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AN ANALYSIS ON THE IMPACT OF ENVIRONMENTAL SCREENING ON RISK AND RETURN ON THE ISEQ 20

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Abstract

Environmental, Social, and Governance (ESG) based investing is a rapidly growing industry. In recent years it has come to the forefront of discussion due to growing demand from investors and increased regulatory requirements on companies to disclose their contribution to ESG practices. There have been numerous studies conducted on the impact of using ESG as a means for investing. The aim of this paper adding to the existing body of research through conducting similar analysis on Irish markets. As will be shown in the literature review, other research compares indices to their corresponding ESG-screened index. Given that there is no ESG screened ISEQ 20 index, this paper will construct two sets of Environmental screened portfolios to increasingly stringent levels of acceptance. The first set of portfolios use Modern Portfolio Theory to find the Global Minimum Variance portfolio and the efficient frontier. The second set of portfolios are constructed to have an equal allocation into all assets.

Declaration

The work submitted in this thesis is wholly the work of the author, and all resources used external to the author have been referenced where appropriate.

Acknowledgements

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1. Introduction

Investor demands are evolving. In recent years, investors are becoming increasingly insistent on the financial products they invest in being environmentally sustainable, socially responsible, and governmentally sound (Tucker and Jones, 2020). These three principles come together to form the concept known as ESG. Aside from investors increasing demands, there is also pressure coming from governments across the globe expecting companies to become more transparent in the role they play in further enhancing the climate emergency. As will be explored below, the vast majority of investors under the age of 37 have deemed ESG to be a key aspect of the financial products they invest in. As wealth transfers to these individuals over time, ESG will be pushed to be one of the main drivers in financial markets.

Two models for using ESG ratings for portfolio construction are explored in the literature review. The first model takes a 'best of industry' approach, where the firms with the highest scoring ESG ratings are selected from each industry. Given that this study will focus on the ISEQ 20, it does not seem appropriate to employ this approach. The second model uses screening measures, wherein a portfolio has strict criteria for an asset to be allowed to be included, and if a company does not fit these criteria it is disallowed. This is the approach that will be taken in this analysis.

There have been numerous studies carried out across financial markets on whether ESG screening has a positive or a negative impact on investment risk and return. Studies have shown that high performers in ESG criteria tend to also be high performers overall, as they have the resources available to focus on adopting ESG compliant processes. This has shown in previous studies that ESG screened portfolios tend to outperform their unscreened counterparts, due to this increased concentration in higher quality companies. As ESG screening models would only allow investment into ESG compliant assets from the total available pool of assets, Modern portfolio theory (MPT) would dictate that as portfolios become less diversified, the risk level should increase. This forms the baseline for this study. The expectation would be that the overconcentration of resources into higher quality firms would cause ESG screening to provide a higher return than the market, however this concentration into fewer total assets would increase the level of risk.

In researching for this dissertation, no papers turned up which used tested the risk and return level of ESG screened ISEQ 20 portfolios against the ISEQ 20 on its own. This dissertation

aims to explore this topic, however due to data constraints the analysis will focus solely on screening for environmental considerations, rather than ESG in aggregate.

2. Literature Review

With this dissertation being focused on the ESG, the literature under review in this subsection aims to highlight some key themes in the field of ESG to provide the background for the research to follow.

2.1 ESG data quality

A challenge that is widely encountered in the field of ESG analytics is the quality of the data available to investors. There is a diverse range of ESG ratings agencies and ESG-styled investment vehicles, and research has been shown that these can differ in formatting, objectives, and style. (Schanzenbach and Sitkoff, 2020).

Research conducted by Bertolotti agrees with Schanzenbach and Sitkoff's findings. Their findings note that there is a general lack of consistency between different ratings agencies, as each agency weighs E, S, and G components based on their own subjective aims. This finding is illustrated using correlation and regression analysis of the organisation ranks between different ESG ratings agencies. The result of this analysis was a correlation of 0.48 in December 2012, with an increase correlation of 0.55 in June 2019. This indicates that ratings are becoming more standardised over time. There is still a debate however on whether ESG data is of sufficient quality compared to other forms of financial ratings, such as bonds ratings. Bertolotti notes that the correlation between bonds ratings fall in the order of 0.9 between different agencies. This indicates that ESG ratings do have some distance to close before the data quality debate can be settled fully. Bertolotti's research also notes that there is no regulatory requirement for companies to disclose ESG information, which could cause their coverage to be insufficient or skewed. (Bertolotti, 2020).

Research conducted by Drempetic et al. agrees, stating that data quality needs to be challenged more by academia. They note that ESG is quite a new field in finance, and that the wider community is focussed more on ESG's profitability, than the reliability of ESG reporting matrices. (Drempetic, Klein and Zwergel, 2020)

In el al. agree with the viewpoints discussed above. They note a 'choice overload' when making investment decisions with ESG data, arguing that the current industry standard does not fully

leverage advanced data technologies to fully optimize the quality of ESG reporting. (In, Rook and Monk, 2019)

Based on the literature, there appears to be a long way to go before ESG data quality is up to the same standard as other investment data, such as bond ratings. Ratings do seem to be improving over time, however.

One major note to make is that ESG data is potentially spotty and unstandardised; because there is no regulatory requirement to report this information, companies may omit data so as not to be painted in a negative light. The observations made by Drempetic et al. of using a data-science driven approach could potentially be a solution to help close the gap here. Ultimately however, Bertolloti makes a persuasive argument that the long-term solution to closing ESG coverage gaps is to make it a regulatory requirement for organisations to disclose this information to the market.

A 2018 study in the Journal of Financial Analysts found that 82% of fund managers who on aggregate managed 43% of institutional assets under management (AUM) used ESG ratings data to inform their investment decision making. The main response for why they do so is because they deem ESG ratings to be 'financially material to investment performance'. In this same study, the inconsistency of ESG ratings across ratings agencies is raised, with it being noted as 'the biggest challenge' to using ESG data in informing investment decision making. (Amel-Zadeh and Serafeim, 2017)

Greenwashing, according to Cambridge dictionary, is "to make people believe that your company is doing more to protect the environment than it really is". (Cambridge, 2021). One study found that firms which they deem to have "High" performing sustainability practices tend to be more readily available to disclose ESG information and are less likely to "Greenwash" their published data. This does seem to be obvious given that if a firm were a high performer in a specific sector, it would make sense for them to advertise it. The interesting point raised here is the process of greenwashing, which given the subjective and voluntary nature of ESG data disclosure, could be an issue for some firms. Given the introduction of the Sustainable Finance Disclosure Regulation (SFDR), this process is sure to change in the coming years. (Eccles, Ioannou and Serafeim, 2011)

2.2 Subjective investor sentiment

Research conducted by Tucker and Jones, noted how consumer demand for ESG will increase drastically over time, as an event known as 'The Great Wealth Transfer' takes place. This wealth transfer is discussed by Tucker and Jones to be the passing of inheritance from older generations to younger generations, and the subsequent reallocation of investment that occurs from this. Their research proves that demand for ESG varies largely based on age, with younger investors having a much higher demand for ESG, with 85% of investors under age 37 having a moderate to high demand for it. This is in stark contrast to investors over the age of 72, where 89% of investors have a low demand for ESG. The authors note that fund managers must be ready to supply this demand that will be created as younger investors inevitably inherit assets from older investors over time. (Tucker and Jones, 2020).

