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Divestment of fossil fuel equities, its financial implications, and alternative asset allocation strategy

By

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Abstract

This study fills the informational gaps on various aspects of fossil fuel divestment, including its plausible financial impacts on fossil fuel companies and investors'. Survey of responsible investors' and students suggest that fossil fuel divestment is unlikely to succeed in oil and gas sector. However, in next 10 years, there are strong chances of divestment succeeding in the coal sector. Respondents to the survey consider falling clean energy costs and environmental legislations as the future drivers to move away from the fossil fuels. It seems that there is a social norm building against fossil fuel companies signalling a wide recognition of the climate risk by both layman and investors'. Perhaps, the time is opportune for fossil fuel companies to implement appropriate climate policies to contribute in the climate change mitigation. As climate movement builds up, it will force governments' to bring climate legislations. In such a scenario, the companies with worst sustainability rankings will be punished by investors first. Results of this study suggest that stigmatization of these fossil fuel companies by the divestment campaign could lead to their devaluation, thus pushing away potential investors.

For investors, divesting fossil fuel equities would mean decreased diversification opportunities, increased investment risk and additional trading cost. Results of our empirical investigation suggest that divestment of fossil fuel equities will increase the portfolio risk and impose a return penalty on the portfolio. Going further, we used inter-market analysis to provide a 'cure' to the investors' conscious of incurring additional risk due to fossil fuel divestment. Our analysis suggest that investors' who choose to divest from fossil fuel sector can reduce incremental portfolio risk by increasing portfolio exposure towards industrial sector, basic materials sector and utility sector. Findings also imply that currency exchange, precious metals, and agricultural commodities are additional viable options for risk hedging to investors'.

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Glossary of Acronyms

CalPERS	California Public Employees' Retirement System
CCS	Carbon Capture and Storage
ETF	Exchange Traded Fund
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-governmental Organisation
NYSE	New York Stock Exchange
OECD	Organisation for Economic Co-operation and Development
OPEC	Organisation of the Petroleum Exporting Countries
SAF	South Africa Free
UNFCCC	United Nations Framework Convention on Climate Change
UN PRI	United Nations Principles for Responsible Investing

Chapter 1: Introduction

1.1 Background

Key findings of the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) suggest that human activities, particularly emissions of carbon dioxide, are causing a sustained and unequivocal rise in global temperatures, leading to climate change. To prevent the severe impacts of climate change, in December 2010, Parties to United Nations Framework Convention on Climate Change (UNFCCC) committed to limit maximum temperature rise to 2°C relative to pre-industrialised levels. Studying Greenhouse-gas (GHG) emissions targets limiting global warming to 2°C, Meinshausen et al. (2009) showed that limiting cumulative CO_2 emissions over 2000-50 to 886 $GtCO_2$ yields a 20% probability of warming exceeding 2°C. The study further mentioned that during 2000-06 CO_2 emissions were roughly 234 $GtCO_2$, therefore to meet the global warming goal less than half the proven economically recoverable oil, gas and coal reserves can be emitted up to 2050. Taking the carbon budgeting math further, Carbon Tracker (2011) mentioned that the proven fossil fuel reserves held by the top 100 listed coal companies and the top 100 listed oil and gas companies represent emission potential of 745 $GtCO_2$. Climate activists opine that if top 200 carbon companies burn fossil fuels at the prevailing rate, we might overshoot the carbon budget by a huge margin. Carbon Tracker (2011) further added that even after the implementation of Carbon Capture and Storage (CCS) technology, and assuming a certain level of investment, carbon budget to 2050 could only be extended by 125Gt CO_2. Carbon Tracker (2013) updated the carbon budget from 2007-50 to 2013-50 and found an even gloomier picture of the energy industry. Previous research studies (Meinshausen et al., 2009); Carbon Tracker, 2011); Ansar, Caldecott and Tilbury, 2013) argued that with significant changes in business practices and climate policies, the proven carbon reserves (Oil, gas and coal) face prospects of becoming stranded, or worthless, under the described climate scenarios. This could trigger a reduction in market valuation of fossil fuel companies as proven reserves in their balance sheets is a significant component of that value (Qurin et al., 2000). This makes future investment in these companies risky (Spedding, Mehta and Robins, 2013).

Inaction of the governments' and international institutions' to bring CO_2 emissions within safe limits (atmospheric concentration of 350 ppm) has led to a widespread fossil fuel divestment campaign led by a not-for-profit organisation 350.org. The fossil fuel divestment campaigners'

has termed climate change as a 'deep moral issue' and therefore consider investment in fossil fuel companies as unethical and morally ambiguous[1]. The divestment campaigners' want *institutional leaders to immediately freeze any new investment in fossil fuel companies, and divest from direct ownership and any commingled funds that include fossil fuel public equities and corporate bonds within 5 years*[2]. Ansar, Caldecott and Tilbury (2013) suggested that the fossil fuel divestment campaign has three main objectives. First, to force fossil fuel companies to stop further mining of fossil fuels. Second, to pressurize fossil fuel companies to undergo 'transformative change' that can cause a reduction in carbon emissions. Third, push government to enact appropriate climate legislations. On the other hand, opponents of fossil fuel divestment suggest that divesting fossil equities will reduce financial resources of oil and gas companies, which in turn will hinder their capability to research, develop and implement carbon capture and storage technologies (CCS)[3]. IEA (2013) indicate that in near future dependence on fossil fuels (especially oil and gas) will only grow due to rapid industrialization happening in the developing countries. Therefore, the opponents of divestment advocate that transition to natural gas is crucial to address the issue of climate change, not divestment. Perhaps, the biggest example of this is coming from the U.S. where carbon intensity of electricity produced during 2007-12 fell by 13%, mostly due to shift from coal to natural gas (U.S. Energy Information Administration, 2013).

The fossil fuel divestment campaign is inspired by 1980s anti-apartheid divestment movement in South Africa, where the pressure on U.S. corporations to divest from South Africa was resulted from the moral outrage that Americans felt in response to treatment of black South Africans by the minority white South African government (Ennis and Parkhill, 1986). The fossil fuel divestment campaign though started in the U.S., has quickly spread to other regions across the Europe and Australia. The campaign has already gained momentum, few institutions[4] including universities, churches, foundations, pension funds have responded to the divestment call and announced their decision to divest from fossil fuel companies.

[1] http://gofossilfree.org/wp-content/uploads/2014/05/350_FossilFreeBooklet_LO4.pdf

[2] http://gofossilfree.org/faq/

[3] http://e360.yale.edu/feature/counterpoint_robert_stavins_divestment_no_substitute_for_real_action_on_climate/2749/

[4] http://gofossilfree.org/commitments/

Most prominent among all divestment decisions came from the Stanford University[5] and Storebrand (a Norwegian pension fund)[6], announcing withdrawal of their direct equities in coal mining companies.

For the past divestment campaigns (e.g. Tobacco, Sudan, South African), several studies were performed to assess the impact of divestment decisions on firms. However, only a few comprehensive studies exist for fossil fuel divestment. Literature on previous divestment campaigns was mostly focused on assessing the impact of divestment on shareholders' wealth of targeted firms. Findings of these studies on South African divestment (Moore et al, 1993; Meznar, Nigh and Kwok, 1994; Wright and Ferris, 1997) suggest that divestment decisions resulted in decreased market valuations of companies doing business in South Africa. The most comprehensive study on fossil fuel divestment till date has been done by Ansar, Caldecott and Tilbury (2013). The study indicate that fossil fuel divestment may negatively affect the market valuation of fossil fuel companies by reduced demand of their shares or through a process of stigmatization.

For an investor, the restrictions imposed by divestment increases investment risk, reduce investment and diversification opportunities, and increase the costs of trading (Grossman and Sharpe, 1986). Findings of previous studies on South African divestment (Rudd, 1979; Wagner, Emkin and Dixon, 1984), Grossman and Sharpe, 1986) and sin stocks divestment (Guerard, 1997; Statman and Glushkov, 2008) suggest that divestment substantially restricts the investment management activities of large portfolios and does not improve portfolio performance of pension funds. Therefore, for the trustees of endowments and pension funds, building a portfolio without fossil fuel companies could be difficult and risky. Most previous studies on fossil fuel divestment have concluded that a carbon-free portfolio in markets with large exposure to oil, gas and consumables fuels have historically incurred a significant risk. Investors who are concerned about reducing the incremental risks associated with divestment, consider increasing exposure to sectors and asset classes (e.g. currencies, government bonds, and commodities) with strong correlation with oil and gas industry.

[5] http://news.stanford.edu/news/2014/may/divest-coal-trustees-050714.html
[6] http://blueandgreentomorrow.com/2013/07/05/norwegian-pension-fund-divests-from-financially-worthless-fossil-fuels/

In the further chapters of this report, by 'fossil fuel companies' I imply companies' mining oil, gas, coal, and other consumable fuels.

1.2 Aims

The aims of this project are the following:

- To understand the attitude of students and responsible institutional investors towards various key issues surrounding fossil fuel divestment;
- To assess the financial impact of divestment on fossil fuel companies and investors;
- To identify an alternative asset allocation strategy for reducing portfolio risk in event of complete fossil fuel divestment by investors;

1.3 Structure of the thesis

The thesis is structured as follows. In chapter 2, I introduce to reader the findings of previous literature on financial impacts of divestment on targeted firms and investors. Next, I describe the existing thoughts on asset allocation and inter-market analysis. Chapter 3 describes the construction of online survey, methodology employed for data analysis, the results, and the plausible reasoning for the survey responses. In chapter 4, I first introduce the data and methodology for inter-market analysis and then I describe the results of the analysis along with their Interpretation and implication. I make recommendation in chapter 5, conclude the study in chapter 6, and discuss the limitation & scope for further research in Chapter 7.

Chapter 2: Literature Review

2.1 Literature review on impact of divestment of investment portfolio

For the purpose of this study, extensive review of the past literature has been conducted on fossil fuel divestment, South African divestment, sin stocks divestment, inter-market analysis, and determinants of oil prices. Though a good number of studies are done latter four, very few exist on fossil fuel divestment. Most of the existing studies on fossil fuel divestment were undertaken by institutional investors or investment advisory/research companies to calculate the impact of divestment on portfolio. In the following subsections, I present an overview of the existing literature in aforementioned areas. First, I discuss the findings of previous literature on impact of divestment on risk/return of a portfolio. To do so, I first discuss the relevant studies on South-African divestment and then the ones on sin stocks and fossil fuel

divestment. Next, I discuss overview of inter-market analysis and discuss findings of previous literature on determinants of oil equity index & oil price. At last, I discuss the past literature describing the impact of divestment on targeted firms.

2.1.1 South-African Divestment

In the beginning of 1978, to protest against the apartheid in South Africa, social and political pressure increased on public pension funds in the U.S., which pushed them to divest their equity from US companies doing business with or in South Africa. The divestment increased sharply with the enactment of U.S. Comprehensive Anti-Apartheid Act of November, 1986 (Ngassam, 1992). Divestment of equities of U.S. corporations doing business in South Africa by pension funds led to numerous studies on the impact of divestment on portfolio performance and transaction costs.

Most South African divestment studies mostly began with selecting a benchmark portfolio (say S&P 500) representing a typical investment policy in absence of divestment. A divestment strategy is then selected to determine a screened portfolio after divesting targeted firms. Rudd (1979), Wagner, Emkin, and Dixon (1984), Grossman and Sharpe (1986) employed a similar methodology to construct two different investment portfolios: one without a divestment policy, and the other, a South Africa Free (SAF) portfolio. Rudd (1979) analysed the impact of a particular divestment strategy on the projected risk and return of a portfolio and also calculated the expected penalty to portfolio performance due to imposed restrictions. Considering S&P 500 as the benchmark to investments, Rudd (1979) created SAF S&P 500 universe after excluding 177 companies doing business in South Africa and used optimisation techniques to create an alternative portfolio that matched the S&P index as closely as possible. On conducting basic statistical analysis, the author found the SAF portfolio is well-diversified (R-squared of 0.989) but has an annual residual standard deviation of 2.21%. Implying that divestment of targeted firms caused an increase in portfolio risk relative to the benchmark index. The author also derived a formula to relate loss return to increase in residual risk and found that a unit increase in variance would be equivalent to 0.0075% loss of returns. In other words, the finding imply that the SAF portfolio with additional residual risk of 2.21% would result in an equivalent loss of $185,000 on original portfolio of $500 million. Loeb (1983) studying trading costs suggested that cost of trading increases significantly with decreasing market capitalisation, and the difference becomes significant as

trade size increases. The study also indicated that investors cannot maximize portfolio returns under certain constraints (e.g. restricting trade of large-cap companies). Since divestment restricted investment in big U.S. corporations (Rudd, 1979), the natural expected outcome of divesting was increased trading cost and diversification loss to institutional investors. The findings of Loeb (1983) were later confirmed by Wagner, Emkin and Dixon (1984), Grossman and Sharpe (1986). To study implications of South-African divestment on large funds, Wagner, Emkin, and Dixon (1984), constructed an 'alternative investment universe' of 152 companies that is free from South African influence. The author choose a SAF universe from S&P 500 index and for each excluded stock, included the largest available non-South Africa-related corporation in the same industry. Like Rudd (1979), the author's goal was to construct a portfolio that could track the performance of S&P 500. The study find that the SAF portfolio was well diversified (R-squared of 0.968), but had 8% more risk (as measured by beta) than the original portfolio. Consistent with the findings of Loeb (1983), the author suggested that due to smaller size of replacement companies in SAF universe, trading cost would be higher than the original portfolio. The study find the estimated transaction costs (of replacing stocks of companies with South African operations with best alternatives) to be 6% of the amount divested, or 2.28% of overall portfolio value. Grossman and Sharpe (1986) considered all stocks listed on the New York Stock Exchange (NYSE) as the investable universe and used a 'buy and hold' divestment strategy to construct a SAF portfolio. The authors find that the residual standard deviation of the SAF portfolio relative to the NYSE was 2.51% per year. Differing from Wagner, Emkin and Dixon (1984), the authors found that initial transaction costs for $1 billion dollar portfolio can be as low as 0.41% of the overall portfolio value, depending on the divestment strategy chosen. Ennis and Parkhill (1986) examining the impact of U.S. corporate divestures from South Africa on pension fund portfolios suggested that divestment leads to the concentration of investment portfolios and introduces a risk of failing to earn the rate of return on an unconstrained portfolio. As suggested in previous studies, he also articulated that divestment increases the cost of administering an investment program and estimated it to be 1.5% on a $1 billion dollar portfolio. Responding to South-African apartheid movement, California Public Employees' Retirement System (CalPERS')-one of the largest pension fund in the U.S. - divested their holdings from companies doing business in South Africa in Jan 1987 and lifted ban in 1994. Due to the divestment the pension fund estimated that they lost $529 million (Hemmerick, 1995).

2.1.2 Sin Stocks Divestment

Though fossil fuel stocks are yet not being labelled as 'sin stocks' by investors[7], there seems to be a social norm building against fossil fuel companies due to the divestment campaign. The activities of 'sin' companies violate social norms and some socially responsible investors avoid them even if they yield higher returns than stocks in other industries (Statman and Glushkov, 2008). Therefore, it is pertinent to review past studies analysing impact of shunning sin stocks on portfolio performance.

Kahn, Lekander and Leimkuhler (1997) analysed the performance of tobacco stocks compared to the S&P 500 over the period 1987-1996. The study found that removing the tobacco stocks from the S&P index reduces its returns by 0.21%, and had a residual risk of 0.46. Furthermore, the study indicated that incremental risk due to divestment could be reduced by replacing tobacco stocks with highly correlated industries. The authors concluded that tobacco divestiture does not stand was an investment decision to a pension fund as the investment restrictions will increase risk for the passive manager and impose excess transaction costs. Guerard (1997) using regression analysis demonstrated that the use of environmental; alcohol, tobacco & gambling; military; and nuclear screens produces portfolios with higher excess returns than unscreened portfolios for the period 1987-96. The author did not find any statistically significant differences between average returns of a screened and unscreened portfolio for the period 1987-96. Statman and Glushkov (2008) analysed returns during 1992-2007 of stocks rated on social responsibility and find that shunning sin stocks bring socially responsible portfolios a return disadvantage relative to conventional portfolios. Hong and Kacperczyk (2009) studying the effect of social norms on stock markets provided evidence that there is a cost to investors for not being able to diversify into publically traded sin companies. Using cross-sectional regressions and controlling for firm characteristics, the study found that for the period 1965-2006 sin stocks outperform their comparable by 29 basis points a month.

[7] http://www.triplepundit.com/2012/12/university-endowments-stop-investing-fossil-fuel-stocks/

2.1.3 Fossil-fuel Divestment

Geddes (2013) examined the impact of divesting thirteen out of the 'Filthy-Fifteen' U.S fossil fuel companies, and Oil, Gas & Consumables industry, on portfolio risk and return by considering Russell 3000 as the benchmark index. The author finds that excluding Filthy Fifteen from the portfolio can get investors a tracking error[8] of 0.14% versus the Russell 3000. This increases absolute portfolio risk by only 0.0006% and would earn investors a return penalty of 0.0034%. Divesting from entire Oil, Gas & Consumable industry resulted in incremental risk of 0.0101% and would result in 0.0034% return penalty. The study also found that exclusion of whole Oil, Gas & Consumables industry, from the portfolio resulted in higher incremental risk (0.0133%) and this would have earned investors a theoretical return penalty of 0.0044%. Kern, Blachman and Cronin (2013) considered a full divestment policy (excluding 72 fossil fuel, utilities, chemical, mining companies from the S&P 500) and a partial divestment strategy (including fossil fuel companies that receive positive ESG ratings) to analyse the impact on portfolio risk. The study find that for the period 1990-2012, the S&P 500 had a lower absolute risk (21.74%) than full divestment (21.96%) and for partial divestment (22.04%). The divested portfolios also had a significant tracking error. MSCI (2014) studied portfolio impact of four different divestment strategies, namely, fossil fuel divestment, low carbon strategy, carbon tilting, and thematic opportunity. For the period, Jan 2007 – Dec 2013, annualized returns for first three approaches ranged from 4.22% to 4.40%, whereas for the benchmark index (MSCI All Country World Index) it was 4.3%. The volatility for carbon reduction strategies was found to be higher than the benchmark index. All three strategies attracted a significant tracking error. Impax Asset Management (2013) analysed various approaches to portfolio construction, including the fossil free portfolio, fossil free plus alternative energy portfolio, fossil free plus environmental opportunities. The study find that excluding the fossil fuel stocks from the MSCI world index for last 7 years ending April 2013 reduced annual returns to 2.3% from 1.8% with no impact on annualized volatility. Geddes et al (2014) examined hypothetical global equity portfolios obtained after excluding industry of Oil, Gas and Consumables Fuels from the available benchmark indices in the U.S., Australia, Canada, and the global market. The study find that on average the annualized returns were

[8] Tracking error is defined as the standard deviation of the expected difference between the annual returns of a portfolio and its target benchmark. In other words, it is the standard deviation of the residual risk.

higher for carbon-free portfolio in each market. The annualized volatility decreased for the Australian market and increased for the other three markets. Bernstein (2014) suggested that divestment of fossil fuel equities should have a negative impact on the portfolio in the short term due to direct costs of divestment including commission costs, market impact costs, and opportunity costs of constraining the portfolio from the overall investment universe. On the other hand, over the long term divesting from certain companies would reduce the risk-adjusted return of the portfolio compare to original investment universe.

In summary, findings of previous research studies suggest that the divestment substantially restricts the investment management activities of large portfolios and does not improve the portfolio performance of pension funds. The restrictions imposed by divestment increases investment risk, reduce investment and diversification opportunities, and increase the costs of trading. Furthermore, the impacts of divestment seem to be governed by the market size targeted by the campaign, legislations imposed by governments in response to the public pressure, and response by targeted companies.

2.2 Literature review on inter-market analysis

Since divestment leads to increased portfolio risk, the interesting question is- should responsible investors choose to divest fossil equities, what options do they have to reduce the incremental portfolio risk? Conventional wisdom suggest that concerned investors can reduce the incremental risk to a certain extent by tilting portfolio to industries sharing a high correlation with fossil fuel industry. However, to the best of my knowledge, no research has been done to empirically investigate the 'asset allocation' problem in the event of fossil fuel divestment. To understand the asset allocation problem, asset allocation patterns of institutional investors, and inter-relations of different asset classes with the fossil fuel market, I first explain the basic terminologies related to asset allocation and inter-market analysis. I will then introduce existing thoughts and research findings in each of the mentioned areas.

2.2.1 Asset Allocation:

Asset allocation is the means to achieve an appropriate package of risk, return, and time through the three steps of context understanding, future thinking and decision implementation (Ambachtsheer, 1986). Sharpe (1992) defined asset allocation as the 'allocation of an investors' portfolio across a number of "major" asset classes'. The ultimate

goal of asset allocation process is to construct portfolios that are optimal with respect to some pre-specified objectives (Brown et al., 2010) and therefore is an extremely critical decision investors' face. It is widely agreed that asset allocation accounts for large part of the variability in the return on a typical investor's portfolio (Sharpe, 1992). However, asset allocation does not, by itself, create return, but can help in optimizing portfolio return by clearly identifying the weighted-average expected return in conjunction with a reduction of portfolio variance Horvitz (2000). The asset allocation strategy varies across investors, depending on expected risk-return profile of the portfolio, whether the asset allocation is intended to provide short-term or long-term targets, transaction costs etc.

2.2.2 Asset Classes

Asset allocation is arguably the most important decision faced by investors, yet there are no accepted criteria to qualify investments as asset classes (Kritzman, 1999). Early classification of were narrow and limited to stocks, bonds, and cash, however the conventional classification has been blurred by the emergence of new complex financial instruments suiting investors' needs (Campbell & Viceria, 2002). Perhaps the most comprehensive definition of asset class was made by Greer (1997), who defined an asset class as 'a set of assets that bear some fundamental economic similarities to each other, and that have characteristics that make them distinct from other assets that are not part of the class'. Following the definition, he defined asset classes at three broad level: (1) capital assets, such as equities, bonds, real estate. All capital assets share a common aspect that these could be valued on the basis of the net present of its expected returns; (2) consumable /transformable assets are goods that could be consumed, transformed to other asset, and has an economic value. This includes physical commodities such as grains, energy products or metals; (3) store of value assets, which cannot be consumed nor can it generate income. Nevertheless, it has a value e.g. currency. Collectively defined three level covers the entire universe of assets.

2.2.3 Inter-market Analysis

"All markets are related'- quoted Murphy (1997) in one of the first books on inter-market. What he meant is that it is no longer possible for traders and investors to study any financial market in isolation, whether its U.S. stock market or gold futures. The main reason why inter-market analysis can help investors enhance profit is that the peak and troughs of particular asset follows a lead or lag relationship with the business cycle (Lian, 2014). Murphy (1991)

explained that bonds could give us good indication of movement in interest rates, a trend which impacts stock prices. Similarly commodity movements signals inflation movement and tend to do better when stock begins to falter. This implies that having some funds in commodities may lessen the impact of stock market fall on the portfolio and provide additional protection from inflation. Foreign markets are also impacted by an impact on U.S. markets and vice-versa. Examining foreign exchange markets, Engle et al. (1990) reasoned that volatility in one market is transmitted to other markets like a 'meteor shower'. Therefore, it is important for financial market participants to understand the volatility transmission mechanism over time and across markets in order to make optimal portfolio allocation decisions (Murphy, 1997). Inter-market linkages provides investors opportunity to optimise portfolio through inter-market diversification, leading to minimal risk and enhanced profits.

2.2.4 Asset Allocation Patterns of Institutional Investors

It is widely recognized and proven fact that effective asset allocation is crucial to the success attainment investment goals. Brinson, Hood and Beedower (1986) claim that 93.6% of performance variation can be explained by strategic asset allocation decisions. Bekkers et al. (2009) noted that the institutions such as pension funds have been strategically shifting substantial part of their investment portfolio to non-traditional assets such as commodities, private equity and hedge funds. He further adds that omitting certain asset class in asset allocation decisions could lead to sub-optimal portfolios. This finding is particularly relevant to the fossil fuel divestment. Agnew et al. (2003) analysed the asset allocation data of 143 U.S. pension funds for the period 1990-2008. Findings suggest that during the study period weight of stocks remained fairly constant, whereas the allocation to alternative investments increased (from 0.6% to 2.9% for hedge funds & 2.7% to 4.6% for private equity). Brown et al. (2010), who did similar exercise on more than 700 university endowment funds during the period 1984- 2005, also noticed increased allocations to alternative assets, fairly constant to U.S. equities, and decreased allocation to fixed income. Overall analysis strongly suggest that asset allocation pattern is skewed towards traditional asset classes; mainly dominated by equities, followed by fixed income instruments and only a marginal allocation to alternative investments. These findings suggest that investors who choose to divest from fossil fuel sector could also allocate divested equity to traditional asset classes and alternative investments to

minimise variability in returns. Therefore, in next section I review inter-relation of oil prices and oil equity indices with other markets/asset classes.

2.3 Literature review on determinants of oil equity index

Oil is globally regarded as the most important commodity, and improving understanding of factors determining its price has been a longstanding research objective (Les Coleman, 2011). Extensive research is done on determinants of oil prices and impact of oil prices on equity value of firms. Malik and Ewing, 2009 suggested that the changes in the price of oil and its volatility have significant effects on the economy and the financial markets. Other research studies suggest (Fan and Xu, 2011) that oil markets are interconnected to exchange rate markets, oil futures market, stock markets and commodity markets. Therefore, to design an appropriate asset allocation strategy for investors' who choose to divest from oil (fossil fuels), it is crucial to understand the determinants of oil prices. Below I summarize the findings of past literature on determinants of oil prices and inter-relationship of oil markets with other markets.

