returns indicative through a higher ratio of positive returns in all three periods followed by the FT4GBUK and FT4UK50 respectively. Periods that account for a potential lagged response, [1, 3], [2, 4] and [2, 5] were also tested but only one significant positive return was detected during period [2, 4] for the FTALLSH. In response to oil price increases the indices generated significant returns on 10 different occasions.

The relationship between index returns and negative oil price shocks are less consistent in comparison to price increases. During this analysis only 3 significant returns were detected; reflected by the marginal ratio of positive to negative returns across all assets and periods. The returns for the FT4GBUK indicate a marginally negative relationship to oil price decreases with a greater ratio of positive returns relative to negative and with marginal significance in the z-statistic, and the Corrado rank test at the 5% level during period [0]. The returns for the FT4GBUK during the event window were also significant at the 10% level in both tests.

The results indicate through a lack of significance that the included indices are not as sensitive to negative oil price movements compared to positive oil price changes. However, a lack of statistical significance in both tests makes it difficult to determine any difference in performance, as only a directional observation was possible. Therefore, evidence suggests that the market does not see oil price movements and the screening of FTSE4good as fundamentally relevant in differentiating against the FTALLSH.

Table 5.5. Index abnormal returns in response to positive changes in Brent crude oil returns in excess of 5%

			[0, 5]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	0.04%	22:18	1.27	0.20	1.40	0.16
FT4UK50	-0.06%	18:22	-1.10	0.27	-0.89	0.37
FTALLSH	0.14%	28:12	3.07	0.00***	2.93	0.00***
			[0, 1]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	-0.01%	21:19	0.25	0.81	0.41	0.68
FT4UK50	-0.06%	18:22	-1.77	0.08*	-1.56	0.12
FTALLSH	0.08%	28:12	2.98	0.00***	2.95	0.00***
			[0, 2]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	-0.03%	21:19	-0.22	0.83	-0.03	0.98
FT4UK50	-0.08%	11:29	-2.28	0.02**	-2.20	0.03**
FTALLSH	0.08%	29:11	2.59	0.01***	2.61	0.01***
			[1, 3]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	-0.02%	21:19	0.08	0.94	0.24	0.81
FT4UK50	-0.07%	16:24	-1.49	0.14	-1.46	0.14
FTALLSH	0.06%	25:15	1.67	0.10*	1.52	0.13
			[2, 4]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	0.00%	19:21	0.49	0.62	0.66	0.51
FT4UK50	-0.04%	18:22	-0.98	0.33	-1.11	0.27
FTALLSH	0.05%	25:15	1.39	0.16	1.27	0.20
			[2, 5]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	0.04%	19:21	1.38	0.17	1.43	0.15
FT4UK50	0.00%	22:18	-0.09	0.93	0.01	0.99
FTALLSH	0.06%	26:14	1.65	0.10*	1.50	0.13
			[0]			
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	-0.01%	19:21	-0.03	0.98	0.24	0.81
FT4UK50	-0.02%	18:22	-1.60	0.11*	-1.51	0.13
FTALLSH	0.04%	27:13	2.39	0.02**	2.46	0.01***
			[1]			
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	0.00%	19:21	0.38	0.71	0.34	0.73
FT4UK50	-0.03%	18:22	-0.91	0.36	-0.69	0.49
FTALLSH	0.04%	27:13	1.83	0.07*	1.72	0.09*

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

Table 5.6. Index abnormal returns relative to negative returns in Brent Crude Oil in excess of -5%

[0, 5]						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	0.02%	19:15	1.59	0.11*	1.63	0.10*
FT4UK50	0.03%	21:13	1.21	0.22	1.47	0.14
FTALLSH	-0.01%	21:13	-0.16	0.87	1.23	0.22
[0, 1]						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	0.01%	17:17	1.29	0.20	1.22	0.22
FT4UK50	-0.01%	14:20	0.49	0.63	0.57	0.57
FTALLSH	-0.01%	17:17	-0.42	0.68	0.33	0.74
[0, 2]						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	0.00%	19:15	1.46	0.15	1.24	0.22
FT4UK50	-0.02%	16:18	0.48	0.63	0.41	0.68
FTALLSH	-0.01%	24:10	-0.14	0.89	1.19	0.24
[1, 3]						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	-0.03%	14:20	0.48	0.63	0.19	0.85
FT4UK50	-0.05%	16:18	-0.57	0.57	-0.37	0.71
FTALLSH	0.00%	21:13	0.13	0.90	1.63	0.10*
[2, 4]						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	0.02%	19:15	1.39	0.17	1.22	0.22
FT4UK50	0.00%	18:16	0.45	0.65	0.77	0.44
FTALLSH	0.05%	20:14	1.74	0.08*	2.33	0.02**
[2, 5]						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	0.01%	16:18	1.04	0.30	1.13	0.26
FT4UK50	0.04%	18:16	1.14	0.25	1.40	0.16
FTALLSH	0.00%	19:15	0.09	0.92	1.27	0.21
[0]						
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	0.04%	23:11	2.19	0.03**	2.28	0.02**
FT4UK50	0.02%	18:16	1.24	0.22	1.27	0.20
FTALLSH	0.03%	22:12	1.43	0.15	1.51	0.13
[1]						
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
FT4GBUK	-0.03%	14:20	-0.36	0.72	-0.55	0.58
FT4UK50	-0.02%	13:21	-0.55	0.58	-0.47	0.64
FTALLSH	-0.04%	16:18	-2.02	0.04**	-1.04	0.30

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

5.1.5 Index Event study rankings and descriptive statistics

The ranking and descriptive statistics summarise and quantify the main features of the index event study results (See Appendix G). Table 5.7 shows the ranking of each FTSE4good index returns compared (paired) with the FTSE All-Share during periods with at least one significant return, 19 from a total of 32 periods. The descriptive and Chi-squared significance statistics for the rankings are also presented.

Table 5.7. Ranking and descriptive statistics for each FTSE4good index against the FTSE All-Share during periods with significant returns across all test events

Rank	*FT4GBUK*	*FTALLSH*	*FT4UK50*	*FTALLSH*
1st	7	13	7	12
2nd	12	6	12	7
Rank Descriptive Stats.				
Mean rank	1.66	1.34	1.66	1.34
Count (N)	19	19	19	19
Chi-Square (X^2)	2.00	-	2.25	-
Degrees of freedom (df)	1	-	1	-
Significance (p)	0.157	-	0.134	-

Overall the FTSE4good indices showed evidence of under-performance across the included events but marginally without significance. Specifically, the FTSE4good Benchmark achieved a mean rank of 1.66, below the FTSE All-Share index that mean rank of 1.34; a result that was statistically non-significant in the Friedman test, as indicated by the Chi-Squared statistic, $X^2(2) = 2.0,$ and the subsequent p-value of $p = 0.157$, marginally outside the minimum 10% confidence p-value of 0.1. The FTSE4good UK 50 also achieved a mean rank of 1.66 compared to 1.34 for the FTSE All-Share that was again not statistically significant in the Friedman test because of the Chi-Squared statistic, $X^2(2) = 2.25,$ and the subsequent p-value of $p = 1.34$, that is again marginally greater than the minimum 10% confidence p-value of 0.1. The significance of the ranking is therefore determined by the distribution of the returns in the descriptive statistics.

The descriptive statistics for the 19 periods with significant returns confirm the relative underperformance of the FTSE4good Benchmark index and the neutrality in the performance of the FTSE4good UK 50 compared to the FTSE All-Share index. The FTSE All-Share was least effected by the events with a mean return of -0.03%

compared to the FTSE4good UK50 mean return of -0.06% and a widening return for the FTSE4good Benchmark at -0.13%. While the median for the FTSE All-Share shows the greatest positive value, the FTSE4good benchmark also has a positive mode despite generating the lowest return values of the three indices. This indicates the presence of outliers or extreme values within the periods that have skewed the overall performance of the index. This is supported by a standard error of 0.12% compared to 0.07% for the FTSE All-Share. Therefore the FTSE4good Benchmark shows evidence of greater volatility throughout the 24 periods (see Table 5.8).

Table 5.8. Descriptive statistics of the index AR & CAR returns during the 19 periods with significant returns only

	FT4GBUK	*FT4UK50*	*FTALLSH*
Mean	-0.13%	-0.06%	-0.03%
Standard Error	0.12%	0.08%	0.07%
Median	-0.01%	-0.02%	0.04%
Mode	0.04%	-0.06%	0.06%
Standard Deviation	0.53%	0.34%	0.31%
Sample Variance	0.00003	0.00001	0.00001
Kurtosis	7.12	5.93	6.58
Skewness	-2.27	-1.92	-2.37
Range	2.54%	1.61%	1.39%
Minimum	-1.90%	-1.17%	-1.04%
Maximum	0.64%	0.44%	0.35%
Sum	-2.41%	-1.17%	-0.62%
Count	19	19	19

While the FTSE4good UK 50 was lower than the FTSE All-Share in the mean returns, it managed to exhibit comparable stability throughout with a standard error of 0.08%, the smallest range of 1.61% and a minimum value of -1.17%. The sum of abnormal returns follows the same trend as the ranking and mean return statistic with a resounding under performance in the FTSE4good Benchmark at -2.41%, followed by the FTSE4good UK and FTSE All-Share at -1.17% and -0.62% respectively. Furthermore, the FTSE4good UK 50 produced the lowest moments of kurtosis and Skewness at 5.93 and -1.92 respectively. The Skewness and kurtosis statistics for the FTSE4good benchmark and FTSE All-Share were comparable with kurtosis at 7.12 and 6.58

respectively; and comparatively high negative Skewness in excess of -2 for both indices.

Below are the descriptive statistics for the returns during all 32 periods that show confirmatory evidence of underperformance for the FTSE4good Benchmark and comparable performance for the FTSE4good UK 50 relative to the FTSE All-Share.

Table 5.9 Descriptive statistics of the index returns during all 32 periods

	FT4GBUK	*FT4UK50*	*FTALLSH*
Mean	-0.13%	-0.09%	-0.01%
Standard Error	0.075%	0.051%	0.043%
Median	-0.01%	-0.03%	0.04%
Mode	0.04%	-0.02%	-0.01%
Standard Deviation	0.43%	0.29%	0.24%
Sample Variance	1.809E-05	8.362E-06	5.949E-06
Kurtosis	9.42	5.64	10.49
Skewness	-2.42	-1.66	-2.81
Range	2.54%	1.61%	1.39%
Minimum	-1.90%	-1.17%	-1.04%
Maximum	0.64%	0.44%	0.35%
Sum	-4.01%	-2.85%	-0.41%
Count	32	32	32

In summary, the link between FTSE4Good inclusion and financial performance, as represented by a comparison between the FTSE4good indices and the FTSE All-Share index, remains consistent with the additional insight of the descriptive statistics. Overall, the results are negative for the FTSE4good Benchmark and neutral/marginally positive for the FTSE4good UK 50. The following table presents the individual results for each event and the subsequent results from the ranking and descriptive statistics.

Table 5.10. Summary of index event study and statistical results using only periods with significant abnormal returns (comparison with FTSE All-Share)

Event	FTSE4good Benchmark	FTSE4good UK 50
Financial crisis	Negative	Positive
BP plc oil spill	Negative	Negative
Iceland Volcanic Eruption	Positive	Positive
Oil price shocks	Neutral	Neutral
Chi-Squared Test	Negative	Negative
Descriptive Statistics	Negative	Neutral

5.2 Discussion

By comparing the FTSE4good indices with the FTSE All-Share, the current analysis is testing between financial performance and FTSE4good's screening process, and whether this link provides adaptive resilience to firms and investors. FTSE4good is designed to be an index of leaders in the area of environmental, social and corporate governance performance. Coupled with the claim that green firms are less susceptible to the effects of unexpected events (HM Government, 2011a; UNEP, 2011b; Ortas et al., 2013; Nofsinger and Varma, 2014), evidence of this should be apparent in the market place if the assumptions of the efficient market hypothesis are upheld and the sustainability inducing effects of FTSE4good's screening criteria are present and assimilated by the market (Ortas et al., 2013; Hayes, 2012).

5.2.1 The resilience of the FTSE4good indices

The ranking of significant periods show that overall the FTSE4good Benchmark index underperformed with a mean rank of 1.66 compared to 1.34 for the FTSE All-Share. Furthermore, the descriptive statistics reinforce the finding that the FTSE4good Benchmark underperformed with a mean return of -0.13% compared to the FTSE All-Share return of -0.03%, a result that was confounded by the variance and range statistics that imply greater relative volatility in the FTSE4good Benchmark. The FTSE4good UK 50 proved to be neutral overall with underperformance in some aspects and outperformance in others. The return rankings were again non-significant and the descriptive statistics indicated a marginally lower return for the FTSE4good UK 50 (-0.06% compared to -0.03%). However, the reduced risk inferred by lower skewness and kurtosis statistics suggest that on balance the FTSE4good UK 50 cannot be differentiated from its base universe because of the inconsistent findings but the results for the FTSE4good Benchmark suggest that investors must pay a financial penalty. Therefore, with respect to resilience performance, it is evident that the FTSE4good Benchmark was less able to resist the effects of the events due to persistent downward returns below those of the FTSE All-Share; furthermore, the FTSE4good Benchmark showed no signs of a capacity for resilience in excess of the FTSE All-Share that would be evident in any return to expected return levels.

A minority of studies find that SRI indices provide significant benefits to stock market performance during a shock event (Ortas et al., 2013; Brzeszczynski and McIntosh, 2013; Ye et al., 2013). Only one found a positive link using FTSE4good; namely Ortas et al. (2013) who found the Spanish FTSE4good index carried less risk than the conventional IBEX-35 index during the 2007/08 economic crisis; a finding that is consistent with the event specific result for the FTSE4good UK 50 in the current analysis. However, Ortas et al, (2013) did not use any other events to test their hypothesis and the study was focused on Spanish equities only, hence the call for wider tests of the FTSE4good across a wider geographical area and multiple ESG dimensions. Opposing these findings, a more recent study by Belghitar et al. (2014) found evidence that a financial penalty was paid for investing in the FTSE4good UK 50 over conventional investments, in this instance the FTSE-100; this study used weekly returns that may not accurately reflect volatility within the market, an interval sampling period that has proven loss of power compared to daily sampling (MacKinlay, 1997).

The event specific results for the FTSE4good benchmark show that during the financial crisis and Deepwater Horizon rig explosion, the FTSE4good Benchmark underperformed relative to the FTSE All-Share despite lower representation within related sectors (see Table 5.11 and Table 5.12). Extreme heterogeneity among firms relating to their type of business has a significant effect on collective performance as this reflects the degree to which the asset is diversified (Cavaco and Crifo, 2014). The following tables (Table 5.11 and Table 5.12) therefore show the relative sector exposure for each index during the financial crisis and Deep Water Horizon rig explosion.

Table 5.11. Sector weightings for the FTSE All-Share and FTSE4good Benchmark during the financial crisis

		FTSE All-Share		FTSE4good Benchmark	
Code	Industry	Number of constituents	%	Number of constituents	%
1	Oil & Gas	23	3	6	2
1000	Basic Materials	28	4	7	3
2000	Industrials	134	20	73	26
3000	Consumer Goods	38	6	15	5
4000	Health Care	27	4	14	5
5000	Consumer Services	103	15	61	22
6000	Telecommunications	9	1	7	3
7000	Utilities	19	3	9	3
8000	Financials	263	39	63	23
9000	Technology	34	5	21	8
	Total	678	100	277	100

Table 5.12. Sector weighting for the FTSE All-Share and FTSE4good Benchmark during the Deep Water Horizon rig explosion and oil spill

Code	Industry	FTSE All-Share	%	FTSE4good Benchmark	%
1	Oil & Gas	27	4	4	2
1000	Basic Materials	31	5	8	3
2000	Industrials	117	19	69	26
3000	Consumer Goods	36	6	14	5
4000	Health Care	17	3	10	4
5000	Consumer Services	93	15	59	22
6000	Telecommunications	9	1	7	3
7000	Utilities	9	1	9	3
8000	Financials	260	41	60	23
9000	Technology	32	5	23	9
		630	100	263	100

During the oil price shock analysis, although largely insignificant, the results point to lower performance during instances of oil price shock increases; again, a surprising result given the requirements to account for increased efficiency and decreased CO_2 emissions, characteristics that should reflect diminishing reliance on oil derived consumption (Chen and Hu, 2012). Published research on the CSR-CFP link using the UK FTSE4Good Benchmark is limited (Collison et al., 2008), and non-existent in instances of event crises. Collison et al. (2008) found that during long run periods of normal trading, the FTSE4good Benchmark underperformed the FTSE All-Share using the risk-return CAPM. Whilst this finding does not reflect performance during a period of crisis, it does remain consistent with the findings of the current study.

The oil price shock results showed non-significant deviations that are reflected in studies that find conventional stock market indices are relatively insulated from oil price movements, therefore accounting for the over performance of the FTSE All-Share (Kopytin, 2014; Scholtens and Yurtsever, 2012). However, a study by Ratti and Hasan (2013) indicates that index diversification can have a detrimental impact on risk exposure to oil prices depending on the industry weighting of the index. Owing to this relationship, it is more common to find studies relating oil price shocks to firm value within a specific sector such as transportation. This effect is based on the theory of diversification and the oil and gas sector representation for the FTSE All-Share is twice that of the FTSE4good Benchmark, perhaps explaining the positive relationship with oil price movements. Despite this, a clear difference could be seen between the event studies of positive and negative oil price shocks. The positive oil price returns showed a greater number of significant responses as the market valued the FTSE All-Share positively and the FTSE4good negatively. Therefore, the market showed evidence of greater interest in the cost implications associated with higher oil prices; with diminishing recognition within the results for decreasing oil shocks. This pattern therefore implies that the market did not see inclusion in FTSE4good as a sign of greater efficiency and decreased exposure to upward trending oil prices.

Lastly, the Deepwater Horizon oil spill yielded results in favour of the FTSE All-Share index despite showing greater weighting in the oil and gas sector. The UK FTSE4good indices include the only UK firm directly associated with the incident, BP, and due to the comparatively small size of FTSE4good relative to the FTSE All-Share, this may be a direct consequence of underperformance; less firms result in less diversification and consequently greater relative exposure to the impacts inflicted by BP (Barnett and Salomon, 2006). It could have been expected that the announcements of moratoriums and changes to policy would have imposed downward pressure on related industries that would see their profits squeezed through higher operating costs and restrictions (Sabet et al., 2012; Fodor and Stowe, 2010).

5.2.2 The FTSE4good index performance, the impact of diversification and firm selection

The index based results are perhaps a consequence of a range of fundamental factors relating to modern portfolio theory and the design of FTSE4good's assessment criteria. Firstly, the mixture of firms in the population has a direct impact on the diversification of the indices. Particularly as CAPM theory implies that as portfolio diversification increases, risk adjusted returns increase (Sharpe, 1966). Therefore, testing for impacts related to a particular shock could be counteracted by associated firms or sectors within the index. Modern portfolio theory also argues that ESG indices are inherently more risky because of the bias caused by the inclusion of certain sectors and the reduced universe that in turn limits diversification (Barnett and Salomon, 2006). This would account for the varied response to the events used within the current study. That said, diversification cannot eliminate systematic risk (risks associated with the entire market) and, therefore, the sensitivity between the results of the FTSE4good indices and FTSE All-Share are likely to be limited to the risks associated with the excluded firms and therefore related to unsystematic risk (risk specific to the firms) (Barnett and Salomon, 2006).

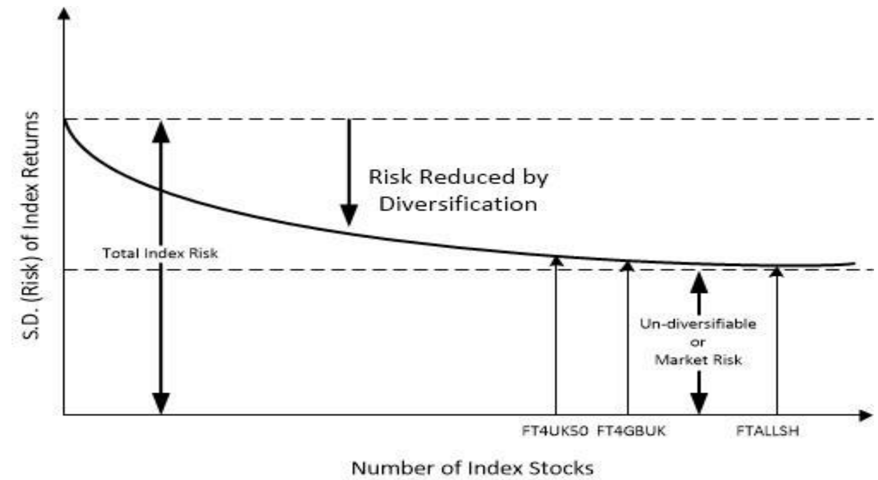

Figure 5.4. The risk reducing effect of stock diversification in relation to stock frequency. The FTSE4good and FTSE All-Share indices are hypothetically positioned to reflect their size and the event study results. Adapted from (Barnett and Salomon, 2006; Sharpe, 1966)

An interesting element in the response of the FTSE4good indices throughout the financial crisis of 2007-08 is that of FTSE4good's wide range of required operational criteria (**see section** 2.3.2**) where** financial management is not included. Therefore, it should logically follow that FTSE4good firms would not outperform their base universe during the financial crisis. This may also be evidence of the issues associated with diversification, and the risk profile of the firms included in the FTSE4good and their exposure to the issues associated with the economic crisis; or an indirect result of the structural and cultural enhancements fostered by FTSE4good's social criteria. However, during the financial crisis, financial services represented 39% of all firms within the FTSE All-Share; this compares to 23% in the FTSE4good Benchmark (see Table 5.11). A result that could be considered an anomaly in terms of what would was expected given the weighting. Therefore, the difference in performance must be accounted for by the markets perception of the remaining firms and how they are perceived to be affected by the events.

Another interesting result is that green firms should be less wasteful and demand less energy, achieved through lower CO_2 emissions (Munich Insurance Group, complete carbon neutrality at headquarters; Apple Computer Corp. 100% renewable energy at their data centres) (Callan and Thomas, 2009). However, there is no indication from the results that FTSE4good firms outperform the base universe when oil prices increase. This is interesting in light of the view of UNEP (2011b) that green firms carry less exposure to costly inputs such as energy. Assuming the efficient markets hypothesis is upheld then the market would use the knowledge of greater efficiency in constituent firms and translate this into their market price in response to the most extreme oil price movements (<5% and >5%).

5.2.3 Higher-order moments in the abnormal of the FTSE4good indices

Lastly, an unusual relationship within the results centres on the level of index performance and the distribution of the returns characterised in the skewness and kurtosis statistics. Firstly, it would be expected that the lowest performers' returns have a relatively lower negative skewness and higher kurtosis statistic that implies lower risk of extreme negative returns. However, the FTSE All-Share performed marginally better than the FTSE4good UK 50 in the mean returns but produced a high kurtosis (6.58) and the lowest skewness statistic (-2.37), greater than the lowest overall performer, the

FTSE4good Benchmark. Belghitar et al (2014) found that on average, conventional indices, the FTSE-100, showed 27% higher skewness and 15% lower kurtosis compared to the returns of SRI indices, in this instance the FTSE4Good UK 50. Therefore, whilst the FTSE All-share produced a more advantageous mean return over the event periods, investors would be less inclined to accept such a marginal benefit in the face of such relatively poor skewness and kurtosis values (Post et al., 2008; Dittmar, 2002).

Therefore, whilst the FTSE4good UK 50 does not show clear signs of an advantage or disadvantage in terms of resilience, evidence does point to it being a more attractive investment than its base universe, the FTSE All-Share; a finding that is supported in another FTSE4good based study (Ortas et al., 2013).

5.2.4 Limitations to the index analysis

The limitations of the index based approach centre on diversification and the FTSE4good screening process. Firstly, by using indices in an event study, the level of ESG performance for included firms cannot be controlled. Therefore, the indices include firms according to a minimum threshold of collective ESG performance that may have been detrimental to the mean return performance of the indices and the FTSE4good Benchmark in particular. Secondly, as stated, there are issues in testing terms with diversification and the effect sector over representation has on the results. Therefore, the issues associated with ESG performance are contended with in Chapter 6 by using FTSE4good's ratings history where the best-in-class ESG performers are identified and tested against the lowest performing firms. The issue of diversification is then accounted for in Chapter 7 through a sector best analysis where events are tested against firms from the relevant sector. Furthermore, Table 5.11 and Table 5.12 show the industry weightings during the financial crisis and Deep Water Horizon events (NOTE: not weighted using market capitalisation). This highlights the potential risk of over-representation within an index and the potential for increased exposure between a particular sector and a related event, for example, financial services and the financial crisis of 2007/2008.

6 Does FTSE4good ESG ratings provide resilience for investors?

6.1 Introduction

The previous chapter highlighted that the approach of comparing aggregate changes in indices may be inconsistent due to the effects of diversification and the potential for lower performing firms to be included in the series thus negating any detectable difference, evidence of which was shown in the results. This chapter therefore aims to select only the best performing firms to propagate a difference in performance that is detectable in the event studies. The following chapter subsequently looks at how the share price of firms grouped according to environmental, social and corporate governance performance compare to one another. The use of FTSE4good ratings as a means of classification has never been attempted before.

A number of studies have however attempted to link SRI portfolios, constructed using subjective, researcher-led methods, with financial performance; some finding a negative or non-significant relationship (Brzeszczynski and McIntosh, 2013; Humphrey and Tan, 2014; Leite and Cortez, 2013; McPeak et al., 2010); and others a positive and significant link (Nofsinger and Varma, 2014; Janda et al., 2014; Chan and Walter, 2014). The mixed findings across the literature reinforce the need to understand the relationship between investments and resilience as a critical component in the business case for driving the green economy (Stephenson, 2010).

The following sections explain the steps taken to investigate the relationship between market values of the top and bottom 100 firms from FTSE4good ratings history across each ESG pillar. First, presenting the data used for the analysis and the rationale behind its use; followed by how firms were selected for each ESG group; a description of the indicators and event study method used to measure performance and compare results that are particular to the ESG portfolio analysis and beyond that of section 4; then the results for each portfolio followed by an overall discussion of the findings.

6.2 Firm classification using FTSE4good ratings history

FTSE4good publish bi-annual ratings of the FTSE All-Share constituents and how they score against the ESG assessment criteria (See Appendix I). Using FTSE4good's historical ratings it was possible to identify and screen for the top 100 and bottom 100 performing firms, within each bi-annual E, S and G pillar (See Appendix J). This allowed for an analysis of the impact each shock event had on the top and bottom performing constituents and whether the market considered ESG performance in valuing these firms.

To the author's knowledge, this analysis of the FTSE4good data has not been attempted. Therefore, this represents a novel contribution to the literature. Investigation into this field of enquiry will clarify whether environmentally and socially conscious firms are more resilient to shocks, identified by their value within the market place. This is the first and only time to date that an ethical index administrators ratings have been used in this way. Previously, studies have relied on the use of the widely available and tradable index, the FTSE4good UK 50.

6.3 Data collection

DataStream and FTSE firm ticker mnemonics differ in many instances and are a barrier to swift data collection and analysis preparation, therefore, the correct firm ticker symbols were identified so that correct firm price data could be downloaded from DataStream. The top and bottom 100 firm lists from each ratings period and within each pillar can be found in appendix K along with price data in appendix F. Ratings are reviewed on a bi-annual basis; therefore, a firm's current FTSE4good rating is based on its performance from the previous six month period. For example, the first published set of ratings were released in 2008, representing the firm's performance since the second rating decision of 2007 until it is reassessed in the second rating of 2008. Identified firms were checked for full data availability for the estimation window and event window. If data was missing then deletions were made and the next ranked firm was included.

FTSE4good produce ratings across a range of criteria. For the selection of firms the absolute scores for environmental, social, and corporate governance pillars were used (See Appendices J and K).

6.4 ESG portfolio Event Study methodology

The event window and estimation window for each event follows the same methodology presented in **section 4.7,** using the market model for estimation and the event frame work for each individual event, details of which are found in **section 4.3**. For the analysis of firms based on ESG performance, the emphasis was on average abnormal returns (AAR) and cumulative average abnormal returns (CAAR) referred to as returns unless specifically stated (AAR are metrics for single days and CAAR for cumulative days). The average abnormal returns are calculated by dividing the sum of the abnormal returns by the number of observations (shown in equation 6-6); and the subsequent calculation of cumulative average abnormal returns are shown in equation (4-7). With each sample size of 100 firms the standard statistical significance tests used for this analysis are robust in line with comments from Gujarati (2011) and the event study literature (Curran and Moran, 2007; Aggarwal et al., 2012a; Aslam and Kang, 2013). For clarification the tests for statistical significance are the z-test and Corrado rank test (Corrado, 1989).

The return results reflect the abnormal deviation from its expected result and not from another asset, such as a competing portfolio. For example, the tables showing AAR and CAAR for the portfolio of bottom 100 social firms represents the abnormal deviation from the expected return for the same portfolio of firms using the market model (Chapter 4.7). The returns for each portfolio are then compared within the tables highlighting significance and magnitude.

6.5 Environmental portfolio performance results

The following chapters present the results of a comparison of portfolios classified according to top and bottom 100 firms from FTSE4good’s environmental performance ratings history. Only periods with significant abnormal returns (CAR, AR, CAAR and AAR) are considered with the z-statistic and Corrado rank test p-values for indication of confidence that the event had a significant impact on the assets. Firms were selected from periods that correspond to the event in question and their financial time series data were obtained from Thomson Reuters DataStream service. Each firm’s respective social, environmental or governance score is not a pre-requisite for inclusion in FTSE4good as some firms score highly in one or two pillars but are still excluded from because of a low score in the third pillar and subsequently their overall rating.

All results are presented but a complete set can be found in appendix L.

6.5.1 The financial crisis and environmental portfolio performance

The market response during the financial crisis event window [0, 50] shows the top 100 environmental firms underperformed with a CAAR 105% below that of the bottom 100 firms. The following results show evidence of underperformance in the returns for the environmental portfolios starting with the event window [0, 50].

Table 6.1. The financial crisis abnormal returns during the event window [0, 50] for firms classified by environmental performance

[0, 50] (Event window)						
Portfolio	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-11.56%	17 : 83	-11.85	0.00***	-2.94	0.00***
BOTTOM 100	-5.64%	36 : 64	-4.72	0.00***	-1.22	0.22

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

As shown in Table 6.1 and Figure 6.1, the event had a significant overall effect on the top 100 environmental firms with an average return of -11.56% compared to -5.64% for the bottom 100 environmental firms. Furthermore, of the top 100 firms produced 17 positive returns against 83 negative compared to a 40:60 split for the bottom 100 firms. The returns for both indices were significant in the z-statistic p-value but only the top 100 was significant in the Corrado rank test.

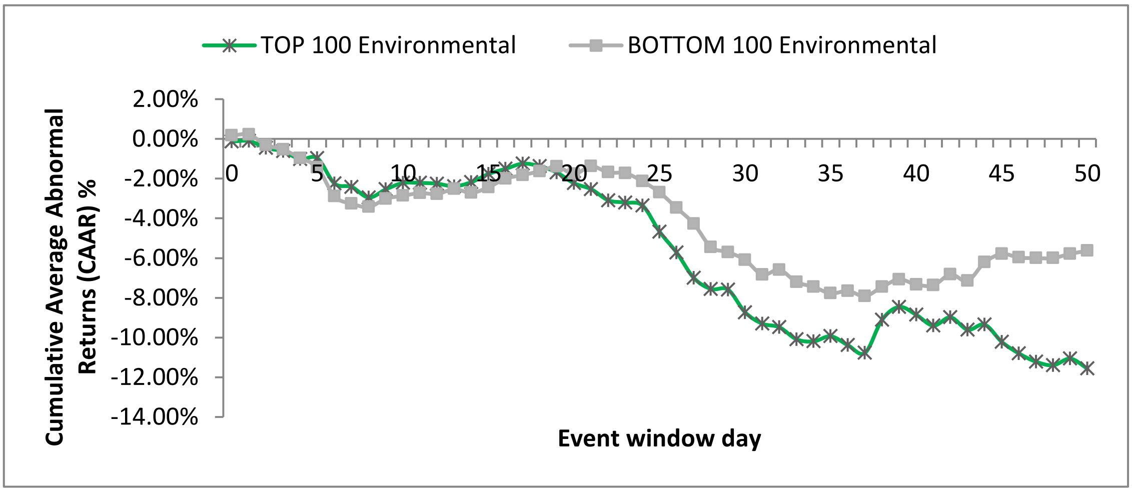

Figure 6.1. Abnormal returns for firms classified by environmental performance during the event window [0, 50] of the financial crisis

The AAR for the event day [0] produced no significant values but the period that includes the event day when BNP Paribas Announced issues with sub-prime debt, to the day when the ECB injected liquidity into capital markets [0, 5], a significant decline was detected at the 1% level in the CAAR for the top and bottom portfolios. The results for which are shown in Table 6.2. In this instance the top 100 firms outperformed the bottom 100 and both were significant in the z-test at the 1% confidence level but the bottom 100 had the highest ratio of positive to negative firm returns at 38:62.

Table 6.2. Abnormal returns for firms classified by environmental performance during periods [0] and [0, 5]

[0] (BNP Paribas Announcement)						
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.13%	46 : 54	-0.74	0.46	-0.21	0.83
BOTTOM 100	0.17%	54 : 46	-0.17	0.86	0.39	0.69
[0, 5] (BNP Paribas Announcement & ECB liquidity injection)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.97%	48 : 52	-2.73	0.01***	-0.44	0.66
BOTTOM 100	-1.44%	38 : 62	-3.37	0.00***	-0.92	0.36
[6, 16] (FED cuts rates - warning of threat to growth)						
Portfolio	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.53%	43 : 57	-1.43	0.15	0.02	0.98
BOTTOM 100	-0.56%	42 : 58	-1.06	0.29	-0.11	0.92

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The following period [6, 16] shown in Table 6.3 represents the rate cut by the US Federal Reserve (FED) that implied a warning of a threat to growth but the market viewed this action to be beneficial and responded with positive returns in both portfolios. The top 100 traded at -0.53%%, compared to a marginally lower return for the bottom 100 at -0.56%%. This result was non-significant in the z-test and Corrado rank test.

Around day 26 of the event window, the returns for both indices witnessed a substantial decrease over ten days that coincided with increasing difficulties with interbank lending as the majority of firm returns were negative as shown in the ratios. The returns for the period when interbank lending became a significant issue are presented in the following table (Table 6.3) along with market reaction to the run on UK bank, Northern Rock during period [25, 28] and the US Federal Reserve Bank rate cut [29, 50].