Rook and Monk record in their study of Taiwanese markets that investors tend to exaggerate ESG information. Their research notes that investors tend to be more optimistic when responding to news from organisations who are perceived by the public as having more diligent ESG practices, and more pessimistic when responding to news from organisations which the public perceive to have insufficient ESG practices.

This point on ESG subjectivity has also been researched by Schanzenbach and Sitkoff. Their research highlights that ESG is highly contextual and is adapted to the subjective whims of the person or group who are selecting the investments. Despite this, there are some fundamental ESG elements noted in their research. These are, strong compliance with environmental initiatives is highlighted as good environmental policies, poor labour conditions and unhealthy products are examples of poor social policies, and poorly incentivised, and entrenched, management being examples of poor Governance.

The issue that ultimately arises, as noted by Schanzenbach and Sitkoff's research, is how each of these factors are weighed. The example given, is how do you evaluate an organisation that has impeccable environmental and sustainability practices, but has a poorly treated and underpaid workforce? This ultimately will lead to subjective weighting, as investors may care more about one issue, and less about another. (Schanzenbach and Sitkoff, 2020).

There does appear to be a consensus in the literature reviewed that there is an element of subjectivity to ESG in its current form. Firstly, there is a large generational divide as to whether ESG is even a factor that should be considered in investments. The generational divide does appear as if it will close over time, with ESG becoming more and more popular. Secondly,

ESG initiatives are open to exaggeration by investors as noted by the study of Taiwanese markets, which could skew the way in which ESG related initiatives are interpreted.

A study from the Journal of Corporation Law notes that investors looking to create social value in firms should initially take a value driven investment approach, followed by using excess capital to make 'impact investments' into specific social areas which the investor deems to be most aligned with the social value they aim to create. While this does give the investor more control over the allocation of the capital in the firm over simply investing directly into the firm, this does add another layer of subjectivity to decision making of the firms ESG resourcing. Impact investments are defined in the paper to be investments which improve socially valuable practices of the investee enterprise. An example of this would be investing directly into reducing a firms greenhouse gas emissions, rather than leaving the decision up to the investee enterprises' management team. (Brest, Gilson and Wolfson, 2018)

This subjectivity may be relevant for the research question in this paper, because the way in which ESG ratings are given by ratings industries could be subject to their own individual biases.

2.3 Organisational change towards ESG

To facilitate further discussion, this subsection will discuss the impact investors make on ESG practices within organisations. Kolbel et al. proposed that organisations do possess the drive to adopt ESG practices, provided this involves small changes to their business model. This paper proposes that larger, more costly changes, or changes which are more time consuming, are less likely to happen due to companies being more apprehensive to their implementation. (Kolbel et al., 2020) This point is enhanced by research which proved that capital allocation forms one of the driving forces of change within organisations with regard to ESG. This research notes this as being an issue however, as 80% of assets which are invested sustainably are invested in publicly listed firms who have ample access to sourcing capital funding. This could cause issue down the line, as companies could simply source capital from investors who do not view ESG as a determining factor of their decision making.

Despite the paper being relatively dated compared to other ESG research in this dissertation, (Carnahan, Agarwal and Campbell, 2010) still remains relevant. In this paper, it is proved that companies will improve their performance in response to receiving ratings from external bodies, and particularly when receiving poor ratings. This is relevant to the discussion for the dissertation as the adoption of using ESG ratings as a means for screening companies should

in theory increase companies ESG performance over time. An interesting finding is that companies who receive a poor rating not only improve their performance after receiving this but tend to overshoot the benchmark. This shows that widespread adoption of a process where companies are rated on their ESG performance can in fact improve the adoption of ESG practices.

Drempetic et al. note that there is a strong correlation between the firm size (number of employees) and the amount of ESG data that they disclose. Larger firms tend to disclose more information than small and medium sized firms, due to larger firms being under more pressure to report information to maintain their legitimacy. This research also notes that some industries have been more willing to adopt ESG into their business models than others. (Drempetic, Klein and Zwergel, 2020)

A major driver of both organisational change and data quality in ESG is the Sustainable Finance Disclosure Regulation which has become applicable in the European Union as of March 10th, 2021. This directive is applicable to all financial market participants and financial advisors operating in the EU and sets specific rules for how sustainability information should be disclosed. This will be discussed in further detail in the review on grey literature and the EU's regulatory framework on ESG below.

2.4 Impact of ESG Screening on investment returns

There have been different studies conducted on whether ESG screening will hurt investment returns over the long run. To show a more rounded view of the broader market's findings, this paper will be using both academic research and research conducted by asset managers and financial advisory firms. It should be noted that findings from these firms are grey literature. However, I do feel discussing their findings will add value to this proposal.

Research conducted for the Journal of Applied Corporate Finance in 2016, found that in three out of the four portfolios analysed, ESG screened investment returns improved fund performance *after* accounting for risk. From their finds, the performance increase from applying ESG screening amounts to about 0.16% annually. The one portfolio in their study which ran a performance loss, netted to a loss of -0.01% annually. This analysis was conducted on the 'Global all' and Global developed markets', which the authors identify to be roughly 85% of global investible equities, and 85% of developed market investible equities respectively. The four portfolio scenarios were created by screening both universes to varying degrees, with ESG thresholds of 10% and 25%. These were compared to the unscreened

portfolios to determine the performance increase/loss. Arabesque Partners, Eccles R.G, Feiner. A, and Verheyden T, (2016).

Research conducted on Indian markets concurs with these findings of increased investment returns generated from ESG screening. In this analysis, which compared the returns from the Indian Nifty and CNX indices to the ESG India index, they found a return of 27.2% per annum for the ESG index, compared to a return of 20.36% and 17.98% per annum for the nifty and CNX indices respectively. (Sudha, 2014)

Research conducted by the Royal bank of Canada which compared returns from well-established indices such as the S&P500 and the MSCI world to their ESG screened counterparts, found that the ESG screened portfolios outperformed their unscreened counterparts. The approach taken in this research was not to exclude any sectors deemed to be 'bad', but to select the "best-of-sector" companies for each individual sector. This conflicts with approaches which air more on the conservative side, and would exclude investments into tobacco, firearms, and other 'sin stocks'. RBC Global Asset Management (2019).