2.3.1 Oil and stock markets

The literature on the dependence between crude oil and stocks prices is in abundance. A few studies suggest that oil prices and stock values move in opposite directions. In this regard, Jones and Kaul (1996) find the negative responses of international stock prices to oil price shocks. One logical explanation is that the volatility in oil prices triggers changes in real cash flows of firms, hence changes in expected returns. Malik and Hammoudeh (2007) using a multivariate GARCH framework noticed a significant volatility spill over from equity market to the oil market in the case of Saudi Arabia. Miller and Ratti (2009) analysed the relationship between the crude oil price and international stock market indices over 1997-2008. Their findings suggest that correlation between oil prices and equity price movement's changes over time. Malik and Ewing (2009) used bivariate GARCH model to examine the volatility and shock transmission mechanism between oil prices and the financial, industrial, consumer, health, and technology sectors. The study find that oil return volatility is indirectly affected by news from financial sector, industrial sector, and health care sector. He also found that oil return volatility declines significantly when demand for consumer products and services is high and consumer services firms are doing well. Cifarelli and Paladino (2009) found evidence that oil price shifts were negatively related to stock price during 1992-2008. Ciner (2001)

found a bidirectional non-linear causality between stock index returns and oil price returns. Studying the determinants of oil prices, Fan and Xu (2011) suggested that since 2000 the links between the oil price and financial market prices such as the stock prices have gone strong. The study indicated that the effect of the stock market on the oil price will vary according to the economic development and the market situation, which will push up or suppress the oil prices accordingly. Choi and Hammoudeh (2010) noticed a negative but weak, non-significant correlation between WTI crude and S&P 500. Basher et al (2011) studied the relationship between oil prices, exchange rates, emerging stock market prices, interest rates, economic activity, and oil supply using structural vector auto-regression model. The study suggested that oil prices respond positively to a positive shock to emerging stock markets. Investigating the correlation between equity markets and oil prices, Zhang and Li (2014) noticed a recent hike in oil-equity correlations. To analyse the interdependence of oil prices and global stock market indices, Sukcharoen et al (2014) used the copula approach and excluded oil and gas effects from stock market index series to remove the direct linkage with oil prices. The study find that the relationship between oil prices and stock market indices will remain symmetric regardless of the state of economy. Overall findings suggest that there are significant inter-linkages between oil and equity markets, which varies according to the market situation and demand & supply constraints.

2.3.2 Oil and other commodities

Oil and the precious metals are commodities that are priced in US dollar and are included in the commodity portfolios of most institutional investors. Studies have shown commodities are good diversifiers in traditional investment portfolios (Holmes, 2006; Gilbert, 2008; Tang and Xiong, 2009) and their dynamic interaction of different market factors had led investors to design diversified portfolios to maximize returns on investments and/or manage risks. Sari et al. (2009) suggested that investors move from dollar-denominated soft assets to dollar-denominated physical assets during expected inflation.

Looking at the market relationship between oil and gold, Fan and Xu (2011) suggested that both are representative investment commodities and are commonly faced with external influences such as US dollar depreciation of inflation. The authors further added that there is an information transmission between oil and gold, as one market is regarded as an indicator of the other one. When risk in the oil market increases as a result or other reasons,

considerable portion of funds may be transferred into gold market to preserve value. Sari et al. (2009) suggested that the relationship between the oil price return and that of gold is very weak and asymmetric. However, the reverse relationship between oil and gold is somewhat stronger as oil explains 1.7% of gold price returns. The study also noticed a strong bi-directional relationship between the oil price return and that of silver, with each explaining more than 2% of each other's variation. On the other hand, palladium and platinum could explain less than 1% variation in oil price return. Choi and Hammoudeh (2010) found a positive but weak, non-significant between Brent Crude and Copper, Gold, Silver. Ji and Fan (2011) studied the influence of the crude oil market on non-energy commodity markets before and after the financial crises. The results suggest that overall correlation between the oil market, agriculture markets, and metal markets increased post financial crises. Campiche et al. (2007) examined the co-variability between crude oil prices and corn, sorghum, sugar and soybean during 2003-07. The results suggest that co-integrating relationship of corn, and soybean prices with crude oil prices increased during 2006-07. Chen et al. (2010) investigated the relationships between crude oil price and global grain prices for corn, soybean and wheat and found a significant impact of crude oil global grain prices.

2.3.3 Oil and Exchange Rate

Trade in the international oil markets is settled in US dollars, so changes in the US dollar exchange rate play an important role in driving oil prices. Bloomberg and Harris (1995) found that negative correlation between commodity prices and US dollar exchange rate increased after 1986. Indjehagopian, Lantz, Simon (2000) tested the interactive relationship between German, French, and Rotterdam heating oil spot price and DM/US, FF/US exchange rates, using a vector error correction model (VECM). The results of the study suggest that the variation in exchange rates had an instantaneous impact on the variations in oil price. Sadorsky (2000) examined the co-integrating and casual relationship between energy futures price for crude oil, heating oil and unleaded gasoline, and the trade weighted index of various US dollar exchange rates. The results suggest that exchange rates transmitted a shock to energy futures price. Zhang et al. 2008 reported a significant influence of US dollar exchange rate on international oil prices in the long run. Cifarelli and Paladino (2009) found evidence that oil price shifts during 1992-2008 were negatively related to exchange rate changes. Sari et al. (2009) a deteriorating dollar against Euro can also push up the oil prices as they are

priced in green currency. Fan and Xu (2011) mentioned that a great dollar depreciation not only affects short-term fluctuations in the oil price, but also in the long term could contribute to a sharp rise in oil prices, as it has been evidenced recently.

2.3.4 Oil and Government Bonds

In contrast to research studies investigating inter-relationship of oil and stock market returns, comparatively little literature exist on the relationship between oil prices and bond market returns. Existing literature suggest that an increase in oil prices leads to inflation which leads to an increase in interest rates and a drop in bond prices (Turhan et al., 2014). Ciner et al. (2013) find a low negative correlation between oil futures' prices and 10 year government bond prices for US and UK. Kang et al. (2014) utilized a structural vector auto regression model to investigate the impact of oil price shock on real bond returns. The results suggest that demand supply shocks driving the global crude oil market jointly account for 30.6% of the long run variation for a US bond index with 5 years maturity period. Turhan et al. (2014) examining dynamic relationship between oil and major asset classes reported an increased correlation between oil and bond market after 2008 global financial crises.

2.3.5 Oil, futures market and speculations

Analysing oil market, Fan and Xu (2011) found that oil market mechanism has undergone an adjustment around March 12, 2004, which was mainly caused by strong oil demand and vast amounts of speculative funds pouring into the oil futures market since 2003. The author salso added that when the stock market is depressed, speculative funds will seek new battlefields such as oil market due to capital profitability, which in turn can boost the oil price. Studying oil price rise in the U.S. between 2004 and the summer of 2006, Dees et al. (2008) suggested this may be due to concerns about the future oil market conditions, materialized by the shift of the futures market in contango. Les Coleman (2011) mentioned that the futures market increased from virtually nothing in the 1980's to over 20 times the size of physical market and seemed to mirror oil prices, and suggested that the growing role of speculators in the oil market may be driving oil prices higher. The author further added that the emergence of a large futures market has increased the nominal price of crude oil by up to as much as $45 per barrel. Fan and Xu (2011) also suggested that speculations, the stock price, gold price, and exchange rate fluctuations etc. enlarge the quantum of increase or decrease of oil prices.

2.3.6 Oil price and economic factors

In the long run, as petroleum is an exhaustible resource, the supply-demand relationship is the fundamental factor determining the long term trend in oil prices. Hamilton 2008 pointed out that low price-elasticity of short-term demand and supply, the vulnerability of supplied to disruptions, and the peak in U.S. oil production account for the broad behaviour of oil prices over 1970-1997. He also mentioned that profound change in demand coming from industrialized countries and recognition of the finiteness of oil as a resource offer plausible explanation for recent developments in oil prices. Basher et al (2011) studied the relationship between oil prices, exchange rates, emerging stock market prices, interest rates, economic activity, and oil supply using structural vector auto-regression model. The author concluded that oil prices respond negatively to an unexpected increase in oil supply and oil prices respond positively to an unexpected increase in demand. Les Coleman (2011) investigated the influence on global oil prices of five groups of independent variables including supply factors (OPEC market share), demand factors (OPEC market share X OECD import dependence), financial measures (AAA rated corporate bonds), political factors (frequency of fatal terrorist attacks in Middle East and and the number of US troops in the Middle East), and global GDP. He concluded that 79% of variation in monthly oil prices is explained by positive relationships with corporate bond yields (financial factor), frequency of fatal terrorist attacks in Middle East (security risk factor), global GDP, the number of US troops in the Middle East (security risk factor), the interaction term incorporating OPEC market share and OECD demand (demand factor), speculative activity in the oil futures market, and by a negative relationship with OPEC's share of global production (supply factor).

2.4 Literature review on impact of divestment on fossil fuel companies

2.4.1 Market Valuation of Fossil Fuel Companies

Talking about market valuation, we would like to empirical investigate the impact of divestment on the market value of a fossil fuel company. Market value of a firm is the multiplication of number of outstanding shares of a firm and price of a share. Ansar, Caldecott and Tilbury (2013) explained that divestment outflows may have direct impact on the valuations of fossil fuel companies in two ways. First, from changes in market norms that closes off channels of previously available money that leads to decrease in stock price of a targeted firm. Second, withdrawal of debt finance to fossil fuel companies by financial

institutions or availability of funds at a higher cost of capital, may indirectly affect fossil fuel companies' ability to undertake projects in difficult technical or environments. Teoh, Welch, and Wazzan (1999) examined the impact of legislative and shareholder boycott on valuation of bank and corporations with South African operations. The study found that due to very little involvement of corporates in South Africa, the divestment campaign had no discernible effect on the valuations of firms with operations in South Africa. Studying the impact of divestment on valuation of fossil fuel assets, Ansar, Caldecott and Tilbury (2013) suggested that maximum possible capital divestment from fossil fuel companies is unlikely to affect their share price. However, since coal stocks are less liquid, divestment of coal equities would impact coal stock prices. Spedding, Mehta and Robins (2013) examined the risks to oil mining majors including BP, Shell, Total, Statoil, Eni and BG in a low carbon world and predicted a 4-15% reduction in share price of these mining companies. This is based on the hypothesis that a large fall in oil demand would almost certainly lead to lower oil prices. All oil companies would lose material value if oil price fall below $50 per barrel. Carbon Tracker (2013) reports that market valuation of 200 publically listed fossil fuel companies with largest fossil fuel reserves totalled around US $4 trillion, with 84% oil & gas and 16% coal activities, at the end of 2012. The current valuations of fossil fuel companies assumes that these companies would be able to fully exploit proven fossil reserves at a consistent production rate and price. In a low carbon world, the lower demand and price of carbon intensive fuels would significantly reduce the market value of oil and gas firms.

2.4.2 Returns on Stocks

Moore et al. (1993) studied the impact of South African decisions on shareholders wealth of divesting firms. The study concluded that average divestment firm experienced statistically significant wealth declines of about 3% in response to a South African divestment decision. Meznar, Nigh and Kwok (1994) find that the stock price of divesting firms was on average 5.5 percent lower during the period surrounding a withdrawal announcement compare to business-as-usual scenario. Wright and Ferris (1997) using an event study methodology examined the impact that public announcements of divestment of South-African operations have on the stock return behaviour of publically traded companies. The results of the study suggest that announcements of corporate divestment of South African business units are associated with significant negative returns.

Looking at the studies on sin stocks, Heinkel, Kraus and Zechner (2001) developed a theoretical model to explain the impact of exclusionary ethical investing (or green investing) on sin companies' behaviour. The report find that if fund managers apply negative screens, sin firms are present in fewer portfolios. This reduces risk sharing opportunities among investors and results in lower stock prices of polluting firms, thus driving higher their expected returns. Hong and Kacperczyk (2009) studying effect of social norms on stock market indicated that sin stocks should be cheaper than other comparable stocks and would outperform them. Consistent with finding of Heinkel, Kraus and Zechner (2001), the study found that sin stocks outperform their comparable by 29 basis points a month.

Chapter 3: Online Survey

3.1 Introduction

Fossil fuel divestment is a rapidly emerging phenomenon within the field of socially responsible investing. However, a very limited literature exist on fossil fuel divestment, including its implications on fossil fuel companies and investors. The most comprehensive study on fossil fuel divestment has been conducted by Ansar, Caldecott and Tilbury (2013), which based its findings on the outcomes of previous divestment campaigns. This study aim to empirically fill the informational gap on fossil fuel divestment and its plausible implications. To do this, we conducted a survey of responsible investors' and divestment campaigners/students, on key issues surrounding fossil fuel divestment. A total of 46 responsible investors and 33 students participated in the survey by completing an online questionnaire. Results indicate some important difference between socially responsible investors' and divestment campaigners' in their beliefs on key issues around fossil fuel divestment.

3.2 Aims

An online survey on fossil fuel divestment was conducted to confirm the following:

- Attitude of responsible investors and students on key issues surrounding fossil fuel divestment;
- Analyse plausible financial impacts of fossil fuel divestment on fossil fuel companies and investors based on survey data;

3.3 Methodology and data

Imperial Qualtrics survey website was used to host the survey online. In order to distinguish between the two types of participants in the sample, two separate links were generated for the same online survey. Separate survey link was posted on relevant online student communities, fossil fuel divestment communities, and responsible investment communities on LinkedIN and Facebook. Additionally, the survey link was sent via email to member investment organisations to United Nations Principles for Responsible Investing (UN PRI) and university endowments in the UK and the US. To get a better professional judgement on the divestment, in particular financial implications of fossil fuel divestment, request to fill up the survey via email was only sent to the chief investment officers' and senior portfolio managers' of signatories to UN PRI network and university endowments in the UK and the US. The survey was constructed after conducting an extensive review of literature on South African divestment campaign, sin stock divestment, and fossil fuel divestment campaign. Brevity was a further important consideration in the construction of survey, to ensure good participation of busy investment professionals in the survey. A tick design box was employed for most questions, with an additional comment box marked 'other' as the last response choice so that respondents could add more detail if they wish to. The overall survey was divided into three segments- 1) general questions on fossil fuel divestment campaign, 2) financial impacts of divestment, and 3) demographic questions. Demographic details and response to future drivers of divestment were collected using self-selected categories. For other questions, responses were constructed using a five-point 'Likert scale'.

Research studies (Jamieson, 2004; Fisher and Marshal, 2008) suggest that median or mode are the most appropriate description of the central tendency for ordinal data. With Likert scale, mode makes analysis and interpretation of data easier for the analyst and reader. Therefore, for the purpose of this study, mode (or the most frequent response) has been used to describe the central tendency of ordinal data. For analyse the central tendency, the ordinal responses were coded and mode of responses is calculated for both student and responsible investor group for each question. Chi square test of independence is used to test the whether the two categorical variables i.e. the responses from student group and responsible group are independent or related. With regard to exploring the relationship between two variables following hypothesis is proposed:

H_0 (Null hypothesis) = Responses of the group (students and responsible investors) are independent i.e. the proportions of responses from students and responsible investors are same across all categories.

H_1 (Alternate hypothesis) = Responses of the students and responsible investors are not related across all categories.

The independence of relationship is tested at 0.05 level of significance. The null hypothesis is rejected if chi-square is greater than the critical value.

3.4 Results

3.4.1 Respondents' details

The organisations that took part in the survey are mentioned in table 1. As can be seen, organisations' involved directly and indirectly in the investment activities comprised more than 50% of responses, followed by students. Name of the organisations are not published, as the responses were provided on the condition of anonymity.

Table 1: Distribution of respondents by organisation

Organisation Type	Number of Respondents	Percentage distribution
University Endowment Fund	2	3.45%
Pension Fund	8	13.79%
Asset Manager	6	10.34%
Foundation	3	5.17%
Mutual Fund	2	3.45%
Research*	9	15.52%
NGO	2	3.45%
Other**	5	8.62%
University (Student)	21	36.21%
Total* **	**58**	**100.00%**

*Include market research, ESG research, and consulting firms, **Include companies from industrial sectors, ***Represent respondents who mentioned organisation's details.

Number of respondents to questions in the survey differ from question to question. Category marked 'number of respondents' in table 1 should be interpreted as the number of people who responded to questions seeking demographic details, but not as 'total respondents' to the survey. In terms of location, almost half of the respondents come from UK, followed by the U.S. and Australia combined representing another quarter of total respondents (see Figure 1). With regard to organisation role/designation, responses can be broadly put into two categories-1) students & entry level professionals, 2) senior professionals (mid-level and above), with each group representing roughly 50% of total respondents (see Figure 1). Overall responses is tilted towards professionals (approx. 64%) which is a good sign in terms of judgement sought on crucial issues in the survey, in particular financial issues.

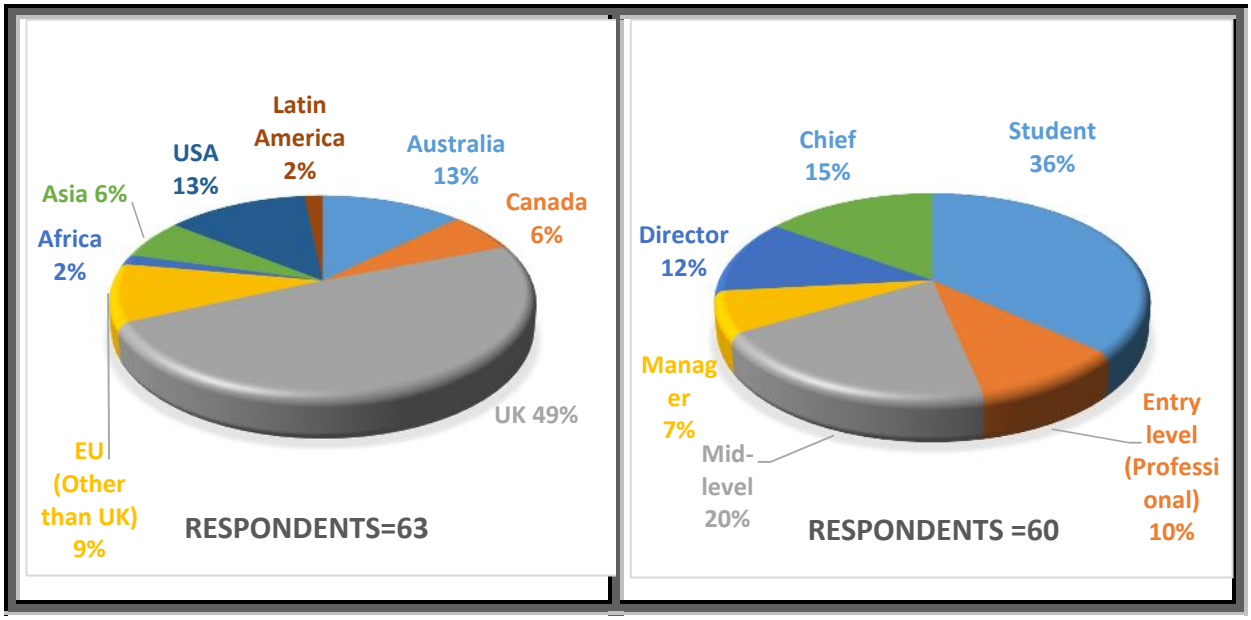

Figure 1: Demographic distribution of respondents

Looking at the data on organisations' investment in the fossil fuel companies, roughly 69% of respondents (see figure 2) mentioned that their organisation has some investments in fossil fuel sectors. With highest number of respondents (approx. 40%) saying that they hold 0-10% of investments in fossil fuel companies, followed by respondents with nil investment in fossil fuel companies.

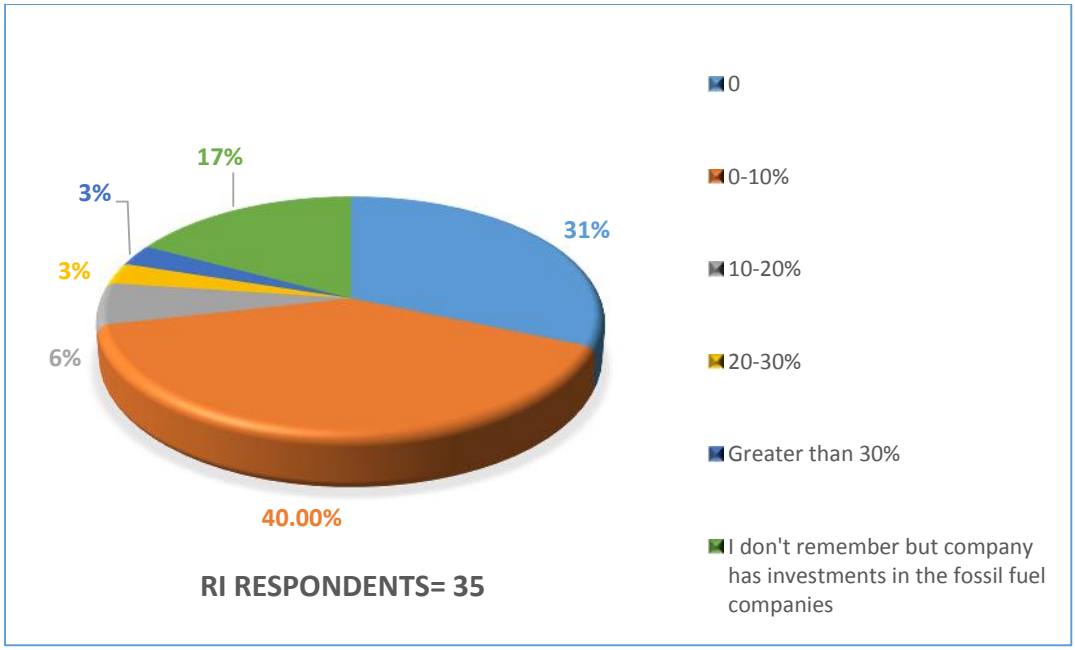

Figure 2: Fossil fuel holding in portfolio of responsible investors

3.4.2 Results and Discussion on Fossil Fuel Divestment

Fossil fuel divestment is the best strategy to address climate change

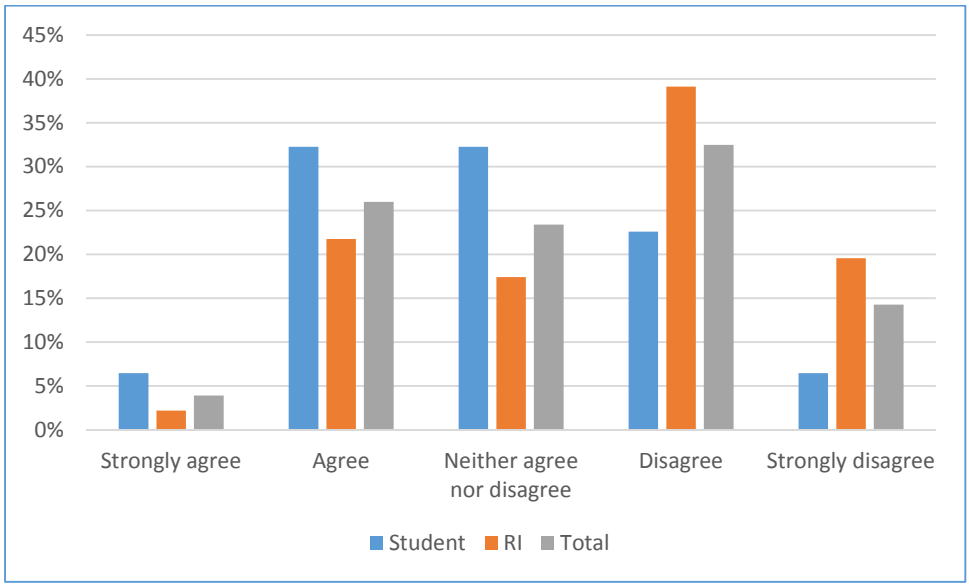

Figure 3: Results of the online survey

A Chi-squared test ($\chi 2 = 7.20$, df = 4, $P>0.05$) suggest that pattern of responses does not vary significantly as a function of the group. Responses suggest that responsible investors (n=46) disagree with the fact that fossil fuel divestment is the best strategy to address climate change, while students agree.

Discussion:

Responsible investors, being more aware on fossil fuel divestment, might have also weighed other options to address climate change like implementing appropriate climate mitigation policies, increasing clean energy share in power generation, before passing the judgement. Opinion of responsible investors also suggest that a certain segment of the group favour divestment as a legitimate step to address climate change. These might be university endowments, foundations, and/or churches who have taken an ethical standing on fossil fuel divestment and decided to divest fossil equities from their portfolio[9]. Other responsible investors like pension funds face much more stringent regulatory constraint than endowments and religious investors. For example, Mayor Mike McGinn of the City of Seattle, U.S., stated in his statement[10] on fossil fuel divestment that *'state and federal law on fiduciary responsibility requires board members to only invest funds to achieve a social or environmental objective when the resulting return on investment and related risk are comparable to other available investments'*. Review of literature on South-African divestment and fossil fuel divestment also suggest that divesting fossil equities leads to reduced diversification opportunities to investors, increase portfolio risk, and investors may incur additional transaction costs. Due to the mentioned reasons, amongst others, responsible investors think that fossil fuel divestment is not the best strategy to address climate change.

On the other hand, students' (n=31) less confidently agree that fossil fuel divestment is the best strategy to address climate change. This may be due to the ethical standing of the student community (campaigners) who consider climate change as a 'deep moral issue'. Campaigners believe in legitimacy of fossil fuel divestment by giving 'carbon budget' arguments and relying on the success of South-African anti-apartheid divestment campaign, which pushed U.S. government to enact regulation banning U.S. corporations to do business in South Africa.

Linking action so closely with fossil fuel divestment may derail other efforts needed to tackle climate change.