The returns for period [17, 24] indicate a greater impact on the top 100 firms at -1.85% compared to -0.14% for the bottom 100. Only the Top 100 was significant at the 1% level in the z-test p-values. Confounding this effect was the run on UK bank, Northern Rock [25, 28] as out of the top 100 firm returns 80 were negative and a mean return of -4.2% and significant in both the z-statistic and Corrado rank test at the 1% level; the bottom 100 produced 72 negative returns with a total mean of 3.32%, also significant at the 1% level in the z-test and Corrado rank test. This widening relationship continues in the final period [29, 50] when the US FED cut interest rates again and the Bank of England (BoE) injected liquidity into UK capital markets. The bottom 100 responded with a return of -0.19% above expected with a marginally even split of positive to negative firms and no significance. The top 100 however, produced a CAAR of -4.01%, significant in both the z-test and Corrado rank test and a positive to negative firm ratio of 27 : 23.

Table 6.3. The abnormal returns for firms classified by environmental performance during periods [17, 24], [25, 28] and [29, 50]

[17, 24] (Interbank lending at highest since 1998)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.85%	29 : 71	-4.97	0.00***	-1.19	0.23
BOTTOM 100	-0.14%	46 : 54	-0.29	0.77	-0.16	0.87
[25, 28] (Run on Northern Rock)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-4.2%	20 : 8	-15.10	0.00***	-3.88	0.00***
BOTTOM 100	-3.32%	28 : 72	-9.63	0.00***	-3.67	0.00***
[29, 50] (FED cuts rates and BoE injects capital)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-4.01%	27 : 73	-6.17	0.00***	-1.9	0.06**
BOTTOM 100	-0.19%	54 : 46	-0.4	0.69	0.36	0.72

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

While a discernible difference could not be established in the early stages, the pattern of returns in Figure 6.1 highlight a diverging trend that continued since the interbank lending issues during period [17, 24] to the end of the window on day [50]. Therefore, the analysis indicates that the highest performing environmental firms did not provide resilience for investors over and above the lowest performing firms during the financial crisis.

6.5.2 Deep Water Horizon oil spill and environmental portfolio performance

Following on from the index analysis of the market response to the Deepwater Horizon oil spill, FTSE4good firms were classified from the 2nd round of ratings in 2010 that covered the date of the incident. Overall, during the event window, the market response to the spill was greater for the bottom 100 firms who produced an inverse average return of -0.16% compared to the top 100 firms' average return of 1.35%, both however were insignificant. The following figure (Figure 6.2) shows the development of the returns for the top and bottom firms respectively. Notably, the returns for the top 100 remain above expected throughout and the returns for the bottom 100 turn negative when financial markets recognise the severity of the incident.

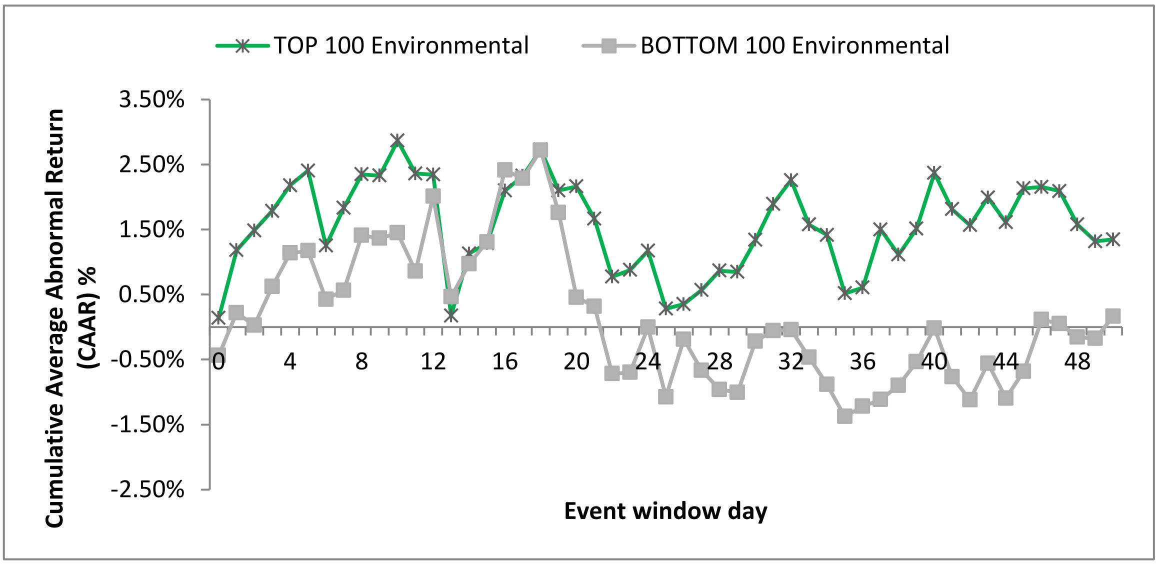

Figure 6.2. Development of the abnormal returns during the Deep Water Horizon oil spill event window [0, 50] for firms classified by environmental performance

On the event day [0], the bottom 100 firms generated a negative non-significant average return of -0.44% that was below the top 100' non-significant positive return of

0.14%. When the BP announcement was made [2, 6], both portfolios generated positive non-significant returns as the top 100 produced a CAAR of 0.07%, and the bottom 100 at 0.21%. The returns for the period when markets first took stock of the event [6, 26] showed a greater negative response for the bottom 100 with a non-significant average return of -1.5% compared to a non-significant return for the top 100 at -0.976%. The results are presented in Table 6.4 along with the first moratorium [26, 34] and President Obama's address to congress [35, 50].

Table 6.4. Abnormal returns for firms classified by environmental performance during the event window [0, 50] and all interval periods

[0, 50] (Event Window)						
Portfolio		Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	1.35%	57 : 43	1.29	0.2	0.7	0.49
BOTTOM 100	0.16%	49 : 51	0.81	0.42	0.76	0.45
[0] (Event day - Rig explosion)						
Portfolio	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.14%	47 : 53	0.39	0.69	0.16	0.87
BOTTOM 100	-0.44%	45 : 55	-1.67	0.1*	-0.45	0.66
[2, 6] (Oil rig explosion and BP announcement)						
Portfolio	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.07%	48 : 52	-0.72	0.47	-0.29	0.77
BOTTOM 100	0.21%	51 : 49	0.54	0.59	0.27	0.79
[7, 25] (Recognition by financial markets)						
Portfolio	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.97%	40 : 60	-1.04	0.3	0.04	0.97
BOTTOM 100	-1.5%	46 : 54	-0.86	0.39	0.24	0.81
[26, 34] (First moratorium)						
Portfolio	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	1.13%	61 : 39	2.49	0.01***	0.62	0.54
BOTTOM 100	0.19%	48 : 52	0.56	0.57	0.26	0.79
[35, 50] (9-10 June President Obama statements)						
Portfolio	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.07%	61 : 39	0.59	0.55	0.33	0.74
BOTTOM 100	1.05%	55 : 45	1.4	0.16	0.5	0.62

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The first moratorium period [26, 34] showed significant differences between the two portfolios with returns at 1.13% for the top 100 and 0.19% for the bottom 100. The subsequent statements by President Obama produced a non-significant response in the top 100 with an average return of -0.07%, compared to another insignificant bottom 100 return of 1.05%.

The pattern of the CAARs throughout the event window and event periods indicate that firms selected on the basis of environmental performance provide a capacity for resilience in response to an environmental disaster of this type; this is despite BP' inclusion within the top 100 group of firms.

6.5.3 The Japanese earth quake and environmental portfolio performance

The Japanese earth quake of 2011 was an unexpected and unprecedented event that moved global markets (The Telegraph, 2011). During the window for this event [0, 10], the top 100 significantly underperformed the bottom 100 with respective average abnormal returns of -1.04% and -0.37%. The only diversions between the two portfolios occurred during periods [0, 3] and [6, 10} respectively. The CAAR for the event window are shown below in Table 6.5 and the pattern of returns in Figure 6.3.

Table 6.5. The Japan earth quake event window abnormal returns for firms classified by environmental performance

[0, 10] (Two working week event window)						
Portfolio	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.04%	42 : 58	-2.37	0.02**	-0.92	0.36
BOTTOM 100	-0.37%	44 : 56	-0.73	0.47	-0.04	0.97

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The early stages of the event (shown in Figure 6.3) are the most pertinent as they reflect the immediate impact of the earthquake and the announcements regarding the Fukushima nuclear reactor leak, to which Germany responded by suspending their nuclear energy programme [0, 3].

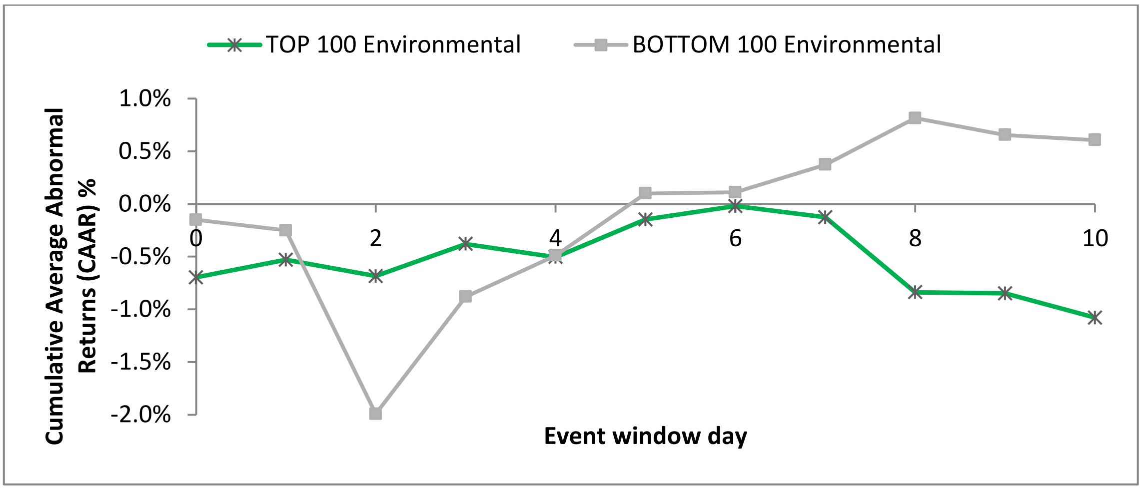

Figure 6.3. Abnormal returns during the Japanese earth quake event window for firms classified by environmental performance

Overall, Figure 6.3 shows a distinctly flat trend for the top 100 portfolio as the actual returns trade close to expected values but the average returns for the bottom 100 show a significant dip on day [2] with an AAR of -1.74, significant in both the z-statistic and Corrado rank test at the 1% level. The results for the event day show that the top 100 responded with a greater negative average return of -0.47% that was significant at the 1% level in the z-test and the 10% level in the Corrado rank test. The bottom 100 was less affected with an average return of -0.32%, significant in only the z-test. The average returns for the event day [0], the announcements of a reactor leak and suspension of Germany's nuclear energy programme [0, 3] can be seen in Table 6.6.

The periods that represent the first and second trading week following the disaster produced no significant average abnormal returns that perhaps reflects the diminishing effect of the event on UK financial markets as values quickly returned to trading in an expected price range.

Table 6.6. The abnormal returns for firms classified by environmental performance during periods [0], [0, 3], [1, 5] and [6, 10]

[0] (Earth quake & announcement that nuclear power stations have been shut down)						
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.7%	33 : 67	-4.72	0.00***	-1.67	0.09
BOTTOM 100	-0.15%	45 : 55	-0.61	0.54	-0.42	0.68
[0, 3] (Announcement of nuclear reactor leak & Germany announces suspension of nuclear programme)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.38%	45 : 55	-2.6	0.01***	-0.62	0.53
BOTTOM 100	-0.88%	44 : 56	-1.95	0.05**	-0.59	0.56
[1, 5] (First trading week following the Friday quake)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.55%	55 : 45	1.09	0.28	0.61	0.54
BOTTOM 100	0.25%	50 : 50	0.41	0.68	0.25	0.8
[6, 10] (Second trading week following the quake)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.93%	34 : 66	-2.85	0.00***	-1.1	0.27
BOTTOM 100	0.51%	50 : 50	0.74	0.46	0.37	0.71

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The results from Table 6.6 and the pattern of returns in Figure 6.3 indicate that the effects of the event are not statistically significant for the top and bottom 100 firms until the announcement by Germany of a suspension in their nuclear energy plans. This effect is more localised for the UK and, therefore, statistically significant for both portfolios. Consequently, the results appear to show evidence that during an event of growing environmental severity, environmental screening provides resilience for investors.

6.5.4 The Icelandic volcano eruption and environmental portfolio performance

The unexpected volcanic eruption of 2010 in Iceland proved relevant in the valuation of the top 100 environmental firms with an event window CAAR of 2.42%. The top 100 significantly outperformed the bottom 100 with a z-statistic of 1% confidence and 10% in Corrado rank test but the bottom 100 generated a non-significant average return of 0.3% (Figure 6.4 and Table 6.7).

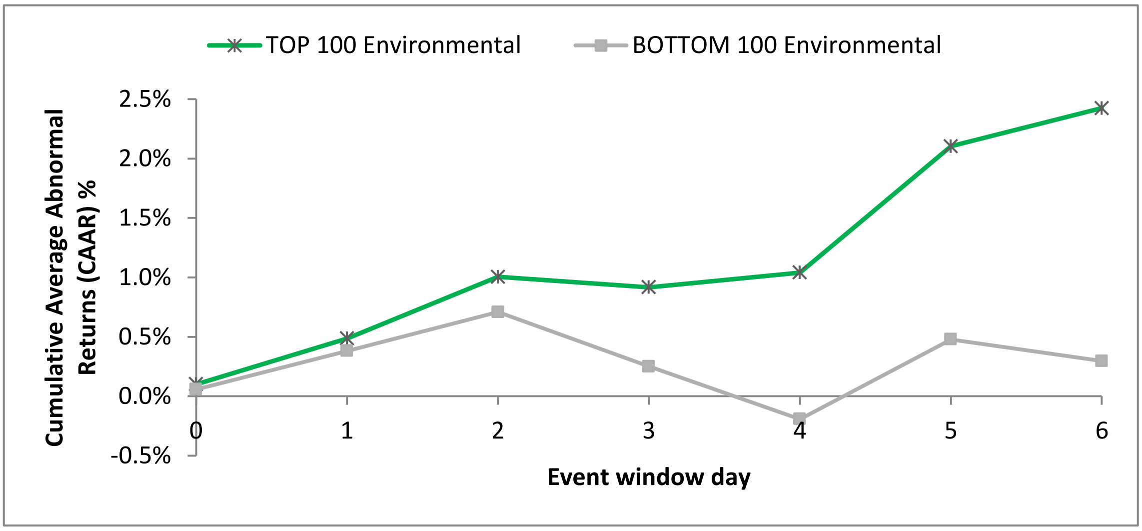

Figure 6.4. Abnormal returns during the Iceland eruption event window for firms classified by environmental performance

The event day [0] produced no significant returns, as early on, the eruption appeared to be irrelevant in the valuation of both portfolios. The greatest effect was detected during period representing EU airspace re-opening where the only significant return was detected (see Table 6.7). During the EU airspace closure period [0, 1], the top 100 firms' produced a non-significant average return of 0.49%. The re-opening of EU airspace during period [2, 6] saw the top 100 outperform the bottom with a z-test and Corrado rank test significant return of 1.94% compared to a marginally expected return for the bottom 100 at 0.08%.

Table 6.7. Abnormal returns during the closure of EU airspace period for firms classified by environmental performance

[0, 6] (Event Window)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	2.42%	72 : 28	4.02	0.00***	1.73	0.08*
BOTTOM 100	0.3%	56 : 44	0.37	0.71	0.44	0.66
[0] (Eruption of Iceland Volcano)						
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.1%	46 : 54	0.44	0.66	-0.01	0.99
BOTTOM 100	0.06%	48 : 52	0.07	0.95	0.10	0.92
[0, 1] (Eruption to closure of EU airspace)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.49%	47 : 53	1.15	0.25	0.31	0.76
BOTTOM 100	0.38%	52 : 48	0.70	0.48	0.28	0.78
[2, 6] (Re-opening of EU Airspace)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	1.94%	72 : 28	4.03	0.00***	1.85	0.06*
BOTTOM 100	-0.08%	46 : 54	-0.01	0.99	0.35	0.73

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

Evidence therefore suggests that despite limited significance, the upper limits of environmental performance provided resilience due to excess performance in abnormal return generation of the top 100 environmental firms above expected values and the abnormal returns of the bottom 100 firms. This is despite even representation of the aviation and tourism industries within both portfolios.

6.5.5 The US presidential election results and environmental portfolio performance

The analysis of firms classified according to environmental performance yielded mixed results throughout the event window [-1, 5] as in the early stages the top 100 showed a marginal advantage that later diminished when the bottom 100 performed better in the later stages of the event window; at which point both portfolios returned to expected levels, with an event window return of -0.1% for the top 100 and -0.33% for the bottom 100; the pattern of which can be seen in Figure 6.5.

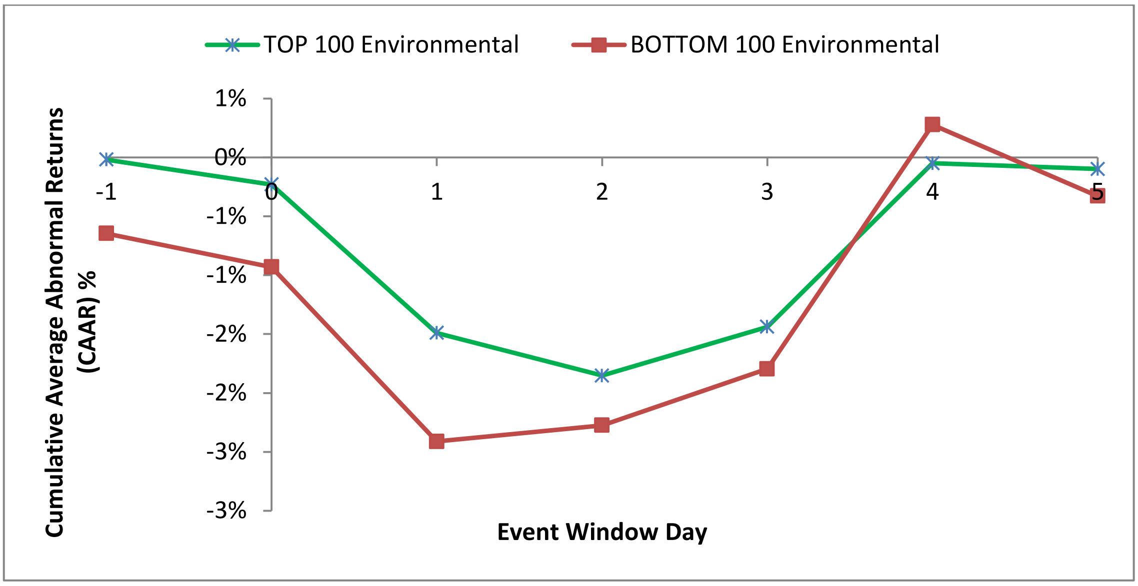

Figure 6.5. The abnormal returns during the US presidential election event window [-1, 5] for firms classified by environmental performance

The periods surrounding the presidential announcement [-1, 1] shows the market generated negative average returns for both portfolios that are significant in the z-test and the Corrado rank test. The bottom 100 firms generated the greatest negative impact with an average return of -2.41%, below the average return of the top 100 at -1.49 (Table 6.8). These results indicate an advantage of resilience to the effects of the event in the early stages.

Table 6.8. Abnormal returns during the US presidential election periods for firms classified by environmental performance

			[-1, 5]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.1%	53:47	-0.47	0.64	-0.23	0.82
BOTTOM 100	-0.33%	50:50	-0.61	0.54	-0.58	0.56
			[-1, 1]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.49%	31:69	-4.02	0.00***	-1.69	0.09*
BOTTOM 100	-2.41%	30:70	-5.26	0.00***	-2.28	0.02**
			[0, 1]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.47%	83:17	-5.63	0.00***	-2.55	0.01***
BOTTOM 100	-1.77%	30:70	-4.8	0.00***	-1.97	0.05**
			[0, 2]			
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.83%	31:69	-5.74	0.00***	-2.67	0.01***
BOTTOM 100	-1.63%	32:68	-3.76	0.00***	-1.43	0.15
			[0, 3]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.42%	34:66	-3.74	0.00***	-1.55	0.12
BOTTOM 100	-1.15%	40:60	-2.28	0.02**	-0.79	0.43
			[0, 5]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.08%	49:51	-0.92	0.36	-0.53	0.6
BOTTOM 100	0.32%	51:49	0.29	0.77	-0.16	0.88
			[2, 5]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	1.39%	61:39	2.86	0.00***	1.16	0.25
BOTTOM 100	2.09%	67:33	3.76	0.00***	1.2	0.23

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

Initially the response to the announcement of a winner for the presidential election was in favour of top 100 environmental firms, but this was short lived. The following period represents the event day down to the event window low [0, 2] during which both portfolios generated negative average returns. The top portfolio was most affected with a CAAR of -1.83% followed by the bottom 100 at -1.63%. This difference in performance continues for the remainder of the event periods with a negative return for the top 100 at -1.42% compared to the bottom 100 at -1.15% in period [0, 3]. During the recovery period [2, 5] the bottom 100 sowed greater signs of resilience with positive average return of 2.09% compared to a top 100 return of 1.39%. All returns were significant at the 1% level in the z-test p-value.

The results show a negligible difference between the two portfolios. However, period [0, 2] shows a significant advantage for the bottom 100 portfolio implying that the re-election was viewed by the market as detrimental to firms with high environmental credentials but the inclusion of pre-event days such as the event window [-1, 5] suggests that markets anticipated the winner and began to value the firms accordingly. In this case the bottom 100 had already been valued negatively before subsequent periods and consequently the top 100 showed evidence of resilience in protecting shareholder wealth; whilst the bottom 100 showed greater evidence of resilience.

6.5.6 Environmental portfolio rankings and descriptive statistics

The following tables show the abnormal return rankings and descriptive statistics for each environmental performance portfolio using only periods with significant abnormal returns (See Appendix G). As was reflected within some events, the ranking of environmental portfolios indicates a mean equality between the two portfolio classes with even ranking and consequently a non-significant Chi-Squared statistic $X^2(1) = 0.00,$ with a $pvalue = 1.00$. Therefore, ranked periods imply that selecting firms using FTSE4good' environmental ratings did not provide an advantage or disadvantage for investors.

Table 6.9. Ranking statistics for periods with significant returns

Rank Descriptive Statistics	*TOP 100*	*BOTTOM 100*
1st	9	9
2nd	9	9
Mean	1.5	1.5
Sum	27	27
Count	18	18
Chi-Square (X^2)	0.00	-
Degrees of freedom (df)	1	-
Significance (p)	1.00	-

However, the descriptive statistics for periods with significant abnormal returns are more indicative, showing a resilient capacity for the portfolio of bottom 100 environmental performance firms with a mean return of -0.9% compared to a top 100 mean return of -1.4%. Furthermore, the top 100 showed greater volatility through a greater minimum and maximum score at -11.56% and 2.42% respectively (range = 13.98%). This compares to the bottom 100 minimum and maximum statistic of -5.64% and 2.09% respectively (range=7.73%). The standard deviation and variance statistics for the top 100 also indicate that whilst the two portfolios ranked equally over the significant periods, the top 100 showed signs of greater volatility compared to a relatively more stable set of figures from the bottom 100.

Table 6.10. Descriptive statistics for periods with significant returns of firms classified by environmental performance

	TOP 100	BOTTOM 100
Mean	-1.4%	-0.9%
Standard Error	0.729%	0.399%
Median	-1.01%	-0.41%
Standard Deviation	3.09%	1.69%
Sample Variance	0.096%	0.029%
Kurtosis	6.73	2.82
Skewness	-2.15	-1.21
Range	13.98%	7.73%
Minimum	-11.56%	-5.64%
Maximum	2.42%	2.09%
Sum	-24.83%	-16.52%
Count	18	18

The Skewness and kurtosis statistics show substantial differences that reflect performance. The top 100 produced the highest kurtosis value at 6.73 compared to 2.82 for the bottom 100; and the Skewness statistics for the top 100 was -2.15 compared to -1.21 for the bottom 100. Therefore, whilst the ranking of significant periods produced an equal and non-significant result, the descriptive statistics indicate that firms picked using FTSE4good environmental ratings history data set do not provide a capacity for resilience over the lowest rated firms.

6.6 Social portfolio performance results

The following chapter presents the results for the comparison between the cumulative average abnormal returns of the top 100 and bottom 100 firms classified according to FDTSE4good's social ratings (See Appendix L).

6.6.1 Financial crisis and social portfolio performance

During the financial crisis, the top 100 firms outperformed the bottom 100 over the event window with an cumulative average abnormal return of -5.86%, 65% above the bottom 100 at -8.08%, both were significant in the z-test and the bottom 100 additionally in the Corrado rank test (see Table 6.11). During the event day, the bottom 100 generative negative returns at -0.42%, significant in the z-test at the 1% level; the top 100 generated a return close to expected and therefore with significance. Period [0, 5] shows that the bottom 100 responded with a significant return of -2.33% compared to a non-significant return for the top 100 at -0.09%. The results for the event window [0, 60] and periods [0], [0, 5] and [6, 16] are shown below in Table 6.11.

Table 6.11. Abnormal returns for firms classified by social performance during periods [0], [0, 5] and [6, 16] of the financial crisis

[0, 50] (Event window)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-5.86%	31 : 69	-6.49	0.00***	-1.87	0.06*
BOTTOM 100	-8.08%	30 : 70	-6.69	0.00***	-2.15	0.03**
[0] (BNP Paribas Announcement)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.02%	45 : 55	0.04	0.97	-0.13	0.90
BOTTOM 100	-0.42%	44 : 56	-2.96	0.00***	-0.79	0.43
[0, 5] (BNP Paribas Announcement & ECB liquidity injection)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.09%	46 : 54	-0.63	0.53	-0.18	0.85
BOTTOM 100	-2.33%	38 : 62	-4.81	0.00***	-1.76	0.08*
[6, 16] (FED cuts rates - warning of threat to growth)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.11%	47 : 53	-0.56	0.58	0.24	0.81
BOTTOM 100	-0.38%	48 : 52	-0.58	0.56	-0.20	0.84

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The period that represents the rate cut by the US Federal Reserve Bank [6, 16] shows the bottom 100 responded with an average return of 0.38% compared to the top 100 return of just 0.11%. Figure 6.6 charts the cumulative abnormal return movements of both portfolios during the event window [0, 50] highlighting a difference in the cumulative performance that represents resilience from the impacts associated with the event.

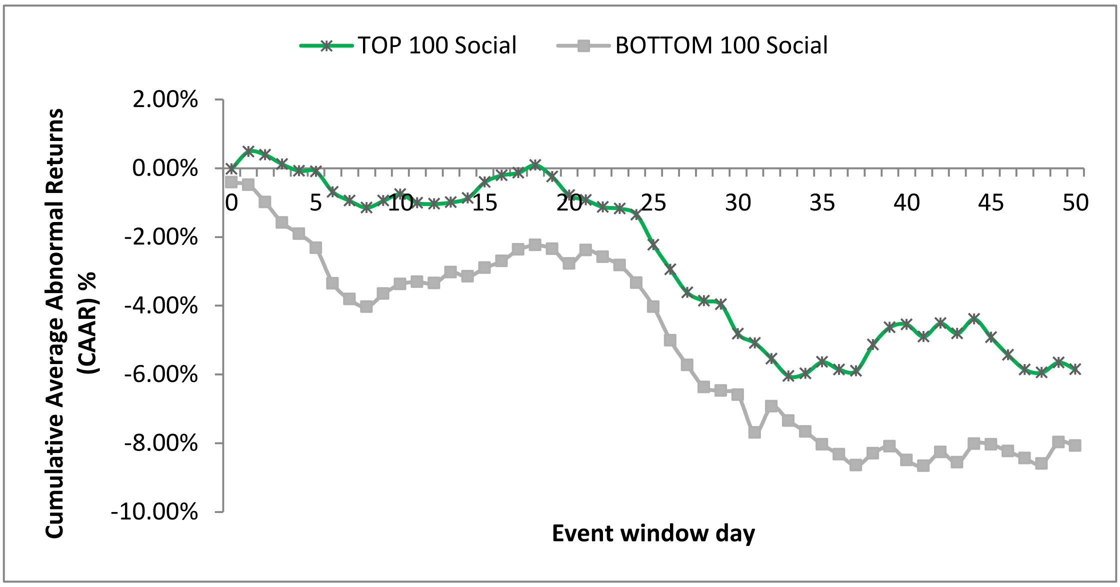

Figure 6.6. The abnormal returns during the financial crisis event window for firms classified by social performance

Figure 6.6 shows a clear difference between the two portfolios throughout despite some similarities in the overall trend. The clearest indication of a difference occurs around the period when interbank lending was perceived as a substantial risk [17, 24]. During this period the bottom 100 portfolio was least affected by the change in interbank lending rates with an average non-significant return of -0.64%; this compares to a significant negative return for the top 100 firms who had a higher ratio of positive to negative returns and therefore produced an average return of -1.15%, significant at the 1% level in the z-test and marginally close to 10% in the Corrado rank test (see Table 6.12).

Table 6.12. Abnormal returns during periods [17, 24], [25, 28] and [29, 50] for firms classified by social performance

[17, 24] (Interbank lending at highest since 1998)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.15%	27 : 73	-3.69	0.00***	-1.53	0.13
BOTTOM 100	-0.64%	38 : 62	-1.23	0.22	-0.43	0.67
[25, 28] (Run on Northern Rock)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-2.5%	30 : 70	-8.64	0.00***	-2.80	0.01***
BOTTOM 100	-3.03%	26 : 74	-9.04	0.00***	-3.17	0.00***
[29, 50] (FED cuts rates and BoE injects capital)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-2%	40 : 60	-3.25	0.00***	-0.81	0.42
BOTTOM 100	-1.71%	45 : 55	-2.66	0.01***	-0.61	0.54

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

Table 6.12 also shows the market response to the run on UK bank, Northern Rock, where the top 100 firms produced a negative average return of -2.5%, significant at the 1% level in the z-test and Corrado rank, compared to the bottom 100 at -3.03%, statistically significant in both the z-test and Corrado rank test. The negative trend continued in period [29, 50] when as the bottom 100 performed best with a return of -1.71% compared to the top 100 CAAR of -2%, both returns statistically significant in the z-test.

Based on the evidence and despite a marginal difference in the later stages of the event, FTSE4good's social screening fostered a capacity for resilience that investors can capitalise on as the top 100 outperformed the bottom 100.

6.6.2 Deep Water Horizon oil spill and social portfolio performance

The social performance portfolio response to the Deep Water Horizon oil spill indicates a marginal performance advantage for the top 100 firms with an event window average return of -0.8% compared to the bottom 100 at -0.95%. Despite this difference, both were statistically insignificant, leaving determination of differences down to the individual periods within the event window. The returns within the window showed volatility throughout, the pattern of which can be seen in Figure 6.7 and the corresponding results for the CAAR periods in Table 6.13.

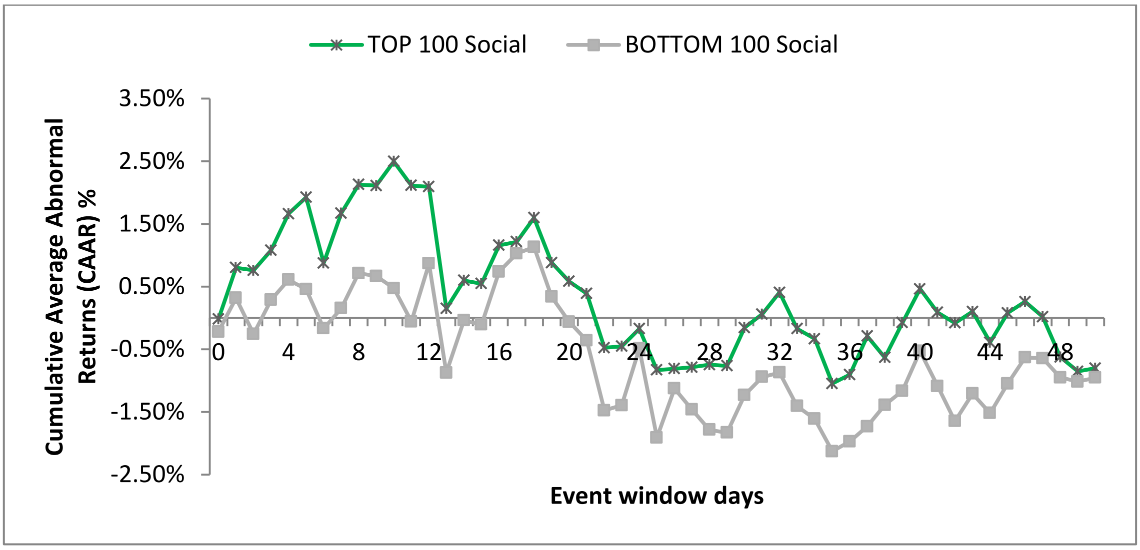

Figure 6.7. Deep Water Horizon oil rig explosion event window abnormal returns for firms classified by social performance

From Figure 6.7 it is evident that the event day produced no significant returns for either portfolio due to the lack of available information. The BP announcement period [2, 6] generated a positive return that were in line with expected for the top 100 at 0.08% but non-significantly, and the bottom 100 at -0.48%, again non-significant. The results for the BP announcement period [2, 6], recognition by financial markets [7, 25], the first moratorium [26, 34], and the Obama statements [35, 50] are shown in Table 6.13.

The period of recognition by financial markets [7, 25] generated only a single significant return as the top 100 averaged -1.71%, marginal difference from the average return of the bottom 100 at -1.74%. The top 100 showed greater evidence of a stronger rebound in response to the news of the first moratorium with a significant return of 0.5%; and the bottom 100 responded with an non-significant CAAR of 0.3%. The Obama statements do not generate any significant returns despite a difference; at -0.47% for the top 100 and 0.66% for the bottom 100. Furthermore, the difference between the two ratio of positive to negative firms are marginal.