Research from the Journal of business ethics in 2009 found that funds which took an approach of screening for the best performers of each market sector performed better than funds which excluded market sectors based on their perceived social cost. This caused a gap in the performance between European and American ESG funds, as European funds took a positive screening approach of selecting for best-of-sector, compared to American funds taking a negative screening approach of excluding 'sin stocks'. Cortez, silva and Areal (2009)

There appears to be wide consensus between authors that ESG not only doesn't cause a loss in performance, but actually increases performance. It should be noted that the study on Indian markets is quite dated with a publication date of 2014. This prior research should set expectations for what the findings of this proposed research question may be.

2009 research on the role that fees had in determining the spread between unscreened and ESG screened returns found that ESG screened portfolios carried a fee premium over portfolios that did not factor ESG. This could imply that even if an ESG screened portfolio slightly outperformed the benchmark unscreened portfolio, it could in actuality be underperforming the portfolio net of fees. Given that 2009 is relatively a long time ago in the field of ESG, I have read into some grey literature to confirm if this is still the case. As of 2021, the Blackrock iShares S&P 500 Core ETF carries a Total exchange ratio (TER) of 0.03%. The iShares ESG Screened S&P 500 ETF carried a TER of 0.08%. (iShares, 2021) these fees are quite low in

comparison to the average return of the S&P500 due to the fact that they are index funds, however it should still be noted that even in 2021 the fee for ESG inclusion in a passively balanced portfolio is almost triple. (Gil-Bazo, Ruiz-Verdú and Santos, 2009)

2.5 Impact of ESG screening on Investment Risk

In 1952 Harry Markowitz penned a journal on portfolio selection which lay the groundwork for Modern Portfolio Theory (MPT). MPT states is the theory of structuring portfolios in such a way that an investor can maximise their expected return for any given level of market risk. In this theory, the more diversified a portfolio is, the less variance (and therefore risk) there is in any given portfolio. What can be extrapolated from this is that if there is a decrease in the total composition of an investment portfolio when screening for ESG, the total level of risk of the portfolio will increase in proportion to the change in portfolio composition. This is something than can be expected and accounted for in the methodology of this dissertation. It is less so a question of 'if' there will be an increase in risk level, but more a question of 'how much' the increase is. (Markowitz, 1952)

A 2007 paper in 'The Financial Review' notes that when diversifying for risk in an investment portfolio, 100 stocks is insufficient for achieving a sufficiently diversified portfolio, and their modelling suggests a portfolio of closer to 200 stocks is required to achieve sufficient diversification. Using hypothesis testing techniques, a 1%, 5% and 10% level of significance was modelled as the percentage chance of a portfolio falling short of a required target at a given future date. This research found that a portfolio of 63 stocks had a 10% shortfall risk, a portfolio of 93 stocks has a 5% shortfall risk, and a portfolio of 163 stocks has a 1% shortfall risk. This is relevant to ESG screening as it would be prudent for a fund manager to take into account the change in shortfall risk that occurs when changing the total composition of the investment portfolio, it is not simply a question of a changing variance. (Domian, Louton and Racine, 2006)

2017 research from the Palgrave Encyclopaedia of Strategic Management argues for a differentiation between the concept of risk and the concept of uncertainty when evaluating investment decisions. In this, uncertainty is characterised as the overarching topic which is harder to quantify and subjective to personal biases, with risk being a quantifiable subset of uncertainty. This is relevant to the discussion on investment risk as there are unpredictable scenarios which can cause excess levels of risk in investment portfolios. While not directly

mentioned in the paper as it was penned in 2017, Covid-19 is a prime example of uncertainty as outlined in this research. (Park and Shapira, 2017)

Research into the impact of ESG screening on investment risk and return in China found the same increase in mean return consistent with all other research in this paper. While this in itself does not contribute anything new to the discussion in this literature review beyond what has already been confirmed, it does note that there is actually a decrease in standard deviation for two of the four ESG screened portfolios. This contradicts the traditional approach of modern portfolio theory, given that a decrease in portfolio diversification decreased risk rather than increased risk. The findings of this paper indicate that the removal of companies which did not comply with ESG screening removed risk from the portfolio which had not been priced into the underlying assets. This is consistent with research indicating that screening for ESG increases returns due to higher performing companies tending to rate higher in ESG scores. (Dai, 2020)

The Sharpe ratio first proposed in 1964 by William F. Sharpe has become one of the more popular ways of evaluating risk-return performance. This model compares an investment to a risk-free asset which allows the tester to find the underlying risk present in any given investment. This model may prove useful in testing absolute risk levels of portfolios in researching this dissertation. (Sharpe, 1964)

2.6 Grey Literature

This subsection will highlight the areas of ESG outside of research papers. These essentially are the policies and mandates that drive change in company and government policy. While it is not directly 'literature' I do feel it is important to critique this within the literature review as these policies ultimately are what will help form the methodology of this dissertation. The policies under review are as follows:

2.6 EU Sustainable Development Goals

In 2015 the United Nations set its 2030 Agenda for Sustainable development. In this, countries across the world agreed to work together towards 17 total goals. Some of these are as follows:

1. The eradication of poverty
2. Finding sustainable and inclusive solutions to development
3. Making sure everyone's human rights are protected globally

4. Ensuring quality education is available to all

Of the seventeen goals identified, each of them could be categorised into three buckets: Goals which help to drive a sustainable, renewable, and cleaner **E**nvironment. Goals which help to promote diversity & inclusion, consumer protection, human rights, and overall a more **S**ocially responsible world. And goals which are tailored around fair, equitable wages and good **G**overnance practices within organisations. These three factors come together to form the framework of **ESG**.

While each of the EU Sustainable development goals will bring about positive change across the world, there are some which stand out from others when looking directly at the financial sector. Firstly, it should be noted that a majority of the sustainable development goals will require financial backing, particularly with regard to transitioning to a carbon neutral and sustainable economy. This will require financial backing, which must come from both government and the financial sector.

2.6 EU Sustainable Finance Action Plan

In 2018, the EU outlined its action plan for financing sustainable growth. The aim of this action plan is to work towards attaining a sustainable financial system to fund future growth, which is consistent with other SDG initiatives. The aim of the action plan is to work with signatory countries to bring in legislative measures for the financial sector. In this, 10 major reforms over three overarching areas are suggested.

The first area aims to reorient capital flows towards sustainable investment to achieve inclusive and sustainable growth. This would be done through various ways, however some of the key ones to note are as follows. The establishment of an EU wide classification system for sustainable activities. The creation of clear labelling for ‘green’ financial products. Increasing capital allocation to sustainable projects. Developing sustainability benchmarks for firms to strive towards, and encouraging investment advisors to incorporate sustainability into their practice.