[9] http://gofossilfree.org/commitments/
[10] http://mayormcginn.seattle.gov/next-steps-on-fossil-fuel-divestment/

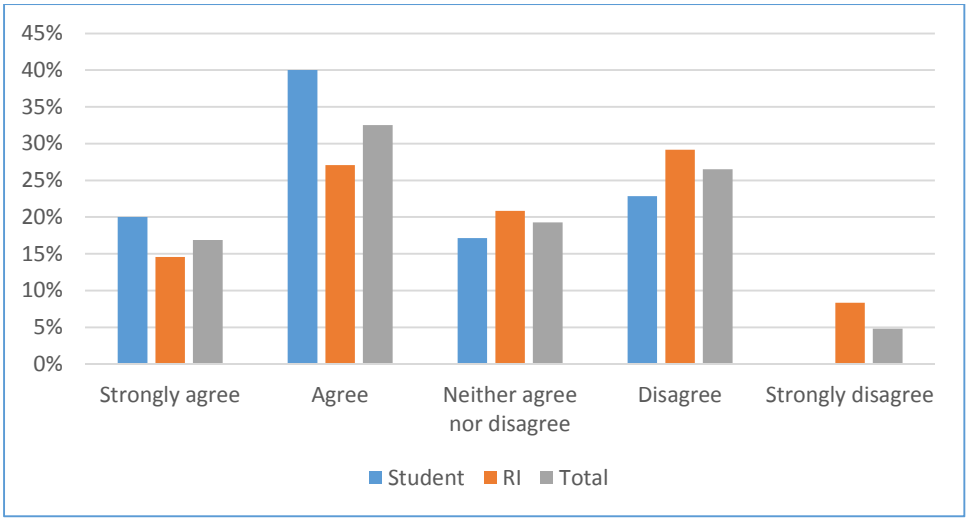

Figure 4: Results of the online survey (continued)

A Chi-squared test (χ^2 =4.7539, df=4, P>0.05) suggest that pattern of responses does not vary significantly as a function of the group. Results suggest that responsible investors (n=48) and students (n=35) agree with the fact that linking action on climate change so closely with divestment may derail other efforts needed to tackle climate change.

Discussion:

Various recent articles published by academicians, investors, media professionals take different position on the fossil fuel divestment issue, giving reasons to justify their viewpoint. Opponent of divestment suggest that divesting fossil equities will reduce financial resources of oil and gas companies, which in turn will hinder their capability to research, develop and implement carbon capture and storage technologies (CCS)[11]. Ansar, Caldecott and Tilbury 2013 suggest that divestment will hurt oil and gas companies' capability to undertake projects in difficult technical and political environment by constraining inflow of capital. IEA (2013) suggest that in near future dependence on fossil fuels (especially oil and gas) will only grow due to rapid industrialization in developing countries, therefore opponents advocate that transition to natural gas is crucial to address the issue of climate change, not divestment. Perhaps the biggest example of this came from the U.S. where carbon intensity of electricity produced in U.S during 2007-12 fell by 13%, mostly due to shift from coal to natural gas (U.S. Energy Information Administration, 2013). Proponents of divestment argue that in an era of

11 http://e360.yale.edu/feature/counterpoint_robert_stavins_divestment_no_substitute_for_real_action_on_climate/2749/

political capture—where corporate lobbyists dictate national policy—the climate movement is using divestment to bypass a broken political system[12]. Divestment campaigners see themselves as counteracting the lobbying efforts of fossil fuel industry in delaying climate legislation, hence, justifying there standpoint. Regardless of the debate, what is without doubt is that the divestment campaign has been extremely successful in creating high profile debates on climate change. Results of overall survey suggest that divestment alone cannot address the whole problem of climate change, huge investments in clean energy and stringent climate mitigation policies will be needed to shift energy dependence away from fossil fuels.

The fossil fuel divestment will succeed in next 5 years.

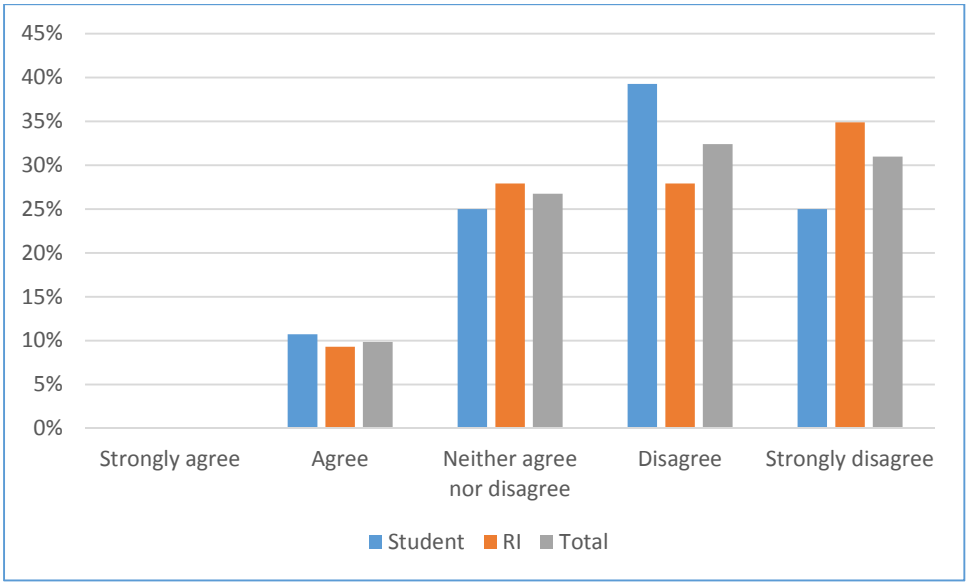

Figure 5: Results of the online survey (continued)

A Chi-squared test (χ^2 =1.3, df=4, P>0.05) suggest that pattern of responses does not vary significantly as a function of the group. Results suggest that both responsible investors (n=43), and student group (n=28) disagree that fossil fuel divestment will succeed in 5 years.

Discussion:

So far the fossil fuel divestment has been successful in making climate change a 'deep moral issue'. It has also been successful in grabbing the attention of investors and policymakers by bringing to lime-light the research findings on spill-over effects of climate risk on financial markets. However, success of fossil fuel divestment is limited to few universities (mostly in

[12] http://read.hipporeads.com/can-divestment-combat-climate-change/

the U.S. and UK), religious institutions, and foundations[13]. Among universities, Harvard rejected the students' call to divest fossil fuel equities by stating that divestment will come at a significant cost which will affect endowment's ability to advance academic goals[14]. The U.S. pension funds have ignored calls from city councils and mayors to divest from fossil fuel companies, resolutions for which were passed 12-18 months ago[15]. Most investment managers understand the additional cost and risks of removing fossil equities from their portfolio. Therefore, chances that large institutional investors will divest from fossil fuel stocks in next 5 years seems quite low, as also suggested by the survey responses.

The fossil fuel divestment will succeed in next 10 years.

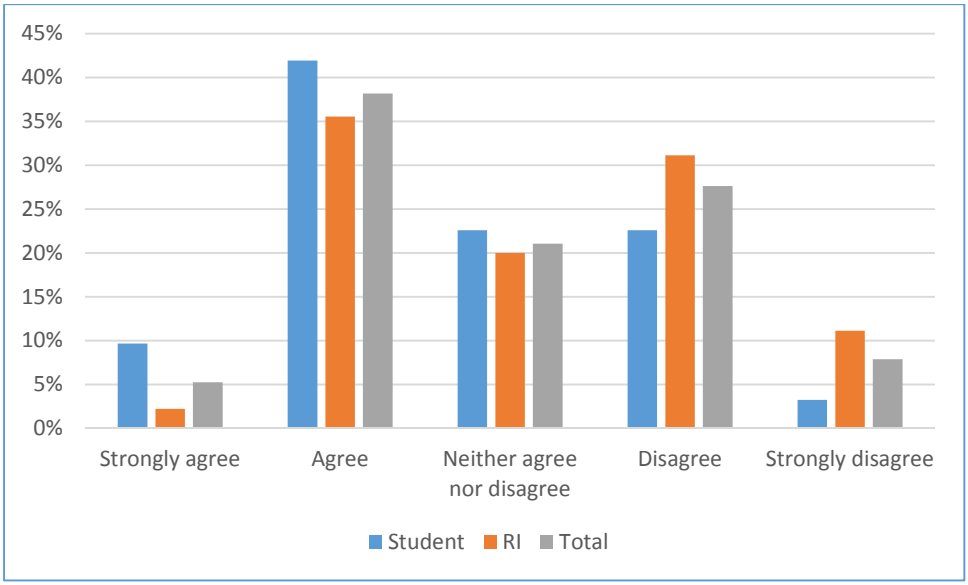

Figure 6: Results of the online survey (continued)

A Chi-squared test (χ^2 =4.12, df=4, P>0.05) suggest that pattern of responses does not vary significantly as a function of the group. Results suggest that both responsible investors (n=45), student group (n=31) and overall respondents suggest that fossil fuel divestment will succeed in 10 years.

Discussion:

[13] http://gofossilfree.org/commitments/
[14] http://www.harvard.edu/president/fossil-fuels
[15] http://www.ft.com/intl/cms/s/0/85c3cf4e-0378-11e4-817f-00144feab7de.html?siteedition=uk#axzz3BnJv3A4N

Results imply that due to growing certainty about climate science, in the long-term respondents see fossil fuel equities as bad investments and expect that institutional investors to remove fossil companies before the enactment of looming stringent climate legislations. Similar to the South-African divestment case, perhaps the governments will respond when the public pressure on fossil fuel divestment reaches a tipping point[16]. In such a scenario, investors will be forced to divest when risk to investment in fossil fuel companies becomes evident. Pitzer College Board of Trustees announcing their divesting decision from fossil-fuel investments added that 'divesting was not going to make a difference in our long-term return'[17]. Therefore, in the long run, long-term responsible investors may divest from fossil fuel companies, even if this means sacrificing minute returns.

Chances of fossil fuel divestment succeeding in the coal sector in next 10 years.

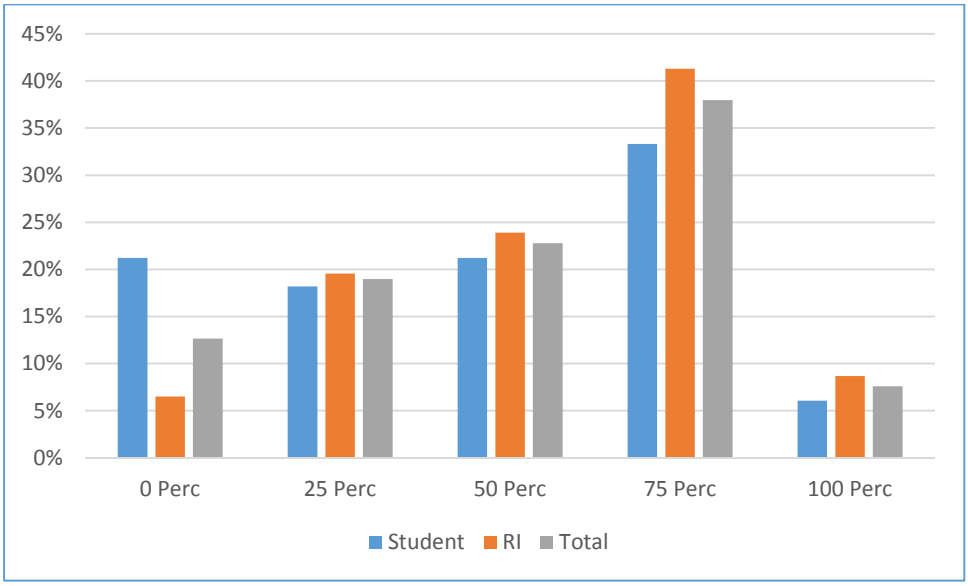

Figure 7: Results of the online survey (continued)

A Chi-squared test (χ^2 =3.854, df=4, P>0.05) suggest that pattern of responses does not vary significantly as a function of the group. Both responsible investors (n=46), and student group (n=33) believe that there is a 75% chance of fossil fuel divestment succeeding in coal sector.

Discussion:

[16] Divestment movement reaches a tipping point when prominent American universities divest (Teoh et al., 1998).
[17] http://chronicle.com/article/Pitzer-College-to-Take/145905/

Results are consistent with the theoretical reasoning on fossil fuel divestment succeeding in coal sector proposed by Ansar, Caldecott and Tilbury (2013). The study suggest that since coal stocks are less liquid, divestment of coal equities would impact coal stock prices. The investors who are willing to divest from fossil fuel sector would first get rid of coal stocks. Hard evidence to the 'coal devaluation theory' came in the form of Storebrand's, a Norwegian pension fund and life insurance company, divestment of 13 coal extractors from their portfolio[18,19]. In its divestment call, the pension fund mentioned that the divestment decision is taken to ensure long-term stable returns, besides reducing portfolio's carbon exposure. Implying in the long term the investors' see coal stocks as risky, which makes them a likely primary target of the divestment campaign.

Chances of fossil fuel divestment succeeding in the Oil sector in next 10 years?

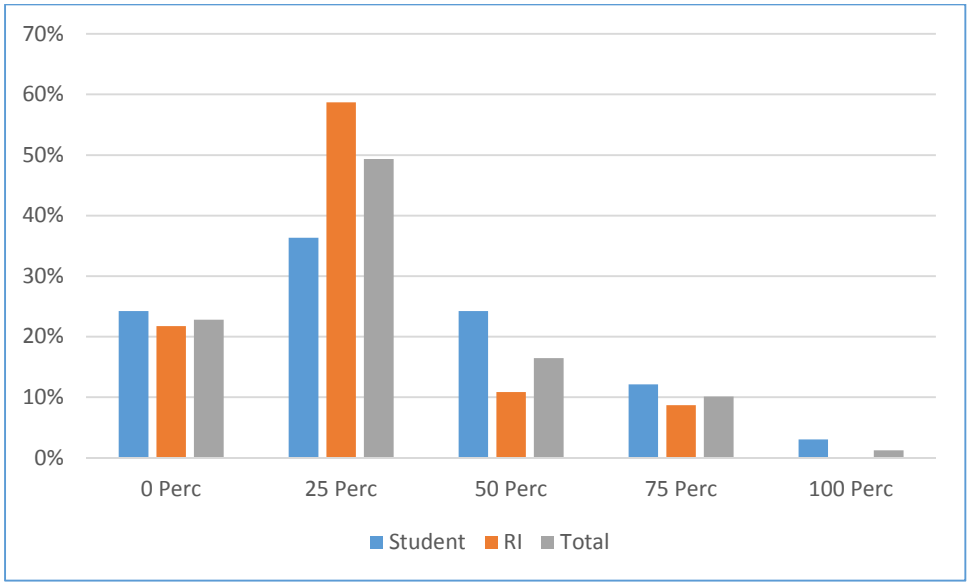

Figure 8: Results of the online survey (continued)

A Chi-squared test (χ^2 =5.69, df=4, P>0.05 suggest that pattern of responses does not vary significantly as a function of the group. Results suggest that both responsible investors (n=46) and student group (n=33) believe that there is a 25% chance of fossil fuel divestment succeeding in oil sector.

[18] http://www.mynewsdesk.com/no/storebrand-asa/pressreleases/storebrand-reduserer-co2-eksponeringen-i-sine-investeringer-19-selskaper-ekskluderes-882693

[19] http://blueandgreentomorrow.com/2013/07/05/norwegian-pension-fund-divests-from-financially-worthless-fossil-fuels/

Discussion

Divestment from oil and gas seems unlikely mainly because of three reasons. First, all global economies (both developed and developing) are heavily dependent on oil and gas in many areas including, amongst others, power generation, transportation, and manufacturing. IEA (2013) mentioned that present share of fossil fuel in the global mix is at 82%, as it was 25 years ago, and strong rise of renewable will only reduce fossil fuel share to 75% by 2035. Second, due to rapid industrialization happening in developing countries, demand of oil and gas is supposed to grow. IEA (2013) states that transport oil demand is expected to rise by 25% by 2035, with most demand coming from India and China. Third, oil & gas companies account for roughly 11% of S&P 500 and 20% of the FTSE 100, this makes market for oil and gas stocks very liquid (Ansar, Caldecott and Tilbury, 2013). Therefore, sizeable withdrawals of oil gas equities by responsible will not affect their share price, which makes them good investment and least likely candidates of divestment. Therefore, due to the huge demand of oil & gas and excess market liquidity of their stocks, divestment is unlikely to succeed in the oil and gas sector.

Chances of fossil fuel divestment succeeding in the gas sector in next 10 years

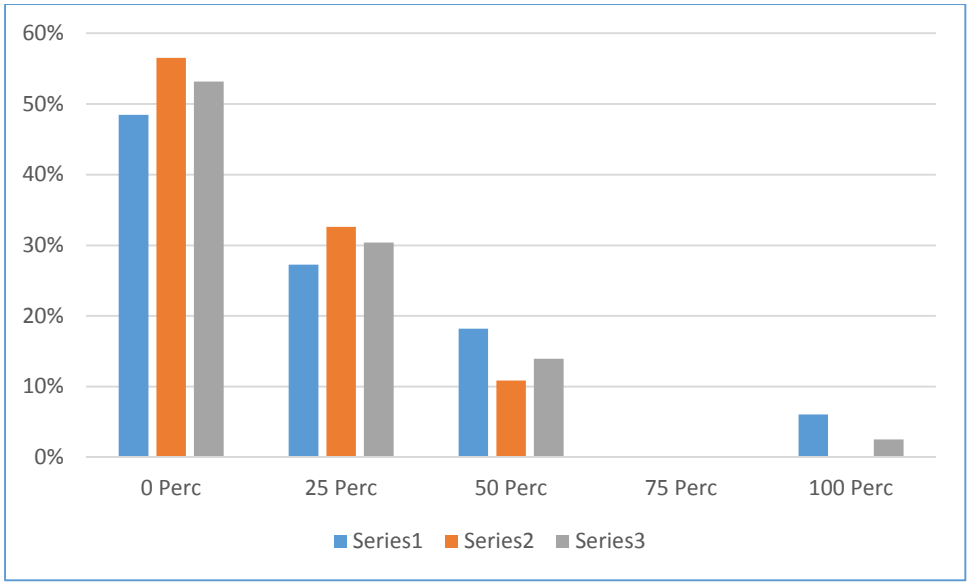

Figure 9: Results of the online survey (continued)

A Chi-squared test (χ^2 =3.93, df=4, P>0.05) suggest that pattern of responses does not vary significantly as a function of the group. Responsible investors (n=46) and students (n=33) believe that there is 0% chance of fossil fuel divestment succeeding in the gas sector. Other

than the reasons already mentioned above, countries see transition from coal to natural gas as crucial in reducing GHG emissions. This is evident from the fact that carbon intensity of electricity produced in U.S. during 2007-12 fell by 13%, mostly due to shift from coal to natural gas (U.S. Energy Information Administration, 2013).

Future drivers of fossil fuel divestment.

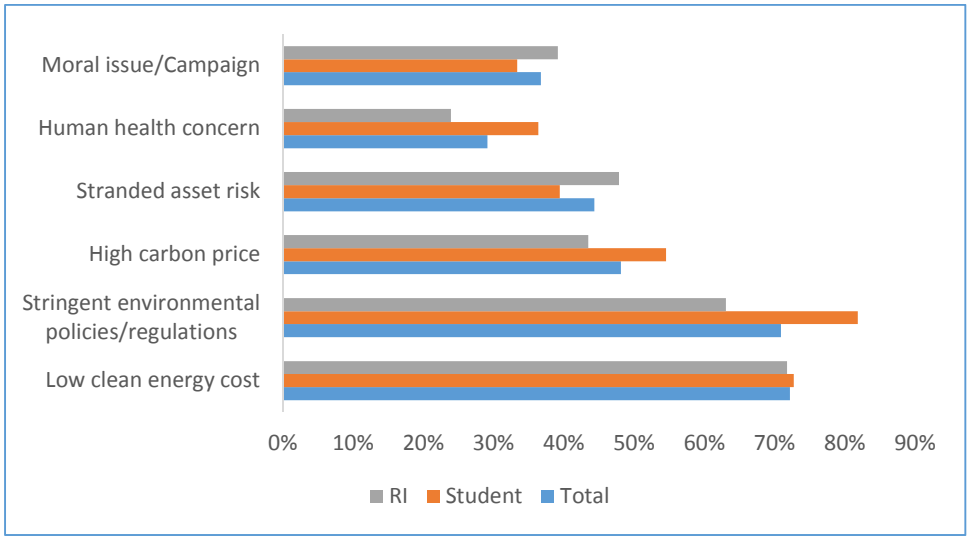

Figure 10: Results of the online survey (continued)

Both responsible investors (n=46) and students (n=33) consider falling clean energy cost as the main driver of fossil fuel divestment, followed by stringent environmental regulations, and high carbon price. This clearly signals that in the future respondents see a shift from fossil fuels to clean energy, and see sense in clean energy investments. Also, more than half the respondents are not convinced with stranded asset argument and place greater emphasis on stringent environment regulations for shifting away from fossil fuels. Views of respondents reflect past divestment campaigns (e.g. tobacco, Sudan, South African), where due to extreme public pressure a tipping point was reached when governments responded by enacting stringent legislations (Ansar, Caldecott and Tilbury, 2013). Interestingly, even the student community do not consider 'morality' as the one of foremost driver of fossil fuel divestment. This is contrary to the belief of divestment campaigners, who have tagged fossil fuel investments as 'unethical' and 'morally ambiguous'[20].

[20] http://gofossilfree.org/wp-content/uploads/2014/05/350_FossilFreeBooklet_LO4.pdf

The fossil fuel divestment campaign has pushed institutional investors to consider climate risk in fossil fuel investments.

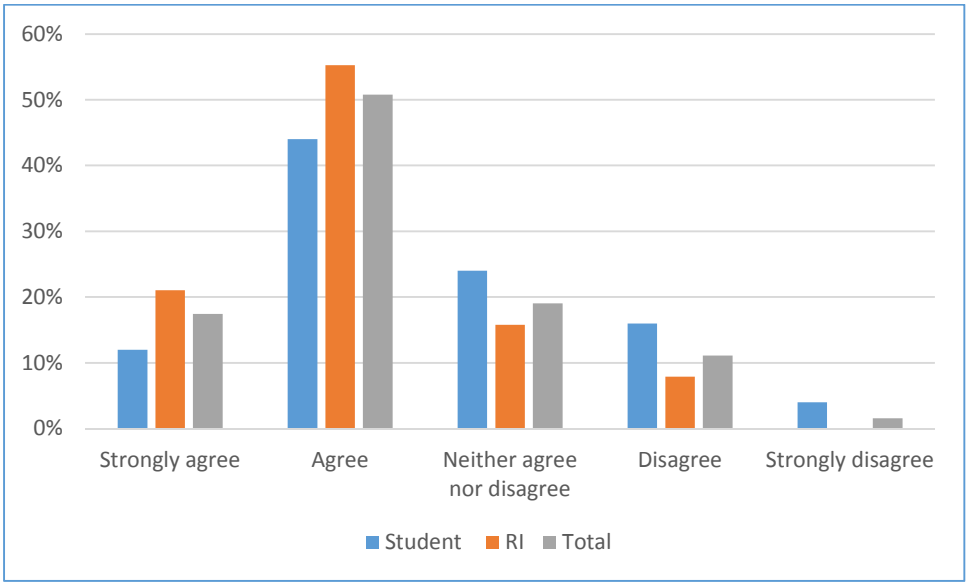

Figure 11: Results of the online survey (continued)

The pattern of responses does not vary significantly as a function of the group ($\chi 2 = 4.02$, df= 4, $p>0.05$). The responses, however, do begin to suggest that responsible investors (n=38) and students (n=25) are less confident that fossil fuel divestment has pushed institutional investors to consider climate risk in fossil fuel investment. Knowland (2010) suggested that climate risk, or the risks posed to companies and investors as a result climate change, is becoming increasingly recognized as an important consideration for the private sector. Results of the survey are also consistent with recent fossil fuel divestment decisions by Stanford University[21] and other big university endowments, Norwegian pension fund Storebrand. Respondents to the survey were also asked if they consider climate risk in investment decisions. Results suggest that 86% of responsible investors consider climate risk as a part of wider ESG issues in the investment decision making process.

Due to fossil fuel divestment campaign investors now face increased material risk in fossil fuel investments.

[21] http://news.stanford.edu/news/2014/may/divest-coal-trustees-050714.html

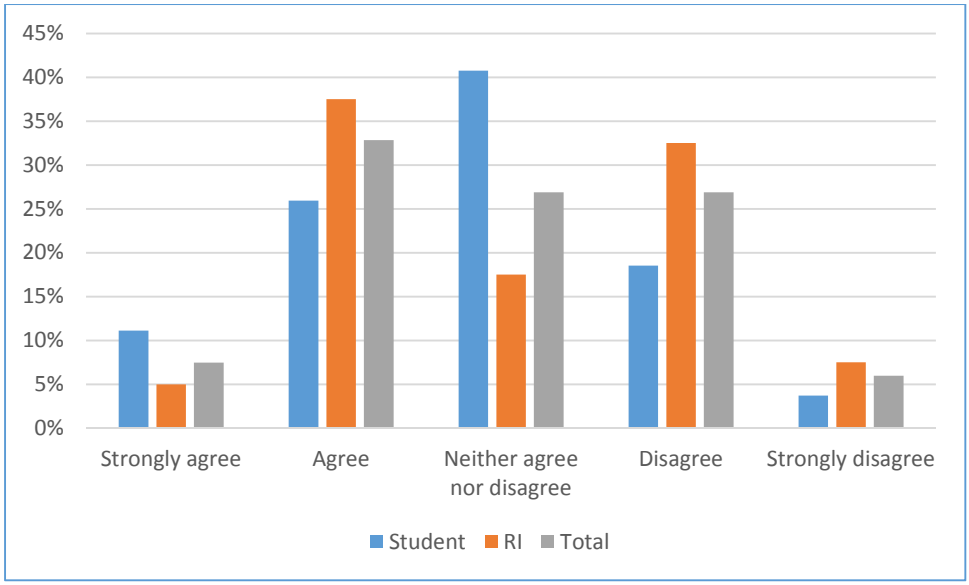

Figure 12: Results of the online survey (continued)

The pattern of responses does not vary significantly as a function of the group ($\chi 2 = 6.26$, df= 4, $p>0.05$). The responses, however, do begin to suggest that responsible investors (n=40) and students (n=27) are less confidently agree that due to fossil fuel divestment investors now face increased material risk in fossil investments. Additional material risk may be due to stigmatization of fossil fuel companies by the divestment campaign, which could lead to their devaluation (Ansar, Caldecott and Tilbury, 2013).