Table 6.13. Abnormal returns for firms classified by social performance during all periods

Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
[0, 50] (Event Window)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.8%	53 : 47	0.27	0.79	0.67	0.5
BOTTOM 100	-0.95%	50 : 50	0.29	0.78	0.38	0.7
[0] (Event day - Rig explosion)						
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.02%	50 : 50	0.35	0.73	0.19	0.85
BOTTOM 100	-0.22%	45 : 55	-0.45	0.65	-0.27	0.79
[2, 6] (Oil rig explosion and BP announcement)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.08%	47 : 53	-0.28	0.78	-0.21	0.83
BOTTOM 100	-0.48%	42 : 58	-0.79	0.43	-0.17	0.87
[7, 25] (Recognition by financial markets)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.71%	39 : 61	-1.70	0.09*	-0.14	0.89
BOTTOM 100	-1.74%	45 : 55	-1.27	0.20	-0.10	0.92
[26, 34] (First moratorium)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.5%	57 : 43	1.72	0.09*	0.68	0.50
BOTTOM 100	0.3%	55 : 45	0.79	0.43	0.31	0.76
[35, 50] (9-10 June President Obama statements)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.47%	57 : 43	0.13	0.90	0.39	0.70
BOTTOM 100	0.66%	60 : 40	1.31	0.19	0.39	0.69

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The results indicated that the selection of the highest socially responsible firms provides marginally better performance during a man-made environmental crisis of this type as the portfolio of top firms resisted the impacts of the shock throughout the event window.

6.6.3 Japanese earth quake and social performance portfolio

The response to the Japan earth quake in valuing the social portfolios followed a similar pattern to that of the environmental portfolio result of the same event (see chapter 6.5.3). Again the portfolio of top 100 firms marginally underperformed on the event day with an AAR of -0.46%, significant at the 10% level in the Corrado rank test, and the periods relating to the announcement by Germany are most representative of a difference.

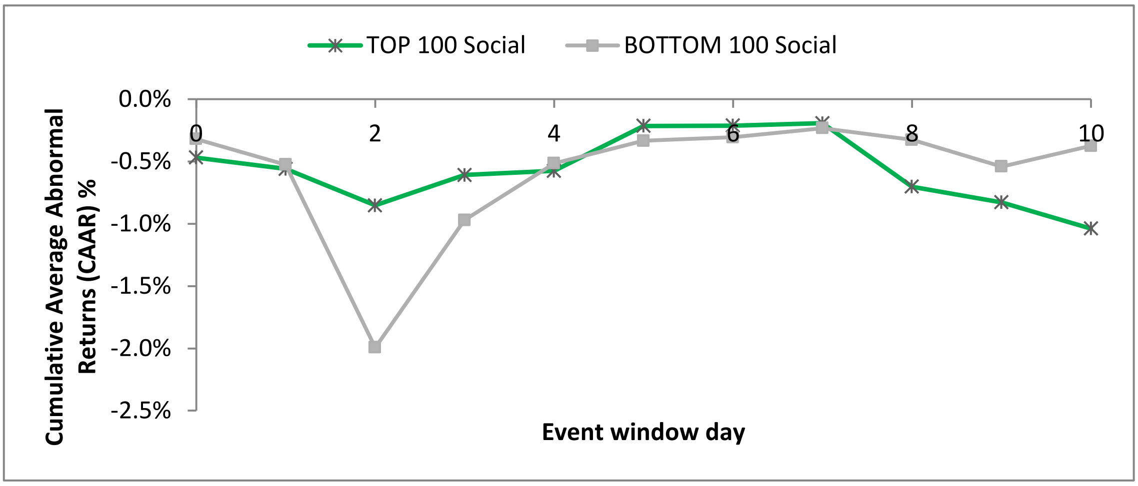

Figure 6.8. Japan earth quake event window [0, 10] abnormal returns for firms classified by social performance

For the bottom 100 Figure 6.8 shows a deviation away from expected levels the day following the event whilst the top 100 remained comparatively close to its expected returns. This pattern appears to relate to the announcement by Germany of an intention to cancel their nuclear energy programme. This would have both positive and negative implications for the utilities sector and firms linked to the supply of energy. However, the cumulative average abnormal returns for the event window do not reflect the announcement as the top 100 produced a mean return of -1.04% compared to the bottom 100 return of -0.37%. Only the return of the top 100 was significant in the z-test with a p-value of 0.02 denoting confidence at the 5% level. These results are shown in Table 6.14.

Table 6.14. Japan earthquake event window [0, 10] and event day [0] abnormal returns for firms classified by social performance

[0, 10] (Two working week event window)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.04%	42 : 58	-2.37	0.02**	-0.92	0.36
BOTTOM 100	-0.37%	44 : 56	-0.73	0.47	-0.04	0.97
[0] (Earth quake & announcement that nuclear power stations have been shut down)						
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.47%	35 : 65	-3.51	0.00***	-1.71	0.09*
BOTTOM 100	-0.32%	41 : 59	-1.65	0.1*	-0.74	0.46
[0, 3] (Announcement of nuclear reactor leak & Germany announces suspension of nuclear programme)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.61%	43 : 57	-2.85	0.00***	-1.08	0.28
BOTTOM 100	-0.97%	42 : 58	-2.31	0.02**	-0.58	0.56
[1, 5] (First trading week following the Friday quake)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.25%	50 : 50	0.48	0.63	0.41	0.68
BOTTOM 100	-0.01%	49 : 51	-0.22	0.82	0.23	0.82
[6, 10] (Second trading week following the quake)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.82%	36 : 64	-2.42	0.02**	-1.01	0.31
BOTTOM 100	-0.04%	49 : 51	-0.12	0.91	0.04	0.97

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

During period [0, 3] the bottom 100 underperformed with an average return of -0.97%, below the return of the top 100 firms at -0.61%, both significant at the 1% level in the z-test. The drop in CAAR for the bottom 100 coincides with the policy decision by Germany to cease all nuclear energy plans. The top 100 firms show consistency and relative stability albeit below expected levels throughout the periods shown in Table 6.14 but a curtailment in performance occurs in the later part of the event window that is difficult to account for.

Therefore, based on the results it is again marginal in determination of whether the highest performing socially responsible firms provide greater resilience for investors. However based on the significant periods surrounding the event, the top 100 social firms show limited evidence of a reduced exposure to the event, a conclusion that is reinforced by the pattern of returns in Figure 6.8

6.6.4 The Icelandic volcano eruption and social performance portfolio

The market response to the volcanic eruption of 2010 in Iceland follows an almost identical pattern to the environmental portfolios. During the event window, the portfolio of top 100 socially responsible firms outperformed the bottom 100 with a return of 1.59%, significant at the 1% level in the z-test with a p-value of 0.01. The event window results are shown Figure 6.9 and Table 6.15.

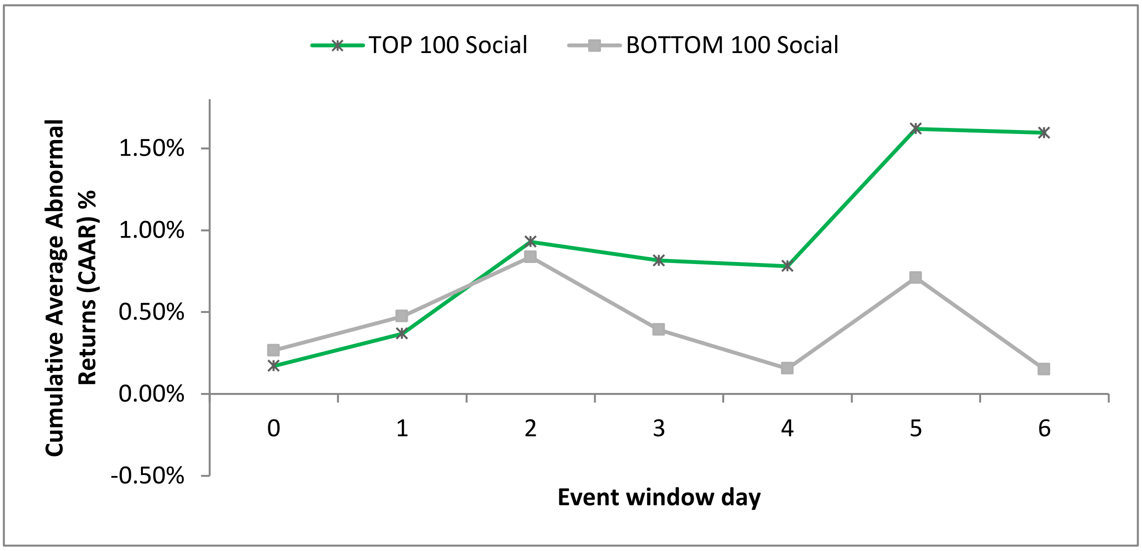

Figure 6.9. Abnormal returns during the Iceland volcano eruption for firms classified by social performance

For the event window the top 100 significantly out performs the bottom 100 but a greater disparity would be expected between in subsequent days because this represents the peak negative period of the crisis when the airspace above Europe was closed, grounding all aircraft. However, the results for the closure of EU airspace period [0, 1] produced no significant returns at 0.37% for the top 100 and 0.47% for the bottom 100.

The difference between the two portfolios becomes substantial upon the re-opening of EU airspace [2, 6] with a return for the top 100 at 1.23%, significant in the z-test and the Corrado rank test. The bottom 100 returned to expected levels without a significant return at -0.32%. Based on the significant returns during the event window, and the re-opening of EU airspace [4, 6], evidence suggests that extreme social performance provides a resilient advantage in the returns for investors.

Table 6.15. Abnormal returns during all periods of the Japan earth quake event study for firms classified by social performance

[0, 6] (Event Window)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	1.59%	59 : 41	2.63	0.01***	1.44	0.15
BOTTOM 100	0.15%	51 : 49	0.16	0.88	0.38	0.70
[0] (Eruption of Iceland Volcano)						
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.17%	43 : 57	0.42	0.68	-0.10	0.92
BOTTOM 100	0.27%	51 : 49	0.41	0.68	0.48	0.63
[0, 1] (Eruption to closure of EU airspace)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.37%	45 : 55	0.32	0.75	-0.17	0.87
BOTTOM 100	0.47%	52 : 48	0.56	0.57	0.44	0.66
[2, 6] (Re-opening of EU Airspace)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	1.23%	65 : 35	2.91	0.00***	1.81	0.07*
BOTTOM 100	-0.32%	41 : 59	-0.17	0.86	0.18	0.86

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

6.6.5 The US presidential election and social portfolio performance

Following the announcement that Barak Obama had won the US presidential election, the social screening by FTSE4good yielded a significant benefit for investors over a portfolio of relatively low performing social responsibility firms as the pattern of returns throughout the event window was significantly positive. These patterns are shown in Figure 6.10.

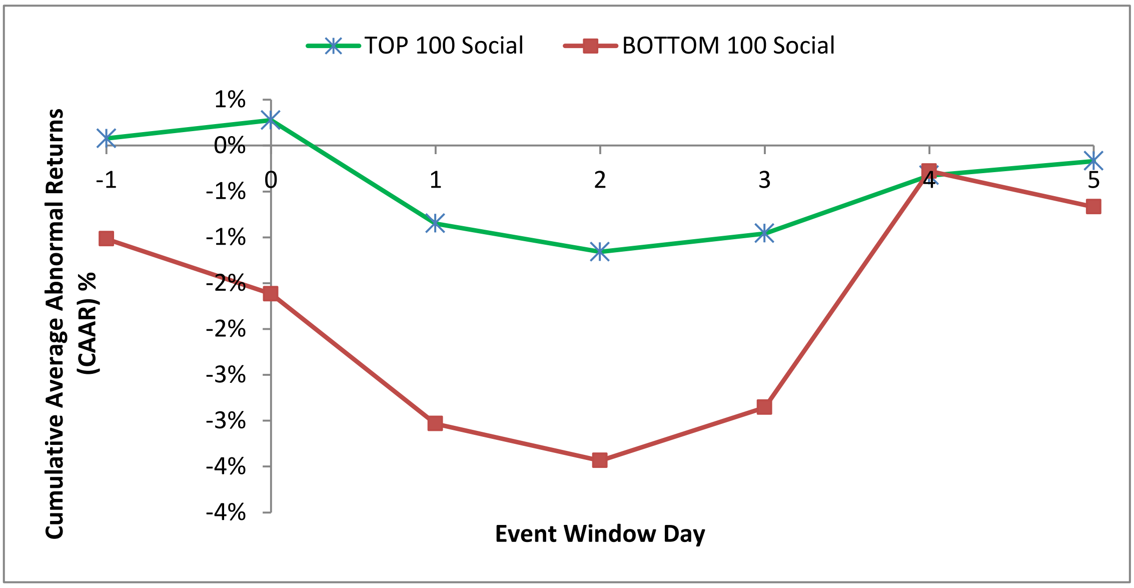

Figure 6.10. The abnormal returns during the US presidential election event window [-1, 5] for firms classified by social performance

The periods surrounding the announcement show a significant decline in the value of the bottom 100 firms starting with [-1, 1] a negative CAAR of -3.03%, significant in both the z-test and Corrado rank test. This compares to a relatively stable top 100 average return of -0.85%. The following periods [0, 1], [0, 2] and [0, 3] follow the same trend as the bottom 100 portfolio is below the top 100 at a significance of 1%. Details of these results are shown in Table 6.16.

During the recovery period [2, 5], the bottom 100 firms showed the greatest return at 2.37% compared to the top 100 at 0.68%. This however is expected given the performance difference between the two portfolios throughout the event window and the market potentially seeing the return low as an opportunity to arbitrage causing the securities to rebound.

Table 6.16. Abnormal returns during all periods during the election event window for firms classified by social performance

			[-1, 5]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.17%	02:50	-0.79	0.43	-0.35	0.73
BOTTOM 100	-0.67%	18:58	-1.58	0.11*	-1.11	0.27
			[-1, 1]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.85%	36:64	-2.53	0.01***	-1.36	0.17
BOTTOM 100	-3.03%	25:75	-6.66	0.00***	-2.8	0.01***
			[0, 1]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.93%	27:73	-4.27	0.00***	-2.25	0.02**
BOTTOM 100	-2.02%	29:71	-6.04	0.00***	-2.62	0.01***
			[0, 2]			
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.24%	32:68	-4.41	0.00***	-2.33	0.02**
BOTTOM 100	-2.42%	23:18	-6.34	0.00***	-2.61	0.01***
			[0, 3]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.04%	37 : 63	-2.93	0.00***	-1.51	0.13
BOTTOM 100	-1.84%	34 : 66	-4.48	0.00***	-1.88	0.06*
			[0, 5]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.25%	43 : 57	-1.53	0.13	-0.72	0.47
BOTTOM 100	0.35%	47 : 53	-0.49	0.63	-0.73	0.46
			[2, 5]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.68%	53 : 47	1.14	0.25	0.71	0.48
BOTTOM 100	2.37%	68 : 32	3.67	0.00***	0.95	0.34

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

Evidence suggests that the extremes of FTSE4good social performance provided consistency in the returns of the top 100 social performance portfolio over and above the returns of the bottom 100. It therefore follows that the social screening of FTSE4good showed evidence of resilience and resilience, protecting investor wealth in excess of firms at the extreme opposite of the social performance spectrum.

6.6.6 Descriptive statistics

The ranking and descriptive results (See Appendix L) show evidence that portfolios formulated from the social performance ratings of FTSE4good provide a capacity for resilience above the portfolio of bottom 100 ranked firms. The top 100 portfolio ranked 1st in twice as many statistically significant periods, produced a lower mean rank and sum that was statistically significant in the Chi-Squared test, $X^2(1) = 3.2,$ at the 10% level due to a $p = 0.074$. Table 6.17 provides details of this result.

Table 6.17. Ranking statistics for firms classified by social performance and during periods with significant returns

Rank Descriptive Statistics	*TOP 100*	*BOTTOM 100*
1st	14	6
2nd	6	14
Mean	1.3	1.7
Sum	26	34
Count	20	20
Chi-Square (X^2)	3.2	-
Degrees of freedom (df)	1	-
Significance (p)	0.074	-

The descriptive statistics for periods with significant abnormal returns show the top 100 outperformed the bottom 100 by more than 64% with a mean return of -0.83% compared to -1.36% for the bottom 100. The range, minimum and sum statistics all indicate an advantage for the top 100 social performance firms, indicating that the bottom 100 showed evidence of greater instability. The Skewness and kurtosis statistics are consistent with the other statistics. The top 100 produced a marginally favourable kurtosis statistic of 5.05, compared to the bottom 100 at 5.82. The returns of both portfolios are negatively skewed but the top 100 less so at -1.6 compared to 1.7.

Table 6.18. Descriptive statistics for periods with significant returns of firms classified by social performance

	TOP 100	BOTTOM 100
Mean	-0.83%	-1.36%
Standard Error	0.35%	0.46%
Median	-0.84%	-0.82%
Standard Deviation	1.57%	2.05%
Sample Variance	0.025%	0.042%
Kurtosis	5.05	5.82
Skewness	-1.6	-1.7
Range	7.45%	10.45%
Minimum	-5.86%	-8.08%
Maximum	1.59%	2.37%
Sum	-16.50%	-27.13%
Count	20	20

The findings within the social portfolio results show a significant advantage for the “best in class” firms from FTSE4good. The implications of which are significant within the investment domain. The table below shows the descriptive statistics for all event study periods relating to social portfolio significant and non-significant returns. The statistics within this table reflect the comparative performance of the returns of Table 6.18 confirming an advantage for firms selected on the basis of social performance.

Table 6.19 Descriptive statistics for the returns of firms classified by social performance during all periods

	TOP 100	BOTTOM 100
Mean	-0.60%	-0.95%
Standard Error	0.0025	0.0034
Median	-0.47%	-0.42%
Standard Deviation	0.014	0.018
Sample Variance	0.00018	0.00033
Kurtosis	7.66	7.90
Skewness	-2.10	-2.14
Range	7.45%	10.45%
Minimum	-5.86%	-8.08%
Maximum	1.59%	2.37%
Sum	-17.28%	-27.42%
Count	29	29

6.7 Corporate governance portfolio performance results

The corporate governance portfolios were formulated using the top 100 and bottom 100 firms according to their absolute governance ratings published by FTSE4good (See Appendix J and K). Firms were selected from the ratings period that retrospectively corresponds to the event. The following chapter is a comparison of abnormal returns between the top and bottom 100 governance performers (See Appendix L).

6.7.1 Financial crisis and corporate governance portfolio performance

Overall the comparison of top and bottom 100 firms during the financial crisis follows a similar pattern to the event window returns of the environmental portfolios (see chapter 6.5.1). Over the event window, the top 100 governance firms underperformed the bottom 100, generating 22 positive to 78 negative returns and a mean return of -8.81%, 72% below the average return of the bottom 100 that generated a positive negative ratio of 35:65 and a mean return of -5.46%. The top and bottom 100 returns were significant at the 1% level in the z-test and only the top 100 was significant at the 1% level in the Corrado rank test (see Table 6.20).

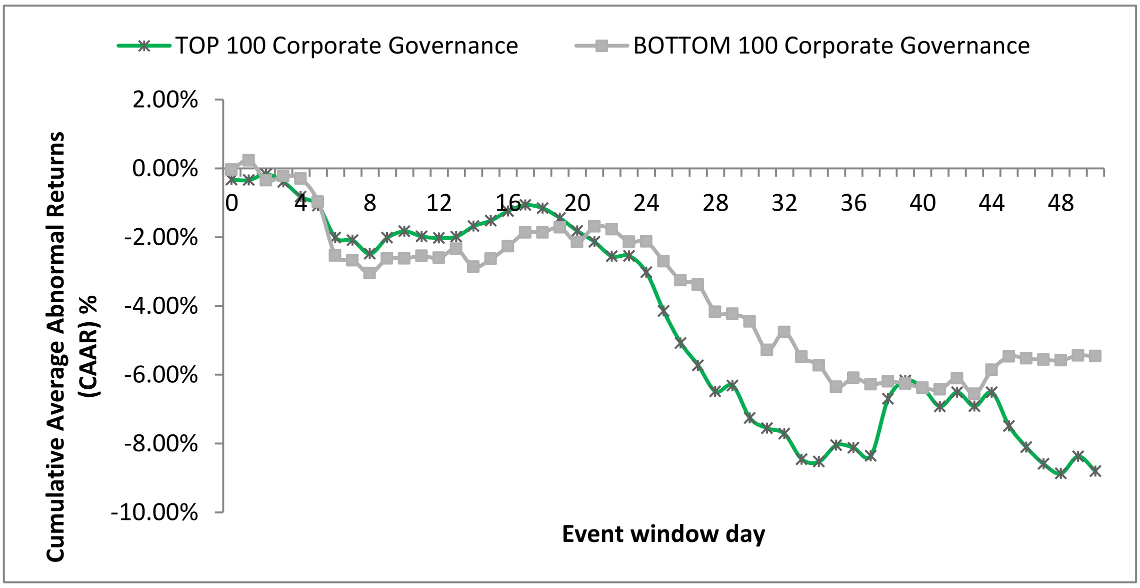

Figure 6.11. Financial crisis event window [0, 50] abnormal returns for firms classified according to corporate governance performance

Figure 6.11 shows two notable deviations between the portfolios; firstly, during period [17, 24] a widening gap between the returns of the two portfolios that follows through to period [25, 28], representing the run UK bank Northern Rock, at which point the top 100 underperformed relative to the bottom 100.

Table 6.20. Financial crisis abnormal returns f for firms classified according to corporate governance performance during the event window [0, 50] and periods

[0, 50] (Event window)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-8.81%	22 : 78	-9.23	0.00***	-2.62	0.01***
BOTTOM 100	-5.46%	35 : 65	-4.37	0.00***	-1.07	0.28
[0] (BNP Paribas Announcement)						
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.33%	40 : 60	-2.05	0.04**	-0.7	0.48
BOTTOM 100	-0.04%	44 : 56	-1.41	0.16	-0.43	0.67
[0, 5] (BNP Paribas Announcement & ECB liquidity injection)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.08%	44 : 56	-2.95	0.00***	-0.63	0.53
BOTTOM 100	-0.98%	45 : 55	-2.23	0.03**	-0.66	0.51
[6, 16] (FED cuts rates - warning of threat to growth)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.16%	53 : 47	-0.59	0.56	0.31	0.76
BOTTOM 100	-1.29%	36 : 64	-1.98	0.05**	-0.48	0.63
[17, 24] (Interbank lending at highest since 1998)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.79%	27 : 73	-4.81	0.00***	-1.44	0.15
BOTTOM 100	0.14%	46 : 54	0.23	0.82	0.01	0.99
[25, 28] (Run on Northern Rock)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-3.46%	23 : 77	-12.40	0.00***	-3.72	0.00***
BOTTOM 100	-2.04%	36 : 64	-5.75	0.00***	-1.99	0.05
[29, 50] (FED cuts rates and BoE injects capital)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-2.32%	36 : 64	-3.92	0.00***	-1.42	0.16
BOTTOM 100	-1.29%	51 : 49	-1.78	0.08***	-0.1	0.92

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The returns for the event day were significant only for the top 100 as it produced a return of -0.33% compared to the bottom 100' close to expected return of -0.04%. The effects of the event are apparent for both groups in period [0, 5] of Table 6.20 and Figure 6.11, where the top 100 produced a mean return of -1.08% compared to the bottom 100 at -0.98%, both significant in the z-test. The following period, when the US FED cut rates [6, 16], produced a significant decline for the bottom 100 at -1.29% compared to a close to expected return for the top 100 at -0.16%. Conversly, the following period, when interbank lending rates peaked [17, 24] it was the top 100 that produced the only significant negative return at -1.79% compared to the bottom 100' close to expected return of 0.14%. The period when Northern Rock announced significant issues that subsequently caused a run on its deposits [44, 48] produced a significant decline away from expected values for both groups; however, the top 100 was most effected with a significant return of -3.46% compared to the bottom 100 return of -2.04% (see Table 6.20).

The closing stages [29, 50] produced significant returns for both groups of frims as the top 100 continued its underperforming trend with a return of -2.32% that was significant in the z-test and underpinned by a positive to negative ratio of 36:64The bottom 100 returns were also negative and significant in the z-test with an even positive negative ratio of 51:49 that still produced a return of -1.29%.

Although the returns during the early periods were too close to distinguish, the event window [0, 50] and later periods [17, 24], [25, 28] and [29, 50] provide the clearest indication of a difference in performance. Therefore, portfolios based on the upper limits of FTSE4good corporate governance performance did not appear to provide investors with comparative resilience throughout the financial crisis.

6.7.2 Deepwater Horizon oil spill and corporate governance portfolio performance

The cumulative average abnormal returns for both portfolios (see Figure 6.12) show closely matched performance throughout the Deep Water Horizon event window [0, 60]. With the exclusion of BP from the analysis the returns of both groups are largely close to expected with some minor exceptions. The interval periods the represent recognition by financial markets [7, 25] and the first moratorium [26, 34] provide some evidence of an impact and differentiation in performance between the portfolios that relate to FTSE4good corporate governance ratings.

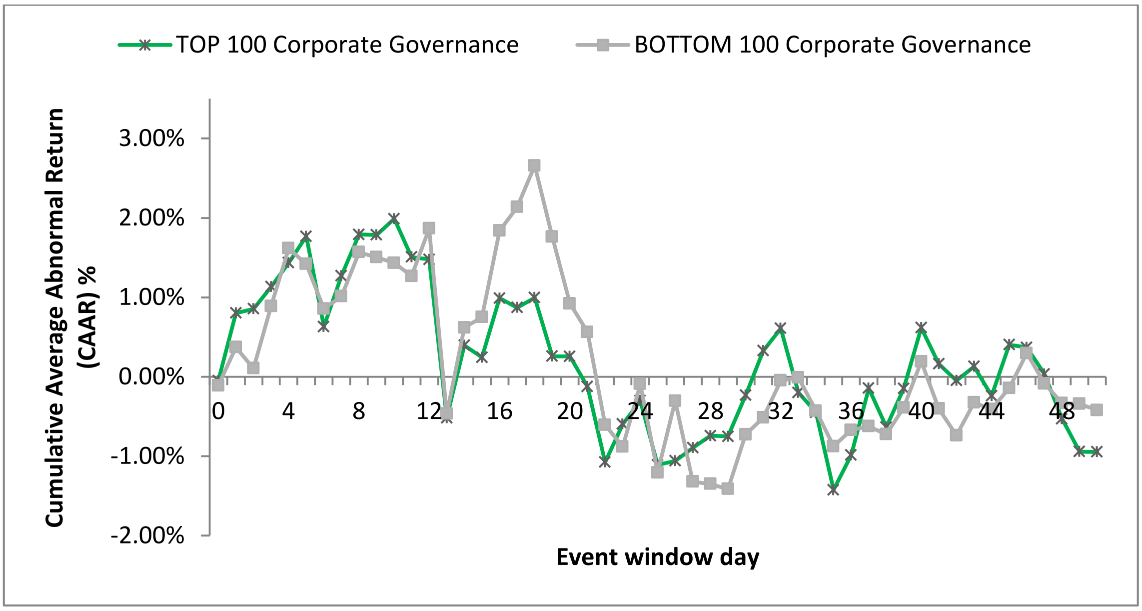

Figure 6.12. Deep Water Horizon oil spill event window [0, 50] abnormal returns for firms classified according to corporate governance performance

As with the other result of the same event, the event day [0] explosion did not have a significant effect on the portfolios. The period leading up to the announcement by BP [2, 6] was negative for the top 100 and positive for the bottom 100 but without significance. The top 100 has greater representation from oil producers. This non-significant result corresponds to the lack of information within the market place. The period immediately after the announcement when financial markets recognised the magnitude of the incident [7, 25], a period that sees substantial volatility and negative average returns for the top 100 at -1.74%, significant at the 10% level in the z-test compared to the average return of bottom 100 at -2.06%, close to significance (Table 6.21).

The following period reflects the first moratorium [26, 34] when the top 100 generated a significant positive average return of 0.66% compared to the bottom 100 positive cumulative average return of -0.78%, close to significance at the 10% level in the z-test. The results for the first moratorium [26, 34] and the Obama statements [35, 50] are shown in Table 6.21.

Table 6.21. Abnormal returns for firms classified according to corporate governance performance during the Deep Water Horizon disaster

[0, 50] (Event Window)						
Index	CAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.95%	56 : 44	0.13	0.9	0.45	0.65
BOTTOM 100	-0.42%	54 : 64	0.52	0.6	0.51	0.61
[0] (Event day - Rig explosion)						
Index	AR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.05%	45 : 55	-0.30	0.77	-0.11	0.91
BOTTOM 100	-0.11%	46 : 54	-0.15	0.88	-0.06	0.95
[2, 6] (Oil rig explosion and BP announcement)						
Index	CAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.17%	43 : 57	-0.94	0.35	-0.33	0.74
BOTTOM 100	0.48%	55 : 45	1.00	0.32	0.55	0.58
[7, 25] (Recognition by financial markets)						
Index	CAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.74%	39 : 61	-1.82	0.07*	-0.31	0.75
BOTTOM 100	-2.06%	39 : 61	-1.53	0.13	-0.29	0.77
[26, 34] (First moratorium)						
Index	CAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.66%	62 : 38	1.86	0.06*	0.76	0.45
BOTTOM 100	0.78%	55 : 45	1.48	0.14	0.52	0.61
[35, 50] (9-10 June President Obama statements)						
Index	CAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.5%	60 : 40	0.4	0.69	0.30	0.76
BOTTOM 100	0.01%	49 : 51	0.54	0.59	0.26	0.8

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

As shown in Table 6.21, the Obama statements during period [35, 50] had little effect on the governance portfolios as neither produced a significant return. Therefore, considering only periods with significant returns, a substantive difference could not be established between the portfolios of top and bottom corporate governance firms implying neither an advantage or disadvantage for either classification of firms.

6.7.3 Japanese earth quake and corporate governance performance portfolio

In response to the Japanese earthquake, the corporate governance performance portfolio of top 100 firms underperforms the bottom 100 throughout the event window. Starting with the AAR of first period [0] through to the CAAR of the event window [0, 10], every result was in favour of the portfolio of bottom 100 firms, the pattern of which is shown in Figure 6.13. The event day produce a return for the top 100 of -0.52%, significant at the 1% level in the z-test and 10% in the Corrado rank test; compared to the bottom 100 return of -0.33%, significant at the 10% level in the z-test.

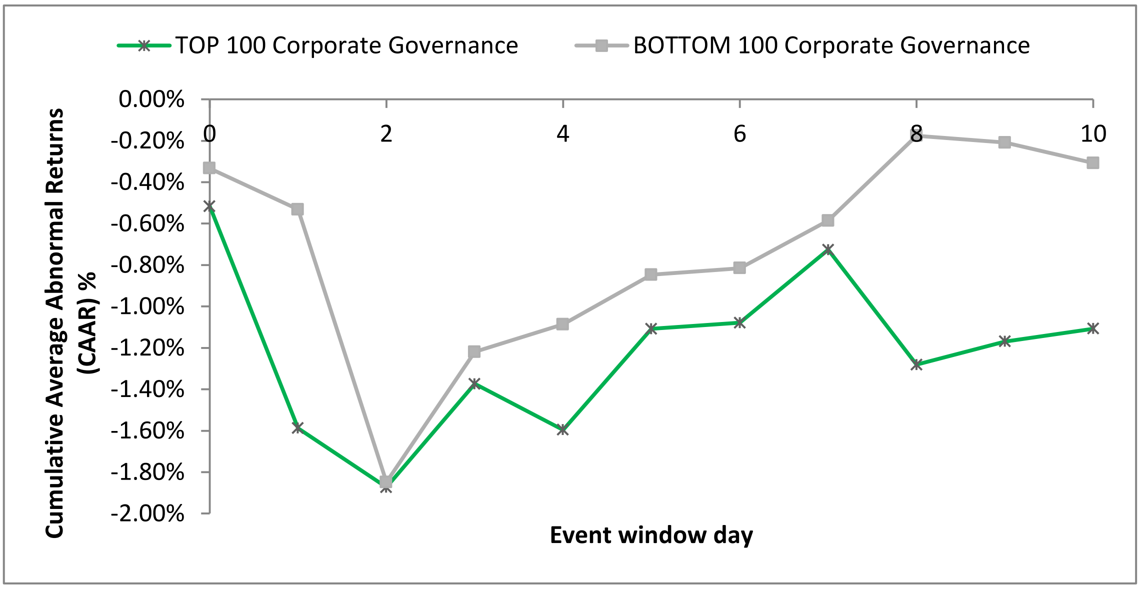

Figure 6.13. Abnormal returns during the Japan earth quake event window for firms classified according to corporate governance performance

Both portfolios rebound on the same event low during the announcement of a nuclear reactor leak and Germany's suspension of their nuclear energy programme period [0, 3] but the top 100 underperforms marginally at -1.37%, compared to the bottom 100 at -1.22%, both significant at the 1% level in the z-test (see Table 6.22) and therefore difficult to differentiate. Following this announcement, both portfolios began an upward trend with the top portfolio showing less consistency in return direction and therefore instability in confidence of the firms. Conversely, the bottom 100 portfolio recovers and plateaus at the end of the window, finishing with a positive CAAR in period [6, 10] signifying superior resilience (see Figure 6.13).

Table 6.22. The abnormal returns for firms classified according to corporate governance performance during periods [0, 10], [0], [0, 3], [1, 5] and [6, 10]

[0, 10] (Two working week event window)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.11%	43 : 57	-2.35	0.02**	-0.76	0.45
BOTTOM 100	-0.31%	47 : 53	-0.58	0.56	0.03	0.97
[0] (Earth quake & announcement that nuclear power stations have been shut down)						
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.52%	33 : 67	-3.49	0.00***	-1.64	0.1*
BOTTOM 100	-0.33%	41 : 59	-1.63	0.1*	-1.04	0.3
[0, 3] (Announcement of nuclear reactor leak & Germany announces suspension of nuclear programme)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.37%	43 : 57	-2.89	0.00***	-0.75	0.45
BOTTOM 100	-1.22%	42 : 58	-2.87	0.00***	-0.78	0.43
[1, 5] (First trading week following the Friday quake)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.59%	52 : 48	0.02	0.99	0.59	0.56
BOTTOM 100	-0.51%	47 : 53	-1.22	0.22	0.09	0.93
[6, 10] (Second trading week following the quake)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.00%	37 : 63	-1.93	0.05**	-0.98	0.33
BOTTOM 100	0.54%	57 : 43	1.08	0.28	0.43	0.67

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

Despite the lack of a clear difference, the top 100 underperformed relative to the bottom 100 throughout with an event window return of -1.11%, significant in the z-test. This compares to a more resistant return for the bottom 100 at -0.31% but without significance (see Table 6.22). Based on the results, FTSE4good's corporate governance screening process did not appear to foster novelty and resilience for investors as the top 100 portfolio underperformed in every aspect of the analysis.