The second area aims to encourage the incorporation of sustainability into corporate risk management practices. This will be achieved through integrating sustainability into ratings and research, encouraging the adoption of these risk management processes within asset managers and institutional investors, and incorporating sustainability into prudential frameworks.

The third area aims to encourage transparency in business practices and the adoption of a long-term view in economic and financial activity. This will be achieved through strengthening sustainability disclosure and rulemaking surrounding accounting practices, and through endorsing sustainable corporate governance practices, while simultaneously discouraging short term governance practices.

2.6.3 Sustainable Finance Disclosure Regulation

The introduction of the Sustainable Finance Disclosure Regulation in March of 2021 will help to close the gap going into the future. All issues highlighted in ESG data quality due to lack of regulatory framework will be present in this dissertation, with all the biases and data inconsistencies that come hand in hand with this lack of clear framework. The expectation would be that in the future, the SFDR will allow for a more consistent approach to be taken, and perhaps this analysis could be undertaken again in a more detailed way. Given that ESG is evolving so rapidly, the expectation would be that if this exact same analysis was conducted from January 1st, 2022 – December 31st, 2024, instead of Jan 1st 2018 – December 31st 2020 would have substantially more data available. The SFDR would be one of the driving factors of this.

The SFDR essentially provides a standardised regulatory framework for companies to operate within for reporting ESG data publicly. While this regulation is not bringing about sweeping changes from day one, the changes brought about over the timeline of this regulations implementation from March 2021 to June 2024 should allow for far more consistency in the approach companies take to disclosing environmental data and in how ratings are generated off of these data.

3. Methodological Approach

3.1 Research question

The research for this dissertation found that there were a number of studies which reviewed the risk and return of applying ESG screening in US, Global, Chinese, and Indian markets. In researching this, no similar studies were available for Irish markets. This paper aims to provide value to the existing body of research through conducting similar analysis on the ISEQ 20. All reviewed literature performed a comparison of a pre-existing index against a pre-existing ESG screened index, for example MSCI world compared to MSCI world ESG. As there is no ESG screened ISEQ index, a different approach would need to be taken to conduct similar research.

This research aims to review the risk and return of companies on the ISEQ 20 when accounting for their **environmental** rating. I have not taken governance or social considerations into account in this paper due to limited access to historical data on these for Irish markets.

3.2 Methodology

Most models analysed in the literature review, when screening for ESG, used scenarios where an index was compared to a pre-existing ESG screened variant of this index. As previously mentioned, an example of this would be the MSCI World Index screened against the MSCI ESG World Index. This allowed for modelling to be done simply based on the comparison of the returns between these two pre-constructed indices. For this research question, there is no ESG variant of the ISEQ 20, so a different approach must be taken in the methodology of tackling this question.

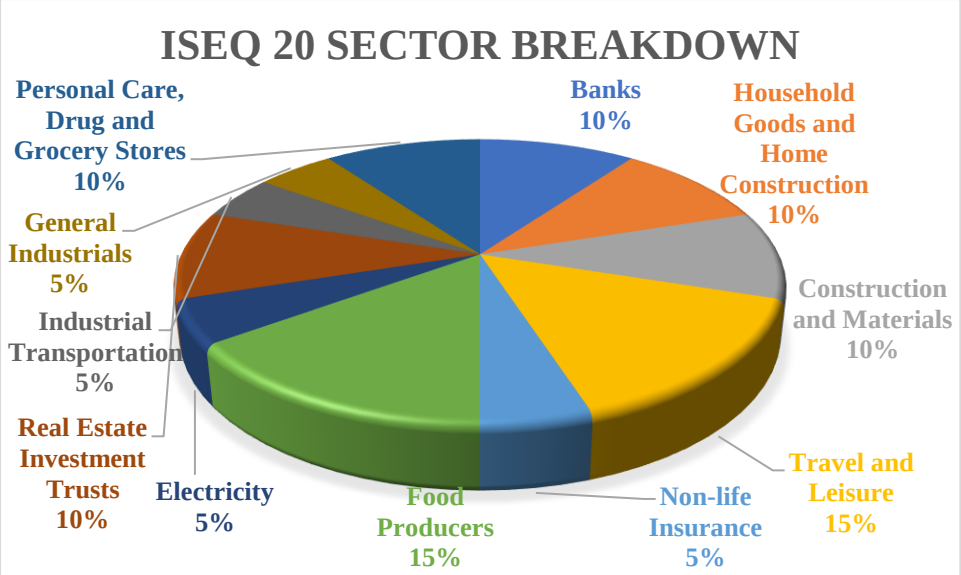
The methodological approach for examining this research question is done in four stages. First, companies were selected to be included in the review based on the availability of their environmental ratings. In total, four ratings agencies were contacted and two were able to provide ratings, these being the Carbon Disclosure Project (CDP) and Morningstar. Originally Morningstar was selected to be the data provider for attaining these screening ratings however they could not provide historic ratings, which prevented this dissertation from exploring the topic over any more than the previous year. The CDP was selected as it was a non-profit with more readily available information compared to Morningstar who had locked their historic data behind a paywall.

Of the twenty companies in review, eight of them had insufficient environmental data available on the CDP website to include in my analysis, (Fig. 1). This meant that to apply the screening model, these companies with insufficient data must be excluded from the analysis. In Fig. 1, any company with a rating of N/A in any time period is excluded, as it prevents a consistent approach from being taken. This raises the question of whether the portfolio of twelve companies accurately represents the risk and return profile of the portfolio of twenty companies, however as discussed below, this twelve-stock portfolio represents the vast majority of the total market capitalisation of the ISEQ 20.

Company	2020	2019	2018
AIB GROUP PLC	A	A-	A
BANK OF IRELAND GP	B-	C	C
CAIRN HOMES PLC	N/A	F	F
CRH PLC ord	A-	B	B
DALATA HOTEL GP.	B	B-	N/A
FBD HOLDINGS PLC	A-	B	B
FLUTTER ENTERTAIN	F	F	F
GLANBIA PLC	D	D	F
GLENVEAGH PROP.PLC	B	F	F
GREENCOAT REN.	N/A	N/A	F
HIBERNIA REIT PLC	B-	N/A	N/A
IRISH CONT. GP.	F	F	F
IRISH RES. PROP.	F	N/A	F
KERRY GROUP PLC	B	B	B
KINGSPAN GROUP PLC	A	A	N/A
ORIGIN ENT. PLC	C	N/A	D-
RYANAIR HOLD. PLC	B-	F	F
SMURFIT KAPPA GP	A-	B	B
TOTAL PRODUCE PLC	C	C	F
UNIPHAR PLC	N/A	N/A	N/A