3.4.3 Discussion on impact of divestment on fossil fuel companies

Fossil fuel divestment campaign pose a serious reputational risk to fossil fuel companies which could lead to their devaluation.

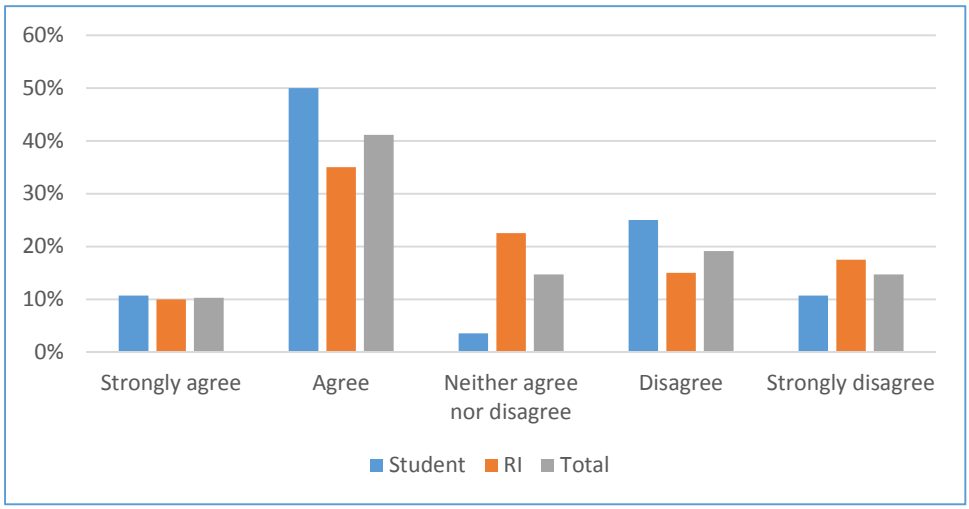

Figure 13: Results of the online survey (continued)

A Chi-squared test (χ^2 =3.93, df=4, P>0.05) suggest that pattern of responses does not vary significantly as a function of the group. Results suggest that responsible investors (n=40), and students (n=28) agree with stigmatization of fossil fuel companies by divestment campaign could lead to their devaluation.

Discussion:

Evidence here confirms the 'stigma theory' on devaluation of fossil firms due to fossil fuel divestment campaign proposed by (Ansar, Caldecott and Tilbury, 2013) which states firms heavily criticised in the media earns a bad image which scares away its partners and stakeholders. This may lead large number of investors to lower the subjective probability of firm's future net cash flows, which results in devaluation of firms.

Divestment of fossil fuel stocks by institutional investors' will affect cost of capital of fossil fuel companies.

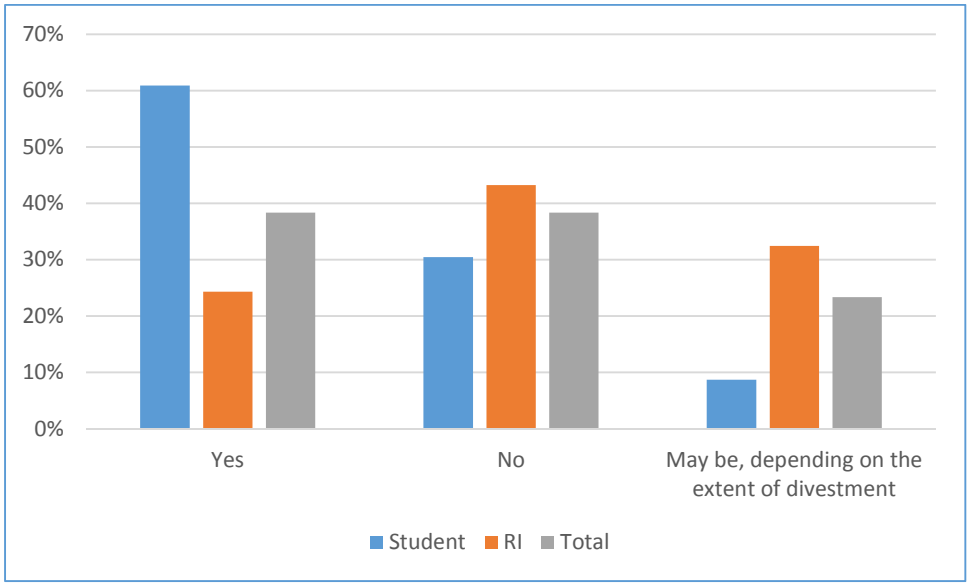

Figure 14: Results of the online survey (continued)

A Chi-squared test (χ^2 =8.97, df=2, P<0.05) suggest that pattern of responses vary significantly as a function of the group. Results suggest that responsible investors (n=37) do not agree that fossil fuel divestment may affect cost of capital[22] of fossil fuel companies. On the contrary students (n=23) thinks otherwise, this may be due to ethical standing of the student group.

[22] In other words, this means that the fossil fuel companies may have to borrow money from banks at a higher interest rates and equity investors may demand higher returns on their investments.

Heinkel, Kraus and Zechner (2001) explained that exclusionary ethical investing leads to polluting firms being held by fewer investors. The lack of risk sharing among unethical investors results in lower stock prices of polluting firms, thus raising their cost of capital. Consistent with these findings, Hong and Kacperczyk (2005) showed that for sin stocks neglect of stocks by large institutions affect their cost of capital. However, the contentions issue to debate is what extent of divestment is needed to affect a fossil firm's cost of capital. Ansar, Caldecott and Tilbury (2013) mentioned that the plausible upper limit of oil & gas equity holding by university endowments and public pension funds is in the range of $200-$400 billion, which is very small in when compared to the market the capitalisation ($4 trillion)[23] of 200 largest fossil fuel companies. Perhaps, the opinion of responsible investors reflects this limited ability of endowments and public pension funds to affect cost of capital of fossil fuel companies.

Fossil fuel divestment campaign will reduce demand of shares of fossil fuel companies.

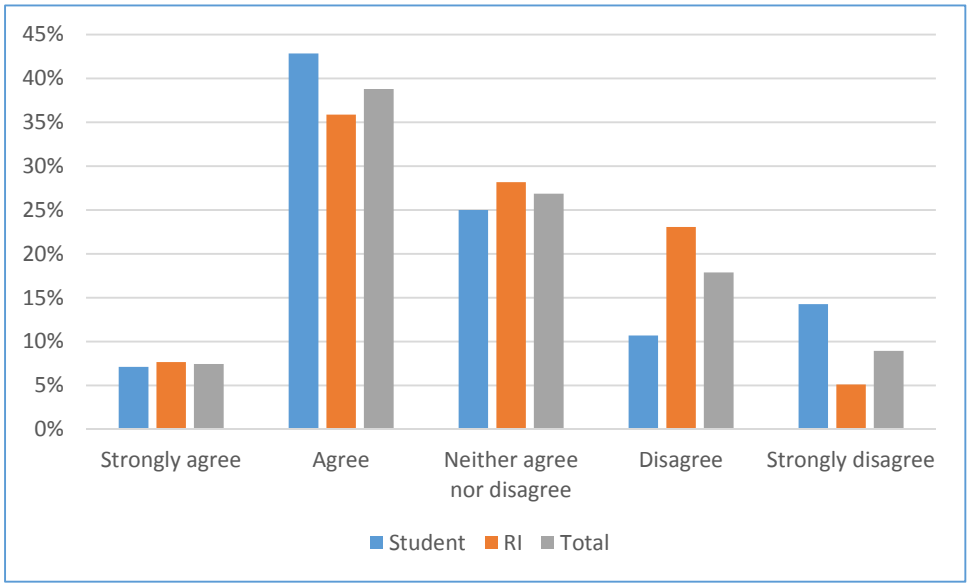

Figure 15: Results of the online survey (continued)

A Chi-squared test (χ^2 =3.18, df=4, P>0.05) suggest that pattern of responses does not vary significantly as a function of the group. Responsible investors (n=39) and students (n=28) agree that the divestment campaign could lead to reduced demand of shares of fossil fuel companies. Results are in line with Ansar, Caldecott and Tilbury (2013), who highlighted

[23] Carbon Tracker (2013)

reduced demand of shares of fossil fuel companies as one of the potential impact of fossil fuel divestment campaign.

3.4.4 Discussion on impact of divestment on investments in fossil fuel companies

In next one year, by how much basis points do you believe the fossil fuel divestment would affect returns on fossil fuel stocks?

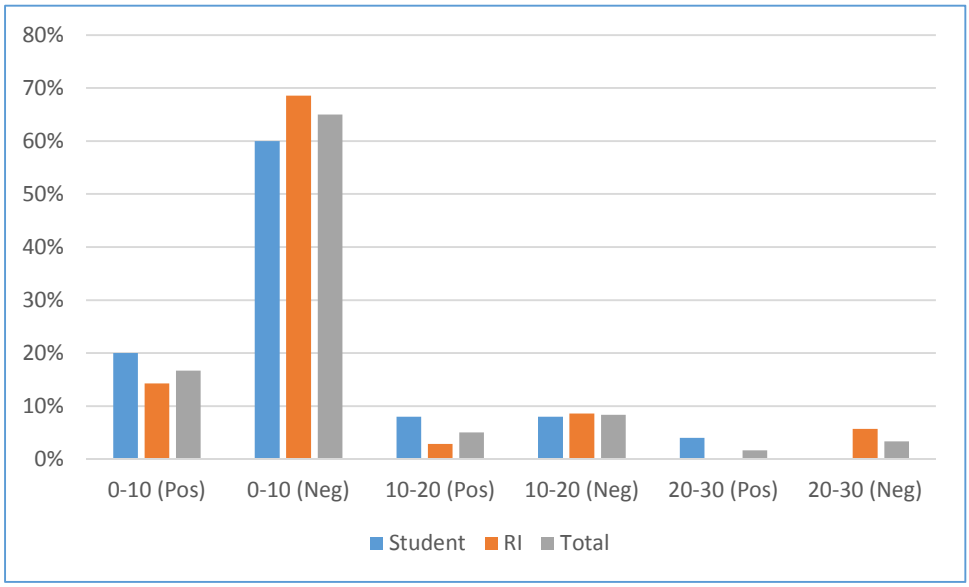

Figure 16: Results of the online survey (continued)

To perform Chi-squared test responses are merged into 4 categories namely 0-10(pos), 0-10(neg), >10 (pos), and >10 (neg). The 'pos' & 'neg' symbol in brackets imply positive or negative sign to the respective scale. For example, 0-10 (neg) means that the scale is between 0 to -10. Similar reasoning is valid for responses to next three survey questions. A Chi-squared test (χ^2 =2.77, df=3, P>0.05) suggest that pattern of responses does not vary significantly as a function of the group. Responsible investors (n=35) and students (n=25) less confidently agree that due to fossil fuel divestment in next one year investors may lose 0-10 basis points (1 basis point = 0.01%) on fossil equity investments. Results are consistent with previous studies on South African divestment (Moore et al, 1993; Meznar, Nigh and Kwok, 1994; Wright and Ferris, 1997). The results of these studies suggest that public announcements of divestment by firms doing business in South Africa resulted in negative returns during the analysis period (short-term). On the contrary, literature (Heinkel, Kraus and Zechner, 2001;Hong and Kacperczyk, 2009) on the 'sin stocks' hypothesise that when green investors refuse to hold stock of sin companies, limited risk sharing between neutral investors results in higher

expected return on 'sin stocks'. How stock market would react to new information on 'fossil fuel divestment' could only be judged best in the future.

In next one year, by how much basis points do you believe the fossil fuel divestment would affect volatility/risk of fossil fuel stocks?

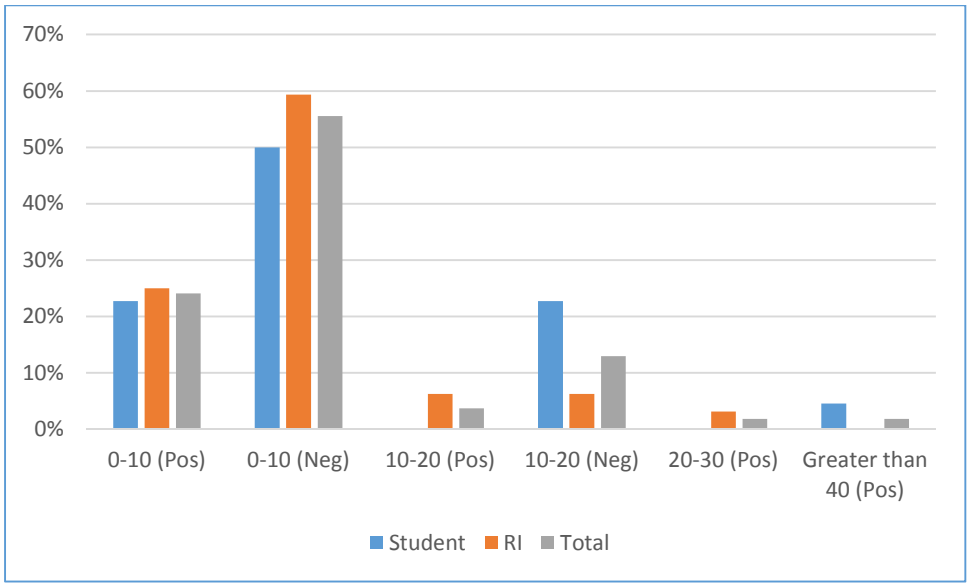

Figure 17: Results of the online survey (continued)

A Chi-squared test (χ^2 =3.37, df=3, P>0.05) suggest that pattern of responses does not vary significantly as a function of the group. Responsible investors (n=32) and students (n=22) suggest that fossil fuel divestment would negatively impact the risk on fossil fuel stocks by 0-10 basis points.

In next one year, by how much basis points do you believe the fossil fuel divestment would affect returns on your portfolio?

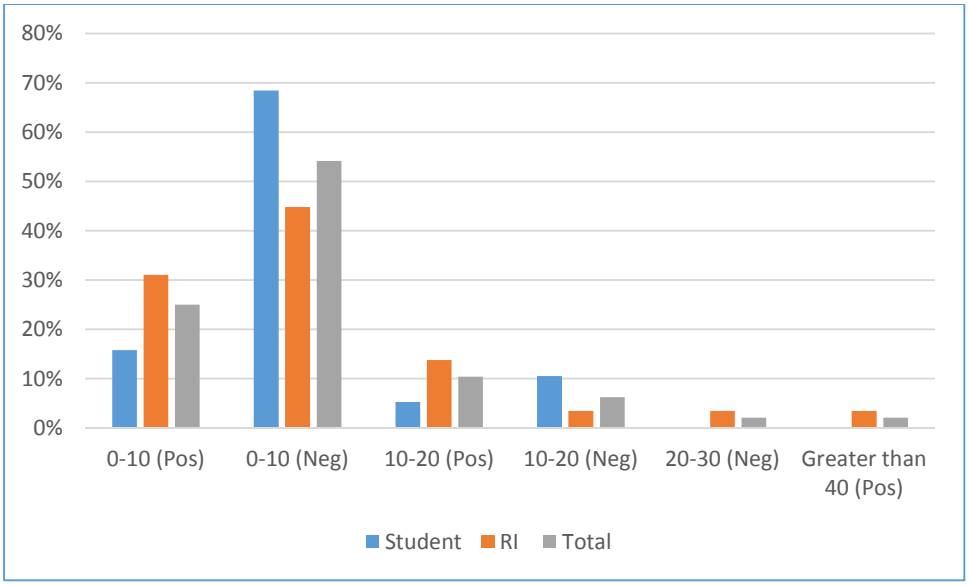

Figure 18: Results of the online survey (continued)

A Chi-squared test (χ^2 =3.74, df=3, P>0.05) suggest that pattern of responses does not vary significantly as a function of the group. Responsible investors (n=29) and students (n=19) suggest that fossil fuel divestment would negatively affect the portfolio returns due to fossil fuel divestment. Results are consistent with Geddes (2013) and Impax Asset Management (2013), who find that excluding fossil fuel stocks will impose return penalty on investors. Bernstein (2014) also suggested that divestment of fossil fuel equities should have a negative impact on the portfolio in the short term due to direct costs of divestment including commission costs, market impact costs, and opportunity costs of constraining the portfolio from the overall investment universe.

In next one year, by how much basis points do you believe the fossil fuel divestment would affect risk in your portfolio?

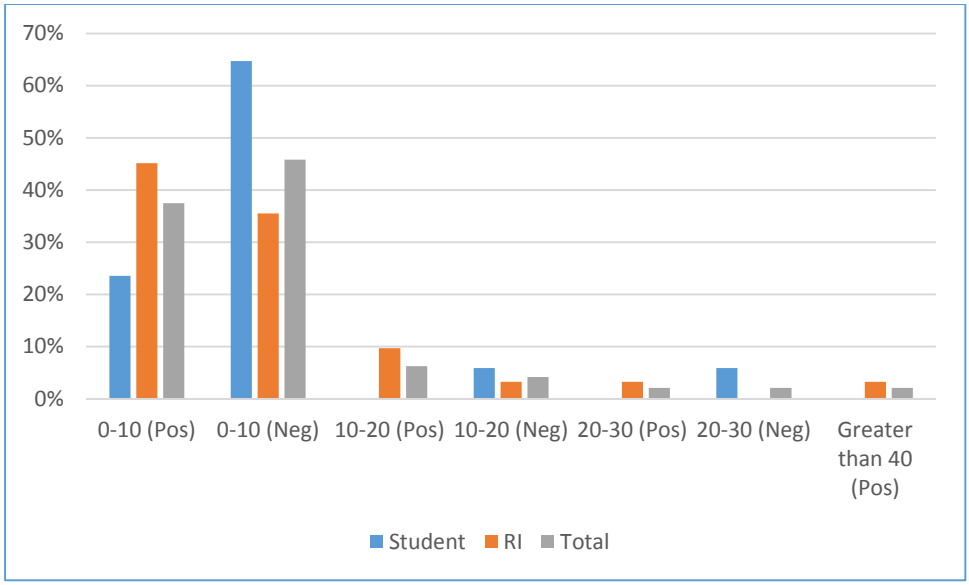

Figure 19: Results of the online survey (continued)

A Chi-squared test (χ^2 =7.43, df=3, P>0.05) suggest that pattern of responses does not vary significantly as a function of the group. Responsible investors (n=31) and students (n=17) suggest that fossil fuel divestment would negatively affect the portfolio volatility. In other words, this means that divesting fossil fuel equity may increase portfolio risk by 0-10 basis points. The result is in line with the findings of previous studies on South African divestment Rudd, 1979; Grossman and Sharpe, 1986) and fossil fuel divestment (Kern, Blachman and Cronin, 2013; Geddes, 2013; MSCI, 2013) predicting that removing targeted companies from the portfolio leads to increased portfolio risk.

CHAPTER 4: Constructing Fossil Fuel Free Index Using Inter-market Analysis Approach

In this section, I first introduce the design of this research study by indicating main research questions and then I will move on to introduce the data and the methodology employed to undertake the research work.

4.1 Introduction

Previous studies on South-African divestment and tobacco divestment suggest that the restrictions imposed by divestment increases investment risk, reduce investment and diversification opportunities. For trustees of endowments and pension funds, building a portfolio without fossil fuel companies could be difficult and risky. Most previous studies on fossil fuel divestment have concluded that a carbon-free portfolio in markets with large

exposure to oil, gas and consumables fuels have historically incurred a significant tracking error. Investors who are concerned about reducing the risks associated with divestment, may consider increasing exposure to sectors and asset classes (e.g. currencies, government bonds, and commodities) with strong correlation with oil and gas industry. In this regard, this study aims to develop a fossil fuel model that could explain the empirical behaviour of the broad fossil fuel sector. Next, we calculate the risks and rewards to investors for divesting fossil-fuel equities. Lastly, we will compare the results from this quantitative analysis with the opinion of survey respondents on financial implications divestment.

4.2 Aims

Using financial data from various asset classes and global markets, the aims of this study are the following:

- Using inter-market approach, develop a fossil free model (index) that could closely replicate the performance of broad fossil energy sector;
- Estimate the cost to investors for divesting from fossil fuel sector;
- Finally assessing the accuracy of survey respondents' opinion on impact of divestment on portfolio performance

4.3 Methodology and data

The below figure summarizes the conceptual framework of the research. Due to the limited scope of this work, I exclude the intangible factors.

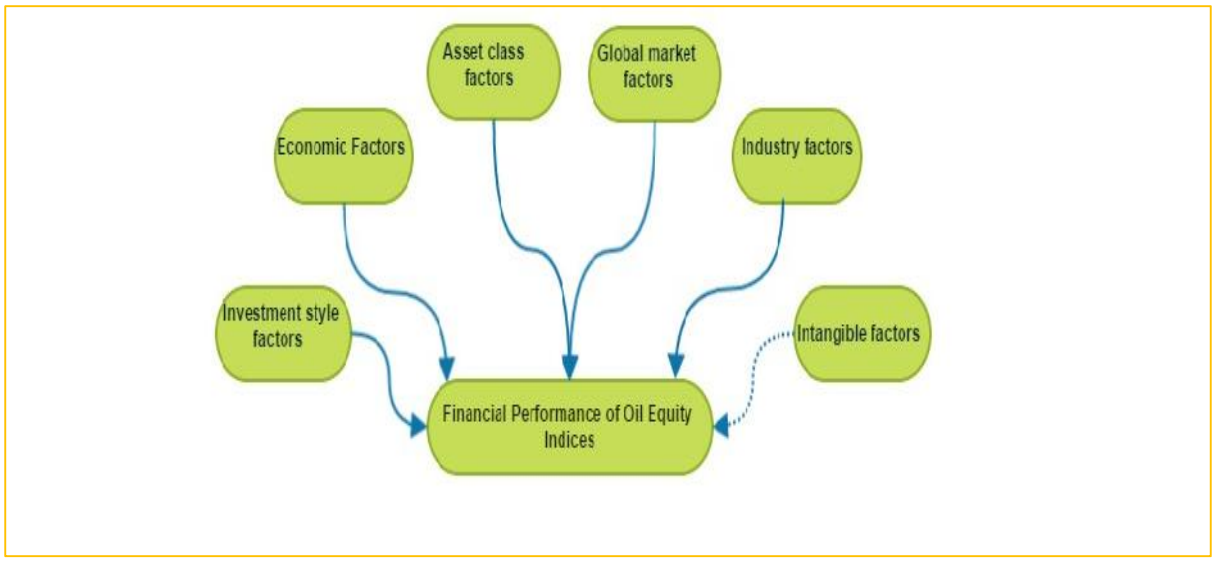

Figure 20: Intermarket approach research framework

To explain the performance of oil equity indices using other asset classes, I use inter-market approach introduced by Schopohl (2013). The methodology is based on a multivariate statistical techniques to map the stock market performance as a function of other relevant factors. Schohol (2013) concluded that inter-market approach is able to explain major components of both the existing and future financial performance for three all stock market levels: market index, sector index, and single stocks. The study reported that for the oil sector index, the model explained 77.4% of its empirical behaviour for the sample period (Feb, 1995-Apr, 2013). To construct a fossil fuel-free model closely replicating the performance of the world oil equity indices, this study considers a broader and frequent dataset for all asset classes and market factors than Schopohl (2013).

As with most research studies, this study too is limited in terms of number of asset class and market factors considered in the analysis. Overview of all factors considered in this study is given in the table 5. The data for this study consists of end-of week stock market prices for 11 developed countries: USA, Japan, Australia, Hong Kong, Singapore, UK, France, Germany, Italy, Spain, Canada; and 5 developing countries: India, China, Russia, Chile, South Africa. Data also covers stock indices tracking the Asia-Pacific, Asia, Europe, and global market. Stock indices data covers countries/regions representing different levels of economic development and thus deemed suitable to describe price variation of oil equity indices with respect to stock markets. Regarding asset class factors, I focus on government bonds, commodities (including multi commodity indices and exchange traded funds), and currency exchange markets. Investment style factors are covered by including stock market indices for small cap, mid cap and large cap stocks. End of week data for all each asset class and market factors has been sourced from Datastream, details of which are included in table 5. Table 6 contains the descriptive statistics of data. I have used MSCI World Oil, Gas and Consumable Fuels Index to represent the performance of fossil fuel sector[24]. The stock market and government bond prices are obtained in local currency in order to capture potential exchange rate effects. As the commodity, the industry indices and the investment styles indices are global factors, they are downloaded in USD. The main analysis is based on the longest common sample, which is from 5th Jan 1990 to 11th July 2013 and covers 1279 observations.

[24] http://www.msci.com/products/indexes/thematic/commodity/

Prior to performing the empirical analysis, all financial data, is transformed into logarithmic returns by using the following formula:

$$R_{i,t} = \ln (P_{i,t}/P_{i,t-1})$$

Where,

$R_{i,t}$ = weekly return on investment 'i' at time 't'

$P_{i,t}$ = price of investment 'i' at time 't'

$P_{i,\,t-1}$ = price of investment 'i' at time 't-1'

The logarithmic returns can be interpreted as continuously compounded returns – so that the frequency of compounding of the returns does not matter and thus returns across assets can more easily be compared (Brooks, 2008). For this reason, I use logarithmic returns for my study.