6.7.4 Iceland volcano eruption & corporate governance portfolio performance

In response to the volcanic eruption of 2010 in Iceland, the corporate governance portfolios derived from the screening by FTSE4good, returned few significant returns throughout the event study. During the event window [0, 6] that covers the eruption, closure and re-opening of EU airspace, the top 100 firms generated the greatest cumulative average returns at 1.61% that were significant at the 1% level in the z-test. The bottom 100 started the event window with a marginal advantage that was eventually lost with a non-significant average return of 0.59%. The patterns of returns are shown in Figure 6.14 where the cross over in performance takes place during the closure of EU airspace [1, 3].

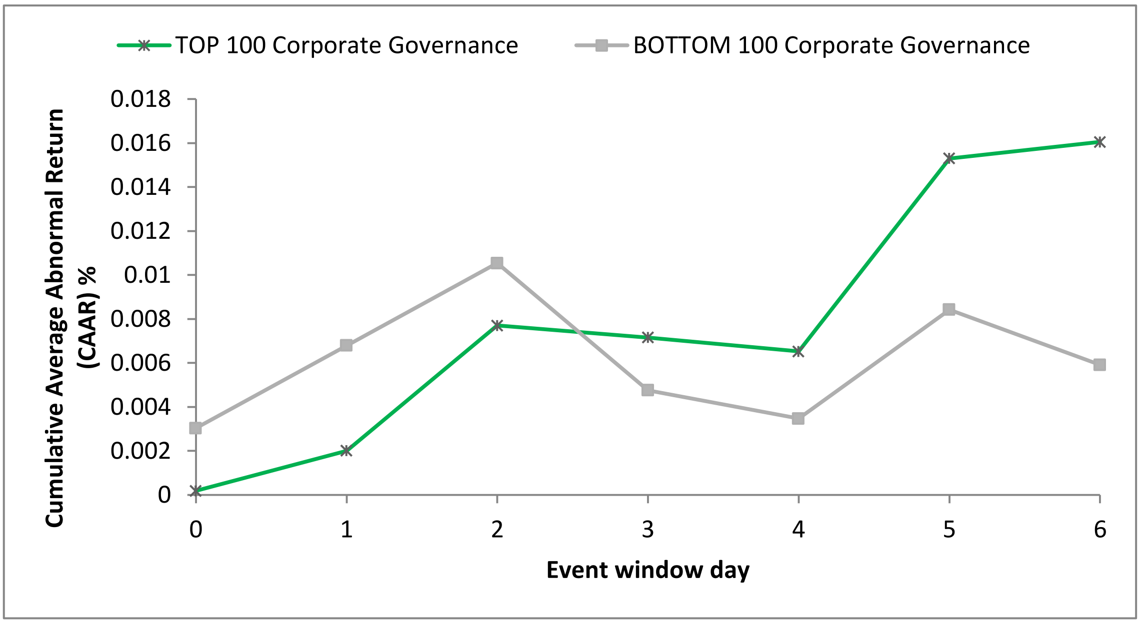

Figure 6.14. Development of the abnormal returns during the Iceland volcano eruption for firms classified according to corporate governance performance

There are no apparent significant returns for either portfolio in the early stages of the event. Only during the re-opening of EU airspace, did the top 100 significantly outperform the bottom 100. On the event day [0] both produce a CAAR close to expected and therefore without significance although the top 100 had a greater ratio of negative firm returns than the bottom 100 (40:60 compared to 49:51) (see Table 6.23).

Table 6.23. Icelandic volcano eruption abnormal returns during periods [0, 6], [0] [0, 1] and [2, 6] for firms classified according to corporate governance performance

[0, 6] (Event Window)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	1.61%	64 : 36	2.68	0.01***	1.39	0.17
BOTTOM 100	0.59%	51 : 49	0.73	0.46	0.68	0.50
[0] (Eruption of Iceland Volcano)						
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.02%	40 : 60	-0.02	0.98	-0.18	0.86
BOTTOM 100	0.3%	49 : 51	0.87	0.38	0.58	0.56
[0, 1] (Eruption to closure of EU airspace)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.2%	45 : 55	0.11	0.91	-0.18	0.86
BOTTOM 100	0.68%	58 : 42	1.45	0.15	0.84	0.4
[2, 6] (Re-opening of EU Airspace)						
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	1.4%	62 : 38	3.10	0.00***	1.76	0.08*
BOTTOM 100	-0.09%	47 : 53	-0.05	0.96	0.27	0.79

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The period that includes the eruption and EU airspace closure also failed to produce a significant response in the market with the top 100 CAAR of 0.2% and the the bottom 100 at 0.68%. The re-opening of EU airspace [2, 6] caused the top 100 to produce a positive average return, significant at the 1% level in the z-test, at 1.4% compared to the bottom 100 non-significant return of -0.09%. Results for the re-opening of EU airspace (recovery) are shown in Table 6.23.

The parity of early period returns are insignificant and, therefore, excluded from further analysis. Conclusion is therefore determined by the returns during the closure of EU airspace when differentiation in performance was most evident. Therefore, the top 100 significantly outperformed the bottom 100 by 172% during the event window, thus appearing to provide a resilient advantage for investors.

6.7.5 US presidential election and corporate governance performance

The market response to the value of the corporate governance portfolios during the US presidential elections shows a similar result to that of the environmental portfolio (Section 6.5.5) but in this instance the returns are marginally in favour of the top 100. The CAAR patterns are shown in event window period [-1, 5] shown in Figure 6.15.

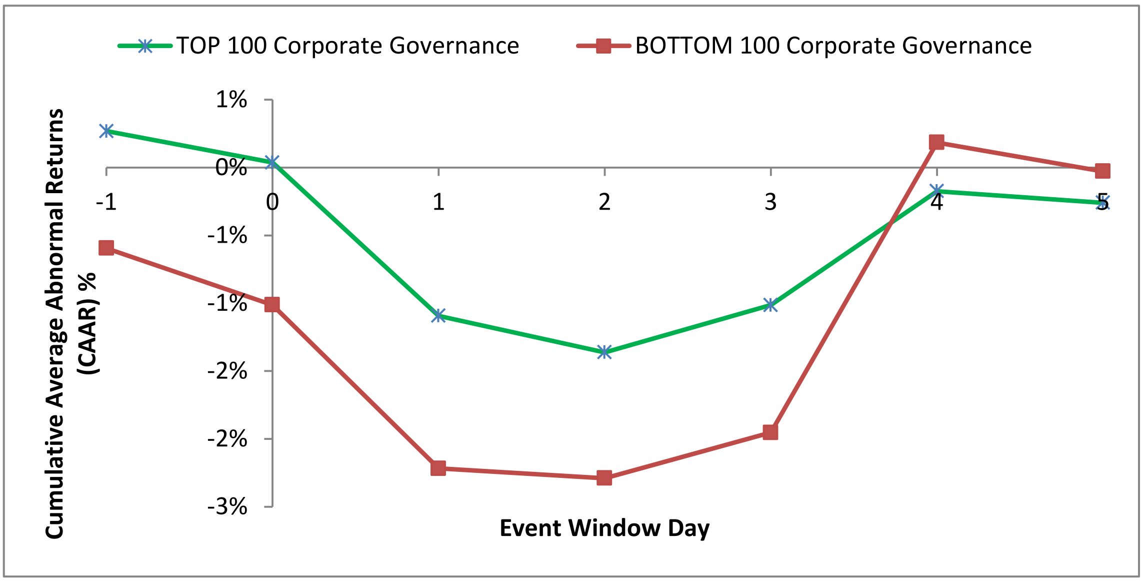

Figure 6.15. Abnormal returns during the US presidential election event window [-1, 5] for firms classified according to corporate governance performance

The period [-1, 1] surrounding the event day shows a rapid and significant decline in the value of the bottom 100 firms at -2.22% compared to a more resistant -1.09% for the top 100. Both are significant in the z-test at the 1% and the Corrado Rank test. The event window low in the following period follows the same trend but the margin is reduced in comparison to the previous period, as shown in Table 6.24.

The post announcement decline also shows a marginal advantage for the top 100 in period [0, 2]. Therefore, the top 100 potentially shows greater resilience to the impacts of President Obama’s re-election and potential policy stance on environmental protection. Following the impacts of the event the market priced a recovery for the bottom 100 at 2.19%, this compares to a recovery return of 0.83% for the top 100. All returns were significant in the z-test.

Table 6.24. US presidential election abnormal returns during all periods for firms classified according to corporate governance performance

			[-1, 5]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.26%	06:46	-0.48	0.63	-0.26	0.8
BOTTOM 100	-0.03%	02:50	-0.33	0.74	-0.93	0.35
			[-1, 1]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.09%	34:66	-3.45	0.00***	-1.67	0.09*
BOTTOM 100	-2.22%	33:67	-5.12	0.00***	-2.41	0.02**
			[0, 1]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.36%	83:17	-5.59	0.00***	-2.94	0.00***
BOTTOM 100	-1.62%	33:67	-4.65	0.00***	-2.19	0.03**
			[0, 2]			
Index	AAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.63%	25:75	-5.39	0.00***	-2.78	0.01***
BOTTOM 100	-1.70%	33:67	-4.36	0.00***	-1.98	0.05**
			[0, 3]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-1.28%	35:65	-3.39	0.00***	-1.69	0.09
BOTTOM 100	-1.36%	41:59	-3.06	0.00***	-1.54	0.12
			[0, 5]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	-0.53%	50:50	-1.31	0.19	-0.79	0.43
BOTTOM 100	0.57%	60:30	0.58	0.56	-0.57	0.57
			[2, 5]			
Index	CAAR	Pos : Neg	z-test	p-value	Corrado rank	p-value
TOP 100	0.83%	61:39	2.35	0.02**	1.11	0.27
BOTTOM 100	2.19%	66 :34	4.00	0.00***	0.85	0.39

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

Based on the evidence within this event study, the periods with significant returns indicate that the corporate governance portfolio enhanced firm resilience and resilience and consequently protected stockholder wealth.

6.7.6 Descriptive Statistics

The ranking statistics for the corporate governance portfolios during the 20 periods with significant abnormal returns show a marginal advantage for the bottom 100 firms due to a mean rank, sum statistic and close ranking placements that are not significantly according to the Chi-Square statistic ($X^2(1) = 0.8, p = 0.371$) and subsequent the p-value of 0.371, which is above the minimum confidence interval threshold of 0.1, or 10% (See Appendix G).

Table 6.25. Ranking statistics for periods with significant returns for firms classified according to corporate governance performance

Rank Descriptive Statistics	TOP 100	BOTTOM 100
1st	8	12
2nd	12	8
Mean	1.6	1.4
Sum	32	28
Count	20	20
Chi-Square (X^2)	0.8	-
Degrees of freedom (df)	1	-
Significance (p)	0.371	-

Given that the ranking statistics failed to show evidence of a statistically significant difference then the descriptive statistics for periods with significant abnormal returns were identified. Firstly, the mean return of the bottom 100 implies greater capacity for resilience at -0.89% compared to -1.18% for the top 100. This is compounded by a smaller range, sum, variance and standard deviation statistic that denote less volatility and lower extreme return values for the bottom 100. Furthermore, the top 100 returns produced a relatively high kurtosis statistic of 7.63 compared to 3.05. The Skewness statistic for the top 100 was negative at -2.24 compared to -0.9 for the bottom 100.

Table 6.26. Descriptive statistics for firms classified according to corporate governance performance during periods with significant returns

	TOP 100	BOTTOM 100
Mean	-1.18%	-0.89%
Standard Error	0.49%	0.35%
Median	-1.10%	-1.10%
Standard Deviation	2.19%	1.57%
Sample Variance	0.048%	0.025%
Kurtosis	7.63	3.05
Skewness	-2.24	-0.9
Range	10.42%	7.65%
Minimum	-8.81%	-5.46%
Maximum	1.61%	2.19%
Sum	-23.55%	-17.77%
Count	20	20

Further to the descriptive statistics in Table 6.26, the following Table 6.27 confirms the observed, that the selection of firms using FTSE4Good' governance ratings does not show evidence of resilience and no advantage is recognised within the market place. The top 100 underperform in all aspects of the descriptive statistics for all periods tested under the corporate governance performance.

Table 6.27 Descriptive statistics for firms classified according to corporate governance performance during all event study periods

	TOP 100	BOTTOM 100
Mean	-0.91%	-0.58%
Standard Error	0.0035	0.0026
Median	-0.53%	-0.31%
Standard Deviation	0.019	0.014
Sample Variance	0.00035	0.00019
Kurtosis	11.58	4.40
Skewness	-2.82	-1.39
Range	10.42%	7.65%
Minimum	-8.81%	-5.46%
Maximum	1.61%	2.19%
Sum	-26.38%	-16.80%
Count	29	29

Table 6.28 provides a summary overview of each portfolios result in comparison to the respective bottom 100 firms. The chi-squared test of the ranking for each period with significant returns is also detailed along with the observed outcome of the descriptive statistics. A neutral result implies that neither portfolio showed evidence of an excess in relative performance which could be viewed as positive for the FTSE4good. Below is a table showing the descriptive statistics for all event study periods.

Table 6.28. Summary of event study and statistical results using only significant abnormal return periods

Event	Environmental	Social	Corporate Governance
Financial crisis	Negative	Positive	Negative
BP plc oil spill	Positive	Positive	Neutral
Iceland Volcanic Eruption	Positive	Positive	Positive
Japan earthquake	Positive	Positive	Negative
US presidential election	Negative	Positive	Positive
Chi-Squared Test	Neutral	Positive	Neutral
Descriptive Statistics	Negative	Positive	Negative

6.8 Discussion

6.8.1 The performance of ESG extremes

Overall the results indicate that when the top and bottom 100 performing firms are separated into portfolios, during 10 out of the 15 events analysed, the top 100 portfolios generated higher returns relative to the bottom 100 portfolios. Individually, the event study tests of portfolios based on social performance show that FTSE4good's screening of top 100 firms achieved higher rates of return consistently over the bottom 100 firms during all five events. Two of the results were marginal but with support from the descriptive statistics, a positive result was concluded because of the comparative significance of the results and the significance of the Chi-squared analysis of significant period rankings. The portfolio of top environmental firms yielded higher returns in the events with a physical environmental impact but underperformed in all other non-environment related shocks. This result was perhaps to be expected because the environmental screening criteria set by FTSE4good makes no provision for financial criteria and therefore, performance in events linked to these factors would be unlikely.

Coupled with the fact that inclusion within the top 100 portfolio does not necessarily mean inclusion in FTSE4good, and therefore the top 100 firms will be a mixture of broadly high performing ESG firms included in the index series along with firms that only perform well within the respective pillar. This would limit any crossover in performance by firms that perform in all three pillars. The corporate governance portfolios yielded mixed results with two events yielding higher rates of return for the top with a neutral result in the Deepwater Horizon oil spill and two further events yielded lower rates of return in favour of the bottom 100. The ranking and descriptive statistics confirm a relative disadvantage associated with the highest performing corporate governance firms.

6.8.2 Higher moments in the distribution of returns

In all instances of higher performance the consistent characteristic that matches a greater or lower rate of return is that of Skewness and kurtosis. The top 100 environmental and corporate governance firms and bottom 100 social firms all produced greater negative Skewness coupled with higher kurtosis. On average the returns of the FTSE4good environmental and governance firms have 57% lower skewness and 80% higher kurtosis than the lowest performing firms. This characteristic reflects a greater chance of extreme negative outcomes that is unattractive to investors due to heightened risk. This finding is fundamental to the economics and finance literature (Brealey, 2008), evidence of which is also found in a FTSE4Good related study by Belghitar et al (2014) the authors of which highlight the relationship between financial performance, skewness and kurtosis, albeit against the performance of the FTSE4good. Conversely, whilst the returns of the top 100 social firms were negatively skewed, the presence of a relatively lower kurtosis statistic suggests lower risk of generating extreme negative values for investors.

6.8.3 Linking financial performance with FTSE4good ESG criteria

The pattern of the results may be linked to FTSE4good's screening criteria and the standards that are required to become constituents. These standards and the rigour with which they are enforced provide, in part, the link to each portfolio's performance and how they are impacted by the events studied here (Cavaco and Crifo, 2014).

Firstly, the environmental portfolios underperformed during the financial crisis and the US presidential election event studies. This result could be a consequence of the added cost of achieving the environmental standards set by FTSE4good, particularly as the constituents are those with the highest ratings and, therefore, higher expenditure. This relationship is supported by previous studies that have shown the same negative relationship between environmental and financial performance (Barnett and Salomon, 2006; Belghitar et al., 2014; Sueyoshi and Goto, 2009; Rassier and Earnhart, 2010). Equally, studies have also shown evidence of a positive relationship between environmental and financial performance (Chong et al., 2006; Yang and Yao, 2012; Pérez-Calderón et al., 2012). One study highlights that the varied findings across studies is caused by the relative exposure to environmental pressures (Pérez-Calderón et al., 2012). For example, a firm from the financial services industry will incur fewer costs to achieve CO_2 reductions than a firm from the energy or engineering sector. Therefore, in some cases industry weighting may help explain why some indices perform better than others. Furthermore, it has been argued that environmentally and socially responsible indices perform better because they are populated by low impact industries such as financial services and information technology (Ratti and Hasan, 2013).

Where the top environmental firms achieved a higher rate of return, FTSE4good's environmental management and climate change criteria impose standards that aim to mitigate associated risks which may have increased share price. For example, highlighting criteria that are relevant to the results; FTSE4good requires that board members are accountable for environmental management policy, the mitigation of environmental issues caused within their industry and public reporting. Whilst not explicitly tested for within the current study, accountability is fundamental to corporate resilience as it propagates a proactive business culture that is argued to have a positive relationship with financial performance (Weber, 2013; Brahimi et al., 2013; Agustinus, 2013). As a crisis hits a firm with high levels of accountability, management systems that are proactive are better placed to respond to threats (Agustinus, 2013). The current study provides evidence of FTSE4good's standards promoting an operative environment that contributes to improved risk management. Chan and Walter (2014) found a stronger relationship between environmentally friendly firms and financial performance albeit not associated with the UK or FTSE4good. They found that from a sample of 748 environmentally friendly firms a statistically significant risk-return premium was evident.

This idea of an improved culture of risk management extends into the results for the social performance portfolios. The portfolio of the top 100 social responsibility constituents outperformed the bottom 100 during all 5 events, reinforced by the ranking and descriptive statistics. The standards set around human labour rights and supply chain labour standards foster benefits through relatively higher employment standards that propagate a more productive workforce (Anonymous2013; Hughes, 2007). Ensuring these standards exist throughout the supply chain for a firm also reduces exposure to damages from riskier enterprises that do not follow and adhere to the same standards (Hofmann et al., 2014).

Despite the benefits implied by performance of firms selected using FTSE4good social ratings, higher wages, increased training and employee relations are all cost implications that many firms are unwilling to fully implement as they are viewed as a downside risk to shareholder value (Aras and Crowther, 2009). That said, FTSE4good's social responsibility criteria is also rooted in accountability with a structural emphasis on communication, both of which are viewed as essential in the achievement of risk mitigation and successful response to a crisis (Hyslop and Collins, 2013; Goffin et al., 2013; Sheffi and Rice, 2005; BRCCI, 2011). This finding is supported by a number of studies that indicate the value enhancement or lower risk perception of socially responsible firms (Humphrey and Tan, 2014; Girerd-Potin et al., 2014). Girerd-Potin et al (2014) found that investors ask for a greater risk premium, above that of socially responsible funds, to hold non-socially responsible securities. Overall evidence from the current study suggests that investors penalise non-socially responsible firms and reward socially responsible ones. Humphrey and Tan (2014) found that screened and un-screened portfolios were no different in terms of return on risk and, therefore, a responsible fund does not lose or gain anything compared to un-screened portfolios, despite the added pressure of socially responsible production. Conversely, the corporate governance results provide no evidence of a financial benefit or provision of resilience or resilience for investors.

The screening process by FTSE4good aims to skew diversity in such a way that it reduces risks for investors. However, in-line with the majority of the literature, a sector based analysis should help isolate the effects of the shock and highlight the benefits induced by FTSE4good's ratings.

7 The performance of FTSE4good firms based on an industrial sector

This chapter presents the comparison of firms from the same industrial sector. Initially, the introduction provides a rationale for this course of enquiry, followed by the methodological adaptations required to make this stage of the analysis possible beyond the method presented in chapter 4. The results are then presented followed by a discussion of the results.

7.1 Introduction

This study initially focused on testing indices to determine the existence of adaptive resilience resulting from FTSE4good's inclusion criteria and subsequent screening process. This approach covered investment strategies available to all, but the results provide little evidence of a benefit. The previous chapter focused on whether FTSE4good portfolios based on an upper and lower limit of environmental, social, and corporate governance performance produced different daily return performance over a range of events. The results indicate that over the majority of events the FTSE4good ratings had some power to provide investor with a tool for mitigating risk; and the results show that tailored properly, the FTSE4good index series has the potential to yield greater returns during adverse events.

The previous two analyses are however limited by the effects of diversification in conclusively attributing causality to FTSE4good. Therefore, an analysis of firms from the same industrial sector classified according to inclusion and exclusion in FTSE4good mitigates the effects of diversification. Furthermore, this level of analysis using FTSE4good ratings has never been done. Therefore, evidence of a benefit contributes to the literature by highlighting the perception of the risk reducing benefits induced by FTSE4good reflected in daily abnormal returns across firms subject to the same pressures induced by the shock. Overall, this study would provide investors with evidence across multiple investment strategies/products. Furthermore, some events are only testable at the industry level as this chapter subsequently investigates how the share price of firms from the same industry responds to the identified events. Here the novelty of the analysis is that firms within the same sector will be compared, where some firms are included in the FTSE4good and others are excluded. Some additional events have been included that are sector specific, for example, food producers are tested using the horse meat scandal event of 2013. The premise of this chapter is to further reduce the effect of fund diversification by including firms from the same sector thus isolating idiosyncratic risk (specific to an asset or group of assets). For example, an aviation focused event would have a greater impact on an index of aviation firms than an index with none. Furthermore, an index that has substitute industries, like car hire and land based transportation, would likely profit causing an asymmetric type response.

7.2 Firm classification and data

Firms were initially matched to an event, and grouped using FTSE industrial classification reference list (See Table 7.1) that classifies firms into 4 sectors (industry, super sector, sector and subsector) with increasing specificity. For example, BP was matched to the BP oil spill and is classified as Industry: Oil & Gas; Super sector: oil & gas; Sector: Oil & Gas producers; and Subsector: Exploration & production. Each classification has a unique code that was used within FTSE4good ratings history to identify all firms within the relevant sector. Once identified, their market data was then downloaded from DataStream. The classification and identification of firms that matches each testable event is outlined in Table 7.1.

Table 7.1. Identification and classification of firms for event testing

Event	Classification level	Industry Name	Code
Financial crisis	Super Sector	Financial Services	8700
	Sector	Oil & Gas Producers	0530
BP oil spill	Sector	Oil Equipment & Services	0570
	Sector	Alternative Energy	0580
Japan earthquake	Super sector	Power Utilities	7500
	Sector	Technology Hardware & Equipment	9570
Iceland Volcanic Eruption	Subsector	Airlines	5751
	Subsector	Travel & Tourism	5759
Horse meet scandal	Sector	Food Producers	3573
	Subsector	Food Retailers & Wholesalers	5337
EU ETS Prohibition Act, US	Subsector	Airlines	5752
	Subsector	Travel & Tourism	5759
EU ETS Stop the clock announcement	Sector	Industrials	2000

In some cases all firms are included or excluded from FTSE4good and in this instance the groups are split into an upper and lower limit according to their respective absolute score within the ratings history. Where a particular firm is linked with the event then their performance is highlighted and in some cases removed for retrospective insight into the performance of the group without the main protagonist, for example, BP plc.

7.3 Event study methodology & UK industrial sectors

The following sections provide details of the specific framework used for each analysis in addition to the method presented in chapter 4. For each event the market model was applied as specified for each analysis, and for new events the details are clarified below. For the sector based event studies the Corrado rank test is replaced by the Boehmer et al. (1991) cross sectional test because it is more robust than other statistical tests in instances of event studies of firms from the same sector. Details of this test can be found in Section 4.7.

7.3.1 Financial crisis & UK financial services sector

The financial sector has significant representation within FTSE4good and accounts for 17.9% of UK share of world exports (BIS, 2012). Therefore, its prominence within the UK economy and subsequent link to sustainability is substantial (Chapter 1.2). Furthermore, the financial crisis caused widespread damage to the UK economy against which the market should recognise the benefits of being included in FTSE4good and the financial sector provides an opportunity to test this idea. The analysis consisted of 50 financial services firms included in the FTSE4good and 31 firms that were excluded. Firms were selected from super sector classification “Financial Services” with code 8700 as shown in Table 7.1. The estimation window, event window and subsequent periods follow the same framework as that of chapter 4.4.1 and previous event studies.

7.3.2 Deep Water Horizon oil spill & the UK oil industry

The industry focused stock market response to the Deepwater Horizon oil spill was tested using a number of sector classifications. Initially the oil industry analysis focused on a comparison of 4 firms included in FTSE4good against 11 excluded firms (see Table 7.1). BP was included in the FTSE4good at the time of the event and because it was the main protagonist of the shock, then an event study of firms was conducted both with and without BP. Additionally, two alternative energy sector firms were included in the comparison because of the potential benefit created by the shock and a flight to quality from risky oil based industry investments to cleaner and safer renewable energy firms. However, the alternative energy firms were excluded from the FTSE4good at the time of the event. PV Crystalox Solar were excluded due to a 0 environmental score but scored high in both the social and governance pillars with 3 and 4 respectively. The second of the two firms were excluded due to “non-disclosure” of FTSE4good requirements. The framework for the analysis reflects the details outlined in chapter 4.4.2.

7.3.3 Japan earthquake and UK utilities and technology firms

To test the sector based response to the Japanese earthquake of 2010 and subsequent nuclear reactor issues, firms from the power utilities and technology hardware & equipment sector were used with respective codes 7500 and 9570 (see Table 7.1). Technology sector firms were divided into two groups consisting of 6 firms included in FTSE4good and 5 excluded. All 5 power utilities firms were included in FTSE4good and therefore divided into two groups of high and low performing firms. The analysis follows the method from chapter 4 and the specific framework from chapter 4.4.3. The estimation window, event window and interval periods remain consistent following on from previous studies.

7.3.4 Iceland volcano and UK travel sector

The Icelandic volcano eruption of 2010 caused unprecedented air-travel chaos throughout Europe. Therefore, the airlines, and travel and tourism sector was thought to be most relevant to test the market response in line with previous studies (Mazzocchi et al., 2010; Miller, 2011). Using FTSE industrial classification benchmark, 1 included and 1 excluded airline was identified along with 1 included and 1 excluded travel and tourism subsector firm with respective sector codes, 5751 and 5759. Each sector is equally represented but the sample size is considered low at 2 included, 2 excluded. Additionally, 6 land based travel firms are included to account for a wider benefit appreciated by the industry as a result of the event. The counterfactual scenario is utilised to determine the positive spill over effects for a group of firms that include land based travel such as coach and car hire. Therefore, a case-by-case comparison was conducted following the estimation and event window framework of chapter 4.4.4.

7.3.5 Horse meat scandal of 2013 & UK food producers

The market response to the horse meat scandal of 2013 centred on the food producer and food retailer subsectors with industry codes 3573 and 5337 respectively. The sample consists of 3 food retailers and 4 producers for the 7 FTSE4good included firms and 1 retailer and 5 food producers for the 6 excluded firms. FTSE4good members Tesco, Sainsbury's, Morrisons and Marks & Spencer account for over 55% of UK market share, providing the interface between food producers and 60 million consumers (Cabinet Office, 2008). Therefore FTSE4good policy that induces a positive effect on constituents in turn has a direct impact on the UK population. The methodology follows the framework presented in chapters 4 and 4.4.6.

7.3.6 THE US, EU ETS Prohibition Act & UK aviation and travel sectors

The EU ETS Prohibition Act that was passed by the US government in 2011 to exempt US based air travel from the European Union Emissions Trading System. Its passing had major implications for the systems credibility and for the aviation and travel sectors regulatory environment. The included subsectors were airline with code 5751 and travel and tourism with code 5759. To test the market response to the passing of the act, 3 firms included in the FTSE4good at the time of the event were identified along with 3 excluded firms. The analysis follows the method presented in chapter 4 and 4.4.8.

7.3.7 EU ETS ‘stop the clock’ announcement

Following the challenges faced by the EU ETS regarding carbon pricing and sovereignty, the European Commission opted to ‘stop the clock’ on including aviation in the scheme on 12/11/2012. This event caused substantial scepticism as to the future of the EU ETS as a whole (GreenAir, 2014). The event study used to test the market response centres on the industrial sector with code 2000. Included firms comprise a sample of 58 and a sample of 39 excluded firms. The window includes one day before the announcement to three days after (-1, 3).

7.4 Results

The following results present a comparison of cumulative average returns for included and excluded firms from the same industrial sector (See Appendix M). Inclusion and exclusion is based on the ratings history relevant to the event (See Appendix I).

7.4.1 Financial crisis & the performance of financial services firms

The returns of both groups show a consistent negative decline as a performance advantage switches from one group to another in response to the various stages of the event. Despite this, the included group show greater evidence of an underperformance disadvantage comparted to the excluded group of firms. The pattern of the returns throughout the event window can be seen in Figure 7.1.

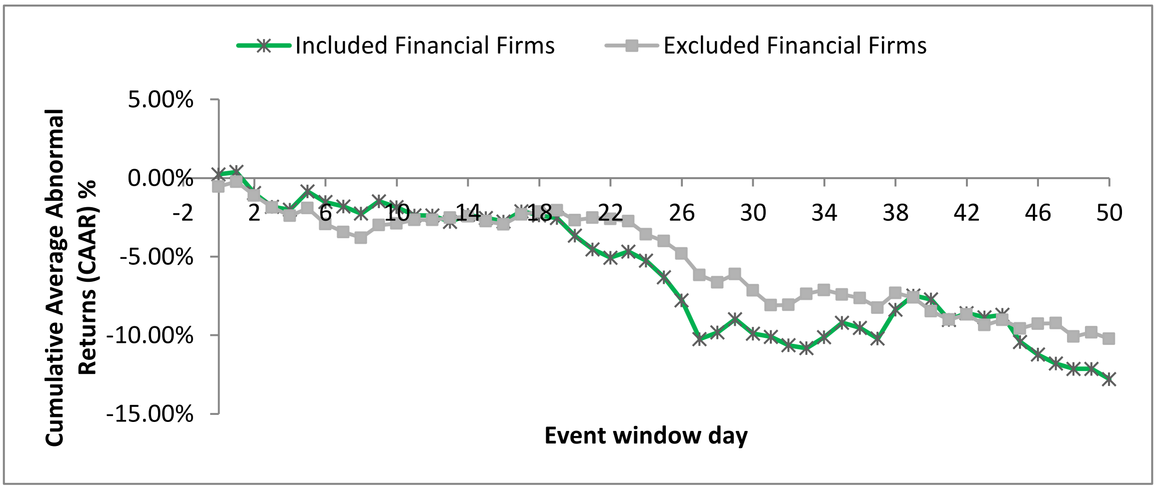

Figure 7.1. Financial crisis event window [0, 50] abnormal returns for included and excluded financial services firms

The event window produced a significant decline in both groups but the included firms showed least capacity for resilience with a return of -12.80%, significant in both the z-test and Boehmer et al. (1991) cross-sectional test This compares to the excluded firms return of -10.24% also significant in the z-test and Boehmer et al (1991) cross-sectional test. The early stages were closely tied but the included firms showed greater resilience with a non-significant return on the event day of 0.23% compared to a significant return for the excluded firms at -0.54%. The results for the early stages in period [0] and [0, 5] are shown in Table 7.2.

Table 7.2. The financial crisis periods [0] and [0, 5] abnormal returns for included and excluded financial services firms

[0, 50] (Event window)						
Group	CAAR	Pos : Neg	z-test	p-value	Boehmer et al.	p-value
Included Financial	-12.80%	10 : 39	-9.95	0.00***	-5.98	0.00***
Excluded Financial	-10.24%	4 : 27	-5.29	0.00***	-5.05	0.00***
[0] (BNP Paribas Announcement)						
Group	CAAR	Pos : Neg	z-test	p-value	Boehmer et al.	p-value
Included Financial	0.23%	24 : 25	0.47	0.64	0.24	0.81
Excluded Financial	-0.54%	12 : 19	-1.65	0.10*	-0.83	0.41
[0, 5] (BNP Paribas Announcement & ECB liquidity injection)						
Group	CAAR	Pos : Neg	z-test	p-value	Boehmer et al.	p-value
Included Financial	-0.86%	22 : 27	-1.89	0.06*	-1.29	0.20
Excluded Financial	-1.92%	11 : 20	-2.67	0.01***	-1.99	0.05**

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The period of the BNP Paribas announcement [0, 5] shows significant negative returns for both groups with the included firms outperforming with a CAAR of -0.86%, significant in the z-test at the 10% level. However, the returns of excluded firms showed a continuing decline with a return of -1.92%, significant at the 1% level in the z-test and 5% in Boehmer et al. (1991) cross sectional test.

The middle to later stages of the event window produced a reversal in performance starting with the US Federal Reserve Bank rate cut during period [6, 16] when the included firms underperformed with a significant return of -1.9% compared to the excluded firms non-significant return of 1.03%. Significant declines returned for both groups in the period that represents interbank lending issues [17, 24], when the included group produced a significant return of -2.49% compared to the excluded firms non-significant return of -0.65%. Details of these results are shown in Table 7.3 along with the returns for the run on Northern Rock period [25, 28].