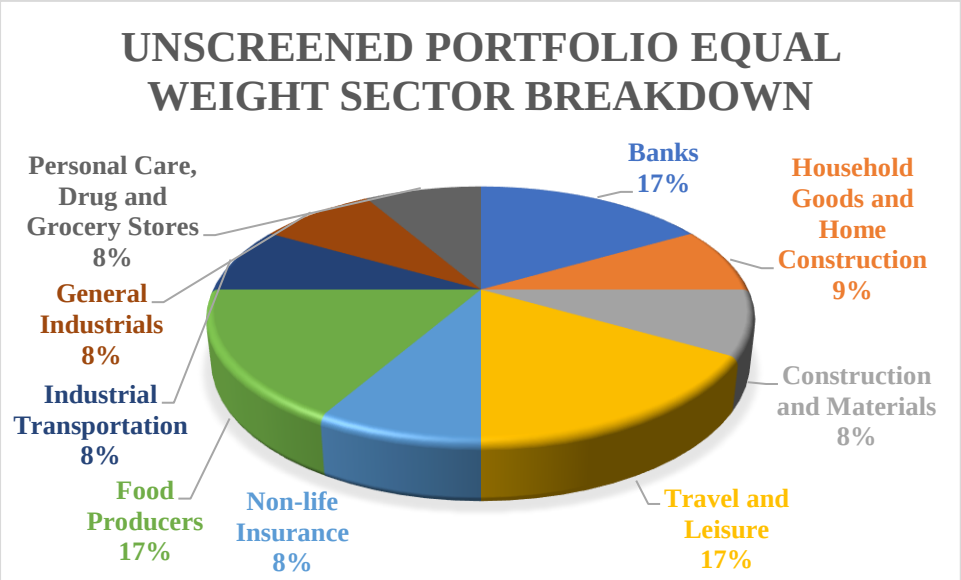
(Fig. 1)

A check can be done at a glance to review the breakdown of the compositions of the twenty-stock portfolio versus the twelve-stock portfolio. This can be seen in Figure 2 and figure 3.



(Fig. 2)

The most noticeable changes are the lack of representation for electricity and real estate investment trusts (REITs) in the portfolio screened to twelve companies.



(Fig. 3)

Having screened out the companies with no readily available environmental data, a table of ratings was constructed in fig. 1 above. These ratings allow for the construction of four separate portfolios of varying compositions based on the rating given to each company in each year. These portfolios were constructed based off the ratings provided by the Carbon Disclosure Project (CDP).

While there is a change in the sectoral weighting between the 20 stock and 12 stock ISEQ portfolio, the 12 stock portfolio does still represent 87.47% of the ISEQ 20 as noted in figure 4. This is due to the fact that the top six companies within the index represent 88.28% of the total ISEQ 20 composition, as noted in the most recent disclosure from Euronext Dublin at the end of 2020. The only major exclusion from the dataset is Kingspan who represent 8% of the index. The need to exclude Kingspan from this review is unfortunate, as Kingspan has scored an A rating every year since 2015 and have disclosed environmental data every year from 2012 until 2020 except for 2018. If Kingspan had have been included in this review, this would have been representative of over 95% of the ISEQ 20 constituents by market cap.

It should be noted that this dissertation does not apply market capitalisation weighted screening in constructing portfolios as the aim is to use the efficient market hypothesis to create an efficient frontier curve, alongside using equal weighted portfolios. The market capitalisation weightings are given simply as an illustration of how much of the total market is represented in the twelve-asset portfolio.

No	Company	Weight
1	CRH PLC ord	20.56%
2	FLUTTER ENTERTAIN	19.81%
3	RYANAIR HOLD. PLC	16.09%
4	KERRY GROUP PLC	16.03%
5	KINGSPAN GROUP PLC	8.04%
6	SMURFIT KAPPA GP	7.75%
7	BANK OF IRELAND GP	2.73%
8	GLANBIA PLC	1.94%
9	AIB GROUP PLC	1.23%
10	HIBERNIA REIT PLC	0.71%
11	DALATA HOTEL GP.	0.68%
12	GREENCOAT REN. GRP	0.66%
13	CAIRN HOMES PLC	0.57%
14	IRISH RES. PROP.	0.56%
15	IRISH CONT. GP.	0.53%
16	UNIPHAR PLC	0.50%
17	ARYZTA AG	0.45%
18	GLENVEAGH PROP.PLC	0.41%
19	TOTAL PRODUCE PLC	0.39%
20	ORIGIN ENT. PLC	0.35%

(Fig. 4)

Two approaches were taken to constructing portfolios. In these approaches, four unique portfolios are constructed. The first portfolio does not use environmental ratings as a screen.

The second portfolio screens any company rated F. the third portfolio screens companies rated F and D. the fourth portfolio screens any company rated F, D, and C. these four portfolios are constructed using both methods discussed below.

3.3 Efficient Frontier Portfolios

The first approach to constructing portfolios uses Modern Portfolio Theory as a basis for plotting an efficient frontier and finding the global minimum variance portfolio (GMVP). The global minimum variance portfolio as outlined in Markowitz theory is the portfolio that provides the lowest level of risk while also falling on the efficient frontier of the given portfolio. The aim of finding the GMVP for each portfolio is to have a basis for comparing the risk and return levels of each portfolio against each other.

Given that the composition of each portfolio is slightly different, if a random allocation of assets was to be selected for each portfolio the overall mean risk and return values for each portfolio would be drastically different. Using the GMVP as a starting point allows for a standardises approach to reviewing each portfolio scenario. As the assets in these portfolios can contain any % of the total portfolio composition, it is important to note here that this is a strictly long portfolio, which does not allow short selling. Therefore, the maximum allocation in any one asset is 100%, and the minimum allocation in any one asset is 0%.

3.4 Equal weight Portfolios

The second set of portfolios are constructed using equal weighting in each portfolio rather than using the efficient market hypothesis. These portfolios are likely to be inefficient portfolios given that they are simply constructed using an equal allocation into all assets available based on the screening criteria of the portfolio, rather than through efficiently allocating investment into these available assets. Despite this, they will represent a more ‘diversified’ portfolio due to these portfolios consisting of all assets available to them, rather than consisting of the assets which are most efficient to reducing standard deviation, which could cause an overconcentration into certain companies or sectors.

3.5 Approach to constructing efficient portfolios

The four scenarios present below were constructed to represent increasingly stringent environmental screening. These portfolios use CDP environmental ratings as a basis for selecting which companies may be included in each portfolio.