Methodologically, the inter-market approach is described in Figure 23. To undertake the inter-market analysis, I first gather the relevant inter-market factors to explain the empirical behaviour of oil stock indices. Next, I calculate the correlation of oil stock index with identified factors and rank them according to their absolute correlation with oil stock index, with highest correlated factor ranked one. Proceeding further, I run an Ordinary Least Square (OLS) regression with the oil equity index as the dependent variable and the highest correlated inter-market factor as the explanatory variable. As noticed in the correlation analysis, the inter-market factors themselves are highly correlated causing the problem of multi-collinearity when introduced to the model. To avoid this, I use orthogonalisation approach proposed by Elton et al. (1993) which offers an accurate statistical correction for the influence of the already introduced factor on the additional explanatory variables to be introduced to the model. I only keep the additional orthogonalised factor in the model if it proves significant at the 20% level and increases the adjusted R^2 of the model. Finally, I decompose the adjusted R^2 of the model according to each factor's contribution. The increased R^2 from introduction of a variable allows me to assess the nature and strength of the inter-market linkages. To control for autocorrelation and heteroskedasticity, all regressions are estimated using Newey-West Standard Errors (Newey & West, 1987).

To construct a fossil fuel-free model, I first exclude all oil related factors like equity indices and commodity indices with 'energy sector' as a constituent, oil commodities, and energy sector indices from the relevant factors tested for the parent model. Constituent sectors for all stock market indices, commodity indices, and commodity ETFs were checked from the from the 'fact sheet' of indices/ETFs available on index providers website[25]. I used the same steps as explained for the parent model to construct a fossil fuel-free model explaining the performance of oil stock index. Fossil free index was constructed by subtracting residual series of the deterministic model from the oil equity index. Average annualized returns for both oil equity index and fossil fuel-free index were then calculated to compare the historical performance of two indices. We calculate downside standard deviation[26] of average annualised returns to estimate absolute risk/volatility for both indices. Grootveld and Hallerbach (1998) mentioned that downside risk concept separates undesirable downside fluctuations from desirable upside fluctuations therefore better matched investors' intuition about risk than variance.

4.4 Results

Overall the inter-market approach (parent model) is able to explain 82.09% performance of the oil-equity index over the sample period, when all asset class factors and market factors were included in the model. Among 38 significant factors in the model that explained the performance of oil equity index, 25 were stock market factors, followed by 6 commodity factors, 6 currency exchange and 1 government bond. NYSE composite index explained 56.12% of adjusted-R^2, followed by S&P 500 (6.48%), S&P GSCI commodity index (3.45%) and S&P TSX composite index (3.21%). Results are consistent with the fact that oil & gas sector constitutes 16.25% of the NYSE composite index and energy sector occupies 10.9% weight in the S&P 500 index[27] [28]. Looking at the asset classes, stock market indices captured of 76.29% adjusted-R^2, followed by commodity (4.43%), currency exchange (1.33%), and government (0.05%). We conclude that model performed well to explain the performance of the oil equity index. Results for the parent model are reported in Table 8.

[25] For e.g. the factsheet for S&P 500 Index is available here http://www.spindices.com/documents/factsheets/fs-sp-500-ltr.pdf

[26] The downside standard deviation, also referred to as downside risk, differs from the ordinary standard deviation insofar as the sum is restricted to those returns that are less than the mean.

[27] http://www1.nyse.com/about/listed/nya_characteristics.shtml

[28] http://www.spindices.com/documents/factsheets/fs-sp-500-ltr.pdf

When all fossil fuel related factors were excluded, the model explained 69.29% of variation of oil equity index over the sample period. The result is in line with Schopohl (2013) who explained 77.40% of the empirical behaviour of oil equity index over the sample period. The lower value of adjusted-R^2 in this study could be due to exclusion of all stock market indices, commodity indices, and commodity ETFs having oil & gas as a constituent. The analysis found that most important factors explaining the empirical behaviour of oil equity index are industry factors. The industrial sector captured 49.69% of adjusted-R^2, followed by basic materials sector (5.52%) and utility sector (5.41%). Looking at the asset classes, stock market indices explained 67.4% of variation in oil equity index, followed by currency exchange (1%), commodity (0.77%), and government bond (0.1%). Regression results are reported in Table 7 and summary of the oil-free model is mentioned in Table 9.

Most of the previous studies on financial impact of fossil fuel divestment focussed on identifying portfolio risk of a fossil fuel-free portfolio. To the best of knowledge, no previous studies in the mentioned area empirically investigated the 'cure' to reducing risk as a result of divestment. In this regard, findings of this research could be useful to investors who are concerned about reducing portfolio risk originating from divesting fossil fuel equities. Results suggest that investors' who choose to divest from fossil fuel sector may consider increasing portfolio exposure to industrial sector, basic materials sector and utility sector. Investors' could also diversify to currency exchange, and precious metals & agricultural commodities to reduce incremental risk due to divestment of fossil fuel equities.

Looking at the risk and return profile of the fossil fuel-free index, results (see Table 2) of the study suggest that the deterministic model (fossil fuel free index) has lower downside risk (absolute) and return than the oil equity index. To investigate the lower risk and return of oil free index, we calculated the weighted risk and weighted return of the factors (Industrial, utility, and basic materials sector) explaining most (~60%) of the performance of the oil equity index. Risk and return for the three factors were weighted by their respective contribution to adjusted-R^2. We find (see Table 3) that during the sample period the weighted risk and weighted return of major determinants of oil equity index were lower than the index itself. For this reason, the fossil-free index exhibits lower risk/return profile than the oil equity index.

Table 2: Risk and Return profile of indices

	MSCI Oil, Gas, Consumable Fuels	Fossil Fuel Free Index	Difference (Basis points)
Sample Period	06/01/1995-11/07/2014	06/01/1995-11/07/2014	06/01/1995-11/07/2014
Annualised Return (Logarithmic)	0.16%	0.13%	-3
Downside Standard Deviation	2.44%	2.25%	-19

Table 3: Weighted risk and return of fossil fuel index

	MSCI World Utility Index	MSCI World Industrial Index	FTSE U.S. Basic Materials Index
Return	0.07%	0.09%	0.13%
Downside Risk	1.70%	2.06%	2.63%
Contribution to adjusted R^2	0.054091	0.496932	0.055198
Weighted Return	0.0000356	0.0004671	0.00007
Weighted Downside Risk	0.0009178	0.0102301	0.0014514
Overall Weighted Return	**0.095%**		
Overall Weighted Risk	**2.079%**		

Chapter 5: Recommendations

5.1 For campaigners

Owning to heavy dependence of world economies on fossil fuels for energy generation and ongoing industrialization in developing countries (IEA, 2013), a world without fossil fuels is unimaginable at present. Therefore, targeting the fossil fuel sector by constraining its financial flows will only hinder the capacity of fossil fuel companies to meet world's future energy demands. Results of this study suggest that for an effective and impactful fossil fuel divestment campaign, campaigners must first target coal industry. Also to assure the

environmental sustainability of oil and gas companies, the divestment campaign should focus on punishing companies with worst environmental performance in the sector.

5.2 For fossil fuel companies

Freeman (1984) and Deephouse (1999) suggested that for a firm to remain competitive in a global arena require superior financial performance and secure social support from external stakeholders. Criticism or condemn of a firm's activities reduces its capacity to find investors, build stable alliance, and maintain a loyal customer (Sullivan, Haunschild and Page, 2007). Therefore, the key strategy of fossil fuel companies should be to keep public disapproval and media criticism to a minimum. Survey result suggest (see Figure 24) fossil fuel companies are not genuinely engaging with shareholders on climate change related issues, and are not taking steps to address stigma attached to them by the fossil fuel divestment campaign. In future, fossil fuel companies implementing stringent climate policies and providing a good level of disclosure on climate mitigation activities will suffer the least devaluation due to the divestment campaign.

5.3 For investors

Given the growing consensus around climate change science, it is rational for investors to expect stringent carbon regulations, with profound economic effects, in the not too distant future (Impax Asset Management, 2013). Though most investors are considering climate risk in investment decision (see Figure 22), divestment of fossil fuel equities could still pose additional risk for trustees of endowments and pension funds. Therefore, trustees or fiduciaries who develop institutional investment policy statement should fully understand the consequences of screening out stocks of companies which produce a product that is inconsistent with their value systems (Fabozzi, Ma and Oiliphant, 2008). Findings of this study suggest that investors who are concerned about reducing portfolio risk associated with divesting fossil fuel equities, may consider increasing exposure to industrial sector, basic materials sector, utility sector, currency exchange, and precious metals & agricultural commodities.

Chapter 6: Conclusion

6.1 Fossil fuel divestment campaign

This research shows that responsible investors and students do not consider fossil fuel divestment as the best strategy to address climate and suggest that linking fossil fuel divestment so closely with climate change may derail other needed efforts to address the issue. Respondents also believe that low clean energy cost and looming climate policies will be the primary reasons for decreasing energy dependence on fossil fuel, but not the divestment campaign. In the long-term, both responsible investors and students see fossil fuel divestment succeeding in the coal sector. However, respondents do not believe that investors will divest their equity in oil and gas sector in at least next 10 years. Respondents agree that due to fossil fuel divestment campaign institutional investors' increased material risks in fossil fuel investments. Perhaps, the biggest contribution of fossil fuel divestment campaign is that it has pushed institutional investors to consider climate risk in fossil fuel investments.

6.2 Financial impact of divestment on fossil fuel companies

Looking at the financial impact of divestment on fossil fuel companies, survey results suggest that stigmatization of fossil fuel companies by the divestment campaign will eventually lead to their market devaluation. Respondents also believe that fossil fuel divestment will also reduce the demand of shares of fossil fuel companies, increase their cost of capital, and negatively affect the performance of fossil fuel stocks. Survey results are in line with the findings of Ansar, Caldecott and Tilbury (2013).

6.3 Financial impact of divestment on fossil fuel investments

With regard to implications of divestment on fossil fuel investment, the empirical investigation suggest that university endowments and pension funds fully divesting from fossil fuel companies, will attract an annualised return penalty in the range of 0-10 basis points on their portfolio. Results of inter-market analysis provide a 'cure' to the investors' conscious of incurring risk due to fossil fuel divestment. This empirical study suggest that investors' who choose to divest from fossil fuel sector can reduce the incremental risk by increasing portfolio exposure to industrial sector, basic materials sector and utility sector.

Investors' could also diversify to currency exchange, and precious metals & agricultural commodities for risk hedging.

Chapter 7: Limitations of this study

Due to limited responses of responsible investors and students to the survey, this study was limited to comparing attitude of two groups on fossil fuel divestment. Further research may focus on developing a mathematical model to explain the attitude of long-term investors (e.g. pension funds, insurance companies, endowments) towards fossil fuel divestment and its financial implications. In this regard, the model could consider impact of divestment on share price of fossil fuel companies and impact of divestment on portfolio returns, as dependent variables in two separate models. The variation in dependent variables could be expressed as linear function of investor's geographical location, investment in the fossil fuel sector, type of organisation etc.

To identify the determinants of oil-equity index, the experiment we conducted could be extended to other oil-equity indices and assess the comparative variation in risk and return profile of resultant oil-free indices. The inter-market approach in this study use standard regressions and employs simple OLS regression, therefore further research studies could apply dynamic correlation method to assess inter-market linkages.

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Appendices

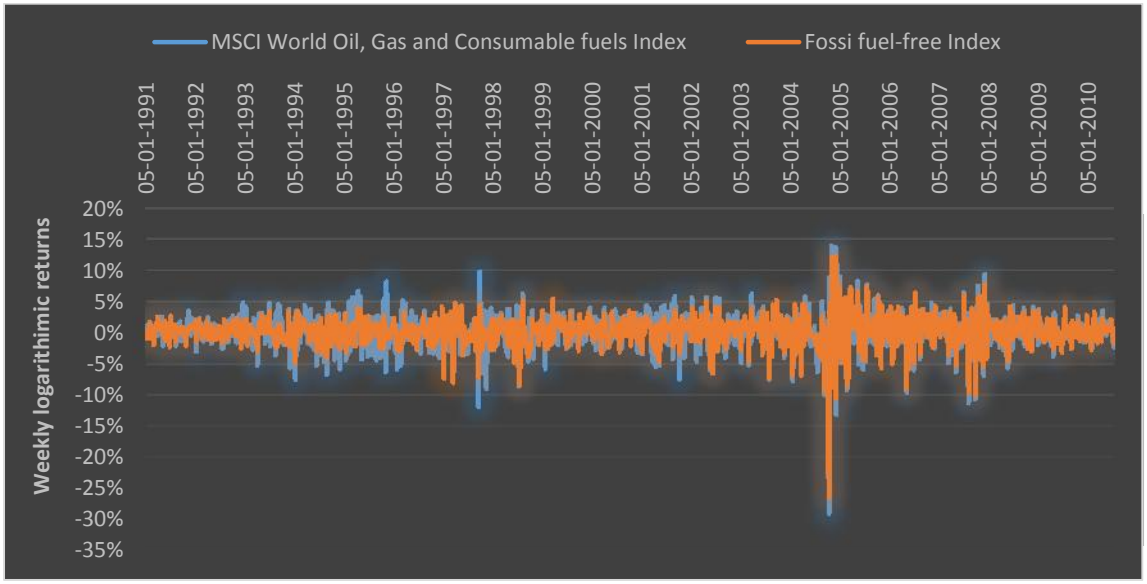

Figure 21: Volatility of returns for oil equity index and fossil fuel-free index

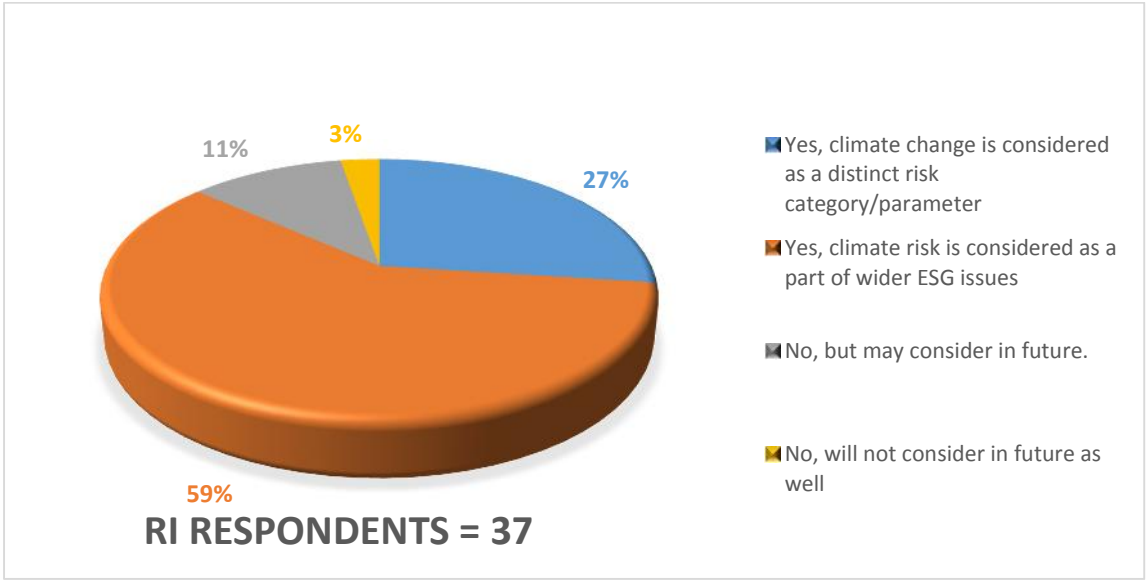

Figure 22: Consideration of climate risk investment decisions by responsible investors

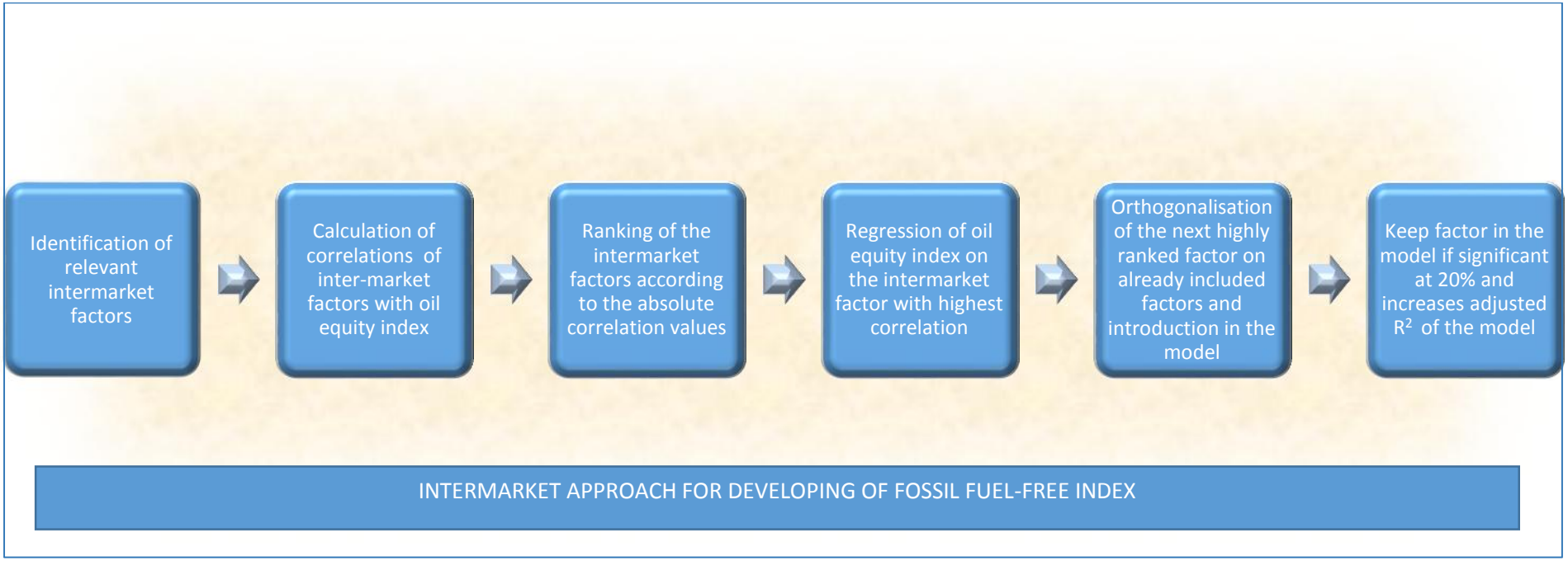

Figure 23: Inter-market approach

Fossil fuel companies are appropriately addressing possible negative consequences of stigma attached to them by the divestment campaign	**Fossil fuel companies genuinely engage with shareholders to address the climate risk**

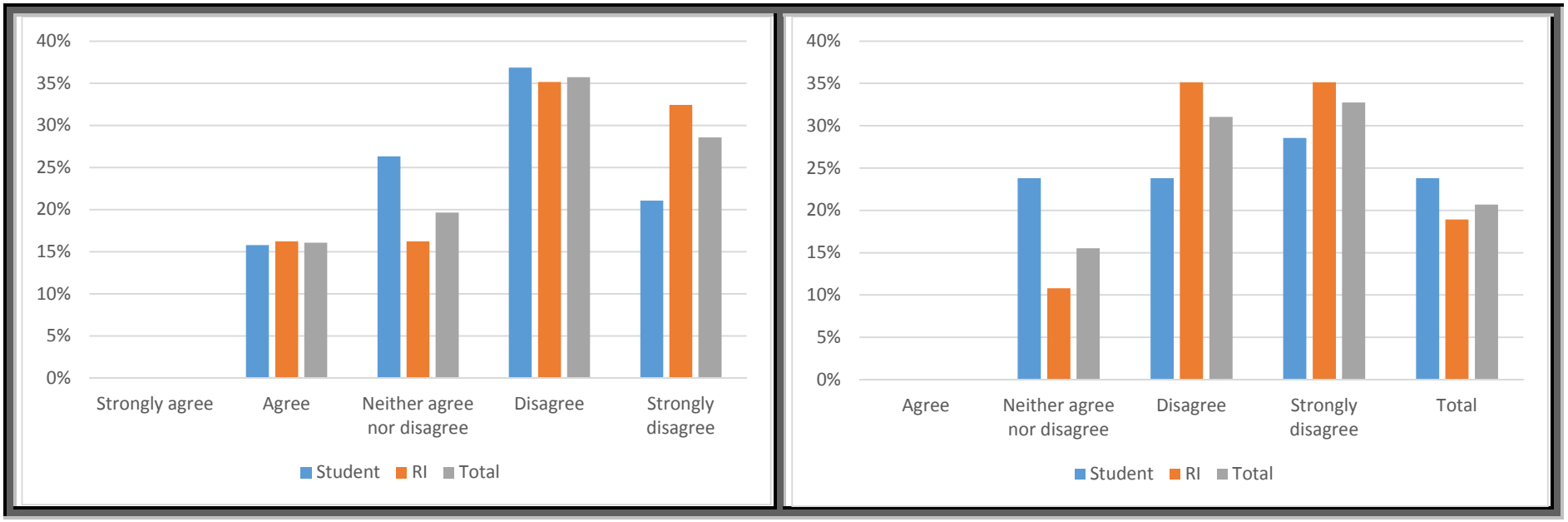

Figure 24: Respondents opinion on attitude of fossil fuel companies towards climate risk and fossil fuel divestment

Table 4: Literature review table for determinants of oil equity index

Explanation: The below table explains the empirical studies on determinants of oil prices that are discussed in section 2.3. The studies are categorised as follows: (a) Determinants of oil prices, (b) Interrelationship between oil prices and other market factors, (c) Determinants of an equity index. Due to the extended size of the table it is divided over multiple pages. First table introduce the research studies, including analytical method employed for the research. Second table, discuss the findings of each research studies. Third table discuss the determinants of oil prices used in different research studies.

Category	Author (s)	Research question	Sample period	Analytical Method

Determinants of Oil prices	Les Coleman (2011)	How does futures market speculation, threats to security in Middle East, and unexpected events influence oil price?	1984-2007	Multi-variable time series regression-Crude oil price is expressed as a linear function of independent and dummy variables.
Determinants of Oil prices	James Hamilton (2008)	What factors are responsible for changes in crude oil prices?	1970-2008	a) Statistical investigation of the basic correlations in the historical data; b) Analysing the predictions of economic theory as to how oil prices behave over time; c) Examining determinants of oil demand
Determinants of Oil prices	Dees et al (2008)	What are the factors behind crude oil price change between 2004 and summer of 2006?	1986-2000	a)The co-integrating relationship for crude oil prices is estimated using the dynamic ordinary least squares (DOLS) developed by Stock and Watson (1993); b) Short run dynamics are estimated using an error correction model.
Interrelationship between oil prices and other market factors	Sukcharoen (2009)	Do oil prices and stock market indices move together when oil and and gas stocks are excluded?	1982-2007	a) Copula approach is used to explore general dependence between series. b) GARCH-GJR model is used with innovations modelled by a Student-t asymmetric generalized distribution of Hansen (1994).
Determinants of an equity index	Garefalakis et al	What are the determinants of Hang Seng Index series?	2002-2009	ARCH model
Determinants of Oil prices	Fan and Xu (2011)	What are the main drivers leading to oil price fluctuations or price shaping?	2000-2009	a) Multi-factor market model; b) Endogenously determined break tests

Interrelationship between oil prices and other market factors	Malik and Ewing (2009)	Is volatility transmitted between oil prices and equity sector returns?	1992-2008	a) Bivariate GARCH model b) BEKK parameterization for the bivariate GARCH
Determinants of Oil prices	Cifarelli and Paladino (2009)	Does speculation affects oil price dynamics?	1992-2008	a) Univariate GARCH-M model b) Multifactor ICAPM model c) Trivariate CCC GRACH-M model
Determinants of Oil prices	Basher et. Al (2011)	What is the relationship between oil prices, exchange rates, and emerging stock market prices?	1988-2008	Six variable SVAR model
Interrelationship between oil prices and other market factors	Zhang et al. (2008)	What is the influence of US dollar exchange rate on the international crude oil price?	4 Jan 2000 to 31 May 2005	a) Cointegration b) VAR model c) ARCH type d) Granger casuality test
Interrelationship between oil prices and other market factors	Zhang and Li (2014)	How is the long run behavious of oil-equity correlations?	04 Jan 1990 to 15 Nov 2012	a) Assymetric dynamic conditional correlation, b) A novel decomposing approach
Interrelationship between oil prices and other market factors	Creti et al (2014)	What is the degree of interdependence between oil price and stock market indices for oil exporting and oil importing countries?	03 Sep 2000 to 03 Dec 2010	Frequency approach allowing for time-varying dynamic correlation between indices and oil prices
Interrelationship between oil prices and other market factors	Hammoudeh et al (2002)	What are the spill-over effects, day effects and dynamic relationships among oil sector indices and oil prices for the U.S. oil markets	17 Jul 1995 to 10 Oct 2001	a) Unit root test b) Co-integration test c) Error correction model

Interrelationship between oil prices and other market factors	Sari et al. (2009)	What is the directional relationship between the spot prices of precious metals, oil price and euro-US dollar exchange rate?	1999-2007	a) Bounds testing approach to check for co-integration b) JJ Multivariate co-integration test c) Dickey-Fuller GLS de-trended unit root tests d) First differences of the data series in the VAR

Author (s)	**Findings**
Les Coleman (2011)	The study conclude that 79% of variation in monthly oil prices is explained by positive significant relationships with corporate bond yields (financial factor), frequency of fatal terrorist attacks in Middle East (security risk factor), global GDP, the number of US troops in the Middle East (security risk factor), the interaction term incorporating OPEC market share and OECD demand (demand factor), speculative activity in the oil futures market, and by a negative relationship with OPEC's share of global production (supply factor).
James Hamilton (2008)	The study find low price elasticity of demand, the strong growth in demand from China, the Middle East and other industrialized countries, and the failure of global production led to increases in oil prices.
Dees et al (2008)	The study suggested that most of the increase in crude oil price between 2004 and the summer of 2006 can be explained by concerns about future oil market conditions, materialized by the shift of the futures market in contango, as well as drop in refinery utilization rate in the U.S. Results of analysis indicate that there is little evidence that increasing refining capacity could lower crude oil prices. Of the variables identified in the paper, only stocks of crude oil effectively participate to lower real oil prices by $2 in the long run.
Sukcharoen (2009)	The study find that most of the relationships were found symmetric, meaning oil price and stock market indices will have similar relationship regardless of the state of economy. The tail dependencies are relatively strong for the stock index returns of large oil consuming and producing countries (US, Canada). Left tail related asymmetry observed in case of France, Germany, Italy, Netherlands, and Spain, and right tail related for the UK.
Garefalakis et al (2008)	The study show a positive transmission of return effect from the U.S. market (S&P500) to the Hong Kong Market. Other findings were that crude oil prices positively affect the Hong Kong Market; the volatility of the gold return series exerts a negative influence on the mean return of the Hang Seng Index series. The results also showed a negative relation between the USD to Yen exchange rate and Hang Seng stock volatility.