Table 7.3. The abnormal returns during financial crisis interval periods for included and excluded financial services firms

[6, 16] (FED cuts rates - warning of threat to growth)						
Index	CAAR	Pos : Neg	patell z	p-value	Boehmer et al.	p-value
Included Financial	-1.9%	15 : 34	-2.93	0.00***	-2.88	0.00***
Excluded Financial	-1.03%	12 : 19	-1.00	0.32	-1.20	0.23
[17, 24] (Interbank lending at highest since 1998)						
Index	CAAR	Pos : Neg	patell z	p-value	Boehmer et al.	p-value
Included Financial	-2.49%	14 : 35	-5.55	0.00***	-4.84	0.00***
Excluded Financial	-0.65%	12 : 19	-0.82	0.41	-0.64	0.52
[25, 28] (Run on Northern Rock)						
Index	CAAR	Pos : Neg	patell z	p-value	Boehmer et al.	p-value
Included Financial	-4.57%	9 : 40	-12.49	0.00***	-5.42	0.00***
Excluded Financial	-3.05%	8 : 23	-5.26	0.00***	-4.31	0.00***
[29, 50] (FED cuts rates and BoE injects capital)						
Index	CAAR	Pos : Neg	patell z	p-value	Boehmer et al.	p-value
Included Financial	-2.97%	19 : 30	-3.41	0.00***	-3.01	0.00***
Excluded Financial	-3.59%	11 : 20	-3.21	0.00***	-2.72	0.01***

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The run on UK bank, Northern Rock [25, 28] produced the greatest returns for the two groups. The excluded group showed greater resilience with a significant return of -3.05% compared to the included financial firm returns of -4.57%, significant in both tests at the 1% level of significance. The following period [29, 50] see a switch in performance with the excluded group generating a significant return of -2.97%, buit the excluded group produced a significant return of -3.59% both significant in the z-test and Boehmer et al (1991) cross-sectional test. In summary, the market showed that during the financial crisis, FTSE4good ratings and subsequent inclusion were not an advantageous factor in the valuation of financial services firms.

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7.4.2 Deep Water Horizon oil spill & the performance of oil sector firms

The Deepwater Horizon rig explosion and subsequent oil spill of 2010 in the Gulf of Mexico has thus far performed outside of expectations because of BP's inclusion in FTSE4good. BP was included with an Environmental pillar score of 5 (highest possible), social score of 5, and a governance score of 3.6. Consequently, the market appeared to value relevant FTSE4good performance against the valuation of stock market indices and ESG portfolios. This, however, has been argued to be heavily influenced by diversification and the risk reducing benefits it bestows.

Therefore, an analysis at the firm level aims to isolate specific relationships between the performances of FTSE4good firms in a sector related to the effects of the oil spill. The sector in question is the oil and gas sector of included and excluded firms with the additional counterfactual inclusion of alternative energy firms. Below are the event window [0, 50] returns for the grouped firms (Figure 7.2).

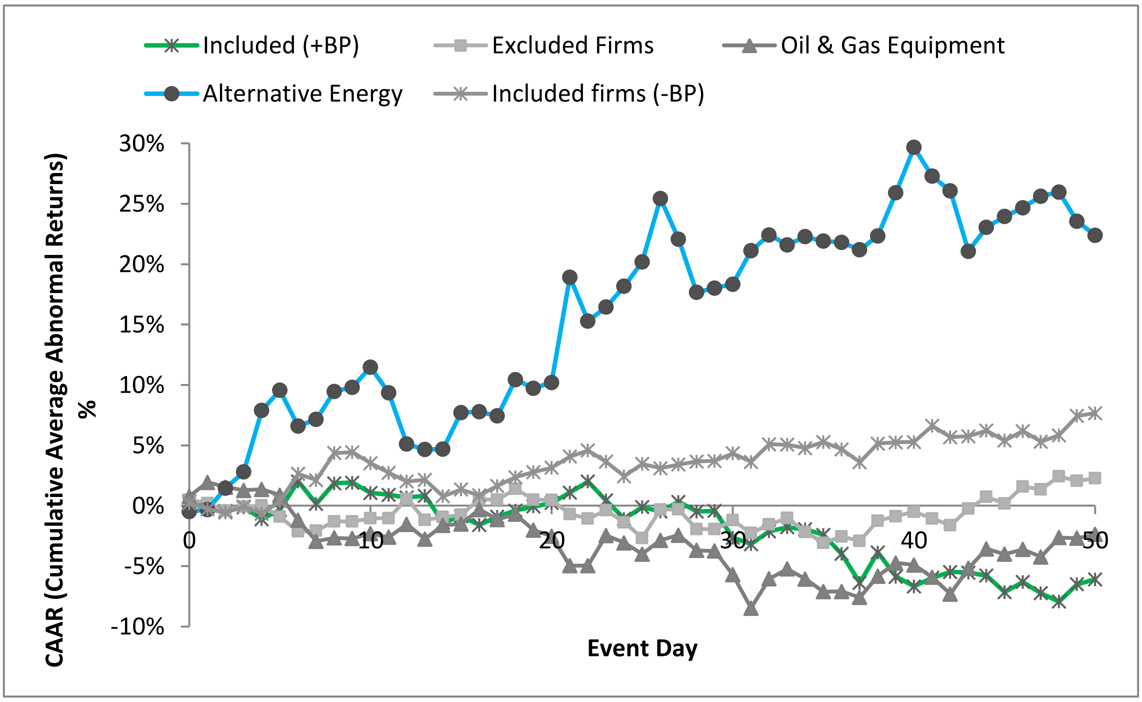


Figure 7.2. Event window cumulative abnormal returns during the Deep Water Horizon oil spill for oil and gas sector firms and alternative energy firms

From the event window cumulative average abnormal returns (CAAR) it is clear that the alternative (renewable) energy firms, Hansen Transmissions (HSN) and PV Crystalox Solar (PVCS), while not included in FTSE4good, outperformed the oil and gas sectors over the event window. The market appears to have seen this event as a period of opportunity for the alternative energy sector and consequently valued the assets with a CAAR of 22.4% over the entire event window. However, this was only marginally significant in the t-test at the 10% level, a result that is due to the method used to test for significance; large values do not automatically qualify as significant as the test relies on historical variance within the estimation window to determine if the abnormal return within the event window is significant. Therefore, if variance is high within the estimation window then high variance is expected within the event window.

During the event window, the included oil producing firms (+BP) underperformed with a statistically significant (10% level) return of -6.09% compared to the excluded oil producing firms' non-significant positive return of 2.27% (see Table 7.4). When BP was removed, the included group outperformed the excluded group over the event window with a CAAR of 7.67%, significant in the t-test and Boehmer et al. (1991) test at the 10% level (p=0.1). At the time of the incident, BP was included in FTSE4good and heavily influenced the returns of this analysis with a CAR during the event window of -61.1%, significant at the 1% level in the t-test and Corrado rank test. The chart below (Figure 7.3) shows returns during the event window for the oil producing firms.

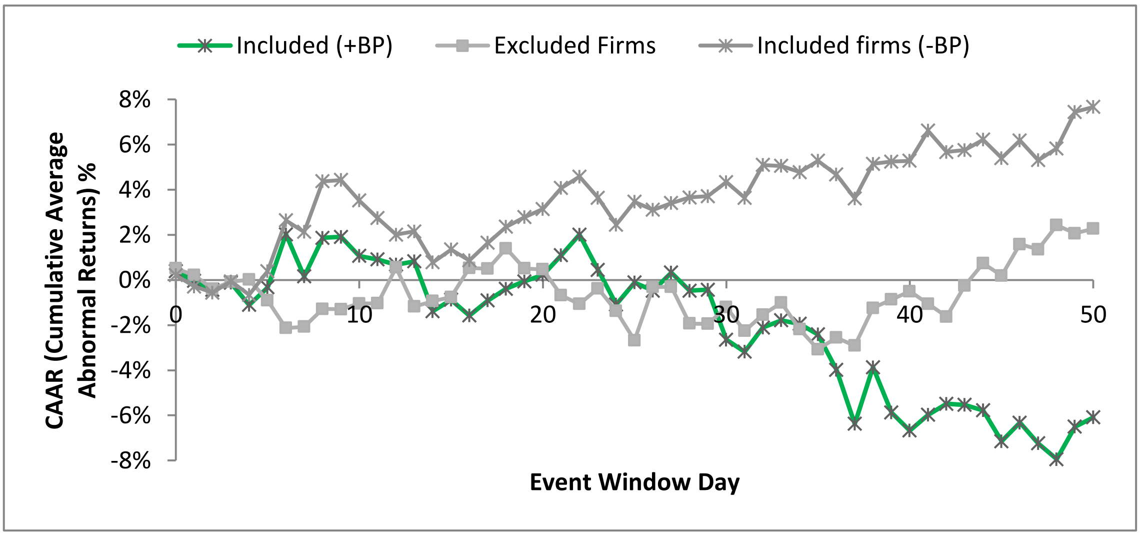


Figure 7.3 Event window returns during the Deep Water Horizon oil spill for oil and gas sector firms, including and excluding BP plc.

The following table shows the CAAR for the grouped firms with the included group +BP along with significance test results.

Table 7.4. Abnormal returns during Deep Water Horizon oil spill event window [0, 50] and subsequent periods for included, excluded, and alternative energy firms

[0, 50] Event Window					
Index	CAR	t-test	p-value	Boehmer et. Al	p-value
Included Firms (+BP)	-6.09%	-1.62	0.1*	-0.62	0.54
Excluded Firms	2.27%	0.47	0.64	1.14	0.26
Alt. Energy	22.4%	1.59	0.11*	0.60	0.55
[0] Event day - Rig explosion					
Index	CAR	t-test	p-value	Boehmer et. Al	p-value
Included Firms (+BP)	0.39%	0.73	0.46	1.67	0.1*
Excluded Firms	0.51%	0.76	0.45	1.38	0.17
Alt. Energy	-0.49%	-0.25	0.8	-0.28	0.78
[2, 6] Oil rig explosion and BP announcement					
Index	CAR	t-test	p-value	Boehmer et. Al	p-value
Included Firms (+BP)	2.07%	1.76	0.08	1.55	0.12
Excluded Firms	-2.34%	-1.56	0.12	-2.98	0.00***
Alt. Energy	6.91%	1.57	0.12	13.64	0.00***
[7, 25] Recognition by financial markets					
Index	CAR	t-test	p-value	Boehmer et. Al	p-value
Included Firms (+BP)	-2.14%	-0.93	0.35	-0.89	0.37
Excluded Firms	-0.55%	-0.19	0.85	0.11	0.91
Alt. Energy	13.59%	1.59	0.11*	0.82	0.41
[26, 34] First moratorium					
Index	CAR	t-test	p-value	Boehmer et. Al	p-value
Included Firms (+BP)	-1.83%	-1.16	0.25	-0.74	0.46
Excluded Firms	0.49%	0.24	0.81	0.51	0.61
Alt. Energy	2.09%	0.35	0.72	1.55	0.12
[35, 50] 9-10 June President Obama statements					
Index	CAR	t-test	p-value	Boehmer et. Al	p-value
Included Firms (+BP)	-4.14%	-1.97	0.05**	-0.77	0.44
Excluded Firms	4.46%	1.66	0.1*	2.9	0.00***
Alt. Energy	0.12%	0.02	0.99	0.01	0.99

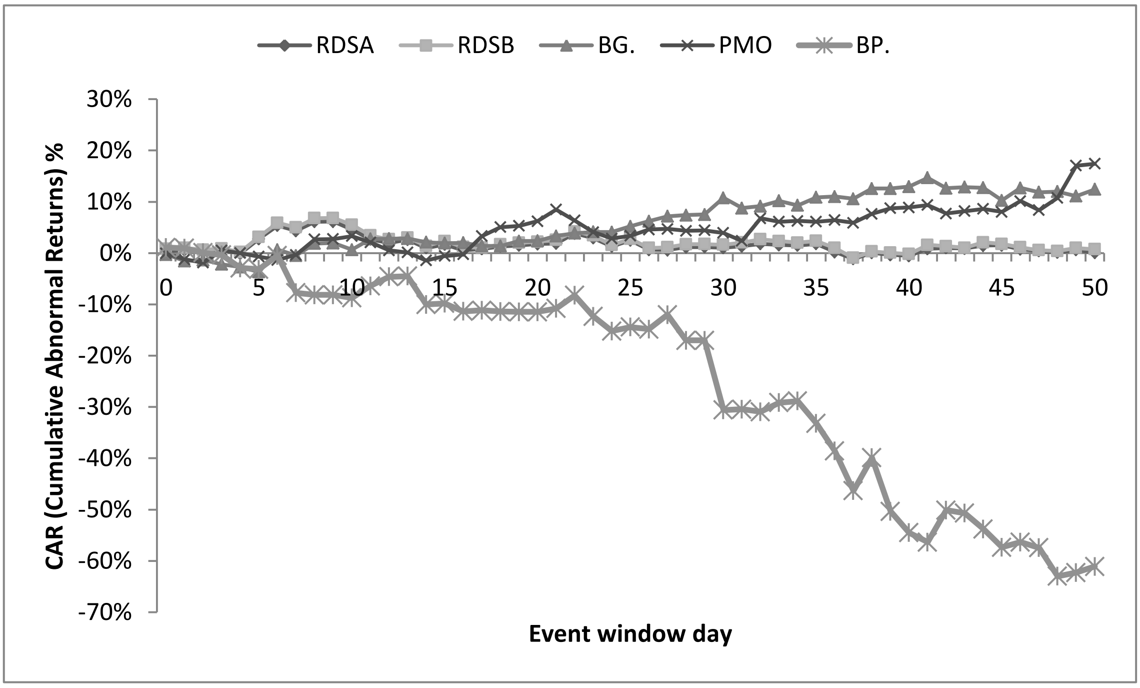
*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The event day [0] returns generated one significant return for the included group at -6.09% as BP was at the time a constituent of the FTSE4good index series. When the was made public up to the point of publication in the Wall Street Journal [2, 6], all three groups produced significant returns; the included group generated a positive non-significant return of 2.07%; the excluded group was negative at -2.34% and significant at the 1% level in the Boehmer et. al test; lastly the alternative energy firms returned a value at 6.91%, significant at the 1% in Boehmer et al. (1991) cross sectional test. (see Table 7.4).

During period [7, 25] only the alternative energy firms generated significant returns. However, during this period BP responded with a return of -13.95% that again weighed heavily on the included firm results with a non-significant return of just 2.14%. The following period [26, 34] reflects the impact of the first moratorium on drilling in the Gulf of Mexico but all returns were non-significant. The included firms generated a negative return of -1.83% followed by the excluded firms' positive return of 0.49%, and the alternative energy firms at 2.09%. These returns were however surpassed by the subsequent period [35, 50] that represents the Obama statements, as the included firms produced a significant negative return of -4.14% compared to the excluded groups significant positive return of 4.46%. The alternative energy group returns were marginal to expected values.

The results provide limited evidence of any significant sector specific returns despite the reduction of diversification. The power of FTSE4good is diminished largely by the effects of a minority of firms, namely BP plc. This is in fact a reality of investment as this incident could conceivably happen to any other oil producing firm (Reader and O'Connor, 2014). However, if BP is isolated from the results, the remaining included firms outperform the excluded firms. To begin, Figure 7.4 shows the returns for the included oil producing firms and the difference between BP and the other included firms is shown.

Figure 7.4. Cumulative abnormal returns of the included oil producers during the event window [0, 60]



Therefore, when BP plc was removed from the aggregated returns of the included group of firms, the result turn from negative to positive and outperforms the returns of the excluded group. The removal means that the group of included firms outperformed the excluded firms in 4 out of the 6 periods but with limited significance.

Overall the determination of benefits induced through FTSE4good is mixed as the sector based analysis initially shows some evidence of underperformance for firms included in FTSE4good. However, the influence of BP plc was apparent as when removed the remaining firms outperformed their excluded counterparts (not alternative energy) albeit with limited evidence of significance. There is consequently a conflict of reality in trading strategies, retrospective insight and the inclusion criteria set by FTSE4good.

Table 7.5. Abnormal return averages for included firms but without BP, and the excluded oil sector firms.

[0, 50] Event Window					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms (-BP)	7.67%	1.75	0.08*	1.89	0.06*
Excluded Firms	2.27%	0.47	0.64	1.14	0.26
[0] Event day - Rig explosion					
Group	AAR	t-test	p-value	Boehmer et. al	p-value
Included Firms (-BP)	0.21%	0.34	0.73	1.06	0.29
Excluded Firms	0.51%	0.76	0.45	1.38	0.17
[2, 6] Oil rig explosion and BP announcement					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms (-BP)	2.94%	2.14	0.03**	2.31	0.02**
Excluded Firms	-2.34%	-1.56	0.12	-2.98	0.00***
[7, 25] Recognition by financial markets					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms (-BP)	0.82%	0.31	0.76	0.01	0.99
Excluded Firms	-0.55%	-0.19	0.85	0.11	0.91
[26, 34] First moratorium					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms (-BP)	1.32%	0.71	0.47	0.75	0.45
Excluded Firms	0.49%	0.24	0.81	0.51	0.61
[35, 50] 9-10 June President Obama statements					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms (-BP)	2.89%	1.17	0.24	0.81	0.42
Excluded Firms	4.46%	1.66	0.1*	2.9	0.00***

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

7.4.3 Japanese earth quake & the performance of UK technology & power sector

7.4.3.1 Technology sector response to Japan earth quake

The Japanese earthquake and subsequent nuclear reactor issues produced markedly different responses in the UK technology and power utility sectors. Overall the technology sector showed no financial performance benefit linked to inclusion in FTSE4good. The pattern of event window returns for the UK technology sector is shown in Figure 7.5. The returns of both classifications are close until the later stages of the event window.

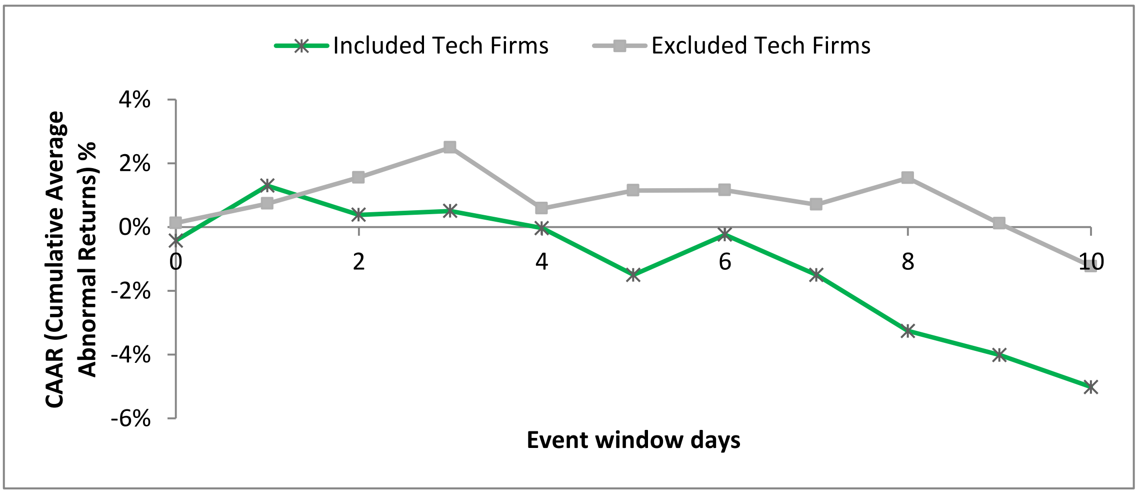


Figure 7.5. Event window periods [0, 10] abnormal returns for included and excluded UK technology firms

The event window shows a significant negative effect for the six technology firms included in FTSE4good with an average return of -5.02% compared to -1.23% for the five excluded firms. The following periods show a similar relative trend in the CAAR but with limited significance (Table 7.6.).

Table 7.6. Abnormal returns during event window [0, 10], and interval periods for included and excluded UK technology firms

[0, 10] (Two working week event window)					
	CAAR	t-test	p-value	Boehmer et. Al	p-value
Included Tech Firms	-5.02%	-1.67	0.09*	-2.04	0.04**
Excluded Tech Firms	-1.23%	-0.26	0.79	-0.51	0.61
[0] (Earth quake & announcement that nuclear power stations have been shut down)					
	AAR	t-test	p-value	Boehmer et. Al	p-value
Included Tech Firms	-0.42%	-0.47	0.64	-0.36	0.72
Excluded Tech Firms	0.13%	0.09	0.93	0.2	0.84
[0, 3] (Announcement of nuclear reactor leak & Germany announces suspension of nuclear programme)					
	CAAR	t-test	p-value	Boehmer et. Al	p-value
Included Tech Firms	0.51%	0.28	0.78	0.19	0.85
Excluded Tech Firms	2.50%	0.89	0.37	2.3	0.02**
[1, 5] (First trading week following the Friday quake)					
	CAAR	t-test	p-value	Boehmer et. Al	p-value
Included Tech Firms	-1.08%	-0.53	0.59	-0.56	0.58
Excluded Tech Firms	1.02%	0.33	0.74	1.26	0.21
[6, 10] (Second trading week following the quake)					
	CAAR	t-test	p-value	Boehmer et. Al	p-value
Included Tech Firms	-3.52%	-1.74	0.08*	-1.79	0.07*
Excluded Tech Firms	-2.37%	-0.76	0.45	-2.14	0.03**

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The event day [0] produced no significant returns. The subsequent period [0, 3] did not yield any benefit in the included firms as they produced a return in-line with expectations at 0.51% compared to an excluded firm return of 2.5%, significant at the 5% level in the Boehmer et al. cross sectional test. The first complete trading week following the incident that includes the Germany announcements produced non-significant returns for both groups but negative for the included firms at -1.08% and 1.02% for excluded firms. This period has previously been the focus of a difference in performance. The second week of trading is when the effects of the disaster take effect as the returns of both groups turn significantly negative. The included group was most effected at -3.52% compared to a less effected return of -2.37% for the excluded firms. The pattern of returns is shown in Figure 7.5.

The comparison of firms within the UK technology sector implies that the market did not value FTSE4good performance in response to the Japan earth quake until the second week of the disaster where the six included tech firms underperformed relative to the five excluded firms. This delayed response may be accounted for by firms taking time to recognise the impact the disaster had on its supply chain.

7.4.3.2 Power sector response to Japan earth quake

To eliminate the effects of a diversified supply chain, the UK power utilities sector provides an opportunity to test the response of the nuclear reactor issues, as has been done in a study of German energy firms (Betzer et al., 2013). The firms included within the analysis are all constituents of FTSE4good but split by an upper and lower limit of two Top and three Bottom performing firms according to their absolute rating. Over the course of the event window, the top power sector firms showed signs of a gradual inverse relationship compared with the three lower performing firms. Figure 7.6 presents this pattern despite early parity in cumulative average abnormal returns. Furthermore, the inverse response occurs following the German announcement [0, 3] of a complete suspension in their nuclear energy plans.

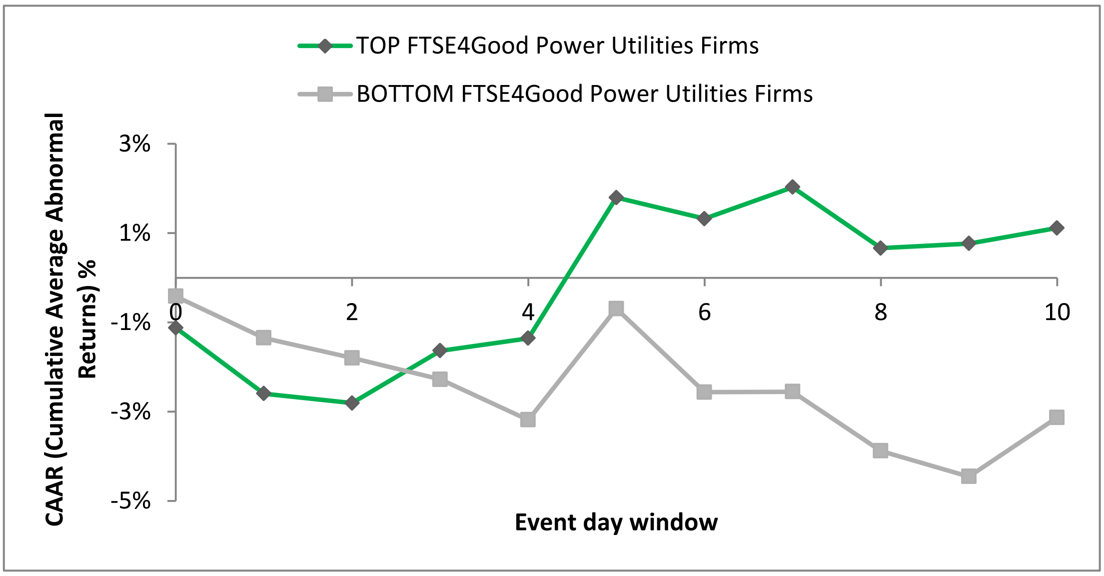


Figure 7.6. Event window periods [0, 10] abnormal returns for top and bottom FTSE4good UK power sector firms

Initially, on the event day [0], the Top power sector firms responded with a Boehmer et al (1991) significant negative return of -1.12%, below that of the Bottom firms at -0.42% and non-significant. The results for the event day [0] are shown in Table 7.7 along with the results for all periods ([0, 3], [1, 5], [6, 10] and [0, 10]).

Table 7.7. Abnormal returns during event window and interval periods for Top and Bottom UK listed power sector firms.

[0] (Earth quake & announcement that nuclear power stations have been shut down)					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
TOP Power Firms	-1.12%	-1.54	0.12	-1.77	0.08*
BOTTOM Power Firms	-0.42%	-0.36	0.72	-0.87	0.38
[0, 3] (Announcement of nuclear reactor leak & Germany announces suspension of nuclear programme)					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
TOP Power Firms	-1.64%	-1.12	0.26	-0.64	0.52
BOTTOM Power Firms	-2.28%	-0.98	0.33	-1.53	0.13
[1, 5] (First trading week following the Friday quake)					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
TOP Power Firms	2.92%	1.79	0.07*	5.25	0.00***
BOTTOM Power Firms	-0.28%	-0.11	0.91	-0.23	0.82
[6, 10] (Second trading week following the quake)					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
TOP Power Firms	-0.68%	-0.42	0.68	-0.56	0.58
BOTTOM Power Firms	-2.44%	-0.94	0.35	-1.42	0.16
[0, 10] (Two working week event window)					
	CAAR	t-test	p-value	Boehmer et. al	p-value
TOP Power Firms	1.12%	0.46	0.64	19.25	0.00***
BOTTOM Power Firms	-3.13%	-0.81	0.42	-1.46	0.15

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

Following the event day, period [0, 3] which represents the announcement by Germany shows a change in the performance of the returns for each group. The top rated power firms show greater resilience to the effects of the announcements and its implications with a return of -1.64% compared to the bottom rated power firms at -2.28%. Both were however insignificant but indicative of a changing trend as the returns develop throughout the event window. The following period [1, 5], which represents the first week of trading, shows a resilient response from the top performing firms with a positive significant return of 2.92% compared to the bottom power firms return of -0.28%. The second trading week continues the trend for the bottom rated firms with a marginally significant negative return of -2.44% compared to the top rated firms' non-significant return of -0.68%. The pattern of returns throughout the event window is fully representative of the event window periods as the top firms returned a positive CAAR of 1.12%, significant in the Boehmer et al. (1991) cross sectional test at 1% compared to the bottom firms negative return of -3.13%, marginally significant in the Boehmer et al. (Boehmer et al., 1991) cross sectional test. The pattern of returns is shown in Figure 7.6 with a downward trend for the bottom firms and asymmetric growth trend for the top performing FTSE4good firms.

Therefore, whilst limited by sample size, the returns for the top performing FTSE4good power utility firms show evidence of enhanced resilience relative to the lower performing firms from the same industrial sector.

7.4.4 Icelandic volcanic eruption of 2010 and the financial performance of UK aviation and travel

In all previous analyses the market response to the volcanic eruption of 2010 has returned a significant benefit for ethical investors in excess of a conventional investment. These analyses were based on large, diversified samples and subsequently this study asks whether the beneficial trend extends into individually selected and smaller samples of stocks. Therefore, two airline and two travel firms were selected to test the market response and whether their inclusion or exclusion is specifically relevant in their valuation within the market against the risks associated with the shock. A further comparison of a counterfactual group of firms is also conducted on the basis of spill-over effects. For example, during this period it could be expected that land based travel would witness a comparable rise in value.

The two firms included in the FTSE4good are British Airways and TUI Travel; the two firms excluded from the FTSE4good are Easyjet and Thomas Cook Group; finally the counterfactual firms are all included in FTSE4good and consist of Stagecoach Group, Go-Ahead Group, National Express Group, First Group, Carnival and Avis Europe. The pattern of average returns for the aforementioned firms are shown in Figure 7.7

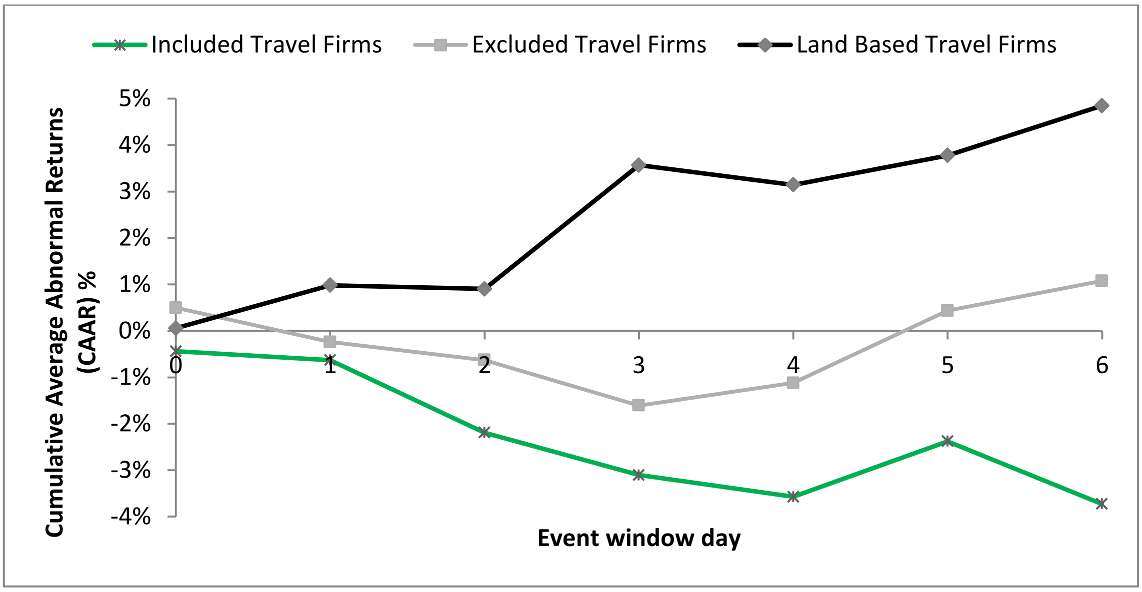


Figure 7.7. Event window abnormal returns for included, excluded and substitute travel firms during the Iceland volcanic eruption

The event window returns for the three groups show a distinctly differently response over the event window. Despite inclusion in FTSE4good, the two travel firms generated returns below that of both the two excluded firms and the land based travel group. During the event window [0, 6] period, the alternative group produced a significant positive return of 4.85% and the included firms produced a significant negative return of -3.73%; the excluded group traded around expected throughout the event window when in produced a non-significant positive return of 1.58% (see Table 7.8).

The event day [0] period returned no significant values as the effects of the event were not fully assimilated into the market until the disruption to EU airspace (Mazzocchi et al., 2010). However, on the event day [0], the excluded group out performed both with a positive return of 1.66% compared to 0.06% for land based travel and -0.44% for the included group. The closure of EU airspace [0, 1] generated a significant response as the counterfactual firms returned a significant value of 0.98%, compared to the the included firms at -0.63%, and the excluded firms 1.01%.

Table 7.8. The abnormal returns during Iceland volcanic eruption event window [0, 6] and periods [0] and [0, 1] for included, excluded and land based travel firms

[0, 6] Event Window					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Travel Firms	-3.73%	-0.98	0.33	-3.66	0.00***
Excluded Travel Firms	1.58%	0.46	0.64	0.76	0.45
Land Based Travel Firms	4.85%	1.86	0.06*	4.91	0.00***
[0] Eruption of Iceland Volcano					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Travel Firms	-0.44%	-0.3	0.76	-0.54	0.59
Excluded Travel Firms	1.66%	1.28	0.2	1.22	0.22
Land Based Travel Firms	0.06%	0.06	0.96	-0.11	0.91
[0, 1] Eruption to closure of EU airspace					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Travel Firms	-0.63%	-0.31	0.76	-1.43	0.15
Excluded Travel Firms	1.01%	0.55	0.58	0.66	0.51
Land Based Travel Firms	0.98%	0.7	0.48	2.61	0.01***
[2, 6] Re-opening of EU Airspace					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Travel Firms	-3.1%	-0.96	0.34	-5.61	0.00***
Excluded Travel Firms	0.58%	0.2	0.84	0.53	0.59
Land Based Travel Firms	3.86%	1.75	0.08*	3.97	0.00***

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The reopening of EU airspace generated significant returns for the included and counterfactual (land based) group of firms. The included firms generated a negative CAAR of -3.1% compared to 0.58% for the excluded firms and 3.86% for the counterfactual firms, significant in the Boehmer et al. (1991) cross sectional test at 1%.

From these results the value performance of firms included in FTSE4good is lower than those that were excluded. This is despite evidence of benefits within other event studies and the theoretical risk mitigation benefits that FTSE4good provides. Larger sample groups would potentially provide a different result but in the empirical context of this study, a UK focus yields no benefit to investors in a sector based selection of individual firms in response to a natural disaster with wide reaching economic consequences.

7.4.5 Horse meat scandal & the performance of food producers

Over the course of the event window the horse meat scandal produced negative periods for the included group of firms in comparison to the returns of the excluded firms. This effect was skewed by the returns of one FTSE4good member, Premier foods, who produced returns in excess of -50% over the course of the event. Premier Foods plc inclusion ratings were 3.4 for environment, 4.3 for social and 4 in governance. This aside, the remaining firms would still have produced an aggregate return below that of the excluded firms and, therefore, in the context of this study and for empirical robustness Premier Foods remained within the group. The pattern of event window cumulative average abnormal returns is presented in Figure 7.8 and Table 7.9.