	AIB GROUP PLC	BANK OF IRELAND GP	CRH PLC ord
Unscreened Portfolio	x	x	x
Light Screen Portfolio	x	x	x
Moderate Screen Portfolio	x	x	x
Substantial Screen Portfolio	x	x	x
	GLENVEAGH PROP.PLC	**IRISH CONT. GP.**	**KERRY GROUP PLC**
Unscreened Portfolio	x	x	x
Light Screen Portfolio	x	-	x
Moderate Screen Portfolio	x	-	x
Substantial Screen Portfolio	x	-	x
	FBD HOLDINGS PLC	**FLUTTER ENTERTAIN**	**GLANBIA PLC**
Unscreened Portfolio	x	x	x
Light Screen Portfolio	x	-	x
Moderate Screen Portfolio	x	-	-
Substantial Screen Portfolio	x	-	-
	RYANAIR HOLD. PLC	**SMURFIT KAPPA GP**	**TOTAL PRODUCE PLC**
Unscreened Portfolio	x	x	x
Light Screen Portfolio	x	x	x
Moderate Screen Portfolio	x	x	x
Substantial Screen Portfolio	x	x	-

(Fig. 5)

Scenario 1 Unscreened

The unscreened portfolio consists of all twelve companies on the ISEQ 20 which have historic environmental ratings available. The companies included in this portfolio are shown in the table above. This portfolio will be used as a benchmark for all screened portfolios, as it is the most representative portfolio of the four scenarios to the ISEQ 20 without environmental screening.

Scenario 2 Light Screen

The light screen portfolio consists of ten companies, and filters exclusively for companies rated F by the CDP for each given year. Given the trend of ESG scores increasing over time as evidenced in research discussed in the literature review, the number of companies which score an F in environmental ratings are also decreasing overtime. In 2018, the portfolio consists of only eight companies, with four of them attaining an F rating. This increases in 2019 to ten of the twelve companies scoring a rating of D and above.

Scenario 3 Moderate Screen

The moderate screen portfolio screens for the same parameters as the light screen portfolio, however the screening is extended to exclude all scenarios rated D and below. Given that there is only three scenarios which are rated D, Glanbia 2019 Glanbia 2020, and Origin 2018, the expectation would be for this portfolio to loosely follow a similar trend to the light screen portfolio, with a slightly higher standard deviation.

Scenario 4 Substantial Screen

The substantial screen portfolio filters for companies rated C and below. This removes the majority of companies in 2018, with only five companies rated A or B. This continues unchanged into 2019 with five companies rated A or B. There is an improvement in 2020 with three additional companies added to the portfolio, however one third of the available assets have been screened completely from this portfolio. The expectation for this would be a higher standard deviation than all other portfolios, however given research that shows top market performers tend to be ESG compliant, the greater concentration of assets into these could show greater return.

3.6 Comparing screened scenario to unscreened scenario

Once the portfolios have been constructed, the mean and variance were compared between each screened portfolio and the unscreened portfolio. The Sharpe ratio was also used as the vehicle for factoring in a risk-free rate. The approach of using the Sharpe ratio is consistent with the methodologies used in research on other markets from the literature review, as it allows us to make comparisons between the risk adjusted return of the portfolio when factoring in a risk-free rate. A spot rate of the Irish government 10y bond return at the closing date of each year was selected as the risk-free rate. This again is consistent with research conducted in other countries from the literature review. A review of the mean values at the GMVP is conducted to review if the percentage increase in standard deviation is in line with the percentage increase

in mean return at the GMVP. These comparisons were also made between the equal weight screened and unscreened portfolios.

3.7 Data gathering

To perform this analysis, four datasets were required. First, a table containing the composition of the ISEQ20 was required. This table was acquired from the Euronext website. Euronext is the leading operator of stock exchanges across Europe, and acquired the Irish stock exchange in 2018, renaming it to Euronext Dublin. This made Euronext the best candidate to gather these data. This dissertation originally aimed to acquire historic market compositions of the ISEQ over the past three years which would have allowed for the portfolios to be rebalanced annually. This rebalancing would have allowed for a greater degree of accuracy in answering the research question, however this information is not available publicly on the Euronext website. Two data management teams at Euronext were contacted for historic market composition data, however information was not tracked by these teams. Ultimately, the approach taken in this dissertation for selecting the market composition was to take a snapshot of the ISEQ 20 as of July 2021, and construct portfolios based off this over the past three years. It was not possible to add a rebalancing effect to the investment portfolios due to lack of data on the side of the Euronext Dublin exchange.

The second dataset required is the historical performance for the constituents of the ISEQ 20 index. Numerous options were available for collecting these data, with the top three choices being Bloomberg, Yahoo Finance, and Google Finance. While all three options were valid, Yahoo Finance was selected for acquiring historical data. Access to Bloomberg was not available whilst gathering this data and given that Yahoo Finance and Google Finance were both equally valid, Yahoo Finance was selected. Both Bloomberg and Google Finance would have been perfectly valid options for acquiring this data. Given that no rebalancing was taking place in this portfolio due to lack of historic market composition data, historic data for the snapshot 20 constituents of the ISEQ was extracted from January 1st, 2018, until December 31st, 2020.

The third dataset required is data to perform the screening. Five data sources were investigated, namely Bloomberg, Morningstar, the Carbon Disclosure Project (CDP) Morgan Stanley Capital International (MSCI) and Standard & Poor (S&P). as was expected from the literature review, datasets were incomplete, and did not follow a consistent approach across ratings providers.

Of the five, MSCI and S&P did not have sufficient ESG data on Irish companies to be able to perform any meaningful analysis. Bloomberg had ratings for some but not all companies, which ruled them out of the data gathering stage. The two companies which remained were Morningstar and the CDP. Morningstar was initially selected as they had ESG ratings for eighteen of the twenty ISEQ constituents. Morningstar required a licence to access historic data however which was prohibitively expensive, which ultimately ruled them out as the source of this data.

An approach was considered whereby the spot rating provided by Morningstar was screened against the spot ISEQ constituents over the past 1 year, however this approach was not adopted as this analysis aims to review the impact of environmental screening over a period longer than 1 year.

Ultimately, the Carbon Disclosure Project's Climate Change ratings were selected as means for screening for this research topic. This caused a change in the initial research question from one of a review of the impact on ESG factors to investment risk and return in Irish markets, to one of Environmental factors impact on risk and return in Irish markets. This lack of data is generally consistent with the findings in the research of literature for this dissertation, doubly so given the approach taken for this dissertation whereby no pre-screened ESG index exists for Irish markets. For this analysis to work, the screening must be done manually which in researching for this dissertation, has not been done before.

The CDP gathers their environmental ratings through self-disclosure by firms. This form of data collection may face the same challenges posed in the research discussed above on firms greenwashing their data when self-reporting. The CDP lists their current guidelines for collection of environmental data publicly to give a benchmark for the type of questions companies are asked in their disclosures. They do note that this methodology is strictly for their 2021 data gathering, and given previous research, the quality of ESG data is increasing over time. This could indicate that the ratings in use for this dissertation do not follow the following methodology exactly, however it should give a good indication as to the approach taken in previous years.