Fan and Xu (2011)	Oil market mechanism has undergone two great adjustments since 2000. First break point, on around March 12, 2004, which was mainly caused by strong oil demand and vast amounts of speculative funds pouring into the oil futures market since 2003. Second breakpoint on around June 6, 2008, which was caused by the outbreak of financial crises. Also, During January 7, 2000 to March 12, 2004, speculation and episodic events were the main drivers affecting oil price changes. Whereas during March 12, 2004 to June 6, 2008, other financial market factors, especially speculation became important drivers affecting oil price changes.
Malik and Ewing (2009)	a) Oil return volatility is indirectly affected by news from financial sector ; b) Oil return volatility declines significantly when demand for consumer products and services is high and consumer services firms are doing well C) Oil return volatility is found to be indirectly affected by the health care sector D) Oil return volatility is affected indirectly by volatility of the industrials returns.
Cifarelli and Paladino (2009)	The higher the volatility, the stronger proves the serial correlation of oil returns, consistently with a model where some traders follow feedback strategies. Secondly, serial correlation of oil returns is influenced by the conditional covariance between factors (Dow Jones Industrial Index and the US Dollar exchange rate). Overall results suggest that traders hedge their portfolio considering oil as a component of their wealth allocation strategy.
Basher et. Al (2011)	Oil prices respond negatively to an unexpected increase in oil supply and oil prices respond positively to an unexpected increase in demand. Secondly, oil prices respond positively to a positive shock to emerging stock markets.
Sari et al. (2009)	Strong bi-directional relationship between the oil price return and that of silver is noticed, with each explaining more than 2% of each other's variation. On the other hand, the relationship between the oil price return and that of gold is very weak and asymmetric. However, the reverse relationship between oil and gold is somewhat stronger as oil explains 1.7% of gold price returns. Also, palladium and platinum could explain less than 1% variation in oil price return. Results also suggest that the changes in exchange rate and oil price return do not have considerable linkages with each other.
Zhang et al. (2008)	The study suggest that there is a unidirectional spill-over effect from US dollar exchange rate on oil price. However, the volatility spill-over effect between two markets is statistically insignificant.
Zhang and Li (2014)	Study noticed a recent hike in oil equity correlations and concluded it as a long run phenomenon

Creti et al (2014)	Inter-dependence between the oil price and the stock market is stronger in oil exporter markets than import countries
Hammoudeh et al (2002)	a) Study suggest that pure oil industry equity and mixed oil price/equity index offers more opportunities for long-run portfolio diversification and less market integration than the pure oil price systems. B) Oil future market has a matching volatility effect on the stocks of some oil sectors

Author (s)	**Dependent Variable**	**Independent Variables (factors)**							
		Demand and Supply	**Economic**	**Oil Price**	**Commodity**	**Currency exchange**	**Stock market**	**Interest rate/ Bonds**	**Events**
Les Coleman (2011)	Crude oil price	Demand factor (OPEC market share X OECD import dependence), Supply factor (OPEC market share)						Aaa rated corporate bonds	Political factors (e.g. Iraq war, hurricanes 2006)
James Hamilton (2008)	Quarterly percentage change in Crude oil price	Lagged real oil price	U.S real GDP rate					U.S. nominal interest rates	

Dees et al (2008)	Real average FOB price for all crude oil imported by the US	Days of forward consumption of OECD crude oil stocks, OPEC capacity utilization, US refinery utilization rate		Difference of four month contract of WTI and a near month contract					
Sukcharoen (2009)	Oil price	N/A					Stock market indices for developed and developing countries		
Garefalakis et al	Hang Seng Index			Crude Oil Price	Gold	USD to Yen	S&P 500 Index Lagged factors of Hang Seng Index		
Fan and Xu (2011)	Log-differenced crude oil price				Log-differenced gold futures price, Log-difference	Log-differenced US Dollar Index			Iraq war, 9/11 attack

					d Baltic Dry Index				
Malik and Ewing (2009)	Crude oil price						Sectoral stock indices		
Cifarelli and Paladino (2009)	Oil Spot price	US dollar exchange rate		Oil Futures price			US Stock Index		
Basher et. Al (2011)	All mentioned independent variables	Global oil production (lag length set at 4)	Global real economic activity (lag length set at 4)	Real oil prices (lag length set at 4)		trade weighted exchange rate index (lag length set at 4)	Real emerging stock market prices (lag length set at 4)	Interest rate spread (lag length set at 4)	
Sari et al. (2009)	Log difference of returns on WTI crude oil				Log difference of returns on Palladium, Platinum, Silver, Gold	Log difference of returns on US dollar/euro exchange rate			

Zhang et al. (2008)	Log of international crude oil price					Log of US dollar exchange rate			
Zhang and Li (2014)	Returns on WTI oil price index						US, UK, Germany and BRICS nations stock market indices		Dotcom crash, US economic recession, oil shocks, European debt crises
Creti et al (2014)	Brent crude oil index						Stock market indices for US, Italy, Germany, the Netherlands, France, UAE, Saudi Arabia, Venezuela, Kuwait		09/11 attacks, Iraq war, Hurricanes in the US, Nigeria attacks
Hammoudeh et al (2002)	Crude oil spot and futures prices			Oil sector indices					

Table 5: Overview of data and data sources

NAME	DATA SERIES	SOURCE	DATASTREAM CODE	DATA PERIOD
STOCK MARKET FACTORS				
Global				
Equities Global	DJ GLOBAL TOTAL STOCK MKT - PRICE INDEX	Datastream	DJDWGI$	29/09/2006-11/07/2014
Equities Global	NASDAQ COMPOSITE - PRICE INDEX	Datastream	NASCOMP	05/01/1990-11/07/2014
Equities Global	DOW GLOBAL $ - PRICE INDEX	Datastream	DOWGBL$	12/01/2001-11/07/2014
USA				
Equities U.S.	DOW JONES INDUSTRIALS - PRICE INDEX	Datastream	DJINDUS	05/01/1990-11/07/2014
Equities U.S.	S&P 500 COMPOSITE - PRICE INDEX	Datastream	S&PCOMP	05/01/1990-11/07/2014
Equities U.S.	RUSSELL 2000 - PRICE INDEX	Datastream	FRUSSL2	05/01/1990-11/07/2014
Equities U.S.	DOW JONES TRANSPORTATION - PRICE INDEX	Datastream	DJTRSPT	05/01/1990-11/07/2014
Equities U.S.	DOW JONES UTIILITIES - PRICE INDEX	Datastream	DJUTILS	05/01/1990-11/07/2014
Equities U.S.	DJ US TOTAL STOCK MKT - PRICE INDEX	Datastream	DJDWCF$	05/01/1990-11/07/2014
Equities U.S.	NASDAQ 100 - PRICE INDEX	Datastream	NASA100	05/01/1990-11/07/2014
Equities U.S.	S&P 400 MIDCAP - PRICE INDEX	Datastream	S&PMIDC	14/06/1991-11/07/2014

Equities U.S.	S&P 600 SMALL CAP - PRICE INDEX	Datastream	S&P600I	05/01/1990-11/07/2014
Equities U.S.	NYSE COMPOSITE - PRICE INDEX	Datastream	NYSEALL	05/01/1990-11/07/2014
Equities U.S.	NYSE ARCA BIOTECHNOLOGY - PRICE INDEX	Datastream	AMXBIOT	05/01/1990-11/07/2014
Equities U.S.	PHILADELPHIA SE KBW BANK - PRICE INDEX	Datastream	PHLXBKX	29/05/1992-11/07/2014
Asia-Pacific				
Equities Japan	NIKKEI 225 STOCK AVERAGE - PRICE INDEX	Datastream	JAPDOWA	05/01/1990-11/07/2014
Equities Asia	THE ASIA DOW $ - PRICE INDEX	Datastream	DJADOW$	21/10/2011-11/07/2014
Equities Asia Pacific	DJ ASIA PACIFIC TOTAL STOCK MKT - PRICE INDEX	Datastream	DJDWAP$	03/04/2009-11/07/2014
Equities Australia	S&P/ASX 200 - PRICE INDEX	Datastream	ASX200I	29/05/1992-11/07/2014
Equities China	SHANGHAI SE COMPOSITE - PRICE INDEX	Datastream	CHSCOMP	04/01/1991-11/07/2014
Equities Hong Kong	HANG SENG - PRICE INDEX	Datastream	HNGKNGI	05/01/1990-11/07/2014
Equities India	S&P BSE (SENSEX) 30 SENSITIVE - PRICE INDEX	Datastream	IBOMSEN	05/01/1990-11/07/2014
Equities India	S&P CNX NIFTY JUNIOR - PRICE INDEX	Datastream	INNSEMC	03/01/1997-11/07/2014
Equities Singapore	STRAITS TIMES INDEX L - PRICE INDEX	Datastream	SNGPORI	03/09/1999-11/07/2014
Equities Russia	RUSSIA RTS INDEX - PRICE INDEX	Datastream	RSRTSIN	01/09/1995-11/07/2014

Equities Japan	TOPIX - PRICE INDEX	Datastream	TOKYOSE	05/01/1990-11/07/2014
Europe and Africa				
Equities Europe	STOXX EUROPE 600 E - PRICE INDEX	Datastream	DJSTOXX	05/01/1990-11/07/2014
Equities UK	FTSE 100 - PRICE INDEX	Datastream	FTSE100	05/01/1990-11/07/2014
Equities Europe	THE EUROPE DOW E - PRICE INDEX	Datastream	DJEDOWE	21/10/2011-11/07/2014
Equities France	FRANCE CAC 40 - PRICE INDEX	Datastream	FRCAC40	05/01/1990-11/07/2014
Equities Germany	DAX 30 PERFORMANCE - PRICE INDEX	Datastream	DAXINDX	05/01/1990-11/07/2014
Equities Italy	FTSE MIB INDEX - PRICE INDEX	Datastream	FTSEMIB	02/01/1998-11/07/2014
Equities Spain	IBEX 35 - PRICE INDEX	Datastream	IBEX35I	05/01/1990-11/07/2014
Equities Europe	FTSEUR1ST 300 E - PRICE INDEX	Datastream	FTEU300	05/01/1990-11/07/2014
Equities South Africa	FTSE/JSE ALL SHARE - PRICE INDEX	Datastream	JSEOVER	30/06/1995-11/07/2014
Americas				05/01/1990-11/07/2014
Equities Canada	S&P/TSX COMPOSITE INDEX - PRICE INDEX	Datastream	TTOCOMP	05/01/1990-11/07/2014
Chile: Santiago IPSA	CHILE SANTIAGO SE SELECTIVE (IPSA) - PRICE INDEX	Datastream	IPSASEL	05/01/1990-11/07/2014
INDUSTRY FACTORS				05/01/1990-11/07/2014

Consumer Electronics	S&P500 CONSUMER ELECTRONICS - PRICE INDEX	Datastream	SP5SCSE	30/12/1994-11/07/2014
Gold Mining	AMERICAS-DS Gold Mining - PRICE INDEX	Datastream	GOLDSAM	05/01/1990-11/07/2014
Aluminum	S&P500 ALUMINIUM - PRICE INDEX	Datastream	SP5SALU	05/01/1990-11/07/2014
Broadline Retailers	AMERICAS-DS Broadline Rtl - PRICE INDEX	Datastream	BDRETAM	05/01/1990-11/07/2014
Internet	S&P500 INTERNET RETAIL - PRICE INDEX	Datastream	SP5SIRT	19/07/2002-11/07/2014
Mortgage Finance	S&P500 THRFTS/MGE FIN - PRICE INDEX	Datastream	SP5STMF	02/05/2003-11/07/2014
Industrial Suppliers	US-DS Inds Suppliers - PRICE INDEX	Datastream	INSUPUS	05/01/1990-11/07/2014
Home Construction	US-DS Home Con - PRICE INDEX	Datastream	HOMESUS	05/01/1990-11/07/2014
Health Care	MSCI WORLD HEALTH CARE $ - PRICE INDEX	Datastream	M1DWHC$	30/12/1994-11/07/2014
Financials	MSCI WORLD FINANCIALS $ - PRICE INDEX	Datastream	M1DWFN$	30/12/1994-11/07/2014
Technology	MSCI WORLD TCH H/W/EQ $	Datastream	M2DWTH$	30/12/1994-11/07/2014
Utilities	MSCI WORLD UTILITIES $ - PRICE INDEX	Datastream	M2DWU2$	30/12/1994-11/07/2014
Consumer Services	MSCI WORLD CONS SVS $ - PRICE INDEX	Datastream	M2DWHR$	30/12/1994-11/07/2014
Industrials	MSCI WORLD INDUSTRIALS $ - PRICE INDEX	Datastream	M1DWID$	30/12/1994-11/07/2014
Consumer Goods	FTSE USA CONSUMER GDS - PRICE INDEX	Datastream	F1USCGL	31/12/1993-11/07/2014

Basic Materials	FTSE USA BASIC MATS - PRICE INDEX	Datastream	F1USBML	31/12/1993-11/07/2014
Telecommunications	MSCI WORLD W/L T/CM SVS $ - PRICE INDEX	Datastream	M3DWWT$	30/12/1994-11/07/2014
Oil & Gas	MSCI WORLD OIL,GAS&C.FUEL$ - PRICE INDEX	Datastream	M3DWOG$	30/12/1994-11/07/2014
Automobile	MSCI WORLD AUTO & COMPO $ - PRICE INDEX	Datastream	M2DWAC$	30/12/1994-11/07/2014
Food, Beverage and Tobacco	MSCI WORLD FD/BEV/TOB $ - PRICE INDEX	Datastream	M2DWFB$	30/12/1994-11/07/2014
Chemicals	MSCI WORLD CHEMICALS $ - PRICE INDEX	Datastream	M3DWCH$	30/12/1994-11/07/2014
Construction and Engineering	MSCI WORLD CON & ENG $ - PRICE INDEX	Datastream	M3DWCN$	30/12/1994-11/07/2014
Machinery	MSCI WORLD MACHINERY $ - PRICE INDEX	Datastream	M3DWMC$	30/12/1994-11/07/2014
Hotels, Restaurants, and Leisure	MSCI WORLD HT/REST/LEIS $ - PRICE INDEX	Datastream	M3DWHR$	30/12/1994-11/07/2014
Media	MSCI WORLD MEDIA $ - PRICE INDEX	Datastream	M3DWME$	30/12/1994-11/07/2014
Paper and Forestry Products	MSCI WORLD PAP/FOR PRD $ - PRICE INDEX	Datastream	M3DWPF$	30/12/1994-11/07/2014
Real Estate	MSCI WORLD REAL ESTATE $ - PRICE INDEX	Datastream	M2DWR2$	30/12/1994-11/07/2014

IT	MSCI WORLD IT $ - PRICE INDEX	Datastream	M1DWIT$	30/12/1994-11/07/2014
Airlines	MSCI WORLD AIRLINES $ - PRICE INDEX	Datastream	M3DWAL$	30/12/1994-11/07/2014
GOVERNMENT BONDS				
U.S. 10 Year	US BENCHMARK 10 YEAR DS GOVT. INDEX - TOT RETURN IND	Datastream	BMUS10Y	05/01/1990-11/07/2014
Germany 2 Year	REX BOND SUB INDEX CURRENT 2 YRS - TOT RETURN IND	Datastream	REXA02Y	05/01/1990-11/07/2014
Germany 10 Year	BD BENCHMARK 10 YEAR DS GOVT. INDEX - TOT RETURN IND	Datastream	BMBD10Y	05/01/1990-11/07/2014
Italy 2 Year	IT BENCHMARK 2 YEAR DS GOVT. INDEX - TOT RETURN IND	Datastream	BMIT02Y	05/01/1990-11/07/2014
Italy 10 Year	IT BENCHMARK 10 YEAR DS GOVT. INDEX - TOT RETURN IND	Datastream	BMIT10Y	23/03/1991-11/07/2014
Japan 2 Year	JP BENCHMARK 2 YEAR DS GOVT. INDEX - TOT RETURN IND	Datastream	BMJP02Y	05/01/1990-11/07/2014
Japan 10 Year	JP BENCHMARK 10 YEAR DS GOVT. INDEX - TOT RETURN IND	Datastream	BMJP10Y	05/01/1990-11/07/2014
Spain 2 Year	ES BENCHMARK 2 YEAR DS GOVT. INDEX - TOT RETURN IND	Datastream	BMES02Y	05/01/1990-11/07/2014
U.K. 2 Year	UK BENCHMARK 2 YEAR DS GOVT. INDEX - TOT RETURN IND	Datastream	BMUK02Y	05/01/1990-11/07/2014
U.K. 10 Year	UK BENCHMARK 10 YEAR DS GOVT. INDEX - TOT RETURN IND	Datastream	BMUK10Y	05/01/1990-11/07/2014
U.K. 30 Year	UK BENCHMARK 30 YEAR DS GOVT. INDEX - TOT RETURN IND	Datastream	BMUK30Y	05/01/1990-11/07/2014

FOREIGN EXCHANGE				05/01/1990-11/07/2014
Euro (EUR/USD)	EUR TO USD (BOE) - EXCHANGE RATE	Datastream	EUUSBOE	05/01/1990-11/07/2014
Yen (USD/JPY)	US $ TO 100 JAPANESE YEN (GTIS/TR) - EXCHANGE RATE	Datastream	JAPYNUS	05/01/1990-11/07/2014
Australia $ (AUD/USD)	AUD TO USD (BOE) - EXCHANGE RATE	Datastream	AUUSBOE	05/01/1990-11/07/2014
Canada $ (USD/CAD)	US $ TO CANADIAN $ (GTIS/TR) - EXCHANGE RATE	Datastream	CDNDLUS	05/01/1990-11/07/2014
Yen/Euro	JAPANESE YEN TO EURO (WMR) - EXCHANGE RATE	Datastream	JPEURSP	01/01/1999-11/07/2014
Euro/Swiss Franc (EUR/CHF)	EURO TO CHF (WMR) - EXCHANGE RATE	Datastream	EUROCHF	18/07/2003-11/07/2014
Mexico Peso (USD/MXN)	US $ TO MEXICAN PESO (GTIS/TR) - EXCHANGE RATE	Datastream	MEXPFUS	05/01/1990-11/07/2014
New Zealand $ (NZD/USD)	NZD TO USD (BOE) - EXCHANGE RATE	Datastream	NZUSBOE	05/01/1990-11/07/2014
Pound (GBP/USD)	GBP TO USD (BOE) - EXCHANGE RATE	Datastream	USSTBOE	05/01/1990-11/07/2014
Pound/Euro (GBP/EUR)	GBP TO EUR (BOE) - EXCHANGE RATE	Datastream	STEUBOE	05/01/1990-11/07/2014
Swedish Krona (USD/SEK)	US $ TO SWEDISH KRONA (GTIS/TR) - EXCHANGE RATE	Datastream	SWEDKUS	05/01/1990-11/07/2014
Swiss Franc (USD/CHF)	US $ TO SWISS FRANC (GTIS/TR) - EXCHANGE RATE	Datastream	SWISFUS	05/01/1990-11/07/2014
Chinese Yuan (USD/CNY)	CHINESE YUAN TO US $ - EXCHANGE RATE	Datastream	CHUSDSP	02/09/1994-11/07/2014
Euro/Pound	EURO TO GBP (TR) - EXCHANGE RATE	Datastream	TSEURSP	05/01/1990-11/07/2014

COMMODITY INDICES				05/01/1990-11/07/2014
Reuters-Jefferies CRB	Thomson Reuters CCI TR - RETURN IND. (OFCL)	Datastream	TRCCIU$	05/01/1990-11/07/2014
S&P GSCI	S&P GSCI Commodity Total Return - RETURN IND. (OFCL)	Datastream	GSCITOT	05/01/1990-11/07/2014
S&P Agriculture Total Return Index	S&P GSCI Agriculture Total Return - RETURN IND. (OFCL)	Datastream	GSAGTOT	05/01/1990-11/07/2014
S&P Soft Total Return Index	S&P GSCI Softs Total Return - RETURN IND. (OFCL)	Datastream	SGSFTOT	05/01/1990-11/07/2014
Palladium	Palladium U$/Troy Ounce	Datastream	PALLADM	05/01/1990-11/07/2014
COMMODITY ETFs				
iShares S&P GSCI Commodity Index ETF (GSG)	ISHARES S&P GSCI CMOD. IDXD.TST. - PRICE INDEX	Datastream	U:GSG	21/07/2006-11/07/2014
Power Shares DB Commodity Index ETF (DBC)	POWERSHARES DB CMOD.IDX. TRCK.FD. - PRICE INDEX	Datastream	U:DBC	03/02/2006-11/07/2014
GreenHaven Continuous Commodity Index ETF (GCC)	GREENHAVEN CNTU.CMIX.FD. - PRICE INDEX	Datastream	U:GCC	25/01/2008-11/07/2014
Power Shares DB Base Metals Fund (DBB)	POWERSHARES DB BASE MTLS.FD. - PRICE INDEX	Datastream	U:DBB	05/01/2007-11/07/2014
Global X Uranium ETF (URA)	GLOBAL X URANIUM ETF - PRICE INDEX	Datastream	U:URA	05/11/2010-11/07/2014
Global X Silver Miners ETF (SIL)	GLOBAL X SILVER MINERS ETF - PRICE INDEX	Datastream	U:SIL	23/04/2010-11/07/2014
iShares COMEX Gold Trust (IAU)	ISHARES GOLD TRUST - PRICE INDEX	Datastream	U:IAU	28/01/2005-11/07/2014
PowerShares DB Gold Fund (DGL)	POWERSHARES DB GOLD FD. - PRICE INDEX	Datastream	U:DGL	05/01/2007-11/07/2014

SPDR Gold Shares (GLD)	SPDR GOLD SHARES - PRICE INDEX	Datastream	U:GLD	19/1/2004-11/07/2014
iShares Silver Trust (SLV)	ISHARES SILVER TRUST - PRICE INDEX	Datastream	U:SLV	28/04/2006-11/07/2014
PowerShares DB Agriculture Fund (DBA)	POWERSHARES DB AGRIC.FD. - PRICE INDEX	Datastream	U:DBA	05/01/2007-11/07/2014
COMMODITIES				05/01/1990-11/07/2014
Crude Oil	Crude Oil North Sea BFO FOB U$/BBL	Datastream	CRUDBFO	05/01/1990-11/07/2014
Brent Crude	Crude Oil-Brent Cur. Month FOB U$/BBL	Datastream	OILBREN	05/01/1990-11/07/2014
Natural Gas	Natural Gas, Henry Hub U$/MMBTU	Datastream	NATGHEN	06/04/1990-11/07/2014
Gold	Gold Bullion LBM U$/Troy Ounce	Datastream	GOLDBLN	05/01/1990-11/07/2014
Silver	Silver LBM Cash Pence/Troy ounce	Datastream	SILVERP	05/01/1990-11/07/2014
Platinum	London Platinum Free Market $/Troy oz	Datastream	PLATFRE	05/01/1990-11/07/2014
Copper	LME-Copper Grade A Cash U$/MT	Datastream	LCPCASH	05/01/1990-11/07/2014
Corn	Corn No.2 Yellow Cents/Bushel	Datastream	CORNUS2	05/01/1990-11/07/2014
Wheat	Wheat, No.2 Hard (Kansas) Cts/Bu	Datastream	WHEATHD	05/01/1990-11/07/2014
Soybeans	Soyabeans, No.1 Yellow C/Bushel	Datastream	SOYBEAN	05/01/1990-11/07/2014
Arabica Coffee	Coffee-ICO Colombian Ara. Avg c/lb	Datastream	COFCOMA	05/01/1990-11/07/2014

Table 6: Descriptive Statistics of data

Explanation: The tables below introduce descriptive statistics for the data series used in this study. They are summarized according to the inter-market factors introduced in table 5. Summary statistics are provided for the log returns of each data series. The number of observations states the observations included in the analysis.