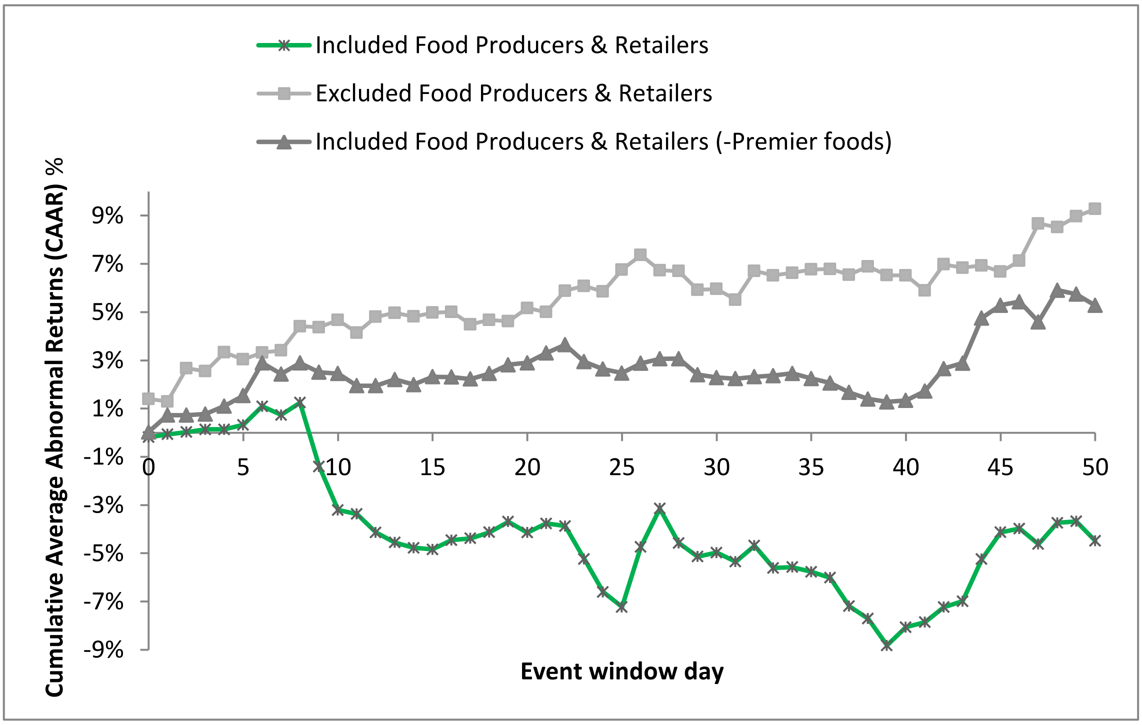


Figure 7.8. Horse meat scandal event window [0, 50] abnormal returns for included and excluded food producers and retailers

Figure 7.8 indicates that from the event day [0] to day 8 a positive relationship was observed across both groups but only the excluded group generating a significant positive return of 0.97% during period [0, 1] compared to the included groups non-significant 0.27% CAAR. The following period [18, 21] which represents the announcement of a Phenylbutazone (Bute) contamination risk shows the group of included firms produced another positive return of 0.51%, significant at the 10% level in the Boehmer et al (1991) cross sectional test, and in excess of the excluded group return of 0.38%. Furthermore, despite the exclusion of premier foods, the included group of firms still underperformed those of the excluded group, albeit with positive returns.

Table 7.9. Abnormal returns during horse meat scandal periods [8, 10], [23, 24] and [26, 27] for included and excluded food producer and food retail sectors

[0, 50] Event window					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	-2.42%	-0.49	0.63	1.14	0.26
Excluded Firms	6.96%	2.20	0.03**	3.13	0.00***
[0, 1] FSAI & FSA announce possible horse DNA contamination					
Index	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	0.27%	0.27	0.79	0.77	0.44
Excluded Firms	0.97%	1.55	0.12	1.8	0.07*
[18, 21] FSA announces risks associated with possible presence of Bute					
Index	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	0.51%	0.37	0.71	1.69	0.09*
Excluded Firms	0.38%	0.43	0.66	1.06	0.29
[22, 24] Arrests made by police & Bute test results published					
Index	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	-2.29%	-1.91	0.06*	-1.93	0.05**
Excluded Firms	0.63%	0.83	0.41	1.91	0.06*
[25, 26] FSA publishes report					
Index	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	1.97%	2.01	0.04**	1.19	0.23
Excluded Firms	1.13%	1.81	0.07*	1.56	0.12

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

Only when arrests were made (Sky News, 2013) and the Bute contamination tests were published did the market begin to recognise the magnitude of the event in period [22, 24]. In this instance a negative response was recorded only for both the included firms at -2.29% that was significant in the t-test and Boehmer et al. (1991) cross sectional test; compared to an non-significant excluded group positive return of 0.63%. On the 25 day the FSA published a report [25, 26] that the market perceived as positive for the included group of firms at 1.97% and the excluded group at 1.13%, both significant in the t-test at the 5% and 10% level respectively. Despite the positive reaction to the FSA report the market still felt that the issues associated with the scandal were not fully transparent and priced into the market (The Telegraph, 2013). During period [27, 31] the included firms resumed negative trading with a CAAR of - 0.69% compared to the excluded group return of -1.39% as shown in Table 7.10.

Table 7.10. Abnormal returns during horse meat scandal periods [26, 27], [28, 30], [33, 39] and [40, 50] for included and excluded food producer and food retail sectors

[27, 31] Test results published & firms withdraw food from sale					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	-0.69%	-0.45	0.65	-0.68	0.5**
Excluded Firms	-1.39%	-1.40	0.16	-2.78	0.01***
[32, 37] Details of FSA sampling programme revealed					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	-1.22%	-0.72	0.47	-0.18	0.86
Excluded Firms	0.77%	0.71	0.47	1.47	0.14
[38, 50] FSA lifts ban on major slaughter house and test results revealed					
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	2.56%	1.02	0.31	1.73	0.08*
Excluded Firms	2.05%	1.28	0.20	1.49	0.14

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

Period [27, 31] represents a time when the FSA published test results and food items were withdrawn from sale. During this period the returns of both groups were non-significant. The following period [32, 37] however produced a significant negative return for the included firms at -1.22% when the FSA announced the results its sampling programme. The excluded firms were in-line with expectations with a non-significant positive return of 0.77%. The concluding period [38, 50] when the FSA lifted its ban on a major slaughter house and publishes further test results, shows the market responded positively for both groups with an included firm return of 2.56%, significant in both the t Boehmer et al. (1991) cross sectional test, compared to the excluded group positive return of 2.05%, significant also in the Boehmer et al. (1991) cross sectional test only.

Throughout the event the included group generate returns constantly below those of the excluded group, in many cases with significance. Therefore, the standards set by FTSE4good were not interpreted by the market as useful in the valuation of the included group of firms in mitigating the risks associated with the event. The implication being that selection of firms from the same sector, based on FTSE4good inclusion does not offer resilience in the face of a sector related crisis.

7.4.6 EU ETS Prohibition Act & performance of UK aviation and travel

The results for the EU ETS prohibition act event study indicate significant differentiation by the market, between the three included and three excluded firms in response to the announcement of the intended implementation date on 06/07/2011. Over the event window, the CAAR for firms excluded from the FTSE4good are significantly lower than those of the included firms at -18.02% and -5.55% respectively. The event window return patterns are shown in Figure 7.9 and the CAAR for period [0, 15] indicate that the start [0] accurately reflects the event date.

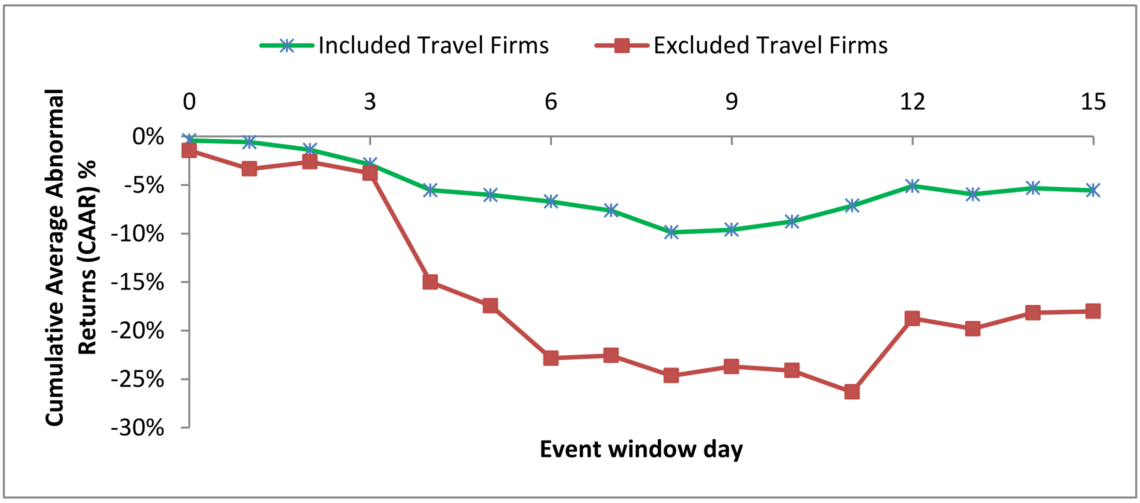


Figure 7.9. EU ETS prohibition act event window [0, 10] abnormal returns for included and excluded airline and travel firms

The CAAR from Table 7.11 show a progressive and significant decline in the value of the excluded and included firms from the event start through all periods. However, days 11 and 12 show a minor recovery for the excluded firms into a flattening of the returns for both groups, indicating an end to the market decline. The excluded firms produced significant returns that underperformed the included firms in all periods after the event day [0].

Table 7.11. EU ETS prohibition act event window [0, 15] abnormal returns for included and excluded airline and travel firms

			[0, 15]		
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	-5.55%	-1.74	0.08*	-1.94	0.05**
Excluded Firms	-18.02%	-3.25	0.00***	-0.90	0.37
			[0]		
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	-0.40%	-0.5	0.62	-0.14	0.89
Excluded Firms	-1.45%	-1.04	0.3	-1.41	0.16
			[0, 1]		
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	-3.34%	-1.7	0.09*	-2.46	0.01***
Excluded Firms	-3.74%	-1.55	0.12	-1.58	0.11*
			[1, 5]		
Group	CAAR	t-test	p-value	Boehmer et. al	p-value
Included Firms	-5.63%	-3.16	0.00***	-2.35	0.02**
Excluded Firms	-16.00%	-5.16	0.00***	-1.44	0.15

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The results therefore indicate that in this non-firm specific event, inclusion in FTSE4good provided resilience against the impacts associated with the event and resilience soon after.

7.4.7 EU ETS "Stop the clock" and industrial sector performance

Following the decision to "stop the clock" on including aviation in the EU ETS, the first announcement of this intention on the 12/11/2012 was tested using the industrial sector firms from FTSE4good's ratings history. Firms were divided into two groups of 58 included and 39 excluded industrial sector firms. Throughout the event window the CAARs show that the excluded group underperform the included group for the duration of the event window apart from during day 3. The event window CAARs are shown in Figure 7.10.

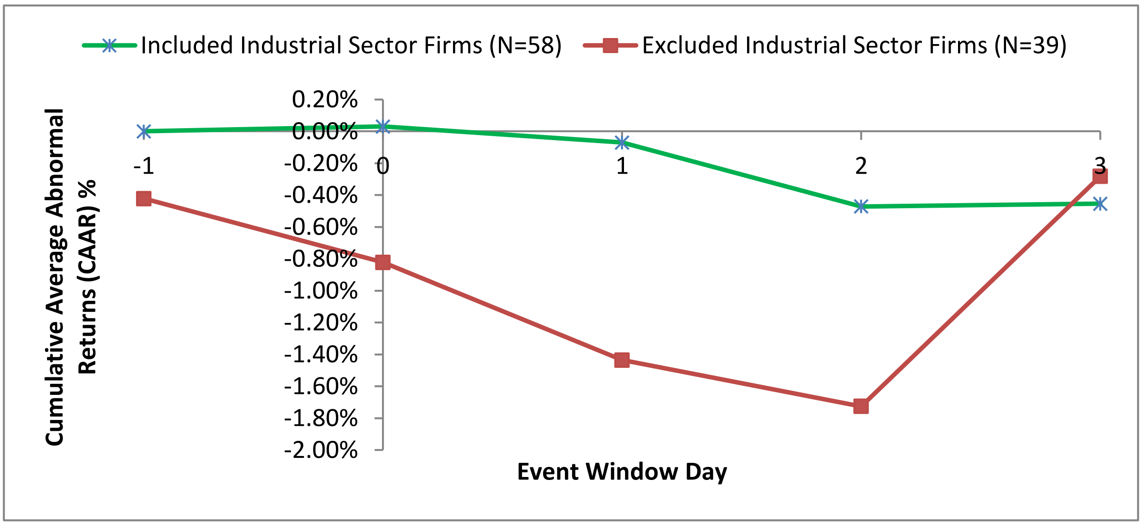


Figure 7.10. Event window returns for included and excluded industrial sector firms during in response to the EU ETS stop the clock announcement.

The event window results show a non-significant return for both groups as the excluded firms returned to normality by day 3 and the included group never deviated significantly from expected levels. Interval period [-1, 0] does indicate that the market anticipated the announcement with a return of -0.82%, significant in the t-test at the 1% level and the Boehmer et al. (1991) cross sectional test at the 5% level. The event consequently produced further downward pressure for the excluded group and the AAR for the event day [0] that was significant in the t-test at the 5% level, indicating that with 95% confidence the return of -0.4% was the result of markets interpretation of the excluded firms' value in relation to the EU ETS "Stop the clock" announcement. The following period [0, 1] continued this trend but with increasing significance for both groups. The included group returns were 50% higher than those of the excluded group at -0.5% and 1.01% respectively.

Table 7.12. EU ETS stop the clock interval periods [-1, 3], [-1, 0], [0], [0, 1] and [1, 3] abnormal returns for included and excluded industrial sector firms

			[-1, 3]			
Group	CAAR	Pos : Neg	t-test	p-value	Boehmer et. al	p-value
Included Firms	0.3%	10:24	0.46	0.65	0.64	0.52
Excluded Firms	-0.28%	17:22	-0.75	0.46	-0.8	0.43
			[-1, 0]			
Group	CAAR	Pos : Neg	t-test	p-value	Boehmer et. al	p-value
Included Firms	-0.07%	01:33	-0.35	0.73	-0.51	0.61
Excluded Firms	-0.82%	14:25	-2.73	0.01***	-2.13	0.03**
			[0]			
Group	CAAR	Pos : Neg	t-test	p-value	Boehmer et. al	p-value
Included Firms	-0.1%	00:34	-0.66	0.51	-0.97	0.33
Excluded Firms	-0.40%	17:22	-2.00	0.05**	-1.27	0.2
			[0, 1]			
Group	CAAR	Pos : Neg	t-test	p-value	Boehmer et. al	p-value
Included Firms	-0.5%	19:39	-1.74	0.08*	-2.34	0.02**
Excluded Firms	-1.01%	13:26	-2.33	0.02**	-1.87	0.06*
			[1, 3]			
Group	CAAR	Pos : Neg	t-test	p-value	Boehmer et. al	p-value
Included Firms	0.37%	11:23	0.87	0.38	1.03	0.3
Excluded Firms	0.54%	21:18	1.26	0.21	1.61	0.11*

*, **, *** represent significance at the 10%, 5% and 1% levels respectively.

The period that includes the return to normality [1, 3] shows the excluded firms generated the greatest return of 0.54%, marginally significant at the 10% level in the Boehmer et al. (1991) cross sectional test. This pattern of performance appears to be a trend within this analysis where an arbitrage between the two securities causes the lowest performer to return to normality with higher relative returns. Given that this only brings the excluded firms back in-line with the included firms, the observation has no impact on the final conclusion.

The EU ETS “stop the clock” event study provides evidence that the market viewed the announcement by the European Commission as fundamental in the valuation of the excluded firms. Consequently the included group showed resilience in protecting shareholder value that was otherwise lost in the excluded group of firms.

7.4.8 Descriptive statistics

The ranking statistics for the sector analysis of included and excluded firms during the periods with significant abnormal returns show an even match between the included and excluded firms. The ranking of 1st to 2nd was 18 for each classification out of 36 significant periods (total of 50 periods). Consequently, the chi-squared test indicates that the rankings were not significantly different ($X^2(1) = 0.00, p = 1.00$) and therefore consistent with other findings of neutrality (See Appendix G).

Table 7.13. Ranking statistics for sector analysis during periods with significant returns

Rank Descriptive Statistics	*Included*	*Excluded*
1st	18	18
2nd	18	18
Mean	1.5	1.5
Sum	54	54
Count	36	36
Chi-Square (X^2)	0.00	-
Degrees of freedom (df)	1	-
Asymptotic Significance (p)	1.00	-

To account for this neutral result, the descriptive statistics for periods with significant abnormal returns were generated. However, these reinforce the non-significant Chi-Squared ranking result due to the marginality of the mean cumulative abnormal return at -1.29% for the included firms compared to -1.2% for the included firms; the median statistic indicates that a greater number of the excluded firms abnormal returns were relatively more resilient than those of the included firms; lastly, the sum statistic remains consistent as the included group generated a total of -46.48% compared to -43.22% for the excluded firms. However, the distribution of the returns suggest otherwise, as indicated through the variance and standard deviation because while the excluded firms generated marginally favourable returns their distribution around the mean was wider implying greater volatility.

This is compounded by a greater minimum and subsequent range statistic that shows the excluded group generated greater volatility in returns (see Table 7.14). The final reinforcement of the risk associated with the abnormal returns is expressed by the skewness and kurtosis statistics. The excluded firms generated returns that were negatively skewed at -2.029, below that of the included firms at -0.552; coupled with a higher kurtosis value at 130% higher, the excluded firms carry a greater risk of extreme negative values. Therefore, the excluded firms show evidence of greater risk in achieving cumulative abnormal returns across the tested events.

Table 7.14. Descriptive statistics for the performance of industrial sector firms during periods with significant returns

	Included firms	Excluded firms
Mean	-1.29%	-1.20%
Standard Error	0.60%	0.81%
Median	-0.78%	-0.48%
Mode	0.51%	2.27%
Standard Deviation	3.58%	4.85%
Sample Variance	0.13%	0.23%
Kurtosis	2.36	5.45
Skewness	-0.552	-2.029
Range	20.47%	24.98%
Minimum	-12.80%	-18.02%
Maximum	7.67%	6.96%
Sum	-46.48%	-43.22%
Count	36	36

The table below (Table 7.15) summarises the findings of the comparison between firms included in FTSE4good against firms excluded from FTSE4good. The column titled retrospective denotes the result of an event study where the main culprit for the event was removed from a retrospective analysis, for example, BP plc.

Table 7.15 Overview of the industry event studies results of a comparison between firms included and excluded from FTSE4good.

Event	Sector analysis	Retrospective
Financial crisis	Negative	N/A
BP plc oil spill	Negative	Positive
Iceland Volcanic Eruption	Negative	N/A
Japan earthquake	Negative	Positive
Horse meat scandal	Negative	Neutral
EU ETS Prohibition announcement	Positive	N/A
Chi-Squared Test	Neutral	
Descriptive Statistics	Negative	

7.5 Discussion

7.5.1 Financial crisis and FTSE4good industrial sector performance

Overall, the relationship between financial performance and inclusion in FTSE4good firms from the same industrial sector has proved to be broadly negative. During five of the six events, the included group of firms failed to out-perform the excluded firms as shown in the ranking of significant periods albeit non-significant Chi-Squared statistic. This could however be viewed as a neutral result given that significance was not determined in favour of the excluded group. The mean return and range statistics also show evidence of heightened performance from excluded group. Despite the initial signs, the included group showed evidence of lower risk in the standard error, standard deviation, skewness and kurtosis of returns. Only when protagonist firms were removed retrospectively from the included groups (see Table 7.15) did event specific evidence emerge of superior performance in FTSE4good, albeit with limited significance. The skewness and kurtosis suggest that investors would carry greater risk of extreme negative values relative to the included firms. This does not explain the mean return performance but instead suggests that a minority of firms generated extreme values away from the groups mean. Therefore, investors may not be willing to buy and hold firms that present an extreme risk to overall returns.

7.5.1.1 The financial crisis and financial services sector

The first event in question was the financial crisis of 2007/2008. The response by investors in valuing financial services firms during the financial crisis provides evidence that overall, inclusion in FTSE4good did not foster resilience in share value. Taking into account the periods with significant returns only; the excluded group of firms showed greater relative resilience to downward price pressure over firms included in FTSE4good. This reflects the FTSE4good Benchmark index response to the same event (chapter 5.1.1), which is also based on inclusion and exclusion using an overall score across environmental, social and corporate governance criteria. These findings contradict the findings of the FTSE4good UK 50 within the current study and those of Ortas et al (2013) who also found the Spanish FTSE4good index carries a lower risk profile. More applicable in the sector context but using older and non-FTSE4good related data is a study by Simpson and Kohers (2002) who found a positive relationship between CSR performance and the financial performance of US based banks pre

2002. However, the authors utilised a subjective measure of social performance over a different financial event, within a different geographical area and most notably using annual return on assets data; a sampling interval that has a proven reduction in power relative to daily data (MacKinlay, 1997).

7.5.1.2 The Deep Water Horizon oil spill and oil and gas industry

This complex exposure to multiple dimensions of risks is also apparent in the results for the Deepwater Horizon oil spill where the included firms underperformed the excluded firms only because BP plc was detrimental to the returns of the group as a whole. As shown in Figure 7.2, when BP was retrospectively removed, the market viewed the remaining firms to be a more attractive investment prospect in the face of oil industry risks born from the Deep Water Horizon explosion and subsequent oil spill. Furthermore, alternative energy firms showed significant benefit in the growth of cumulative abnormal returns above that of expectations generated from the market model. The market therefore showed evidence of a valuation shift away from lower performing ESG firms, excluding BP; firstly in favour of included FTSE4good firms followed by a substantial interest in alternative energy. The reality, however, is that despite relatively high ESG scores for BP plc (Environmental=5, Social=5, and Governance=3.6), FTSE4good failed to mitigate the risks directly associated with the event resulting in BP's erroneous inclusion in the index series. This error is not likely to be an oversight with respect to FTSE4good's inclusion standards; instead it is potentially evidence of a discrepancy in the inclusion criteria set by FTSE4good.

7.5.1.3 The Japan earthquake, technology and power utility sector performance

The sector based response to the Japanese earthquake indicated that UK based technology firms that were included in FTSE4good were more exposed to the effects of the event than the excluded technology firms. The included firms underperformed throughout the event window [0, 10] and second trading week [6, 10] with significant negative abnormal returns. Furthermore, during the announcement of a reactor leak [0, 3] the excluded group generated a significant positive return of 2.5% compared to that of the included group at 0.51%, almost 80% lower in cumulative abnormal return performance over the same period. For the energy sector, the returns for firms included in FTSE4good show evidence of heightened performance over excluded firms. Despite the negative return during the industry announcement on Germany's nuclear energy plans, the included group moved into positive territory soon after, finishing with a significant event window return of 1.12% compared to -3.13% for the excluded group. Therefore, the market viewed inclusion in FTSE4good as a less risky alternative to the excluded firms when faced with the prospect of changing energy policy that emerged from the Japanese disaster. Betzer et al (2013) tested the equity value response of German energy firms to the announcement of changes in policy on the provision of energy from nuclear sources; an event study found that the change in policy was detrimental to firm stock values in Germany. Therefore, the outperformance by energy firms included in FTSE4good could potentially reflect relative exposure to nuclear energy thus providing protection to investors against higher risk energy strategies.

7.5.1.4 The Iceland volcano eruption and travel sector performance

During the volcanic eruption in Iceland and subsequent disruption to travel, the market did not indicate a significant preference to firms that were either included or excluded from FTSE4good. Instead, the market favoured land based travel firms that include car hire, bus and rail companies, all of which were included in FTSE4good. This flight to quality produced cumulative abnormal returns that were substantially above those of the included and excluded firms. The most significant response was associated with the disruption to air based travel. Therefore, it could be argued that FTSE4good could not be expected to impose standards that would fully mitigate the risks associated with an abrupt shift in travel demand. Evidence of which is shown in a lack of differentiation between the included and excluded firms. The clearest benefit however, was enjoyed by the land based travel sector as the market recognised the short-term increase in returns that would result in an increased demand in land based travel due to airspace closure; this result was also concluded by Mazzocchi et al (2010) who looked at the EU airline industry without the classification of FTSE4good inclusion and exclusion.

7.5.1.5 The horse meat scandal and food industry performance

The horse meat scandal of 2013 transcends social responsibility and corporate governance issues that FTSE4good's inclusion criteria aims to correct. The event had a substantial impact on the way society views the manufacturing, supply, and safety of food which manifested in consumer behaviour that was consequently detrimental to sector returns (The Telegraph, 2013; Abbots and Coles, 2013). The catalyst for this event originated from improper governance in the supply chain where firms should have ensured transgressions were mitigated through proper due-diligence and checks (Pendrous, 2013). Therefore, it was expected that a change in share market values for related industrial sector firms would be evident. Consequently, the cumulative abnormal returns for the included group of firms indicate that the market did not value FTSE4good performance favourably throughout the event; particularly in the case of Premier Foods plc who were most affected by the event and responsible for the negative abnormal return trend for the whole group despite high social (4.3), and governance (4) pillar scores. However, even following the removal of Premier Foods, the included group of firms still under performed relative to the excluded group albeit without significance. The event window and interval periods indicate that with or without the offending firm, financial markets did not recognise inclusion in FTSE4good as a means of valuing firms favourably in the face of contraventions related to the meat.

Like the oil industry response to the Deep Water Horizon event study, the Horse meat scandal results were heavily influenced by one firm. The reoccurrence of such a result highlights potential inadequacies in the supply chain governance within the offending firms that should have been mitigated through proper adhesion to FTSE4good standards (Pendrous, 2013). Lin-Hi and Blumberg (2011) found that oil industry governance and subsequent violations are negatively correlated; stating that “deficits in the institutional environment foster the pursuit of quick wins through violations of corporate governance”. The standards set by FTSE4good should therefore mitigate this type of pursuit and ideally the market would be aware of this provision and the degree to which it is adhered to as per the ratings; evidence of which would also be seen in financial performance.

7.5.1.6 The EU ETS, travel and industrial sector performance

The final two events used to estimate a difference in the financial performance of included and excluded firms related to the EU ETS. Given the negative nature of both events, namely a change in policy that turns in the face of environmental protection, it could reasonably be expected to be positive for excluded and lower performing firms who do not advocate a relative interest in ESG standards and environmental protection more specifically. However, both included sectors outperformed the excluded firms. Firstly, the announcement that the US intended to prohibit it’s aviation industry from participating in the EU ETS saw markets recognise inclusion in FTSE4good as positive in their valuation with an event window cumulative average abnormal return of -5.5% compared to the excluded firms -18%. While both groups produced negative returns, the market interpreted the announcement and related information as being detrimental to the excluded group of travel firms. Secondly, the announcement of the European Commission' intention to exclude aviation from the EU ETS produced returns in favour of the included group of industrial sector firms. In both events the market showed evidence of recognising inclusion in FTSE4good as a positive advantage in their valuation in excess of excluded firm returns.

7.5.1.7 Conclusion

During the sector based analysis, where diversification is limited to inherent firm activity, evidence suggests that the market did not conclusively differentiate between FTSE4good inclusion and exclusion in valuing the respective assets. It must also be clarified that a single event is not the only factor in the valuation of a firm and therefore, this study relies on the inclusion of significance statistics to quantify the likelihood that the event has impacted on prices. The assumption is that with a degree of confidence, ranging from 90% to 99%, the deviations in abnormal returns are associated with the events in question. Whether or not these deviations accurately reflect all available information is open to debate given the restricted access to FTSE4good's ratings data.

8 Synthesis

8.1 Introduction

This research aimed to establish whether a positive relationship existed between corporate social performance and corporate financial performance during crisis events. To establish this link, FTSE4good was used as a proxy to CSP and green performance. Firstly, FTSE4good's index products were compared to the performance of the FTSE All-Share; secondly, firms were classified and compared according to an upper and lower limit of ESG performance; and finally, firms were selected from industrial sectors, classified and tested according to inclusion in and exclusion from FTSE4good. Following on from the discussions that relate to each analysis, the following chapter is a synthesis of the overall findings and how they compare to the literature. In response to the results, limitations of both the research and FTSE4good are identified and subsequent recommendations are made at all-time linking back to the literature.

8.2 Linking FTSE4good with financial performance during market crisis

This study makes a novel contribution to the literature by analysing the effect to which FTSE4good' E (environmental), S (social) or G (governance) screening criteria impacts on share value in response to a shock event; to the author's knowledge no other study exists on the performance of firms from FTSE4good selected according to their respective performance within each ESG domain and classified under industrial sectors.

All FTSE4good based studies have instead focused on indices such as the FTSE4good UK 50 and whether it outperforms a conventional index (in most cases either the FTSE All-Share or FTSE-100). The results from this literature are at best, mixed (Ortas et al., 2013; Curran and Moran, 2007; Collison et al., 2008; Belghitar et al., 2014; Brzeszczynski and McIntosh, 2013; Collison et al., 2009). Furthermore, the wider literature on the link between corporate social responsibility (CSR) and corporate financial performance (CSR-CFP) is also mixed (Tebini et al., 2014), driving continued research to achieve consistency in the findings. Overall, the findings of the current study also produced mixed evidence during the specified events but some findings are consistent with the literature that is in rare cases FTSE4good specific.

Firstly, the mean effect of the events on the returns of the indices (chapter 5) suggests that the FTSE4good benchmark significantly underperformed the FTSE All-Share index; a result that was reinforced by the performance ranking and descriptive statistics (chapter 5.1.5). This finding is supported by Collison et al. (2008) who also found, without significance, that the FTSE4good Benchmark underperformed relative to the FTSE All-Share; albeit using a different method, namely the risk return ratios of the capital asset pricing model (CAPM). Conversely, the FTSE4good UK 50 showed evidence of superior performance above the returns of the FTSE All-Share; a finding that is supported by Belghitar et al. (2014) but other studies have found significant evidence of a financial penalty for investing in the FTSE4good UK 50 (Belghitar et al., 2014) albeit using a different method, longer interval periods (weekly) and compared against the FTSE-100. Therefore the FTSE4good benchmark failed to provide resilience to investors and actually showed signs of heightened risk relative to the FTSE All-Share. The FTSE4good UK 50 was marginally neutral in providing resilience to investors due to the returns relative to the FTSE All-Share, however an observation on the risk profile of the FTSE4good UK 50 suggests that it carries far less risk than the FTSE All-Share, a finding that potentially tips the balance of an advantage in favour of the FTSE4good UK 50.

The subsequent analyses of best in class firms classified according to FTSE4good ESG performance also produced mixed results with a neutral/negative finding for both the environmental and governance portfolios. Whilst no supporting evidence exists directly relating financial performance to portfolios constructed using the FTSE4good ratings, research has been conducted into SRI portfolios that support this neutral/negative finding (Brzeszczynski and McIntosh, 2013; Humphrey and Tan, 2014; Leite and Cortez, 2013; McPeak et al., 2010). For the social portfolios a positive relationship was found in the average firms returns, and finding that has support within the literature (Nofsinger and Varma, 2014; Janda et al., 2014; Chan and Walter, 2014). In all instances the descriptive statistics support the finding of the mean return ranking.

Finally, the sector focused analysis of firms included and excluded from FTSE4good showed evidence of a financial penalty for investing in included firms; a finding that again cannot be supported directly by equivalent research into FTSE4good, but the findings of (Park and Lee, 2009) provide support, albeit within a sector not represented within the current study. The majority of studies suggest that sector focused social responsibility has a positive relationship with financial performance (Simpson and

Kohers, 2002; Serwinowski and Marshall, 2010) again this association has never been made with FTSE4good.

Overall the variations within the existing literature can be accounted for by the range of methods used to test performance. In some cases classification and the rating of firms has been subjective and undertaken by the researcher; and in others, such as in the current study, this has been exogenous to the authors' decisions as classification has been made by an external entity, such as FTSE4good (Lu et al., 2014). Furthermore, Cavaco and Crifo (2014) highlight that research into this field is plagued by issues of model misspecification due to inappropriate interval periods (weekly, monthly), small samples, old data, extreme firm heterogeneity and the direction of causality. All of which the current study aimed to address in the design of the event study methodology or at least highlight in the discussion of the results.

Like the compendium of existing research, the results within the current study have also been varied, a consequence of the multiple constructs that are the foundations of CSR, ESG and SRI; which as Cavaco and Crifo (2014) state, the multi-dimensional constructs of CSR, in this case ESG, need to be considered simultaneously to effectively make a connection with financial performance. Therefore, evidence suggests that variations in performance might be the consequence of faults in FTSE4good's inclusion standards and over-representation by firms that excel within a particular pillar of environmental, social, or corporate governance performance. An issue highlighted by Fowler and Hope (2007) and Barnett and Salomon (2006), who found that firms included primarily on the basis of strong environmental performance had an economic disadvantage because of the increased costs of meeting new regulatory standards. This may account for the underperformance of the environmental portfolios and industry sector firms included in FTSE4good. Furthermore, FTSE4good risks eliminating entire industries due to the reduced universe created by ESG screening (Fowler and Hope, 2007). Therefore, compared to both FTSE4good indices, the FTSE All-Share is always more diversified (Fowler and Hope, 2007) evidence of which is shown in the sector weightings during the financial crisis and Deepwater Horizon event studies that can be seen in Table 5.11 and Table 5.12.

The majority of research into the CSR-CFP link during crisis has focused on market events with little to no connection to the environmental, social or corporate governance standards employed by FTSE4good and other sustainability indices. The most prominent events used for testing are the financial crisis of 2007/08 and relevant news releases. Within these studies mixed results have been found on the benefits of investing in ethical indices during such events and conditions; some have been positive (Ortas et al., 2013), and others negative (Belghitar et al., 2014). The two aforementioned studies have however focused on the FTSE4good indices as a means of classifying CSR performance, given the comments by Cavaco and Crifo (2014) that highlight CSR is multi-dimensional, this approach may not be the most effective method for establishing a causal link. This in part provides rationale for the analysis into firms and their respective ESG performance and how this relates to financial performance. The findings of this study also support the argument from modern portfolio theory (Ortas et al., 2013), that ESG screening does reduce the benefits of diversification due to the elimination of entire sectors that consequently impacted on the relative performance of the FTSE4good indices and portfolios.

The only significantly positive result within the current study centres on firms classified according to FTSE4good' social ratings, as seen in the portfolio analysis in section 6.6.1, which proved resilient to the effects of the events when compared to lower performing firms. Nofsinger and Varma (2014) also found that during market crisis, firms with relatively higher ESG attributes outperform, in an asymmetric pattern, conventional, lower performing firms; and that firms selected through positive screening, the likes of which are used by FTSE4good, are the main drivers of performance. Whilst a truly asymmetric response was not witnessed within the current study, the social portfolio results also concur with Kempf and Osthoff (2007) who found that maximal abnormal returns were achieved by selecting the best in class firms in terms of extreme social performance. Whilst this was not a study based on FTSE4good' social ratings, it is consistent with the findings of the current study and confirmatory of the best in class approached used to classify ESG performance. Previous evidence has suggested that financial performance of the social portfolios reflect a quality workforce that is better positioned to market products and services, creating an economic advantage for the firm (Greening and Turban, 2000). Furthermore, research into the financial performance of firms relative to ethical CEO leadership has also proved positive, linking with FTSE4good and potentially explaining the superior performance of the best socially responsible firms (Eisenbeiss et al., 2014). Aras and Crowther (2009 p.282) support this notion, highlighting that organisational culture is fundamental to the sustainability concept and defines it as the "relationship between the corporation and internal stakeholders". Otherwise referred to as stakeholder management theory, significant positive relationships have been found between the employee characteristics of CSR related firms and financial performance (Clarkson, 1995).

Social performance is only one aspect of the CSR construct that FTSE4good aims to promote through its ESG standards, and the mixed results of the other event studies are therefore contentious in advocating the financial security of a green economy. The following illustration (Figure 8.1) delineates the areas of sustainability and the areas of focus that corporations apply their resources, inherently and proactively.

Figure 8.1 Corporate social responsibility model (adapted from Aras and Crowther (2009) **by author)**

The model shown in Figure 8.1 reflects FTSE4good' ESG criteria but highlights a missing fundamental component from within their criteria, finance, and the ability for a FTSE4good firm to maintain output whilst managing variability within other areas of their business (McDonald, 2006). Therefore, as all the included events transcend the areas highlighted within Figure 8.1 it would seem appropriate to comprehensively include all aspects of CSR to mitigate associated risks.

Consequently, the results appear to show that investors are able to identify a portfolio of firms from FTSE4good' social responsibility ratings that are able to provide resilience through heightened performance over conventionally constructed portfolios during shock events. However, the omission of certain standards, namely economic (finance), may have contributed to the underperformance of the FTSE4good overall. A suggestion that is supported by Porter and Kramer (2006a) in their scathing assessment of CSR ratings. However, despite the environmental and corporate governance portfolios failing to generate returns above lower performing firms, these results were not significant, therefore, FTSE4good are well positioned to develop a stronger ethical investment model, particularly within their indices. Firstly, a study by Bello (2005) found that socially responsible mutual fund characteristics are no different to the characteristics of conventional funds; a result that was skewed by the inclusion of firms with a level of ESG performance that hindered the overall performance of the FTSE4good Benchmark index. The issue being that the score threshold employed by FTSE4good allows the inclusion of firms that are in part homogenous to the excluded group of assets, therefore, creating a group of firms whose ESG characteristics cause their financial performance to potentially overlap. Therefore, the index and sector based results are likely to be impacted by an inclusion score threshold that is too low to yield a significant and conclusive benefit that is detectable across the included events. However, if the top 100 social portfolios are able to provide increased benefits then this indicates that a higher inclusion score threshold could yield greater benefits for the FTSE4good Indices, making the products a more attractive investment prospect that drives the green investment. This finding of a negative influence by firms with a middle ground ESG performance is supported by Barnett and Salomon (2006) and Fowler and Hope (2007) who state that the funds which utilise a relatively higher number of screens that are more stringent tend to eliminate financial underperformance; whilst funds that utilise the fewest social screens or just negative screening also perform higher due to increased diversification.

A number of additions could serve to bolster the criteria set by FTSE4good to directly mitigate the impacts associated with events such as the financial crisis. One such requirement would be transparency and disclosure on a firm's ability to meet any calls on its liquidity, and the extent to which a firm is invested in derivatives would also constitute a significant part of the SRI domain (Sarra, 2012; Chatterji and Levine, 2006). The primary aim is to isolate short-term profit maximising firms that impose risk on third parties or the entire economic system. Furthermore, compensation structures could be introduced to negate excessive risk taking by firms and to encourage confidence in third parties to invest knowing that if a contravention should occur, like the Deepwater Horizon oil spill, then some compensation would be paid to investors (Perez, 2011; Sarra, 2012).

Administering greater precautionary standards would require greater investment in individuals with technical proficiency in the high risk areas within which firms operate, such as geological and engineering experts (Porter and Kramer, 2006a). The same is true for financial risk, the standards of which would be set and assessed by finance experts. Particularly as many of the returns generated by FTSE4good were severely hindered by single firms, the actions of which should have been mitigated by FTSE4good. In support of this link, Kim et al (2014) found that firms engaged in heightened transparency through CSR were less exposed to stock price crash risk.

It must however be stated that exposure to high yielding sectors such as oil and gas and financial services also brings substantially high risks (Walsh, 2012; Reader and O'Connor, 2014). The results indicate that the influence of FTSE4good standards is diminished when a sector specific incident occurs within a high risk sector such as oil and gas. For example, environmental incidents are infrequent but when they do occur they have a substantial impact on associated firms. Therefore, while FTSE4good might reduce risk, as shown in the social portfolio results (Section 6.6), its influence is severely diminished if a related sector specific disaster occurs. Therefore, investors should recognise that investment in an FTSE4good firm is never entirely risk free.

Cavaco and Crifo (2014) identify some of the biases and issues associated with previous work in establishing a link between CSR and CFP; highlighting that significant firm heterogeneity invalidates cross-sectional analyses; a statement that potentially renders the majority of CSR-CFP research defective. Therefore, a further novelty of this study and a second contribution to the literature is the sector based analysis that aimed to further moderate the effect of diversification that is seen in the index and portfolio analyses. Analysing two groups of firms from the same sector, one included in FTSE4good and the other excluded, this study aimed to identify whether inclusion offered a competitive advantage. The results of this analysis showed that industry securities included within the FTSE4good, do not outperform those of excluded firms during an industry related shock event. The ranking and descriptive statistics suggest a marginal disadvantage for FTSE4good firms, although this was not statistically significant. Despite the heterogeneity issues within other studies, few have attempted to investigate the CSR-CFP link within specific sectors, satisfying an implied need for homogeneity of firms. The literature points to conflicting evidence of the relationship between financial performance and corporate social responsibility in a sector focused analysis (Simpson and Kohers, 2002; Serwinowski and Marshall, 2010).

Central to the event study method is the assumption that markets are efficient in assimilating available information into the price of assets (Tuck, 2005). However, as Brown (2011) points out, the price is not necessarily correct as it only reflects the information that is available. In support of this it must be clarified that the ratings history by FTSE4good is prescription only from FTSE and therefore not readily available to all market participants, hindering FTSE4good' effectiveness as a signal of risk to the market as a whole. Subsequently, if the market is not aware of the ratings available from FTSE4good then it is difficult to be priced accurately into the market. Therefore, a recommendation for the administration of FTSE4good is that the ratings of all FTSE All-Share firms be made readily available to the investing community. This would increase accountability and open the ratings for wider interpretation and likely see a change in the price response of listed firms. Given this potential issue and the absence of significance in this study and the wider literature; is CSR a causal function of financial performance or is CSR attained due to financial performance, a link that has been tested in the literature (Waddock and Graves, 1997). This implied misdirection of causality is however not conclusive as Scholtens (2008) states, interactions vary according to the CSR dimension.

The limitations of the overall method centre on the effectiveness of the event study market model and the omission of risk-adjusted-returns associated with volatility; an inference made possible through CAPM analysis using the Sharpe (1994) ratio for example. Another limitation to the analysis was the sample size during some of the industrial sector event studies. To account for this, future studies could include firms from a wider geographical area; this would however move the focus of any study away from the UK which would have an effect on the events that could be used to test for ESG related performance.

The issues associated with establishing a causal link between FTSE4good and market value are thought to be due to the subscription basis of the ratings. Therefore, any future study should establish what percentage of the market subscribes to this information? This information can then be linked to the efficient markets hypothesis in determining how inefficient markets are in relation to FTSE4good' privately held ratings data. Only when the markets are efficient to the ratings can causality be tested in linking FTSE4good performance to resilience performance within the market. This could be tested further through agent-based modelling where a market is created to simulate the FTSE All-Share for example and the addition of rules indicate how current uptake of FTSE4good ratings, followed by increases in uptake impact on interactions and performance. The autonomous conditions of these behaviours can be used to assess multiple aspects of ESG performance and the impact on the system as a whole.

9 Concluding remarks

The findings of the current study show mixed results regarding the resilience of green firms as is broadly reflected within the literature. Overall, it cannot be said that green firms are more resilient to shocks than non-green firms. Firstly, the distinction between green and non-green is contentious as firms operate on many levels of green performance. Secondly, green refers to a wide range of characteristics that are present within some operative and administrative systems but not in others; for example, FTSE4good and DJSI employ different management frameworks with distinctly different criteria. Thirdly, and continuing on from the subjective variability of green characteristics; as shown in the results some aspects of green performance, namely social responsibility, are able to provide resilience whereas, classification in other areas, namely corporate governance, does not. Consequently, green investments, ESG or SRI are too broad a term to accurately reflect the link between CSR and CFP during a shock event.

Therefore, when asked if green firms are more resilient to shocks, it could be said that green, CSR and many other references to socially responsible investing are too broad to identify with a single investment strategy. However, the results indicate that broadly speaking green firms are not more resilient to shocks but the social performance results and the identification of a range of systematic challenges suggests that under a revised administrative system and ESG performance classification, firms selected from the upper limits of ESG performance have the potential to mitigate related risks and thus provide investors with a capacity for resilience over and above their counterparts, evidence of which is shown in the FTSE4good UK 50 and social portfolios.

For the green economy to develop through green investment, firms must be acknowledged and known to be green. This can only be done with the release of relevant information such as the FTSE4good ratings. Investors can then utilise the ratings to select the highest performing firms that reflect the areas of risk they are most interested in mitigating, accepting that not all risks can be alleviated.

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APPENDICES

Appendix A : Systematic review of the green economy (2011)

Given the uncertainty of impacts that a green economy could have on economic activity and ultimately human progress, a robust, best evidence based characterisation and definition is required. Much that has been written on green economies is largely underpinned by theory without any reference to empirical and applied conditions. Therefore, this section undertakes a systematic review of the green economy concept to provide a consensual, clear and comprehensive definition for practitioners, government and business leaders to effectively formulate, communicate and implement their ideas.

The aim of the review is to:

- Delineate and define all meanings and characteristics of a “green economy”.
- Identify the obstacles that hinder the progress towards a green economy.
- Identify gaps in the knowledge around green and environmentally friendly economies for further research.

The Systematic review method was initially founded and most commonly used within the medical research field (Tranfield et al., 2003). A systematic review is used to thoroughly locate, select and critically appraise all relevant knowledge while providing consistent and accurate findings, synthesised to meet the reviewer’s aims and objectives (Cuevas, 2006). It is designed to provide an organised framework that informs decision makers with unbiased evidence based knowledge.

Because of the growth in information technology there has been a rapid increase in published articles (2 million annually in biomedical sciences alone), a systematic literature review is therefore a fundamental means for collecting and evaluating previous work given the magnitude of information available (Tranfield et al., 2003) A traditional narrative review is thought to be open to bias, lack of critical assessment and insufficient scope of knowledge used for synthesis (Cuevas, 2006).

The systematic review process is performed through a methodical framework that is transparent for researchers and practitioners to follow and reproduce Therefore, the systematic review minimises bias by use of an extensive and explicit literature search together with a record of the researcher's decisions, procedures and conclusions. The robustness of the review process ultimately forms the basis for informed decision making (Tranfield et al., 2003).

Systematic reviews have intrinsic benefits for both qualitative and quantitative research where the aim is to determine consistency across the knowledge base (Tranfield et al., 2003). A systematic literature review is, therefore, a useful method in any research project attempting to define and delineate the "green economy" and all adjoining definitions.

Due to the qualitative nature of the proposed literature review on "green economies", the management based works of Tranfield et al (2003) and Cuevas (2006) served as guidance to the systematic review methodology via the following steps:

1. Outline the aims and objectives of the review.
2. Select a review panel and determine member responsibilities.
3. Perform a scoping study to determine search terms.
4. Search and screen for all potentially relevant articles.
5. Critically determine which information is relevant in a clear and reproducible manner.
6. Evaluate selected research and strength of findings and conclusions.
7. Appraise individual studies using specified framework.
8. Communicate results in a transparent and comprehensive report.

The following sections follow this process.

Aims and Objectives of the review

Scoping Study

A scoping study was performed to assess the relative size of the subject area, bound and determine the focus of the review topic by identifying search terms and keywords. Reading was initially focused around definitions and broad characteristics of a green economy presented in the articles returned from the "green economy" search term online and within citation database, Scopus. It is initially clear that no single, unbiased, best evidence based definition for a green economy exists. The environmental awareness media website OneWorld (2012), states that "there is no consensual definition” for a green economy. Attempts to define a green economy are often confused with clean energy economies, accountancy methods that could be used to measure a green economy and definitions from potentially biased sources that have an ideological, subjective interest. It also seems that there is cross use of terms that causes confusion, for example: Are low carbon; circular economy and green economies all one in the same?

Methodology / Review Protocol

The methodology for the systematic review follows the framework of Tranfield et al. (2003) and Cuevas (2006) where the procedures used to collect, critique and synthesise the evidence in support of the aims of the review are presented in more detail.

The Review Panel

A review panel was formed to approve key elements of the review process as appropriate, such as the keywords used for the search string and inclusion criteria for source selection. The review panel consists of the reviewer / researcher, the senior academic supervisor and lead. Both supervisors are experienced in the use of systematic review processes and, therefore, qualify to advise and steer the review through regular consultation.

Table 1: Systematic review advisory panel

Panel Member	Role / Title and Affiliation
Myles Donnelly	Reviewer, PhD Student, Cranfield School of Applied Sciences
Dr Andrew Angus	Academic Supervisor, Cranfield School of Applied Sciences
Fiona Lickorish	PhD Supervisor, Cranfield School of Applied Sciences (CERF)

Search Strategy

Information Sources

Data sources for the systematic review are shown in Table 2 and include journals from citation databases and media publications. Manual searches through the internet were also carried out to locate further relevant sources such as government reports, theses and conference papers.

Table 2: Data sources used for the literature review

Data source	Description	
Citation Databases	Scopus (18'500 journals, 425 trade publications, 325 book series, 250 conference Proceedings): ▪ Science Direct ▪ EBSCO ▪ Web of Knowledge ▪ Proquest	
Specific Journals	ENDS – Environmental Data Services Energy Policy Energy Economics RPR (Review of Policy Research) Economics Management and Financial markets Journal of Environment & Development Ecological Economics Natural Resources Forum	
Media publications	**Printed:**	**Electronic:**
	▪ Times Online	▪ YouTube (UNEP – United Nations Environment Programme)
	▪ The Economist	▪ Oecd.org
	▪ FT	▪ Guardian.co.uk/environment/green-economy
	▪ TIME	
Reports	▪ HM Government (2011a) "*Enabling the Transition to a Green Economy: Government and business working together*" ▪ UNEP (2011b) "*Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication – A Synthesis for Policy Makers"*	
Bibliographic	A wide range of books relating to search terms and focus of review.	
Expert opinion	Information provided by industry and academic experts	
Thesis	Systematic Review Papers: (Tranfield et al., 2003; Cuevas, 2006)	

Search terms

Because of the ambiguity of the subject area, an extensive range of search terms and keywords were initially formulated from the scoping study and tested individually within the citation database to ascertain the number of returned articles. Those that returned no relevant articles were removed along with terms that returned the same articles. Both British and American spellings were considered to ensure all available literature was located.

The search terms outlined in the search string box were entered into the aggregators shown in Table 2 on April 2012. The following search string was developed without any exclusion criteria to net as many articles relating to green and eco-friendly economies and adjoining terms so as to conform to the wide reaching principles of a systematic literature review.

Search string used April 2012.

"Green economy"	"Circular economy"	"Green strategy"
"Green growth"	"Low carbon economy"	"Big society"
"Green deal"	"Sustainable economy"	"Carbon plan"
"Green economics"	"Ecological modernization"	"Ecological modernisation"
"Clean energy economy"	"Green jobs"	"Green business"

The search string returned 2'806 articles from Scopus and the terms were utilised as appropriate to generate relevant material for the review before screening. Coupled with the bibliographic search and other sources of information, the total amount collected for screening was 2'856.

Screening and selection criteria

The results from the search string were exported into a spread sheet that included information on the author, article title, year, source title, abstract and keywords. Using this information, studies were screened through a multi stage process comprising of selection by relevance and quality assessment, which identified the most appropriate and significant, high quality sources available at the time of the search. Studies that met the inclusion criteria would be included for review. Studies that conflict with the inclusion criteria would be excluded.

Search and selection protocol

The general scope of the review was to understand the concept and literature around green economies with a view to define the system, highlight challenges and gaps in the knowledge. The scoping study indicated significant interest in the field with little empirical evidence regarding the costs and benefits of transitioning to a green economy. Given the contemporary nature and limited amount of research, an open time frame was adopted so that all opinions and theories could be considered in defining a green economy. English only was selected given that the UK and EU publish all their material in this language. Again, so as not to eliminate any relevant sources of information, all disciplines where considered. The search protocol is outlined below in Table 3 and delineates the search into a manageable and focused process.

Table 3: Scope of the systematic literature review

Component	Description
Focus	Define and delineate the meaning and characteristics of a green economy, highlighting gaps in the knowledge
Time Frame	All dates within the available data sources
Language	English only
Discipline	Primarily social sciences but all literature is considered dependent on relevance to green economies and their characteristics

Screening and selection by relevance

Initially, the primary method for screening was to scan the citation title, abstract and keywords. The literature had to clearly indicate relevance to the subject of “green economies” or related search terms and show evidence of descriptive emphasis. At this stage the screening process reduced the collection down to 300. The second stage consisted of a more comprehensive evaluation of the title, abstract and text body. At this stage studies were included if they inform of key characteristics of a green economy or those thought to be closely related. Studies that are appropriate to review generally have pertinent research questions with a detailed and high quality methodology (Tranfield et al., 2003). At this point the collection was reduced to 141.

Quality assessment selection

The final stage in the selection process informs of a papers internal validity in achieving the author’s aims and objectives. Because of the contemporary and qualitative nature of the research on green economies, selection by quality assessment is challenging as qualitative studies are by nature non-standard, complex and open to the author’s subjective opinion and experience (Mulrow, 1994). The relevance of each individual source was assessed based on its quality and excluded if it failed to meet a minimum standard as judged by the author against a set of criteria outlined in Table 4.

Table 4: Quality assessment selection criteria

Variable	Description
Transparency	Are the aims and purpose of the study clearly stated?
Theoretical robustness	Is the study consistent with existing theory? Are the arguments compelling and justifiable?
Design	Is the design fit for the purpose/aims of the study?
Analysis	Are the methods used for analysis suitable and accurately described?
Conclusion	Do they follow on from the purpose and aims of the study? Are they significant within the context of economic systems?
Empirical relevance	Is the study useful within a real environment?
Overall quality score	Overall feel for the study?

Synthesising strategy for literature review

Descriptive analysis methodology

An overall picture and organisational structure of the field of enquiry is ascertained by generating descriptive analysis tables that inform of the relevant, homogenous or heterogeneous aspects of the review sources (Cuevas, 2006). Table 5 provides detailed information on the variables used for the descriptive analysis.

Table 5: Variables used for the descriptive analysis

Variable	Description
Type of study	Theoretical, empirical, quantitative, qualitative, mixed etc.
Methodology	What methods were used to explore the subject area?
Journal/Organisation	From where did the work originate?
Chronology	Year the sources where published?
Geopolitical focus	What is the geopolitical focus of the study?
Economic Orientation	What type of "green" economy does the study focus?
Theoretical framework	What are the main theories that underpin the study?
Rationale	What does the study aim to achieve?
Key findings	What are the main conclusions and research gaps?

Thematic analysis methodology

The final part of the systematic review involves an in depth analysis where the literature is broken-down into its principle components. Tranfield et al. (2003) state that the relevant components are then synthesised into a new arrangement that provides consensual or a non-confirmative narrative. Given the contemporary and qualitative nature of the subject area, a narrative synthesis will be adopted to generate the best evidence for defining a green economy and highlighting the gaps in the literature.

Descriptive Analysis of the review

Results of the systematic review

Using the search string terms, the citation databases outlined in Table 6 returned a total of 2’806 references with an additional 55 reports and publications from a manual search via the internet. The 2’856 references where then reduced to 300 through selection by relevance screening where source title, abstract and keywords were assessed accordingly. A more in depth review of the remaining sources was conducted to ascertain relevance which reduced the number to 141. The final selection process to ascertain quality reduced the sources for a final review to 41 thus rejecting 100 due to quality, irrelevance and non-access. The descriptive analysis is based on the remaining 41 references.

Table 6: Search statistics

Search Variable	Qty
Databases searched	5
Key words used	14
References returned (including manual search)	2856
After applying relevance selection criteria	300
After applying in-depth relevance selection criteria	141
Final review list	41

The 41 sources were categorised according to the primary orientation of the study, indicated in Table 7 below. 20 sources were classed as qualitative, 12 as mixed, 9 as theoretical and 0 were classified as primarily quantitative.

Table 7: Classification of study type

Study classification	Qty
Qualitative	20
Mixed	12
Theoretical	9
Quantitative	0

The methodological underpinning of all the studies included for review was largely descriptive and thematic as they followed a qualitative narrative in addressing their aims and objectives. Some studies did however tackle the issues with some statistical emphasis whilst some utilised futures methods to explore possible trends and scenarios. Table 8 shows the primary methodological emphasis of the studies included for review.

Table 8: Methodological orientation of the review sources

Study classification	Qty
Descriptive/Thematic	32
Descriptive/Thematic/Statistical	6
Descriptive/Thematic/Statistical/Scenarios	3

The following table (Table 9) outlines the origins of who published the review sources. With publications from a large number of high profile organisations and within high impact journals, the importance of the green economy is evident.

Table 9: Journal and Organisational origin of review sources

Journal/Publisher	Qty
UN	2
UNEP	2
OECD	2
HM Government UK	2
European Commission	2
International Journal of Green Economics	2
GAIA - Ecological Perspectives for Science and Society	1
Sustainable Europe Research Institute	1
Sustainability Science	1
Sustainable Development Commission	1
Scientific American	1
Problemy Ekorozwoju	1
OECD Observer	1
NIGP	1
Natural Resources Forum	1
Journal of Material Cycles and Waste Management	1
Journal of Environmental Policy and Planning	1
Journal of Cleaner Production	1
International Journal of Sustainable Development and World Ecology	1
Intereconomics	1
Indiana Business Review	1
Herald of the Russian Academy of Sciences	1
Global Environmental Change	1
Futures	1
Ecological Economics	1
Earth Charter Commission	1
Development and Change	1
Current Opinion in Environmental Sustainability	1
CDKN (Climate & Development Network)	1
BioResources	1
Annals of the New York Academy of Sciences	1
Aldersgate Group	1
Conference Paper	1
International Union for Conservation and Nature (IUCN)	1
European Environment Agency (EEA)	1
GAIA – Ecological Perspectives for Science and Society	1
Stake Holder Forum	1

Chronological results

No date restrictions were applied to the search, as the origins of all modern sustainable economic thinking were considered. The majority of references originate from between 2007 and 2012 with a single article before 2000. Figure 1 shows the chronological distribution of the sources used for review.

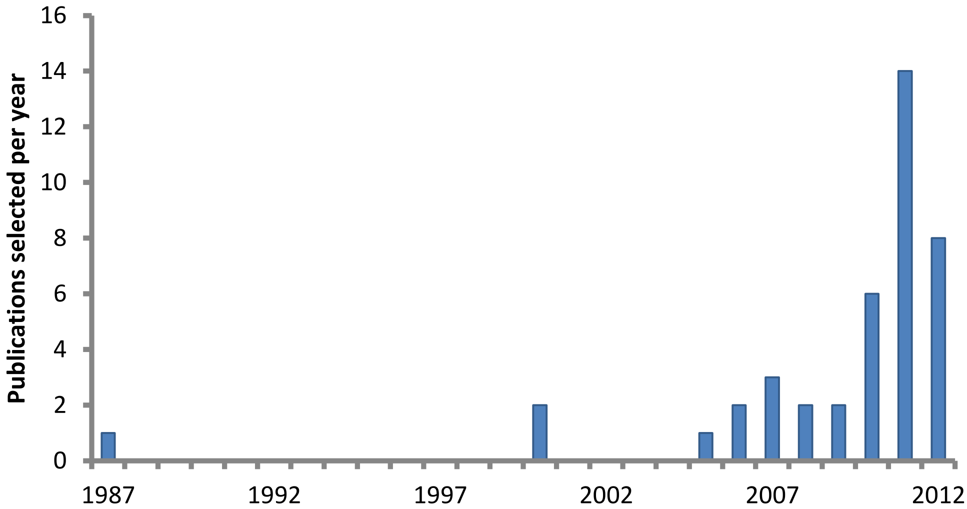

Figure 1: Chronological distribution of the review sources.

Geopolitical focus of the literature

The geopolitical focus of the review sources are indicated in Figure 2 below with a global majority of 30 (72%). The OECD, EU and UK each contribute 3 (7%) references to the review with China contributing 2 (5%). The results show a largely macroeconomic interest in the subject area.

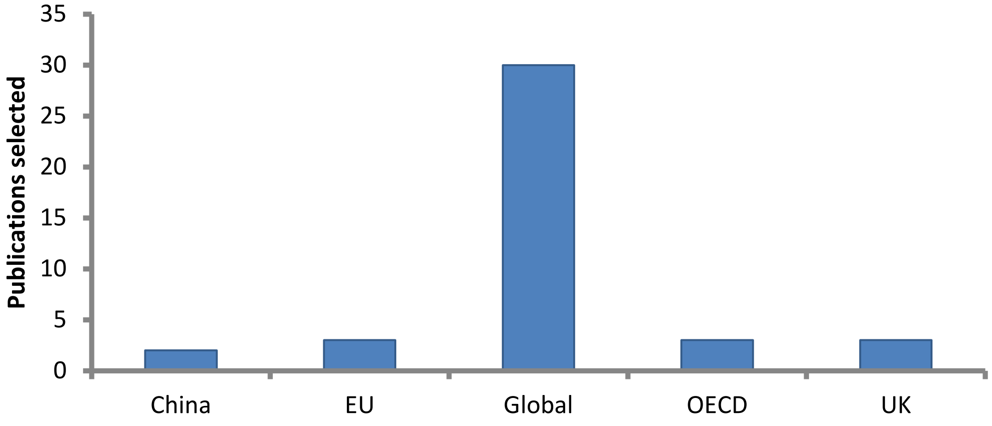

Figure 2: Geopolitical focus of the review sources by region.

Economic orientation of the review sources

The majority of sources included for review were primarily related to the green economy with 36 (88%) references. The remaining two economic themes consist of a circular economy and ecological modernisation that contribute 3 (7%) and 2 (5%) references respectively. Figure 3 below shows the subject focus of the review sources.

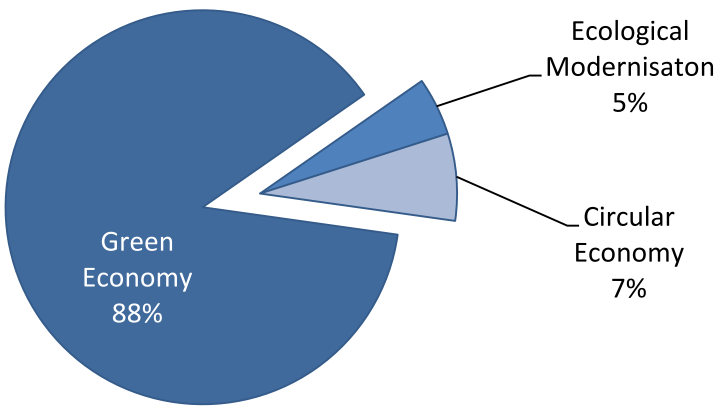

Figure 3: Economic orientation of the review sources by theme.

Theoretical framework of the review sources

The sources included for review consist mostly of sustainable development (SD) at 25 (61%). Contributing 5 (12%) is a mix of sustainable development and neoclassical economic (SD/NCE) theory. Futures and sustainable development (SD/F) along with Ecological Economics (EE) account for 2 references each (5%) respectively. The remaining theoretical mix consists of 1 (2%) reference with a theoretical mix indicated below in Figure 4. The theoretical mix in addition to those already indicated consists of ecological modernisation (EM), Keynesian, Pigouvian, Schumpeterian (K/P/S) theory.

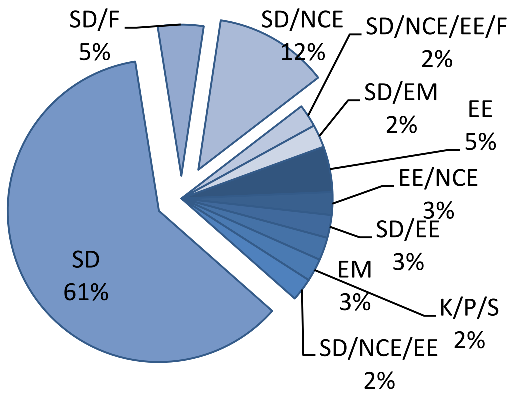

Figure 4: Theoretical mix of the sources used for review.

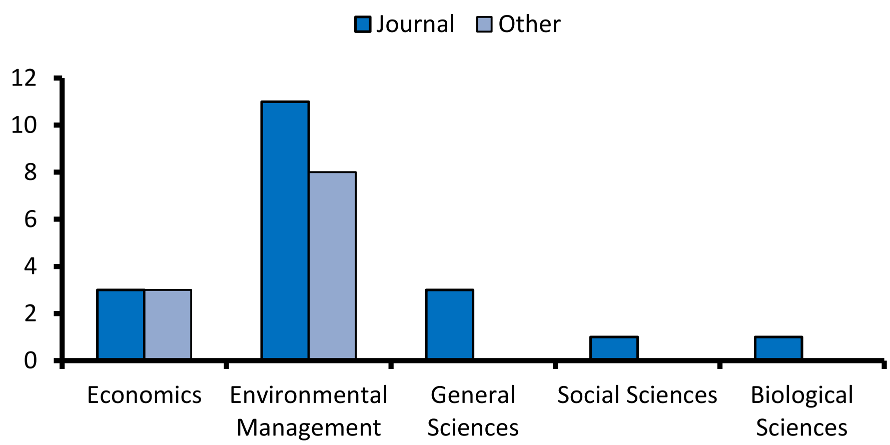

Figure 5: Subject area of publications included in the review.

Figure 5 highlights the subject area of the sources included within the review, highlighting a dearth of economic application.

Appendix B : Literature review of the green economy

Visions of a Green Economy

UNEP (2011) defined a green economy in terms of its outcomes, an economy "that result in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities". Based on its macroeconomic models, UNEP also suggest that a green economy would achieve greater rates of GDP growth than a "fossil fuel based, business-as-usual (BAU) economy", in addition to protecting natural capital and achieving development goals (Victor and Jackson, 2012). However, Victor and Jackson (2012) argue that the UNEP macroeconomic models are flawed in that their scenarios fail to differentiate between geographic regions and income inequality. A report by UNDESA (2012) highlights the prevailing conflict in how the green economy should be expressed with the eight definitions published in the appendix. Brockington (2012) refers to UNEP's expression of a green economy as a "general statement", implying a lack of critical detail with a perceived disconnect with reality in what the definition conveys relative to the economic status quo, as discourse has been likened to a "science fiction novel".

Despite this, the OECD and EC base their vision of a green economy on the UNEP definition. The OECD (2011) argues that: "green growth" is about fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. It is also about fostering investment and innovation which will underpin sustained growth and give rise to new economic opportunities". The European Commission (2010) defined a green economy as "a smart, sustainable and inclusive economy delivering high levels of employment, productivity and social cohesion."

Csaba (2010) argues that the definitions and strategies set out by the EC and OECD are mission statements to set the scene for policy makers rather than operational documents. The OECD (2011) also adds in their "Towards Green Growth" report, that "there is no one-size-fits-all prescription for implementing strategies for green growth". By focusing on the outcomes, the above definitions fail to explain the mechanics of achieving a green economy that is distinct from the business-as-usual (BAU) system (Brockington, 2012).

Brand (2012) states that the issues around adopting a green economy are not new as like sustainability discourse the visions and strategies remain contradictory to others within the same framework. Pochet (2010) highlights some of the contradictions in achieving EU2020 (European Commission, 2013), an example of which is the importance of utilising technology in the protection of the environment but intellectual property rights prevent its dispersion and consequent effectiveness. Conflicts are largely associated with growth and the underlying production and consumption habits ingrained within society, all of which are covered in the following section.

Economic problems

Growth and environmental degradation

Economies and the factors within are part of a large, autarkic, complex and organic global system. This system is bounded by the Earth's life support system and natural capital and must, therefore, be appropriately reflected within green economic strategies (Kosoy et al., 2012). Particularly as, despite the majority of the population being well-fed, clothed and housed, new demands continue to be created. New technology, fashions, and adaptations to existing products help drive demand to unprecedented levels beyond the actual "needs" of society (Nellis and Parker, 2004). Daly (2005) and Jackson (2009) imply that such growth has reached a "futility limit" where additional growth does not necessarily increase utility. In this circumstance, the challenge is to decouple development from the unsustainable use of natural capital (UNEP, 2011a), as most of the current BAU material flows are wasteful and unsustainable (Ellen MacArthur Foundation, 2012). Victor and Jackson (2012) argue that growth must be curtailed if environmental degradation and social inequality are to be collectively reduced; contradicting UNEP (2011b), which states that a green economy should pursue growth. If society continues to rely on virgin materials for economic growth, then environmental degradation, ecological scarcities and social inequality are thought difficult to reduce at the same time (Jackson, 2009). In contradiction to this however, UNEP (2011b) implies that the green economy can only exist with ever-increasing consumption and market expansion.

The development of a green economy therefore needs to address these contradictions (Reardon, 2007). Figure 1 below shows a generalised map of the spill-over impacts that occur with material flows and economic activity.