	GLOBAL STOCK INDUSTRY FACTORS			AMERICAS STOCK INDUSTRY FACTORS	
	DJ GLOBAL TOTAL STOCK MKT	NASDAQ COMPOSITE	DOW GLOBAL $	CHILE_SE_SELECTIVE	S_P_TSX_COMP
Mean	0.000653	0.001771	0.001351	0.003012	0.001042
Median	0.004122	0.003406	0.004265	0.003315	0.002427
Maximum	0.113495	0.17377	0.12361	0.14668	0.128171
Minimum	-0.220088	-0.291753	-0.236005	-0.215977	-0.175418
Std. Dev.	0.028637	0.031694	0.027875	0.028865	0.022575
Skewness	-1.430397	-0.963154	-1.222522	-0.299423	-0.909146
Kurtosis	12.999	11.29757	12.00454	7.302321	10.36705
Jarque-Bera	1829.775	3866.863	2557.387	1005.538	3068.512
Probability	0	0	0	0	0
Sum	0.265038	2.265525	0.952632	3.852311	1.332491
Sum Sq. Dev.	0.332125	1.283786	0.547008	1.064827	0.651309
Observations	406	1279	705	1279	1279

	U.S. STOCK INDUSTRY FACTORS

	DOW JONES INDUSTRIALS	S&P 500 COMPOSITE	RUSSELL 2000	DJ US TOTAL STOCK MKT	NASDAQ 100	S&P 400 MIDCAP	S&P 600 SMALL CAP	NYSE COMPOSITE
Mean	0.001415	0.001345	0.001503	0.001403	0.002238	0.002012	0.001813	0.001306
Median	0.002912	0.002411	0.003674	0.002577	0.004	0.00367	0.003998	0.003217
Maximum	0.106977	0.113559	0.151709	0.120695	0.191403	0.153111	0.142268	0.121278
Minimum	-0.200298	-0.200837	-0.179592	-0.198651	-0.291011	-0.185575	-0.160815	-0.217345
Std. Dev.	0.022744	0.023268	0.028577	0.023636	0.035613	0.02659	0.027681	0.023071
Skewness	-0.822353	-0.73892	-0.715469	-0.820577	-0.646593	-0.673088	-0.595579	-0.933075
Kurtosis	10.32927	9.819917	7.983097	10.17672	8.800653	8.978947	7.076941	12.06208
Jarque-Bera	3006.893	2595.053	1432.418	2888.34	1882.256	1884.26	961.3978	4561.965
Probability	0	0	0	0	0	0	0	0
Sum	1.809883	1.720355	1.922377	1.79396	2.862106	2.422561	2.318662	1.670323
Sum Sq. Dev.	0.661081	0.691923	1.043696	0.713994	1.620868	0.850527	0.979259	0.680243
Observations	1279	1279	1279	1279	1279	1204	1279	1279

	ASIA-PACIFIC STOCK INDUSTRY FACTORS									
	NIKKEI 225 STOCK AVERAGE	THE ASIA DOW $	DJ ASIA PACIFIC TOTAL STOCK MKT	S&P/ASX 200	SHANGHAI SE COMPOSITE	HANG SENG	S&P BSE (SENSEX) 30 SENSITIVE	S&P CNX NIFTY JUNIOR	STRAITS TIMES INDEX L	RUSSIA RTS INDEX
Mean	-0.000724	0.001776	0.002037	0.001013	0.002238	0.001643	0.002717	0.002939	0.000544	0.00267
Median	0.000943	0.001322	0.003286	0.00253	0	0.003027	0.003388	0.006663	0.001544	0.004756
Maximum	0.114496	0.077659	0.073833	0.091137	0.900825	0.139169	0.230007	0.215446	0.153205	0.341876
Minimum	-0.278844	-0.05249	-0.079631	-0.170163	-0.226295	-0.199212	-0.183027	-0.221981	-0.164684	-0.341144
Std. Dev.	0.030971	0.019598	0.021665	0.020105	0.056173	0.034117	0.038006	0.041862	0.02744	0.063261

Skewness	-0.692774	0.446635	-0.331502	-0.848228	5.699877	-0.399677	-0.061558	-0.669945	-0.410935	-0.399687
Kurtosis	8.7736	4.928564	4.652955	8.879125	82.49636	5.92985	5.796844	6.667537	8.298896	7.323252
Jarque-Bera	1878.755	26.7273	36.34393	1800.34	329737.1	491.5082	417.673	580.6235	928.5073	792.5098
Probability	0	0.000002	0	0	0	0	0	0	0	0
Sum	-0.925864	0.252172	0.560216	1.169015	2.745561	2.10181	3.475284	2.686077	0.421732	2.62697
Sum Sq. Dev.	1.225839	0.054154	0.128611	0.466065	3.86856	1.487528	1.846016	1.599954	0.582785	3.933874
Observations	1279	142	275	1154	1227	1279	1279	914	775	984

	EUROPE-AFRICA STOCK INDUSTRY FACTORS									
	TOPIX	**STOXX EUROPE 600 E**	**FTSE 100**	**THE EUROPE DOW E**	**FRANCE CAC 40**	**DAX 30 PERFORMANCE**	**FTSE MIB INDEX**	**IBEX 35**	**FTSEUR1ST 300 E**	**FTSE/JSE ALL SHARE**
Mean	-0.000637	0.000882	0.000787	0.001963	0.000604	0.001306	-0.00022	0.000981	0.000866	0.002366
Median	0.000963	0.002731	0.001907	0.003198	0.001771	0.003738	0.002946	0.002759	0.002186	0.003295
Maximum	0.108383	0.124337	0.125845	0.090585	0.124321	0.149421	0.193609	0.135857	0.124743	0.160396
Minimum	-0.220185	-0.242539	-0.236317	-0.049697	-0.250504	-0.24347	-0.243591	-0.238266	-0.246682	-0.186022
Std. Dev.	0.028133	0.024732	0.023492	0.021699	0.029444	0.031168	0.034209	0.030771	0.024957	0.027777
Skewness	-0.534299	-0.948988	-0.826717	0.102533	-0.677932	-0.635641	-0.760091	-0.630366	-0.95959	-0.391422
Kurtosis	6.566318	12.49824	13.24946	4.169591	8.123027	7.886786	8.95536	7.252224	12.75862	7.732565
Jarque-Bera	738.6506	4999.768	5744.053	8.342467	1496.631	1358.769	1356.833	1048.292	5271.284	952.0395
Probability	0	0	0	0.015433	0	0	0	0	0	0
Sum	-0.814617	1.128282	1.006799	0.278732	0.772122	1.669813	-0.189417	1.254453	1.107534	2.349134
Sum Sq. Dev.	1.011487	0.781705	0.705316	0.06639	1.107992	1.241495	1.00759	1.210069	0.796023	0.765373
Observations	1279	1279	1279	142	1279	1279	862	1279	1279	993

	INDUSTRY FACTORS								
	AMERICAS-DS Broadline Rtl	**AMERICAS-DS Gold Mining**	**DOW JONES TRANSPORTATION**	**DOW JONES UTIILITIES**	**MSCI WORLD W/L T/CM SVS $**	**FTSE USA CONSUMER GDS**	**MSCI WORLD FINANCIALS $**	**MSCI WORLD HEALTH CARE $**	**MSCI WORLD INDUSTRIALS $**
Mean	0.001376	0.000419	0.001521	0.000704	0.001272	0.000753	0.000533	0.001758	0.00094
Median	0.001929	0.00046	0.002708	0.001211	0.003294	0.001804	0.001977	0.002164	0.003281
Maximum	0.11717	0.239645	0.13507	0.088489	0.134253	0.118609	0.202112	0.095079	0.120767
Minimum	-0.173998	-0.213745	-0.26431	-0.23782	-0.19644	-0.19785	-0.27245	-0.21497	-0.16889
Std. Dev.	0.027951	0.048705	0.031681	0.023397	0.033611	0.024935	0.032	0.022067	0.025785
Skewness	-0.27674	-0.070811	-0.5859	-1.29007	-0.56859	-0.84715	-0.91032	-1.17137	-0.76316
Kurtosis	5.412514	4.784151	8.076879	13.90598	6.761925	10.22364	14.17826	13.86423	8.043241
Jarque-Bera	326.4948	170.7067	1446.753	6693.302	689.2447	2456.678	5446.056	5244.452	1178.81
Probability	0	0	0	0	0	0	0	0	0
Sum	1.760169	0.535644	1.945874	0.900076	1.36205	0.806376	0.543045	1.790935	0.957795
Sum Sq. Dev.	0.998457	3.031624	1.282726	0.699584	1.20879	0.66526	1.042447	0.495725	0.676854
Observations	1279	1279	1279	1279	1071	1071	1019	1019	1019

	INDUSTRY FACTORS								
	MSCI WORLD OIL,GAS&C.FUEL$	**MSCI WORLD TCH H/W/EQ $**	**MSCI WORLD UTILITIES $**	**MSCI WORLD CONS SVS $**	**MSCI WORLD W/L T/CM SVS $**	**NYSE ARCA BIOTECHNOLOGY**	**PHILADELPHIA SE KBW BANK**	**S&P500 ALUMINIUM**	**S&P500 CONSUMER ELECTRONICS**
Mean	0.001644	0.001332	0.000658	0.001311	0.00156	0.002513	0.000986	7.28E-05	-0.00033
Median	0.003412	0.003527	0.001353	0.00266	0.002917	0.003944	0.001721	0.001114	0

Maximum	0.139063	0.142417	0.102998	0.131064	0.17638	0.238126	0.317965	0.242846	0.2441
Minimum	-0.28998	-0.20085	-0.25409	-0.18469	-0.21758	-0.28597	-0.27102	-0.53664	-0.62057
Std. Dev.	0.03046	0.036823	0.020045	0.02547	0.035168	0.045386	0.041826	0.050621	0.051157
Skewness	-1.10287	-0.572	-2.19336	-0.65431	-0.19106	-0.16102	0.07791	-1.08814	-2.15875
Kurtosis	12.91887	5.251526	29.64632	9.377783	7.279219	6.829284	14.69472	15.40579	31.93104
Jarque-Bera	4383.794	270.8045	30963.58	1799.749	783.6843	689.748	6577.358	8454.184	36329.29
Probability	0	0	0	0	0	0	0	0	0
Sum	1.675254	1.357387	0.670225	1.335787	1.589322	2.816534	1.138132	0.093048	-0.33954
Sum Sq. Dev.	0.9445	1.380365	0.409038	0.660414	1.259064	2.307123	2.017096	3.274798	2.664162
Observations	1019	1019	1019	1019	1019	1121	1154	1279	1019

	INDUSTRY FACTORS				**CURRENCY EXCHANGE**			
	S&P500 INTERNET RETAIL	**S&P500 THRFTS/MGE FIN**	**US-DS Home Con**	**US-DS Inds Suppliers**	**AUD_TO_USD**	**EUR_TO_USD**	**EURO_TO_CHF**	**EURO_TO_GBP**
Mean	0.004678	-0.00542	0.002485	0.002088	-0.00014	-7.49E-05	0.000412	-9.33E-05
Median	0.004408	-0.00091	0.001581	0.001904	-0.00118	-0.00026	0.00012	-0.00014
Maximum	0.221641	0.309465	0.346039	0.2213	0.173708	0.058775	0.045684	0.075993
Minimum	-0.20083	-0.43877	-0.23169	-0.16942	-0.07099	-0.05338	-0.08547	-0.05439
Std. Dev.	0.048953	0.053454	0.051925	0.036295	0.016542	0.013813	0.009185	0.010805
Skewness	-0.09194	-2.19724	0.362016	0.09915	1.44028	0.211977	-0.9912	-0.01176
Kurtosis	5.301118	21.76815	6.238416	6.413873	15.50122	3.847549	20.89978	6.955234

Jarque-Bera	138.7749	9041.17	586.8246	623.185	8770.638	47.85999	7743.425	817.4214
Probability	0	0	0	0	0	0	0	0
Sum	2.923828	-3.16321	3.178895	2.669963	-0.17628	-0.09577	0.235835	-0.11702
Sum Sq. Dev.	1.495329	1.665803	3.445771	1.683506	0.349689	0.24385	0.048253	0.14628
Observations	625	584	1279	1279	1279	1279	573	1254

	CURRENCY EXCHANGE								
	GBP_TO_EUR	**GBP_TO_USD**	**JAPANESE_YEN_TO_EURO**	**NZD_TO_USD**	**US_$_TO_100_YEN**	**US_$_TO_CAND_$**	**US_$_TO_KRONA**	**US_$_TO_MEX_PESO**	**YUAN_TO_US_$**
Mean	4.17E-05	-3.32E-05	4.85E-05	-0.0003	0.000276	6.08E-05	-7.42E-05	-0.00124	-0.00031
Median	0	-0.00062	0.001415	-0.00127	-0.00049	0.000399	0.00073	-0.0003	-1.21E-05
Maximum	0.052944	0.103889	0.055932	0.114767	0.145977	0.054026	0.064615	0.07654	0.012125
Minimum	-0.08003	-0.05319	-0.13931	-0.06659	-0.05956	-0.08415	-0.13387	-0.29209	-0.02019
Std. Dev.	0.010827	0.013297	0.017536	0.016457	0.015472	0.010564	0.016342	0.016661	0.001559
Skewness	0.033556	0.884889	-1.01768	0.856108	0.92891	-0.75537	-0.60103	-5.44802	-2.45061
Kurtosis	6.994242	8.65806	9.016764	7.848127	9.769514	10.37613	7.062786	86.49588	37.03632
Jarque-Bera	850.4538	1872.976	1361.614	1408.82	2626.097	3021.086	956.6471	377853.1	51044.29
Probability	0	0	0	0	0	0	0	0	0
Sum	0.053334	-0.04252	0.0393	-0.38821	0.353032	0.077766	-0.09485	-1.57976	-0.32161
Sum Sq. Dev.	0.149801	0.22596	0.248776	0.346123	0.305951	0.142612	0.341309	0.354772	0.002516
Observations	1279	1279	810	1279	1279	1279	1279	1279	1036

	GOVERNMENT BONDS

	ES__2YEAR_DS_GOVT_	IT_10YEAR_DS_GOVT_	IT_2YEAR_DS_GOVT_	JP_10YEAR_DS_GOVT_	JP_2YEAR_DS_GOVT_	UK_10YEAR_DS_GOVT_	UK_2YEAR_DS_GOVT_	UK_30YEAR_DS_GOVT_
Mean	0.001264	0.001799	0.001322	0.000869	0.000366	0.001515	0.001137	0.001642
Median	0.001176	0.001894	0.001108	0.001149	0.000138	0.001879	0.000988	0.001806
Maximum	0.027623	0.080831	0.022635	0.030669	0.00721	0.050168	0.022888	0.064786
Minimum	-0.01995	-0.04975	-0.0238	-0.0409	-0.0072	-0.03861	-0.01042	-0.09938
Std. Dev.	0.003363	0.010384	0.003685	0.006168	0.001293	0.009329	0.002523	0.01496
Skewness	0.884942	0.376981	0.036071	-0.69482	0.576774	0.017257	1.257137	-0.31009
Kurtosis	15.08022	8.889935	12.8002	7.868415	7.572319	4.861596	13.6832	5.823898
Jarque-Bera	7943.881	1785.027	5118.622	1366.002	1185.035	184.7478	6419.107	445.4666
Probability	0	0	0	0	0	0	0	0
Sum	1.616179	2.185245	1.690222	1.111289	0.468209	1.937197	1.453587	2.0997
Sum Sq. Dev.	0.014456	0.130913	0.017354	0.048624	0.002135	0.111222	0.008132	0.286026
Observations	1279	1215	1279	1279	1279	1279	1279	1279

	COMMODITY							
	COFFEE	CORN_NO_2_YELLOW	CRUDE_OIL_BRENT	CRUDEOIL_NORTHSEA	GOLD_BULLION_LBM	LME_COPPER	LONDON_PLATINUM	REUTERS_CCI_TR
Mean	0.000619	0.000381	0.0012	0.001189	0.000933	0.000818	0.000874	0.000821
Median	0	0.002176	0.003873	0.003864	0.001596	0.001324	0.001821	0.00196
Maximum	0.365135	0.223144	0.212561	0.241416	0.131393	0.135185	0.198549	0.065721
Minimum	-0.24512	-0.21052	-0.45123	-0.31033	-0.13254	-0.252	-0.17289	-0.11905
Std. Dev.	0.044575	0.039821	0.049727	0.049505	0.022365	0.035691	0.029646	0.019478
Skewness	0.653998	-0.42492	-0.9858	-0.52695	-0.21316	-0.80974	-0.49183	-1.04451
Kurtosis	9.620486	6.140056	9.70552	6.192582	6.93561	7.861507	8.654092	8.159544
Jarque-Bera	2426.992	563.9422	2603.362	602.3717	835.1221	1399.276	1755.233	1003.136

Probability	0	0	0	0	0	0	0	0
Sum	0.792065	0.487856	1.535183	1.520136	1.193717	1.045976	1.11721	0.637664
Sum Sq. Dev.	2.539333	2.02658	3.160217	3.132002	0.639262	1.62794	1.123179	0.294401
Observations	1279	1279	1279	1279	1279	1279	1279	777

	COMMODITY						COMMODITY ETFs	
	S_P_GSCI_AGRI_TR	**S_P_GSCI_CMD_TR**	**S_P_GSCI_SOFTS_TR**	**SILVER_LBM**	**SOYABEANS**	**WHEAT__NO_2_HARD**	**GBLX_SILVER MINERS_ETF**	**GBLX_URANIUM_ETF**
Mean	-0.00029	0.000742	-0.00028	0.001057	0.000641	0.000136	-0.00015	-0.00661
Median	-0.00045	0.001593	-0.00023	0.000423	0.002281	0	0.001736	-0.0082
Maximum	0.107726	0.121319	0.093283	0.254126	0.123379	0.229495	0.150426	0.136665
Minimum	-0.14617	-0.21135	-0.1368	-0.34045	-0.24506	-0.17493	-0.20642	-0.24809
Std. Dev.	0.025966	0.029492	0.028173	0.039397	0.034492	0.040365	0.055099	0.052482
Skewness	-0.24968	-0.85435	-0.21715	-0.67248	-0.78423	0.260824	-0.29007	-0.52811
Kurtosis	6.072387	7.277609	4.493169	10.86588	7.100562	5.463424	3.770615	5.84498
Jarque-Bera	516.3389	1130.719	102.3695	3393.663	1027.179	337.8998	8.528841	73.67591
Probability	0	0	0	0	0	0	0.01406	0
Sum	-0.37272	0.949082	-0.2834	1.3517	0.820048	0.174353	-0.03353	-1.2694
Sum Sq. Dev.	0.861645	1.111546	0.805639	1.983654	1.520409	2.082241	0.664869	0.526073
Observations	1279	1279	1016	1279	1279	1279	220	192

	COMMODITY ETFs								
	GREENHAVEN_ETF	**ISHARES_CMOD_ETF**	**ISHARES_GOLDTRUST**	**ISHARES_SILVERTRUST**	**POWERSHARES_CMOD_ETF**	**POWERSHARES_DB_GOLD**	**POWERSHARES_DBAGRIC**	**POWSHA_BASEMTLS_ETF**	**SPDR_GOLDSHARES**
Mean	-0.00042	-0.001	0.002254	0.00093	4.91E-05	0.001579	0.00011	-0.00078	0.0021
Median	0.001085	0.002839	0.005166	0.003357	0.001056	0.003925	0.001328	0	0.00537
Maximum	0.084917	0.123833	0.132613	0.147888	0.046081	0.129186	0.088244	0.091852	0.129336
Minimum	-0.11583	-0.16594	-0.09572	-0.30732	-0.06099	-0.09588	-0.14854	-0.16234	-0.09655
Std. Dev.	0.025399	0.034237	0.027409	0.051107	0.012839	0.027373	0.02865	0.037417	0.027202
Skewness	-1.03746	-0.80268	-0.35965	-1.24619	-0.82178	-0.28811	-0.80901	-0.67066	-0.36914
Kurtosis	7.258011	5.694789	4.610456	8.251085	5.994325	4.700629	7.319089	5.203037	4.518741
Jarque-Bera	315.0386	170.5433	63.9045	602.5136	213.9002	52.66134	347.4513	108.6572	59.76573
Probability	0	0	0	0	0	0	0	0	0
Sum	-0.14303	-0.41552	1.111199	0.398105	0.021603	0.618962	0.043059	-0.30517	1.05644
Sum Sq. Dev.	0.216754	0.486456	0.369607	1.115284	0.072367	0.292974	0.320935	0.547402	0.371464
Observations	337	416	493	428	440	392	392	392	503

Table 7: Regression Results for fossil fuel/oil free model

Explanation: The below presents the results of the regressions of the oil equity index (dependent variable) on other oil-free inter-market factors mentioned in table 5 above. Each column indicate the result of regression run for the independent variable included in the model. Values in brackets are the t-statistics of the respective factor. All regressions are estimated on the Newey-West Standard Errors (Newey & West, 1987). 'Ortho' before the factor imply that the factor is orthogonalised before including the model. ***, **, * indicate significance at the 1%, 5% and 10% level.

R^2	**0.497426**	**0.50287**	**0.558394**	**0.571776**	**0.579829**	**0.581284**	**0.592615**	**0.594954**

(adj.)R^2	**0.496932**	**0.501891**	**0.557089**	**0.570087**	**0.577755**	**0.578802**	**0.589795**	**0.591745**
Constant	0.000861 (1.556454)	0.000861 (1.536987)	0.000861 (1.634443)	0.000861 (1.638008)	0.000861 (1.652784)	0.000861 (1.66146)	0.000861 (1.680548)	0.000861 (1.676422)
MSCI WORLD IND $	0.833139*** (15.51312)	0.833139*** (16.05549)	0.833139*** (18.844)	0.833139*** (20.22734)	0.833139*** (20.93335)	0.833139*** (20.55384)	0.833139*** (22.0939)	0.833139*** (22.3176)
Ortho.MSCI WORLD FIN		0.147462** (2.075105)	0.147462** (2.213231)	0.147462** (2.457535)	0.147462** (2.338808)	0.147462** (2.352039)	0.147462** (2.564405)	0.147462** (2.557309)
Ortho.FTSE USA BASMATS			0.367824*** (8.853808)	0.367824*** (8.436194)	0.367824*** (8.663101)	0.367824*** (8.833518)	0.367824*** (9.297816)	0.367824*** (9.345301)
Ortho.MSCI WORLD HEALTH				0.221397*** (2.867935)	0.221397*** (2.773849)	0.221397*** (2.787426)	0.221397*** (3.029185)	0.221397*** (3.074629)
Ortho.FTSE USA CONGDS					-0.16782*** (-3.31044)	-0.16782*** (-3.32441)	-0.16782*** (-3.39978)	-0.16782*** (-3.46064)
Ortho.MSCI WRD CONS SVS						-0.08592 (-1.46148)	-0.08592 (-1.50183)	-0.08592 (-1.53107)
Ortho.DJ TRANSPORT							-0.18136*** (-3.55483)	-0.18136*** (-3.65137)
Ortho.PHILADELPHIA BANK INDEX								-0.07065* (-1.94658)

R2	**0.648967**	**0.650516**	**0.659949**	**0.661374**	**0.662801**	**0.663837**	**0.665255**	**0.667643**
(adj.)R2	**0.645836**	**0.647049**	**0.656235**	**0.657335**	**0.658439**	**0.65915**	**0.660249**	**0.662336**

Constant	0.000861 (1.802578)	0.000861 (1.811255)	0.000861 (1.821378)	0.000861 (1.806073)	0.000861 (1.802709)	0.000861 (1.796205)	0.000861 (1.790995)	0.000861 (1.801377)
MSCI WORLD INDUSTRIAL	0.833139*** (27.49199)	0.833139*** (27.93134)	0.833139*** (29.23507)	0.833139*** (29.91045)	0.833139*** (30.52723)	0.833139*** (31.13779)	0.833139*** (30.86368)	0.833139*** (30.88909)
Ortho.MSCI WORLD FINANCIAL	0.147462*** (3.685347)	0.147462*** (3.652245)	0.147462*** (3.696052)	0.147462*** (3.793922)	0.147462*** (3.850336)	0.147462*** (3.876253)	0.147462*** (3.880449)	0.147462*** (3.957816)
Ortho.FTSE USA BASIC MATERIALS	0.367824*** (9.927422)	0.367824*** (9.766867)	0.367824*** (10.32971)	0.367824*** (10.38446)	0.367824*** (10.38526)	0.367824*** (10.35306)	0.367824*** (10.56692)	0.367824*** (10.59051)
Ortho.MSCI WORLD HEALTH	0.221397*** (4.314381)	0.221397*** (4.32125)	0.221397*** (4.427527)	0.221397*** (4.656387)	0.221397*** (4.656577)	0.221397*** (4.818613)	0.221397*** (4.835556)	0.221397*** (4.91335)
Ortho.FTSE USA CONSUMER GOODS	-0.16782*** (-3.527)	-0.16782*** (-3.5338)	-0.16782*** (-3.62067)	-0.16782*** (-3.6374)	-0.16782*** (-3.63624)	-0.16782*** (-3.70876)	-0.16782*** (-3.6812)	-0.16782*** (-3.66272)
Ortho.MSCI WORLD CONSUMER SERVICES	-0.08592* (-1.70569)	-0.08592* (-1.74235)	-0.08592* (-1.74432)	-0.08592* (-1.73831)	-0.08592* (-1.76133)	-0.08592* (-1.75731)	-0.08592* (-1.76237)	-0.08592* (-1.77552)
Ortho.DJ TRANSPORT	-0.18136*** (-4.50922)	-0.18136*** (-4.4849)	-0.18136*** (-4.56934)	-0.18136*** (-4.5971)	-0.18136*** (-4.59257)	-0.18136*** (-4.60344)	-0.18136*** (-4.6222)	-0.18136*** (-4.61655)
Ortho.PHILADELPHIA BANK INDEX	-0.07065** (-2.04114)	-0.07065** (-2.05308)	-0.07065** (-2.04593)	-0.07065** (-2.06014)	-0.07065** (-2.10557)	-0.07065** (-2.13233)	-0.07065** (-2.12249)	-0.07065** (-2.13021)
Ortho.MSCI WORLD UTILITY	0.53127*** (7.516142)	0.53127*** (7.422068)	0.53127*** (7.56263)	0.53127*** (7.913958)	0.53127*** (7.841865)	0.53127*** (8.099796)	0.53127*** (8.033277)	0.53127*** (8.213624)

Ortho.MSCI WORLD TECHNOLOGY		-0.04729* (-1.80065)	-0.04729* (-1.85196)	-0.04729* (-1.84469)	-0.04729* (-1.84074)	-0.04729* (-1.84338)	-0.04729* (-1.8532)	-0.04729* (-1.86464)
Ortho.US to CAND DOLLAR			0.320766*** (4.681616)	0.320766*** (4.691975)	0.320766*** (4.711251)	0.320766*** (4.68811)	0.320766*** (4.639131)	0.320766*** (4.665472)
Ortho.SP 500 ALUMINUM				0.037371 (1.606204)	0.037371 (1.617544)	0.037371 (1.63966)	0.037371* (1.667374)	0.037371* (1.67872)
Ortho.AMS DS BROADLINE RETAIL					-0.05963 (-1.62256)	-0.05963 (-1.62128)	-0.05963 (-1.63039)	-0.05963 (-1.63228)
Ortho.AUD to USD						-0.07739 (-1.54876)	-0.07739 (-1.54986)	-0.07739 (-1.5666)
Ortho.LME COPPER							0.037461* (1.742343)	0.037461* (1.764916)
Ortho.NZD to USD								0.145513** (2.486712)

R2	**0.668122**	**0.670575**	**0.672801**	**0.674105**	**0.676267**	**0.683048**	**0.68363**	**0.685075**
(adj.)R2	**0.662486**	**0.664646**	**0.666578**	**0.667574**	**0.669449**	**0.676047**	**0.676317**	**0.677471**
Constant	0.000861 (1.800643)	0.000861 (1.799801)	0.000861 (1.807065)	0.000861 (1.812741)	0.000861 (1.801391)	0.000861 (1.798064)	0.000861 (1.794555)	0.000861 (1.81478)
MSCI WORLD INDUSTRIAL	0.833139*** (30.83831)	0.833139*** (30.75394)	0.833139*** (30.82555)	0.833139*** (30.3233)	0.833139*** (30.71458)	0.833139*** (30.17696)	0.833139*** (30.28325)	0.833139*** (30.27162)
Ortho.MSCI WORLD FINANCIAL	0.147462*** (3.95895)	0.147462*** (4.013956)	0.147462*** (4.044162)	0.147462*** (4.103442)	0.147462*** (4.03254)	0.147462*** (4.029382)	0.147462*** (4.057858)	0.147462*** (4.099767)

Ortho.FTSE USA BASIC MATERIALS	0.367824*** (10.60122)	0.367824*** (10.90795)	0.367824*** (10.812)	0.367824*** (10.93272)	0.367824*** (11.11699)	0.367824*** (11.50063)	0.367824*** (11.52078)	0.367824*** (11.58133)
Ortho.MSCI WORLD HEALTH	0.221397*** (4.917313)	0.221397*** (4.762544)	0.221397*** (4.688074)	0.221397*** (4.706984)	0.221397*** (4.695368)	0.221397*** (4.419545)	0.221397*** (4.419149)	0.221397*** (4.648019)
Ortho.FTSE USA CONSUMER GOODS	-0.16782*** (-3.6593)	-0.16782*** (-3.57789)	-0.16782*** (-3.56059)	-0.16782*** (-3.53552)	-0.16782*** (-3.53314)	-0.16782*** (-3.54721)	-0.16782*** (-3.55789)	-0.16782*** (-3.56688)
Ortho.MSCI WORLD CONSUMER SERVICES	-0.08592* (-1.77658)	-0.08592* (-1.77858)	-0.08592* (-1.77985)	-0.08592* (-1.78433)	-0.08592* (-1.7992)	-0.08592* (-1.75018)	-0.08592* (-1.75011)	-0.08592* (-1.75182)
Ortho.DJ TRANSPORT	-0.18136*** (-4.6117)	-0.18136*** (-4.61632)	-0.18136*** (-4.59397)	-0.18136*** (-4.55221)	-0.18136*** (-4.54755)	-0.18136*** (-4.71254)	-0.18136*** (-4.73604)	-0.18136*** (-4.80312)
Ortho.PHILADELPHIA BANK INDEX	-0.07065** (-2.13138)	-0.07065** (-2.14649)	-0.07065** (-2.1651)	-0.07065** (-2.1862)	-0.07065** (-2.21239)	-0.07065** (-2.22935)	-0.07065** (-2.21253)	-0.07065** (-2.21743)
Ortho.MSCI WORLD UTILITY	0.53127*** (8.207237)	0.53127*** (7.900217)	0.53127*** (7.949381)	0.53127*** (7.858208)	0.53127*** (7.888937)	0.53127*** (7.490654)	0.53127*** (7.499731)	0.53127*** (7.83752)
Ortho.MSCI WORLD TECHNOLOGY	-0.04729* (-1.86466)	-0.04729* (-1.84768)	-0.04729* (-1.84225)	-0.04729* (-1.84448)	-0.04729* (-1.848)	-0.04729* (-1.89419)	-0.04729* (-1.88821)	-0.04729* (-1.89736)
Ortho.US to CAND DOLLAR	0.320766*** (4.65782)	0.320766*** (4.612881)	0.320766*** (4.721735)	0.320766*** (4.723523)	0.320766*** (4.66474)	0.320766*** (4.584781)	0.320766*** (4.577471)	0.320766*** (4.669035)
Ortho.SP 500 ALUMINUM	0.037371* (1.679077)	0.037371* (1.661765)	0.037371* (1.667217)	0.037371* (1.674506)	0.037371* (1.728348)	0.037371* (1.803117)	0.037371* (1.817322)	0.037371* (1.804013)

Ortho.AMS DS BROADLINE RETAIL	-0.05963 (-1.63169)	-0.05963 (--1.62531)	-0.05963 (-1.62032)	-0.05963 (-1.62616)	-0.05963 (-1.63101)	-0.05963* (-1.66174)	-0.05963* (-1.65756)	-0.05963* (-1.66126)
Ortho.AUD to USD	-0.07739 (-1.56248)	-0.07739 (-1.55285)	-0.07739 (-1.543)	-0.07739 (-1.53437)	-0.07739 (-1.53051)	-0.07739 (-1.54013)	-0.07739 (-1.54184)	-0.07739 (-1.56034)
Ortho.LME COPPER	0.037461* (1.767072)	0.037461* (1.790895)	0.037461* (1.834)	0.037461* (1.841498)	0.037461* (1.831907)	0.037461* (1.844343)	0.037461* (1.840979)	0.037461* (1.864284)
Ortho.NZD to USD	0.145513** (2.490015)	0.145513** (2.51321)	0.145513** (2.558641)	0.145513** (2.544129)	0.145513*** (2.564104)	0.145513*** (2.621265)	0.145513*** (2.621909)	0.145513*** (2.633964)
Ortho.GBLX SILVERMINERS ETF	0.039148* (1.752207)	0.039148* (1.70969)	0.039148* (1.840943)	0.039148* (1.907241)	0.039148* (1.896102)	0.039148* (1.827906)	0.039148* (1.854441)	0.039148* (1.928478)
Ortho.DJ UTILITIES		0.11868** (2.222964)	0.11868** (2.222736)	0.11868** (2.240009)	0.11868** (2.240751)	0.11868** (2.256818)	0.11868** (2.262972)	0.11868** (2.278144)
Ortho.ISHARES SILVERTRUST			0.064599*** (2.710436)	0.064599*** (2.669393)	0.064599*** (2.71513)	0.064599*** (2.880871)	0.064599*** (2.875736)	0.064599*** (2.974525)
Ortho. UK 10 YEAR DS GOVT				-0.13239 (-1.61894)	-0.13239 (-1.61889)	-0.13239* (-1.72542)	-0.13239* (-1.71984)	-0.13239* (-1.70889)
Ortho.POWER SHARES DBAGRIC					0.105778** (2.460278)	0.105778** (2.460278)	0.105778** (2.486988)	0.105778** (2.482082)
Ortho.AMS DS GOLD MINING						0.066462*** (3.471525)	0.066462*** (3.486913)	0.066462*** (3.56275)
Ortho.S&P GSCI AGRI							0.036205 (1.332196)	0.036205 (1.340859)
Ortho. Gold BULLION								-0.08088 (-1.54352)

R2	**0.685758**	**0.686498**	**0.690435**	**0.691902**	**0.694387**	**0.69638**	**0.7014**	**0.702075**	**0.702882**
(adj.)R2	**0.677847**	**0.678281**	**0.682001**	**0.683188**	**0.685425**	**0.687161**	**0.692021**	**0.692406**	**0.692928**
Constant	0.000861 (1.811308)	0.000861 (1.804309)	0.000861 (1.800193)	0.000861 (1.804666)	0.000861 (1.818941)	0.000861 (1.830148)	0.000861 (1.852805)	0.000861 (1.85219)	0.000861 (1.855743)
MSCI WORLD INDUSTRIAL	0.833139*** (30.35377)	0.833139*** (30.58973)	0.833139*** (32.30435)	0.833139*** (31.51836)	0.833139*** (30.6033)	0.833139*** (30.91457)	0.833139*** (29.94071)	0.833139*** (29.66323)	0.833139*** (29.64368)
Ortho.MSCI WORLD FINANCIAL	0.147462*** (4.114405)	0.147462*** (4.143038)	0.147462*** (4.057432)	0.147462*** (4.004582)	0.147462*** (3.867018)	0.147462*** (3.940263)	0.147462*** (3.777365)	0.147462*** (3.711385)	0.147462*** (3.776622)
Ortho.FTSE USA BASIC MATERIALS	0.367824*** (11.68498)	0.367824*** (11.8114)	0.367824*** (12.12872)	0.367824*** (11.99489)	0.367824*** (12.00834)	0.367824*** (11.88841)	0.367824*** (12.19526)	0.367824*** (12.13121)	0.367824*** (12.07846)
Ortho.MSCI WORLD HEALTH	0.221397*** (4.640565)	0.221397*** (4.684426)	0.221397*** (4.651132)	0.221397*** (4.667329)	0.221397*** (4.621177)	0.221397*** (4.64013)	0.221397*** (4.428926)	0.221397*** (4.410838)	0.221397*** (4.435887)
Ortho.FTSE USA CONSUMER GOODS	-0.16782*** (-3.56767)	-0.16782*** (-3.5598)	-0.16782*** (-3.62886)	-0.16782*** (-3.6038)	-0.16782*** (-3.59345)	-0.16782*** (-3.58011)	-0.16782*** (-3.56532)	-0.16782*** (-3.5761)	-0.16782*** (-3.56349)
Ortho.MSCI WORLD CONSUMER SERVICES	-0.08592* (-1.7503)	-0.08592* (-1.76407)	-0.08592* (-1.8417)	-0.08592* (-1.7948)	-0.08592* (-1.80693)	-0.08592* (-1.8057)	-0.08592* (-1.74228)	-0.08592* (-1.73141)	-0.08592* (-1.72104)

Ortho.DJ TRANSPORT	-0.18136*** (-4.80871)	-0.18136*** (-4.80067)	-0.18136*** (-4.81405)	-0.18136*** (-4.84047)	-0.18136*** (-4.89562)	-0.18136*** (-4.88731)	-0.18136*** (-4.9098)	-0.18136*** (-4.90814)	-0.18136*** (-4.91775)
Ortho.PHILADELPHIA BANK INDEX	-0.07065** (-2.21986)	-0.07065** (-2.20778)	-0.07065** (-2.35242)	-0.07065** (-2.3532)	-0.07065** (-2.29611)	-0.07065** (-2.29042)	-0.07065** (-2.26377)	-0.07065** (-2.28207)	-0.07065** (-2.29327)
Ortho.MSCI WORLD UTILITY	0.53127*** (7.791234)	0.53127*** (7.824555)	0.53127*** (8.014999)	0.53127*** (8.020624)	0.53127*** (8.014866)	0.53127*** (8.15792)	0.53127*** (7.870959)	0.53127*** (7.831738)	0.53127*** (7.753807)
Ortho.MSCI WORLD TECHNOLOGY	-0.04729* (-1.90082)	-0.04729* (-1.92253)	-0.04729* (-1.92347)	-0.04729* (-1.91224)	-0.04729* (-1.909)	-0.04729* (-1.92317)	-0.04729* (-1.94979)	-0.04729* (-1.92976)	-0.04729* (-1.9096)
Ortho.US to CAND DOLLAR	0.320766*** (4.772028)	0.320766*** (4.745287)	0.320766*** (4.763078)	0.320766*** (4.721057)	0.320766*** (4.683957)	0.320766*** (4.745439)	0.320766*** (4.772414)	0.320766*** (4.726511)	0.320766*** (4.678179)
Ortho.SP 500 ALUMINUM	0.037371* (1.786168)	0.037371* (1.783197)	0.037371* (1.806922)	0.037371* (1.825639)	0.037371* (1.812006)	0.037371* (1.83355)	0.037371* (1.880323)	0.037371* (1.883046)	0.037371* (1.918922)
Ortho.AMSDS BROADLINE RETAIL	-0.05963* (-1.6517)	-0.05963* (-1.65931)	-0.05963* (-1.68504)	-0.05963* (-1.67883)	-0.05963* (-1.68665)	-0.05963* (-1.68194)	-0.05963* (-1.71667)	-0.05963* (-1.72858)	-0.05963* (-1.73333)
Ortho.AUD to USD	-0.07739 (-1.56055)	-0.07739 (-1.56431)	-0.07739 (-1.57295)	-0.07739 (-1.59697)	-0.07739 (-1.61506)	-0.07739 (-1.6084)	-0.07739 (-1.59777)	-0.07739 (-1.59546)	-0.07739 (-1.62251)
Ortho.LME COPPER	0.037461* (1.878132)	0.037461* (1.896313)	0.037461* (1.886902)	0.037461* (1.88563)	0.037461* (1.913624)	0.037461* (1.948395)	0.037461* (1.973256)	0.037461* (1.986069)	0.037461* (1.996496)
Ortho.NZD to USD	0.145513*** (2.617837)	0.145513*** (2.621689)	0.145513*** (2.618291)	0.145513*** (2.636531)	0.145513*** (2.679044)	0.145513*** (2.690807)	0.145513*** (2.724593)	0.145513*** (2.720104)	0.145513*** (2.730307)

Ortho.GBLX SILVERMINERS ETF	0.039148* (1.93171)	0.039148* (1.94709)	0.039148* (1.928929)	0.039148* (1.926884)	0.039148* (1.932569)	0.039148* (1.960441)	0.039148* (2.033429)	0.039148* (2.019146)	0.039148* (2.045375)
Ortho.DJ UTILITIES	0.11868** (2.26938)	0.11868** (2.278933)	0.11868** (2.286758)	0.11868** (2.271611)	0.11868** (2.308484)	0.11868** (2.295751)	0.11868** (2.272935)	0.11868** (2.279241)	0.11868** (2.27709)
Ortho.ISHARES SILVERTRUST	0.064599*** (3.0438)	0.064599*** (2.985752)	0.064599*** (3.032019)	0.064599*** (3.068587)	0.064599*** (3.064496)	0.064599*** (3.136596)	0.064599*** (3.175537)	0.064599*** (3.205049)	0.064599*** (3.234132)
Ortho. UK 10 YEAR DS GOVT	-0.13239* (-1.70679)	-0.13239* (-1.71237)	-0.13239* (-1.73354)	-0.13239* (-1.75329)	-0.13239* (-1.72212)	-0.13239* (-1.71072)	-0.13239* (-1.73298)	-0.13239* (-1.72548)	-0.13239* (-1.73119)
Ortho.POWERSHARES DBAGRIC	0.105778** (2.518291)	0.105778** (2.516103)	0.105778** (2.560128)	0.105778*** (2.596924)	0.105778*** (2.6279)	0.105778*** (2.648296)	0.105778*** (2.748754)	0.105778*** (2.737564)	0.105778*** (2.727967)
Ortho.AMSDS GOLD MINING	0.066462*** (3.581131)	0.066462*** (3.59312)	0.066462*** (3.488731)	0.066462*** (3.485816)	0.066462*** (3.581388)	0.066462*** (3.557808)	0.066462*** (3.545558)	0.066462*** (3.54167)	0.066462*** (3.542618)
Ortho.SP GSCI AGRI	0.036205 (1.337823)	0.036205 (1.347884)	0.036205 (1.35932)	0.036205 (1.360378)	0.036205 (1.39984)	0.036205 (1.393111)	0.036205 (1.418787)	0.036205 (1.421014)	0.036205 (1.419372)
Ortho. Gold BULLION	-0.08088 (-1.54352)	-0.08088 (-1.55226)	-0.08088 (-1.58358)	-0.08088 (-1.58893)	-0.08088 (-1.58443)	-0.08088 (-1.59032)	-0.08088 (-1.55405)	-0.08088 (-1.56601)	-0.08088 (-1.55832)
Ortho.WHEAT	-0.02765 (-1.57806)	-0.02765 (-1.57891)	-0.02765 (-1.60406)	-0.02765 (-1.60773)	-0.02765 (-1.63759)	-0.02765 (-1.6366)	-0.02765 (-1.67686)	-0.02765 (-1.67058)	-0.02765 (-1.65827)
Ortho GBP EUR		-0.07785 (-1.44476)	-0.07785 (-1.45771)	-0.07785 (-1.46836)	-0.07785 (-1.46381)	-0.07785 (-1.4528)	-0.07785 (-1.5217)	-0.07785 (-1.49978)	-0.07785 (-1.49816)
Ortho.MSCI WORLD CHEMICAL			0.115402*** (3.061599)	0.115402*** (2.929101)	0.115402*** (3.052282)	0.115402*** (3.089895)	0.115402*** (3.089881)	0.115402*** (3.064181)	0.115402*** (3.086947)
Ortho.MSCI WORLD				0.062297 (1.583335)	0.062297 (1.583335)	0.062297 (1.608288)	0.062297 (1.60892)	0.062297 (1.591648)	0.062297 (1.589304)

CONS and ENGI									
Ortho.MSCI World HOTEL, RESTAURANT and LEISURE					-0.12998** (-2.34926)	-0.12998** (-2.2673)	-0.12998** (-2.30133)	-0.12998** (--2.26836)	-0.12998** (-2.28563)
Ortho.MSCI WORLD REAL ESTATE						-0.08121*** (-2.6171)	-0.08121*** (-2.61851)	-0.08121*** (-2.61643)	-0.08121*** (-2.64104)
Ortho.MSCI WORLD AIRLINES							-0.12051*** (-3.42028)	-0.12051*** (-3.43298)	-0.12051*** (-3.44153)
Ortho.PALLADIUM								0.018768 (1.410371)	0.018768 (1.409652)
Ortho.MSCI WORLD MACHINERY									0.077739 (0.1307)

Table 8: Contribution to Adjusted-R^2 by factor and asset class for the parent model (oil inclusive)

Explanation: The table explains the contribution of each factor in Adjusted-R^2 and cumulative Adjusted-R^2 after introduction of the factor in the model. Note that profound regression results for the parent model (oil-inclusive) are not presented because of space limitation. The results of the parent model mentioned below indicate its efficacy in explaining the broad empirical behaviour of the oil equity index.

Factor	**Type**	**Adjusted R-Square after inclusion of respective factor in the model**	**Contribution of respective factor to Adjusted R-Square**

NYSE Composite	Equity Index	0.561184	0.561184
Ortho.DJ_Global TSM	Equity Index	0.572601	0.011417
Ortho.S&P 500 Composite	Equity Index	0.637383	0.064782
Ortho.DJ US TSM	Equity Index	0.639555	0.002172
Ortho.MSCI WORLD FINANCIALS $	Equity Index	0.64782	0.008265
Ortho.FTSEUR1ST 300 E	Equity Index	0.661608	0.013788
Ortho.FTSE USA BASIC MATERIALS	Equity Index	0.668265	0.006657
Ortho.STOXX EUR 600 E	Equity Index	0.674377	0.006112
Ortho.S&P/TSX COMP	Equity Index	0.706506	0.032129
Ortho.FRANCE CAC 40	Equity Index	0.708334	0.001828
Ortho. FTSE 100	Equity Index	0.717677	0.009343
Ortho.MSCI WORLD CONSUMER SERVICES $	Equity Index	0.719042	0.001365
Ortho.FTSE USA CONSUMER GOODS	Equity Index	0.721689	0.002647
Ortho.MSCI WORLD UTILITY	Equity Index	0.737608	0.015919
Ortho.PHILDELHPHIA BANK INDEX	Equity Index	0.740528	0.00292
Ortho.DJ TRANSPORT	Equity Index	0.741646	0.001118
Ortho.MSCI WORLD TCH $	Equity Index	0.744391	0.002745
Ortho.FTSE MIB INDEX	Equity Index	0.745021	0.00063
Ortho.DJ ASIAPACIFIC TSM	Equity Index	0.745714	0.000693
Ortho.RUSSIA RTS	Equity Index	0.751002	0.005288
Ortho.IBEX 35	Equity Index	0.753498	0.002496
Ortho.POWERSHARES CMOD ETF	Commodity ETF	0.758705	0.005207

Ortho.AMERICAS DS BROADLINE RTL	Equity Index	0.762305	0.0036
Ortho.ISHARES CMOD ETF	Commodity ETF	0.762615	0.00031
Ortho.SP GSCI CMOD TR	Commodity Index	0.797145	0.03453
Ortho. US to CAND $	Currency Exchange	0.797536	0.000391
Ortho.LME COPPER	Commodity	0.797882	0.000346
Ortho.AUD to USD	Currency Exchange	0.798342	0.00046
Ortho.MSCI WRD WLTCM	Equity Index	0.802093	0.003751
Ortho.GBP to USD	Currency Exchange	0.809299	0.007206
Ortho.CRUDEOIL NORTHSEA	Commodity	0.81031	0.001011
Ortho.CRUDE OIL BRENT	Commodity	0.813175	0.002865
Ortho.CHILE SE SELECTIVE	Equity Index	0.814106	0.000931
Ortho.TOPIX	Equity Index	0.815226	0.00112
Ortho.EUR to USD	Currency Exchange	0.818404	0.003178
Ortho.UK 10YEAR DSGOVT	Government Bond	0.818927	0.000523
Ortho.EUR to CHF	Currency Exchange	0.819212	0.000285
Ortho.USD to 100YEN	Currency Exchange	0.820981	0.001769

Table 9: Contribution to Adjusted-R^2 by factor and asset class for the oil free model

Explanation: The table explains the contribution of each factor in Adjusted-R^2 and cumulative Adjusted-R^2 after introduction of the factor in the model. Note that complete regression results for the oil-free model are presented in Table 7.

Factor	**Type**	**Adjusted R-Square after inclusion of respective factor in the model**	**Contribution of respective factor to Adjusted R-Square**
MSCI WORLD INDUSTRIAL	Equity Index	0.496932	0.496932

Ortho.MSCI WORLD FINANCIAL	Equity Index	0.501891	0.004959
Ortho.FTSE USA BASIC MATERIALS	Equity Index	0.557089	0.055198
Ortho.MSCI WORLD HEALTH	Equity Index	0.570087	0.012998
Ortho.FTSE USA CONSUMER GOODS	Equity Index	0.577755	0.007668
Ortho.MSCI WORLD CONSUMER SERVICES	Equity Index	0.578802	0.001047
Ortho.DJ TRANSPORT	Equity Index	0.589795	0.010993
Ortho.PHILADELPHIA BANK INDEX	Equity Index	0.591745	0.001950
Ortho.MSCI WORLD UTILITY	Equity Index	0.645836	0.054091
Ortho.MSCI WORLD TECHNOLOGY	Equity Index	0.647049	0.001213
Ortho.US to CAND DOLLAR	Currency Exchange	0.656235	0.009186
Ortho.SP 500 ALUMINUM	Equity Index	0.657335	0.001100
Ortho.AMS DS BROADLINE RETAIL	Equity Index	0.658439	0.001104
Ortho.AUD to USD	Currency Exchange	0.65868	0.000241
Ortho.LME COPPER	Commodity	0.660249	0.001569
Ortho.NZD to USD	Equity Index	0.662336	0.002087
Ortho.GBLX SILVERMINERS ETF	Commodity ETF	0.662486	0.000150

Ortho.DJ UTILITIES	Equity Index	0.664646	0.002160
Ortho.ISHARES SILVERTRUST	Commodity ETF	0.666578	0.001932
Ortho. UK 10 YEAR DS GOVT	Government Bond	0.667574	0.000996
Ortho.POWERSHARES DBAGRIC	Commodity ETF	0.669449	0.001875
Ortho.AMS DS GOLD MINING	Equity Index	0.676047	0.006598
Ortho.SP GSCI AGRI	Commodity Index	0.676317	0.000270
Ortho. Gold BULLION	Commodity	0.677471	0.001154
Ortho.WHEAT	Commodity	0.677847	0.000376
Ortho GBP EUR	Currency Exchange	0.678281	0.000434
Ortho.MSCI WORLD CHEMICAL	Equity Index	0.682001	0.003720
Ortho.MSCI WORLD CONS and ENGI	Equity Index	0.683188	0.001187
Ortho.MSCI World HOTEL, RESTAURANT and LEISURE	Equity Index	0.685425	0.002237
Ortho.MSCI WORLD REAL ESTATE	Equity Index	0.687161	0.001736
Ortho.MSCI WORLD AIRLINES	Equity Index	0.692021	0.004860
Ortho.PALLADIUM	Commodity	0.692406	0.000385
Ortho.MSCI WORLD MACHINERY	Equity Index	0.692928	0.000522