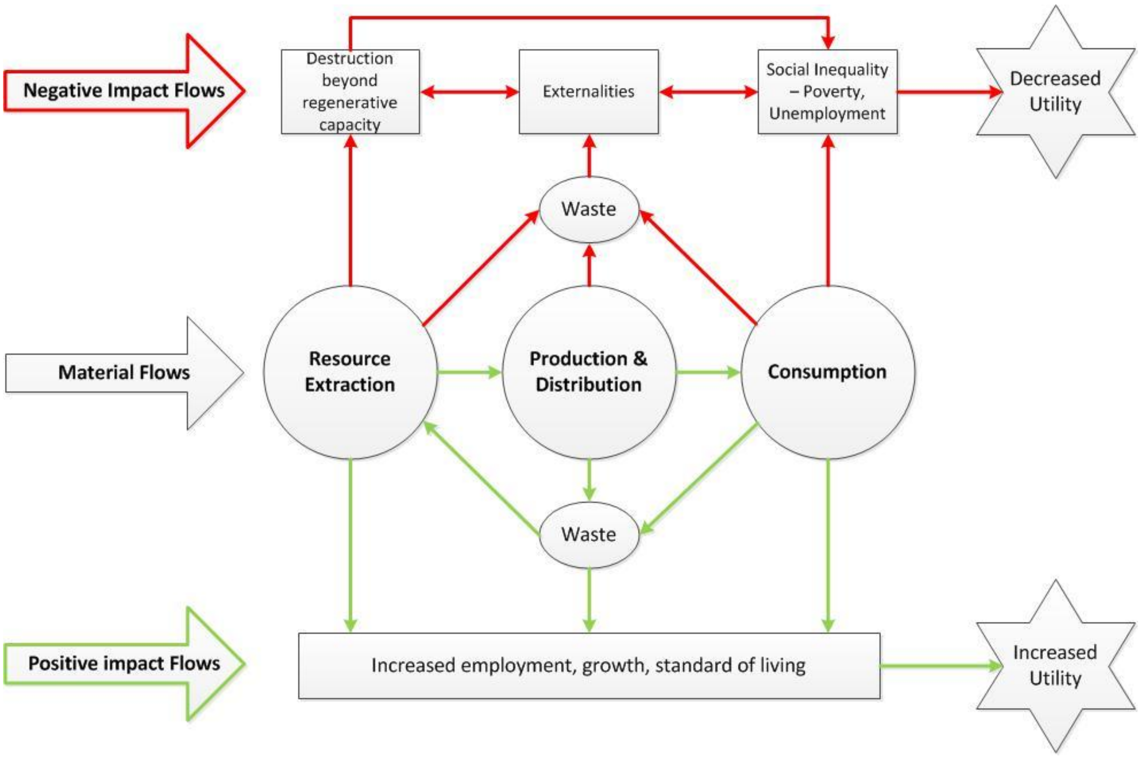

Figure 1: Causality schematic showing the trade-offs and co-benefits of economic activity (developed by author).

The spill-over impacts in Figure 1 represent the trade-offs associated with growth and negative externalities, which affect utility and well-being (Brand, 2012; Pochet, 2010; Reardon, 2007). This point is also demonstrated by the link between GDP per person and the level of waste produced per person within a range of countries (Figure 2).

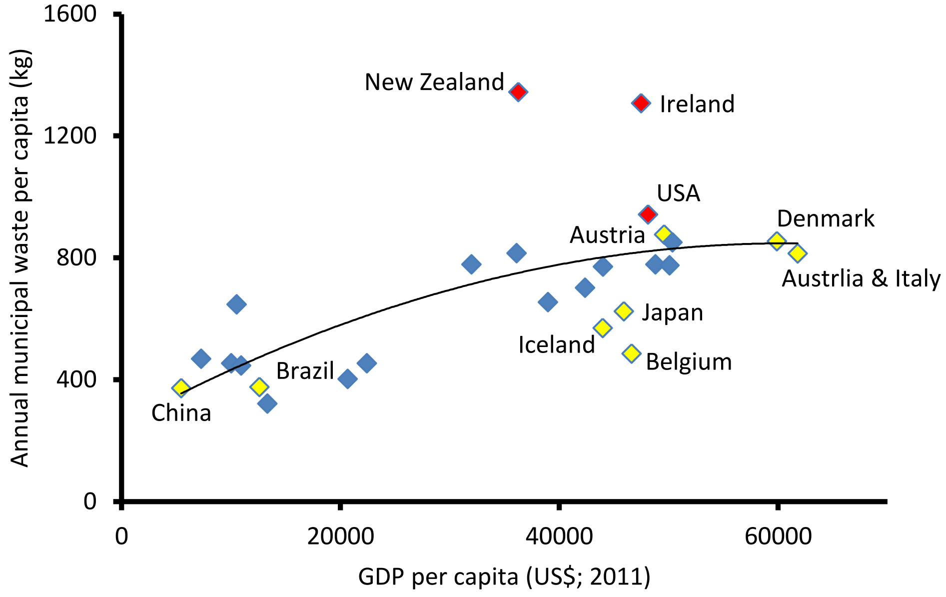

Figure 2: At a national level does a) mean GDP per person determine the level of municipal waste per person, or b) does the level of municipal waste partly determine GDP? (GDP from World Bank, 2013; municipal solid waste from World Bank, 2012)**. Data from selected countries.**

Figure 2 highlights New Zealand, Ireland and USA as having high levels of GDP and municipal waste production per person. Japanese, Belgian and Icelandic citizens, although having a comparable GDP, produce around half the amount of municipal waste and therefore could serve as a benchmark for material efficiency. Figure 2 explains why it is unsurprising that growth strategies adopted by emerging and developing economies result in high levels of material consumption and subsequent waste production (UNEP, 2011a). Published research on Japanese municipal solid waste provides evidence of the existence of an environmental “Kuznets Curve” at the micro level with the assistance of government intervention (Hossain and Miyata, 2012).

As indicated by Figure 2 the issues associated with growth pose significant challenges. Poorer countries may see greater resource use as worthwhile for economic and social progress thus closing the gap between the rich and poor (Bowen and Fankhauser, 2011). Advanced economies are prepared to accept greater relative financial and economic costs to protect the environment and increase social welfare (Victor, 2010). This outlook represents a Kuznets Curve scenario where poorer countries adopt policy targets and instruments that oppose sustainability discourse in an attempt to mimic the progress achieved by advanced economies (Kosoy et al., 2012).

To address the issues associated with wasteful production and consumption markets are the suggested as a means for altering these behaviours (European Commission, 2011). These market mechanisms are designed to modify price signals that internalise externalities (Bowen and Fankhauser, 2011) but these price movements are potentially problematic in the supply of essential commodities and common goods (Dasgupta, 2010). Therefore, as Ackerman and Gallagher (2000) suggest, if the market is a blueprint for the green economy then the prices must be right or the green objectives will fail as recent evidence suggests in the EU Emissions Trading Scheme (Pielke, 2013). Brand (2012) argues that the market alone is insufficient and Kosoy (2012) states also that the governance for common goods should be controlled by non-market mechanisms thus protecting them from the insatiable logic of the market. This view is also supported by OECD (2011).

Social equity and inequality

One of the most pressing challenges within green economic discourse is social inequality (Jackson, 2009). Brand (2012) argues that the global pursuit for economic growth hinders social equality. For example, Kosoy et al. (2012) states that inequality creates a negative spiral that intensifies status competition that motivates excess consumption, population growth and conflict, and thereby greater inequality. They, therefore, argue that a green economy can only be fully realised if poverty is significantly reduced and wealth is more equitably distributed (Jackson, 2009). Despite improvements, modern social classes are still determined by wealth that gives greater opportunity for access to resources and social mobility. These relationships are strongly supported by data from the World Economic Forum (2013) Global Risks report.

Inequality can also bring tensions that make a person more self-serving and individualistic, which then inhibits solutions that are seen to benefit the wider community (Jackson, 2009). This is because of the perceived disparity between social classes where the poorer in society are less willing and as mentioned, able to contribute to green initiatives for fear that someone else will receive all the benefits (Kennet and Heinemann, 2006). A successful transition to a green economy could be undermined by issues of this nature. Adams and Jeanrenaud (2008), therefore, argue that priority should be given to eradicating absolute poverty where people are unable to meet their own life supporting needs through the provision of food, shelter, healthcare and the means to progress their lives.

Bringing the world's poorest into more equal status would also provide global opportunity for trade and broader economic development, benefiting the populations that live close to the poverty line (Dittrich et al., 2012). However social mobility and population also poses significant challenges as equitable distribution of resources could accelerate the decline of the natural capital base (Daly, 2005). A report to "The Club of Rome" (Kapitza, 2006) highlights that increasing populations and social development have a negative impact on resource depletion and environmental quality. For instance, increased populations with increasing disposable income generate more greenhouse gas emissions from the current market for production and consumption that extend beyond the sequestration rates of the planet (UNEP, 2011a). This also supports OCED (2011) suggestions that while technology and innovation serve as an essential tool in the successful adoption of a green economy, the targeting of business and consumer behaviour must be at the forefront of this emerging system.

Economic solutions

The green economy & the circular economy

Industrial ecology and the circular economy provide a way to address the tension between growth and resource use. Building on industrial ecology theory, the "circular economy" is being promoted as a way to address the wastefulness of current linear models (Li and Wang, 2010). This organised system of material throughput in its most basic form is underpinned by the self-explanatory "three R's" principle of reduce, reuse, and recycle (Yong, 2007)

China has integrated the concept of the "circular economy" into its current five year plan with a focus on a progressive closer-loop, cleaner and more efficient value chain with high levels of waste recovery thus minimising environmental degradation and maximising the longevity of resource use (Li and Wang, 2010). The process requires collaboration across sectors. For example, Chinese company, "Guigan Sugarcane" has found a market for its waste products. Their filter sludge is used as an alternative fuel in the cement industry and molasses in the production of alcohol based goods (Ellen Macarthur Foundation, 2013). Agents are, therefore, motivated to work together to utilise waste as raw material inputs for different production processes across the economy (Andersen, 2007). Those resources that are unfit for reuse must be recycled and those that are unfit for recycling must re-enter the natural system safely (Su et al., 2013).

The consumer is also integral to the success of a circular economy by complying with the 3 R's, reducing un-necessary consumption, reusing and then recycling products depending on usefulness or value of material content (Yong, 2007). The circular flow of resources is supported by government instruments and the cultural foundations of a nation (Mathews, 2011). Manufacturers also have responsibility for increasing the working life of consumables so more can be achieved with less, freeing productive capacity for other economic uses (Victor, 2010). However, longer-lived products are also likely to carry a higher price tag thus making them less affordable (Barbiroli, 2011). Figure 3 represents a basic example of the general flows within a circular economy. The detailed processes and exchanges within recycling (r) and the flows associated with consumption (C) (reduce and reuse) are what drives the circular economy in the form of industrial ecology and behavioural synergies (Li and Wang, 2010).

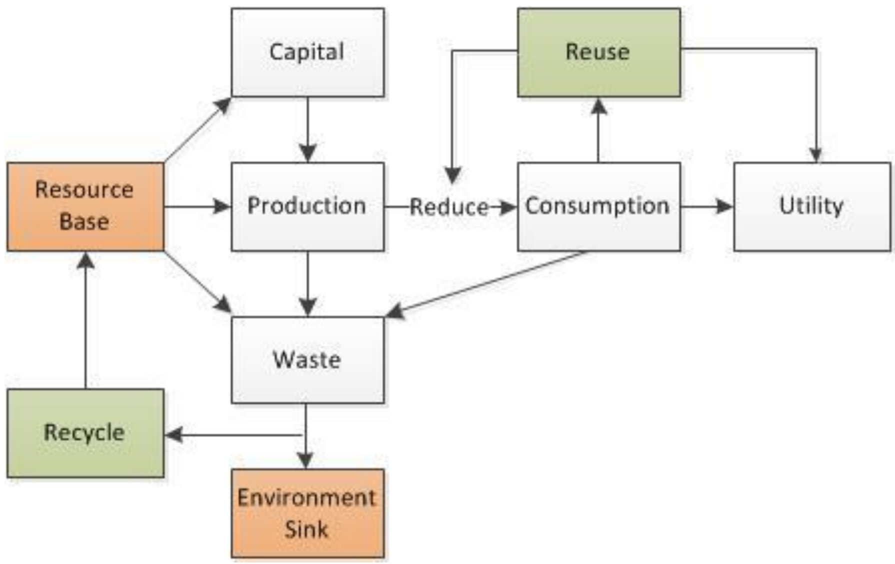

Figure 3: A schematic representation of a macro circular economic system.

It is clear that a circular economy saves materials and energy while increasing utilisation rates relative to the BAU economic model (Andersen, 2007). The circular economy is also believed to foster the development principles of quality service provision, rather than a virgin material based production system, and it provides greater opportunity for environmental protection and for social development such as through new areas of employment (Li and Wang, 2010). For example, a circular economy or industrial ecology approach promotes localised production and distribution services that can bring positive spill-overs such as raised employment and reduced emissions through decreased logistical needs (Reardon, 2007). The consensus within the literature is that a circular, green and sustainable economy operates near to or continually moving towards zero waste. The consumers' appetite to raise living standards through consumption of material resources is met by the principle of the circular economy (World Bank, 2012).

A move to a circular economy could have negative impacts on international trade because of "green barriers" (Su et al., 2013). A circular economy also cannot endlessly recycle as there will remain thresholds (which will vary with product) beyond which recycling provides little to no net benefit (Andersen, 2007). The adoption of such systems will also only occur if the private economic gains are financially viable (Ellen MacArthur Foundation, 2012; Andersen, 2007). Jackson (2009) also argues that re-circulation of resources is just a short term answer to the resource conundrum as continued growth in the global population and consumption rates will still inevitably exhaust resources.

Despite these challenges, the consensus is that the transition from a producing to a re-producing economy (with an emphasis on the waste sector) is at least initially integral to the success of a green economy (UNEP, 2011b). It is of particular importance to developing economies, such as China, that require higher levels of material throughput (Yong, 2007). The increase in service based systems could also improve resource use with positive impacts on job creation and income equality (Dittrich et al., 2012).

Innovation and technology

Much of the current discourse assumes that technology will solve the economic, ecological and social difficulties of the current system through increased efficiency and new markets (Department of Economic and Social Affairs, 2011). It is hoped that such changes will uncouple the links between growth and natural capital (UNEP, 2011b; Dittrich et al., 2012). Langhelle (2000) states “the accumulation of knowledge and the development of technology can enhance the carrying capacity of the resource base”.

However dependence on technology and innovation to correct future market failures is a high risk speculative strategy (Jackson, 2009; Bosselmann et al., 2012). Gains achieved through efficiency can result in lower prices that contribute to increased supply and demand (Victor, 2010). Furthermore, in some sectors, efficiency gains have been achieved by an increase in resource input to decrease labour factor costs (Ellen MacArthur Foundation, 2012). Brand (2012) argues that the application of new technologies will result in the demise of resource intensive industries that fail to adapt. Although changes in technology can also result in unemployment and the need for retraining (Fulai et al., 2011), technology is an essential part of the solutions to our economic, environmental and social difficulties (Gurtowski, 2011).

Barbiroli (2011) provides a qualitative account of many of the costs and advantages in transitioning to a green economy. Higher prices for environmentally harmful goods encourage the development of substitutes, production alternatives and technologies that bring efficiency gains. An example of a shift in production and consumption caused by innovation is the development of virtual networks and digital services such as electronic e-readers and mobile technologies that contribute to the de-materialisation of traditional paper derived industries (Brand, 2012; Dittrich et al., 2012; Barbiroli, 2011). Technology can also provide significant social benefits. For example, renewable energy technologies can lift people out of poverty and promote health and well-being (Reardon, 2007; Department of Economic and Social Affairs, 2011). This is a fundamental target of the green economy, to generate energy with diminishing impact on the environment.

Governance – policy targets and instruments

Brand (2012) and Ban Ki-moon (2010) argue that the success of the green economy depends on governments having integrated political strategies that foster sound policy and investment across the three pillars of sustainability. The implication is that the green economy depends on government interventions. For instance, the EU emissions trading scheme (ETS) or the Individual Transferable Quota (ITQ) system that tackles open access to marine resources of New Zealand are examples of long run, instruments that work in conjunction with markets to achieve policy targets (Daly, 2005; Yang et al., 2013).

The EU ETS has recently (2013) run into trouble regarding the downward and ineffective price of carbon (Scott, 2013). This coupled with diminishing support from the European Parliament who indicate a preference towards economic growth and energy price stabilisation (Pielke, 2013). The ITQ fish quota system that is represented across the globe has however shown evidence in New Zealand and Alaska of successfully conserving and regenerating targeted marine species whilst also improving profitability (Yang et al., 2013; Earth Island Journal, 2013). This system also has inherent economic risks as evidence has shown that small-scale fishermen in New England, USA are struggling due to unfair quota allocation (Earth Island Journal, 2013).

The UN Secretary General, Ban Ki-moon (2010) therefore emphasises the importance of governance for propagating the adoption of a green economy in a similar way that the current BAU economic system makes use of tax and subsidy regimes. India for example, set a target to increase its global share of renewable energy by 2012 to 10%. Reforms that included tax exemptions and fines motivated the Indian economy to achieve its policy targets; raising India's renewables sector to the world's fourth most attractive in terms of investment (Porfir'ev, 2012). UK Council recycling programmes are a good example of localised integrated policies that have wide reaching benefits across a range of environmental, social and economic issues (HM Government, 2011c).

Policies are in part based on the precautionary principle concept that is designed to place the responsibility of providing proof of impacts on the proponent rather than society (Reardon, 2007). With the precautionary principle as its underpinning, green policies and mechanisms work to prevent foreseeable impacts, protecting future generations and the environment they will inherit (Kennet and Heinemann, 2006). However, the same precautionary thinking processes are also applied to protect high yielding economic activities that are harmful to the environment thus preventing change, "the economic precautionary principle" (Reardon, 2007). An example of such economic precautionary behaviour is the recent decision by the European Parliament to not postpone the issuing of CO_2 emissions permits because of a faltering economy and high energy prices (Pielke, 2013). The following table provides a basic overview of the risks associated with choosing certain policies according to the state of the world.

Table 1: A risk/reward matrix for the outcomes of policy orientation according to the state of the world.

	State of the World	
	Optimists Right	Pessimists Right
Optimistic Policy	High	Disaster
Pessimistic Policy	Moderate	Tolerable

If an optimistic policy option is selected and the optimists (brown economy) are right then rewards are high but if they are wrong then irreversible disaster. If a precautionary or pessimistic policy is chosen then optimistic (brown economic) gains are moderate and if wrong then the issues are tolerable and can be mitigated. This captures the essence of green economic policy in tackling issues such as climate change and bio diversity loss.

Evidence therefore suggests that green policies can have negative spill overs. For example stringent green policies in some advanced countries can result in industry moving to pollution havens in the developing world (UNEP, 2011b). Actors that know the future is difficult will make the most of the present, undermining efforts to reduce impacts and mitigate harmful changes to the biosphere (Bowen and Fankhauser, 2011). The difficulties associated with rare earth mineral supply and Chinese control are an example of such manipulation and protective policies (Humphries, 2010).

Strategies that are perceived as good or bad (depending on point of view) will reflect the economic objectives of most governments that are typically high economic growth, full employment of labour, natural and manmade resources, low inflation, and a positive balance of payments with a stable currency (Nellis and Parker, 2004). The UNEP (2011b), OECD (2011) and the EC (2010) argue that a green economy can deliver these objectives. Despite the technologies and mechanisms that will enable a green economy, governments currently lack the political will to drive it forward and choose instead to favour economic stimulus (Kennet and Heinemann, 2006; Happaerts, 2012; Schindler et al., 2011). A government will utilise a range of controlling or incentivising methods within an economy that promote desirable or suppress harmful activities that hinder the achievement of the mentioned objectives (Jackson, 2009).

However, governments will typically intervene in market-based economies to ensure the rule of law and to address issues of equity (e.g. welfare support; education, health care, inflation), and the failure of the market (e.g. natural monopolies) (Nellis and Parker, 2004). Victor and Jackson (2012) argue that an economy can only be labelled as green if both social and environmental issues are tackled collectively (Victor and Jackson, 2012). Kosoy et al (2012) and Csaba (2010) identify five steps to securing a green economy. These are:

1. Acknowledge that the economy exists for the purpose of human well-being steeped in the values set out by the Earth Charter (2000).
2. Technology must be coupled with a reduction in demand and not as a driver to stimulate further consumption.
3. Acknowledge that ecology, economy and society all operate within one inter-dependent system.
4. Measurement to assess levels of well-being must be consistent with the goals and values of the new economic system.
5. Acknowledge and alter the perception that the economic status quo is the best means to proceed given the historical failures that have prevailed.

Beyond the design and implementation of economic strategies, to effectively measure the success of the green economy and provide a basis for sound decision making at the macro-level, ecological economics provides a useful perspective (Kennet and Heinemann, 2006). This most constructive contribution in defining the green economy is the relationship between GDP (scale of economic growth) and impact per unit of GDP (also known as intensity). An economy where Impacts decreases disproportionately faster than GDP increases is considered to be “green” whereas impacts that decline slower than GDP increases are typical of the BAU economy (Victor, 2010).

The green economy – How do we get there?

Mathews (2011) suggests that the BAU, fossil-fuelled economy is already “greening” and that a green economy will be the default state by mid-century. Stern (2007) likens the transformation, or evolution to that of the industrial revolution or the free market liberalism and financial deregulation during the Regan and Thatcher years. This is an expression of evolution, based on the idea that the economy is an innovation algorithm that is bound by differentiation, selection and amplification (Beinhocker, 2007). In some cases this is in stark contrast to the green economy literature, which views the green economy as a distinct alternative, rather than something that the BAU economy will evolve into (HM Government, 2011a).

Based on the ideas of evolutionary economics, which is gaining traction in the economics literature, an economy is dynamic, active and always in a state of flux as determined by the environment, the actors, and their interactions (Beinhocker, 2007). Therefore, the economic and social environment is constantly changing either by design or through natural “mutation” (Dale, 2012). Acclaimed economist Thomas Malthus (1798) made reference of a more specific nature regarding population control where preventative checks should be implemented (design) or positive checks such as famine, war or plague will prevail. The preventative checks could be viewed as the implementation of the green economy and the positive checks are the result of continued BAU economic activity. Either way, the agents and factors within must respond to such changes or face the risk of failure at some related point (Jänicke, 2008). Employment opportunities lost from polluting and resource intensive industries make way for more efficient and “greener” sectors (Mathews, 2011). This is the evolutionary theory in practice. Agents within the economy help set the conditions for which evolution occurs.

Current definitions of the green economy fail to communicate the complex, interconnected and inter-dependant nature of all systems within the earth’s boundaries as the OECD (2011) conclude in their “towards green growth” report that the economy, environment and society can no longer, each be considered in isolation (Girouard, 2010). This is because economic systems are non-linear with many interdependencies, spill over and feedback effects that must be organised and prioritised in any future system and decision making framework (Beinhocker, 2007).

Ecological modernisation

A key issue in the evolution of the BAU economy to a green economy is the designation of the limits of sustainable resource use and the establishment of robust objectives (Lannoo, 2010). For example, European governments have agreed specific targets for greenhouse gas emissions in 2050, which in turn has led to the establishment of the EU emissions trading scheme (ETS) (European Commission, 2011). Hence European companies must adapt to these regulations (Mathews, 2011). Some research suggests this form of steering can result in positive impacts to core business operations and actually increase productivity (Porter and van der Linde, 1995). However, it is also possible that the targets become politically unacceptable, and the whole process can be quickly undermined, as demonstrated by the recent refusal of the European Parliament to address the current over-supply of carbon emission permits (Pielke, 2013; Scott, 2013)

This type of adaptive policy is known as “ecological modernisation” (EM) and is based on the Porter hypothesis (Porter and van der Linde, 1995), where stringent environmental policy is thought to drive innovation and even provide economic benefits through gains in efficiency, increased productivity and access to new markets (Jänicke, 2008). Ecological modernisation is viewed as a necessary function within a green economy but is widely regarded as being part of a range of policies required to achieve a green economy (Langhelle, 2000; Jänicke, 2008). EM is designed for commercial and localised issues, but is not designed to contend directly with social injustices and wider environmental issues. Thus, EM fails to tackle issues such as global biodiversity loss or global warming that provide negligible commercial advantage (Langhelle, 2000).

There is overwhelming consensual evidence of the global economies reliance on natural capital. Jackson (2009) highlights that the BAU economic model consists of circular flows of man-made and natural capital with the drive to increase productivity central to its core. This is in itself is a contradiction where the need to increase productivity harms the resource base (and ultimately GDP) upon which it depends. The financial sector among others is a key mediator within these flows (UNEP, 2011b). Therefore, implementing systems as a primary means of reallocating public and private finance away from environmentally damaging practices is essential. Mathews (2011) suggests a revised criterion for investments that includes both ‘credit’ and ‘eco’ worthiness, where positive and negative externalities are identified to determine the merit of an investment; highlighted by Green Bonds and Climate Bonds that give investors an ethical choice.

Discussion - a framework for a green economy

From the systematic review it is clear that there exists an imbalance of knowledge that is conveyed from varying sources. The majority of green economy focused texts are non-economic and significant numbers are non-academic. The economy is certainly an issue of multiple disciplines but central to its core is Economics and research should reflect this. The work by UNEP and other non-academic sources is undoubtedly profound in theoretical terms but is ambiguous as to what constitutes a green economy relative to the BAU system. Therefore, at best this work offers a starting point for designing a green economy.

There is also a lack of studies that have empirically investigated mechanisms for transitioning to a green economy. There are however a range of concepts that this study has proposed could be useful in this respect. For instance, circular economy and ecological modernisation are currently being adopted in a global patchwork of piecemeal ventures. For these models to work, they must fit the cultural, economic and natural characteristics of the adopting economy or region. For instance, China's adoption of the circular economic strategy in its current five year plan fits well within their industrialisation strategy, cultural and social belief structure. Private ventures that are driven by ecological modernisation are also being undertaken. For example Apple is addressing their environmental impact across their business through solar farms that power data centres and supply chain adaptations that increase efficiency and utilisation of logistics (Thomson Reuters Foundation, 2012). This increased efficiency has reduced their exposure to energy markets and raised productivity by reducing waste and therefore costs (smaller packaging). As the main goal of economic activity is to raise living standards and enhance welfare then this patchwork of green activity needs to be expanded.

Therefore, to sustain growth and living standards by maintaining enough material through-put, the green economy will re-circulate resources (re-use and recycle) within the supply chain. In the longer run however the greatest challenge is to significantly reduce all throughputs by altering consumer and industry behaviour. This may be achieved by a move from products to services. For instance, Amazon and Google sell music, print and other forms of entertainment media digitally as a service, rather than a product. However, where products are made, the goal should be for them to be durable, premium products that can be reused and deconstructed easily and effectively for recycling.

To set the scene, the literature is largely suggestive that transitioning to a green economy requires significant government intervention, both in terms of setting stringent environmental policy, but also regulating financial markets so capital is allocated to those projects that deliver the most in terms of social, economic and environmental gain. This may require new institutions to be designed to achieve effective intervention. For example, the literature fails to convey the mechanics of a more equitable welfare system that reduces inequality and improves cohesion within society. Reform of the welfare economy would serve to establish and support this much needed cohesion. A mixture of benefiting society through an equitable health, education and welfare system, while demonstrating that tax payers receive a good return on their taxes is essential to the success of the green economy.

If governments are to set in place the preventative checks that bring about evolutionary change towards a green economy then the conflict between these measures and existing market "forces" must be addressed. Contrary to what the UK government (2011a) have stated, it therefore seems unlikely that the green economy could be adapted as an entirely new system distinct from the BAU economy. History suggests that an economy evolves and the green economy is likely to be a possible future evolutionary step. This step will be based on the principles of mixed private and public ownership guided by government regulation, fiscal policy, judicial public sector procurement that favours socially beneficial development and a strong emphasis on green finance.

The evolution to a green economy may require a minimum level of GDP/capita, in the style of Kuznets curves. As Figure 2 represents the existence of the environmental "Kuznets Curve" at the macro level; some economies therefore currently have insufficient GDP/capita to decouple growth from natural capital and they should be afforded time to develop their economies. The eventual decoupling of consumption and natural resource depletion may be achieved through a knowledge based, or service economy supported by renewable sources of energy, closed loop supply chains, sustainable production of resources and more virtualised consumables and services. Traditional industries that are resource intensive, environmentally and socially harmful will either adapt to changes initiated by the market and governments or disappear.

To propagate this new system, the flow of financial capital is essential in the development and progress of the concepts outlined within this review as it generates growth and incomes on the supply and demand side of an investment. Despite this evidence, it remains to be seen whether these changes can be achieved through market forces alone. The growth in ethical investments and “green” indices such as the FTSE4Good are indicative of the desire to shape tomorrow’s world whilst providing the opportunity for economic gain. The literature on ethical and green index investment performance largely focuses on a period of unprecedented growth (1997-2008) with little to no evidence of performance during the recent recessionary period (2008-2013) and other periods of shock. Research has however shown that family run firms and firms that adopt the similar operative principles (Nestle) often outperform non-family run, performance focused firms due to an emphasis on resilience. Do green firms follow the same trend due to their inherent structure and outlook? Given that fund managers and investors alike are concerned with the resilient performance of their portfolios then the question remains how resilient are investments environmentally and socially screened like the FTSE4Good?

The management and economics literature use resilience as a generic term and therefore fail to precisely convey the difference between the range of interactions and reactions to a shock or event, namely stability, resilience and resilience as individual concepts. The literature on “engineering” and “ecological” resilience does however provide this much needed distinction that can be applied to economics literature to determine the metrics of a firm’s resilience effectiveness. Therefore a firm’s ability is reflected in its value as this is primary reason for building resilience based strategies.

The organisational examples provided (Apple, Amazon, Kenco) represent adaptability which is a key component of business resilience and is thought to be inherent to the green economy and green firms. Economic resilience encompasses all the theoretical concepts that derive from physics, ecology and engineering, depending on the context of the affected system. Firms sought to maintain a stable business that is resistant to shocks (engineering resilience) but also must be adaptable and able to take advantage of new operative domains (ecological resilience). Therefore “green” firms are thought to be resistant and resilient to economic shocks if they are able to operate within the limits of the environment whilst also maintaining effective output and growth. This drives the need for efficiency where outputs are achieved with diminishing material inputs decreasing exposure to natural resources and all events that effect their determination. The speed at which a firm reverts back to normal value and beyond could represent a significant measure of resilience. It is also evident that industries that are perceived not to be “entirely green” can receive significant economic benefits by adopting green strategies such as those outlined in the Kenco (2013) and Rainforest Alliance example (2013).

Despite this the majority of research indicates that inclusion in green indices does not affect firm behaviour and that investors do no better or worse with or without these types of indices. That said if the resilient characteristics of family run firms determine performance during periods of economic difficulty this could point to significant risk, reward trait that might exist within green firms or firms that show high levels of ESG performance.

All of the evidence that implies this benefit is theoretical with no empirical study to support this claim. Given that there are existing investment frameworks that support green investment then they are of limited benefit if the firms within are unable to operate effectively throughout economic shocks whilst delivering on green objectives. There is a lack of academic literature on the resilience of “green” firms despite the repeated indication that the green economy and complimenting firms are more resilient to shocks. All of the literature that focuses on UK sustainability indices for instance is based on accounting and the associations between profit and loss with little to no reference to external causality.

Evidence also suggests that despite the theoretical attractiveness of the green sector there is still a significant gap in funding. This is due to the belief that more traditional stocks will generate better and less risky returns despite repeated discourse stating that socially responsible investments (SRI) offer the safest and most reliable place to invest but this has not been unequivocally proven.

In light of this literature review and in concordance with the neo-classical definition, this study offers a new definition of a green economy and suggests metrics for measuring progress. A green economy could be defined as: “the allocation of resources that enables effective production, distribution and consumption to best satisfy society but within limits that do not compromise the environment”. For pragmatic purposes this definition is an elastic expression where the adopting economy can utilise a useful metric in determining the success of a green economy that fits within the context of their economic, social and environmental characteristics. For example, given that GDP plays such an important role in the measurement and subsequent motivation of an economy then, as the literature highlights the use of the scale and intensity approach appears to be the most appropriate measure of how successful a specific economy’s green systems are operating at the macro level. Therefore, an economy whose issues centre on developing cleaner technologies in the supply of energy (low-carbon) would utilise a CO_2 per unit of GDP as a measure of green success. The “effective” element of the definition hints at resistant and resilient abilities within the economy along with overall performance that is linked to social satisfaction. This must all be achieved within ecological limits, where the rate of use is equal to or below the rate of regeneration and assimilation.

Conclusion

The green economy marks the next possible evolutionary stage of the global economy, where the mechanisms outlined in this review could be adopted to raise living standards and enhance social well-being without compromising natural and social capital. The BAU economy is thought by some to be unsustainable in terms of its use of natural capital. Therefore focusing a designed evolution to a more sustainable system rather than reacting to external shocks could provide greater long run economic and social benefits. Given that finance is such a powerful tool in influencing behaviour that generates significant desirable returns then evidence of benefits from sustainable investments are essential if the green economy is to succeed.

This literature review found that the habits of society and business in conforming to green initiatives without external pressure are the most challenging. Therefore, the green economy will evolve through the conditions created by central government and market pressures. As Thomas Malthus said, we can adopt the preventative checks now and continue to thrive or wait for the positive checks and risk everything.

This study proposes that the green economy could be underpinned by frameworks embodied in the circular economy and ecological modernisation ideas that provide resilience for businesses and the wider economy but government strategies that foster socially desirable growth are significant. Markets are essential in defining the choices made by consumers that foster a green economy and therefore proof of benefits in the pursuit of green pathways is needed to support this path. The flow of capital is therefore a key requisite in the development of a green economy where investment choices are made recognising social, economic and environmental impacts and benefits rather than just financial gain.

10 Electronic appendices (Accompanying DISC)

IMPORTANT NOTE: See accompanying disc for the following restricted data (property of FTSE4good with access rights for Myles Donnelly only)

Appendix C : Method testing (Folder)

C.1 Accounting – Enterprise value, ROE, ROA

C.2 CAPM – Sharpe, Traynor and Jenson ratios

C.3 Event study – Market model and constant mean return

C.4 Event study – Constant mean return model

Appendix D : Excluded event examples (Folder)

D.1 Japan earth quake index event study

D.2 Horse meat scandal index event study

D.3 Mumbai attacks index event study

Appendix E : Index price data (daily stock prices)

Appendix F : Firm price data (daily stock prices)

Appendix G : Event study ranking & descriptive stats.

Appendix H : Index event study results

Appendix I : FTSE4good ratings history

Appendix J : ESG firm rating classification

Appendix K : ESG firm code identification

Appendix L : ESG event study results

Appendix M : Sector event study results