First, applicant companies must select which questionnaire they would like to complete, full or minimum disclosure. The minimum disclosure takes into account data points exclusively for the company in question. The full disclosure collects data for both the company, and the sector in which it operates. The minimum disclosure is available only to respondents who are

disclosing for the first time or have an annual revenue of €250m or less. The questionnaire is broken down into 14 modules, which take into account the business strategies, the way in which they structure their performance and targets, and the way in which the firm is governed. These management questions are asked alongside questions relating to the companies' structure towards curbing carbon emissions, their energy usage, and any and all climate related risk they engage in.

The fourth and final dataset required was risk-free rate figures for calculating the Sharpe ratio. The ten-year Irish government bond yield is selected for this, as it allows for a more stable figure for comparison over a three year or one year bond yield. The spot rate at the end of each year, 2018, 2019, and 2020 was selected as the yield for comparison as it is the final day in scope for this analysis.

3.8 Data analysis and formulae

Preliminary analysis

The first step in analysing the data is to create returns on each individual stock. This is done through taking the adjusted closing price of each stock and calculating the percentage change between each day. The adjusted closing price is selected over the normal closing price as it takes corporate actions into account which could distort the dataset. The formula for calculating this percentage change is simply:

(New Value – Original Value) / Original Value

This allows for accurate comparison between stocks with different adjusting closing prices.

The Mean and Standard deviation for each asset form the baseline of the construction of each portfolio. These are found through the formulae:

Mean = Sum of Observations / Number of Observations

The mean shows the average return of each asset.

$$\sigma = \text{sqrt}[\ \Sigma\ (\ Xi - \mu\ )2 / N\ ]$$

The standard deviation shows the percentage difference each value has from the mean, essentially it shows the deviation from the mean. This deviation allows us to measure risk.

Allocating environmental ratings

Using the ratings framework provided by the CDP, four scenarios were constructed. These ranged from, which is environmentally non-compliant firms who fall into the F category on the

ratings analysis conducted by the CDP, to environmentally compliant firms who fall into the B and A categories of the analysis. The framework constructed is as follows.

A/ B = Green

C = Yellow

D = Amber

F = Red

These ratings of green, yellow, amber, and red allows for the screened portfolios to be created based on specific criteria. The criteria for acceptance into each portfolio are below. A Y value indicates inclusion into the portfolio, an N value indicates that an asset cannot be included in the portfolio.

Portfolio	Red	Amber	Yellow	Green
Unscreened	Y	Y	Y	Y
Light Screen	N	Y	Y	Y
Medium Screen	N	N	Y	Y
Heavy Screen	N	N	N	Y

With the data table of which assets can be included in each portfolio created, we can now use the mean and standard deviation of each asset that is valid for inclusion to construct an efficient frontier curve for each portfolio.

Efficient frontier

The formulae used in calculating the efficient frontier stem from Modern Portfolio Theory and these specific notation stem from Quantitative Investment Analysis third edition by the CFA institute. The formula for calculating the portfolio expected value is as follows

E(w1R1 +w2R2… wnRn)

Where the expected return of the portfolio is the weight in asset n multiplied by the expected return of asset n.

Portfolio Covariance is calculated with:

Cov(Ri,Rj) = E[(Ri=ERi)(Rj-ERj)]

Where Asset i and asset j are two separate portfolio constituents. To construct our variance covariance matrix, a structure of covariances are used as follows.

Cov(Ra,Ra)	Cov(Ra,Rb)	Cov(,Ra, Rc)
Cov(Rb,Ra)	**Cov(Rb,Rb)**	Cov(,Rb, Rc)
Cov(Rc,Ra)	Cov(Rc,Rb)	**Cov(,Rc, Rc)**

This matrix continues until every portfolio constituent has been captured. Given that the diagonal is aiming to find the covariance between itself and itself, this will always be 1. I have highlighted these in the formula to make a note of this.

From here, a row vector is constructed which shows the standard deviations of each asset weighted to the amount of the asset within the portfolio. This weight cannot exceed 100% between all assets, as we have limited the portfolio to not allow for short selling. The formula for this row vector is as follows:

σ1W1	**σ2W2**	**σnWn**

Where the standard deviation of asset 1 is multiplied by the weight in asset 1, and so on until all assets in the portfolio are accounted for.

From here, matrix multiplication is used to solve for the efficient frontier. The excel syntax for these calculations can be found in the appendix below, alongside an explanation describing the process. Given that this analysis was conducted on Excel, there is no formula to include in this subsection.

With all of these values calculated, these excel functions are designed in such a way as to change the portfolio mean and the portfolio standard deviation through changing the weight into each asset. This allows the solver function on excel to be used to plot an efficient frontier by changing the weight in each asset. Through this, we can solve for the global minimum variance portfolio through simply selecting the standard deviation cell as the focus cell, and the portfolio weights as the cells to change, and solving for the 'minimum' possible value. An efficient frontier can be plotted through solving for points along the curve between the 'minimum' possible mean return of the portfolio, and the 'maximum' possible return of the portfolio.

Sharpe Ratio

The last test used for examining the difference in performance of each portfolio when taking risk free rates into account is the Sharpe ratio. The formula for the Sharpe ratio is as follows:

$Sa = E(Rp – Rf)/ \sigma p$

Where:

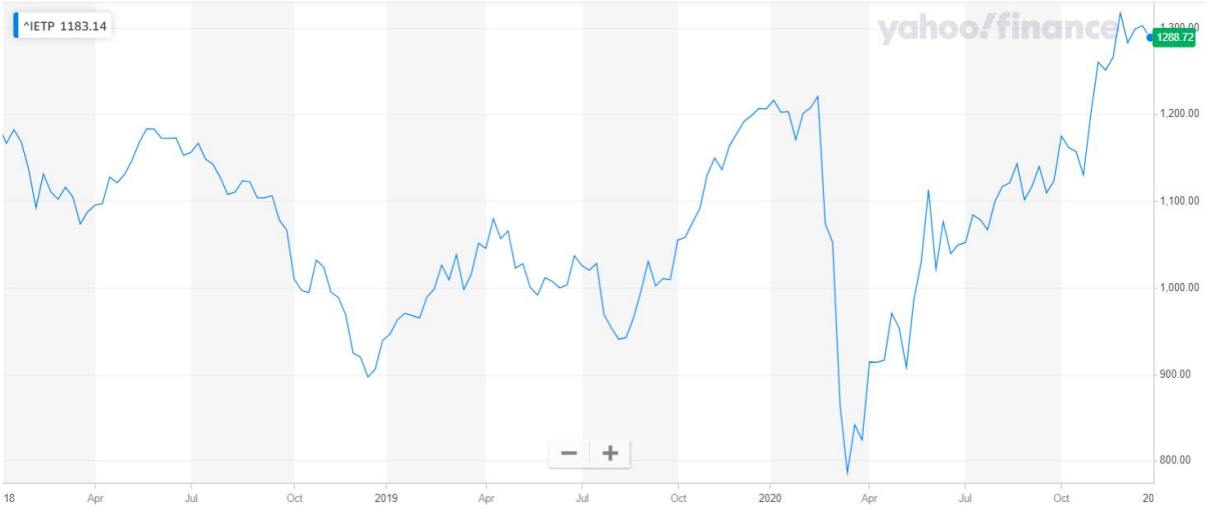
Sa = Sharpe Ratio

E(Rp – Rf) = the expected return on the portfolio minus the risk free rate

σp = The portfolio standard deviation

4 Findings

The following findings stem from applying the methodology as outlined above. Calculated values are examined in comparison to each other, rather than comparative to other investment on other markets. While there is some comparison of the returns of these portfolios to an Irish risk-free rate, these portfolios do not attempt to compete with portfolios on international markets. The returns on these figures do appear to be quite low, however this is in line with the time period selected given the impact covid-19 had on the ISEQ 20 over the time period selected. The chart below extracted from Yahoo Finance shows the slow growth of the ISEQ 20 over the time period selected. Given that the ISEQ 20 has grown by 17.23% from January 2021 to August 2021, it would be interesting to conduct this analysis over 2021 once additional environmental data is available as the portfolios would likely provide a better return.



(Fig. 7, Yahoo Finance, 2021)

For the efficient portfolios, I have elected to not include any data points where the mean return is below 0% as it would not make sense to invest in an asset pool that would lose an investor money when other combinations exist that provide both a higher return and lower risk. This is particularly noticeable in the unscreened portfolio efficient frontier, as the global minimum variance portfolio falls only marginally above 0%. These four scenarios essentially provide the highest return for the lowest possible level of risk for each given portfolio.

Given that these portfolios are constructed to solve for minimum variance within a pool of assets, some assets receive no investment, even when they are available for receiving investment based on the screening criteria. portfolios consisting of equal weighted assets are explored in the next subsection below.

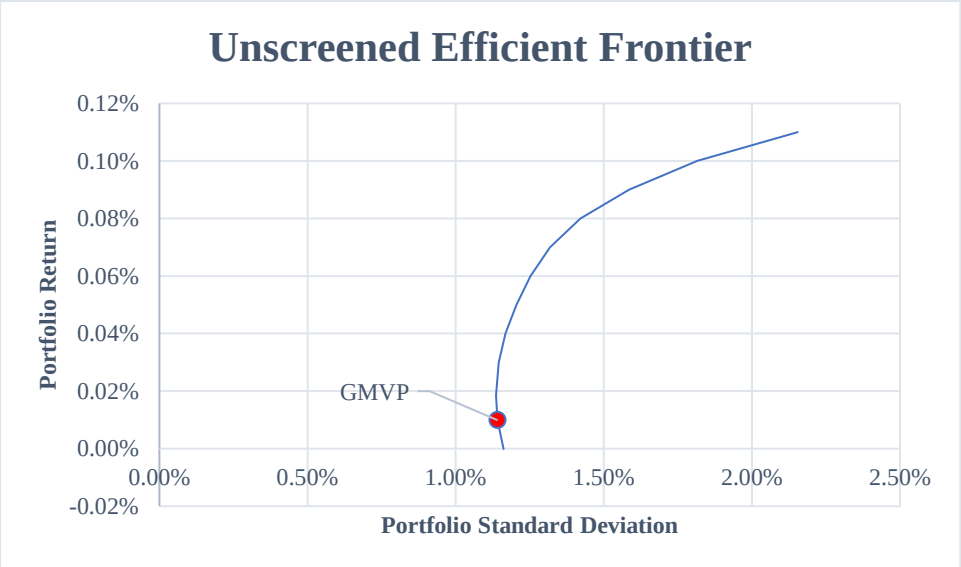
The expected return and standard deviation for each scenario are as follows:

All Years	No Screen	Light	Moderate	Substantial
Mean	0.0186%	0.0398%	0.0433%	0.0438%
Standard deviation	1.14%	1.22%	1.23%	1.27%

(Fig. 8)

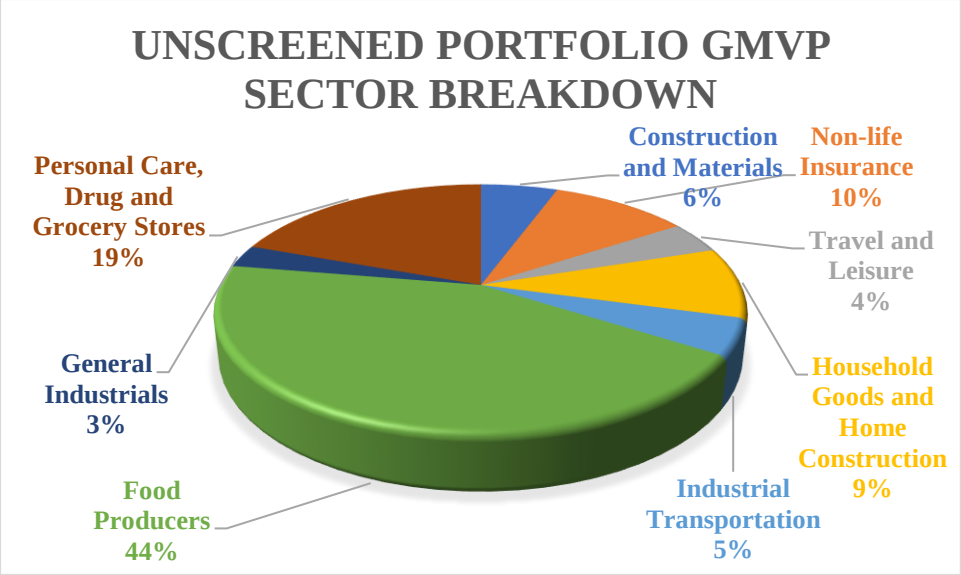
4.1 Unscreened Efficient Portfolio

Of the four portfolios, the unscreened portfolio scored the lowest mean return with a return of 0.0186% and had the lowest standard deviation of all four scenarios with a standard deviation of 1.14%. of the four portfolios, this portfolio was the only one to maintain the majority of the underside of its efficient frontier in negative returns, as seen on the frontier plotted below.



(Fig. 9)

These findings are in line with the general trend of the index over this time period, with a marginal increase in value from the beginning of the screening period until the end.



(Fig. 10)

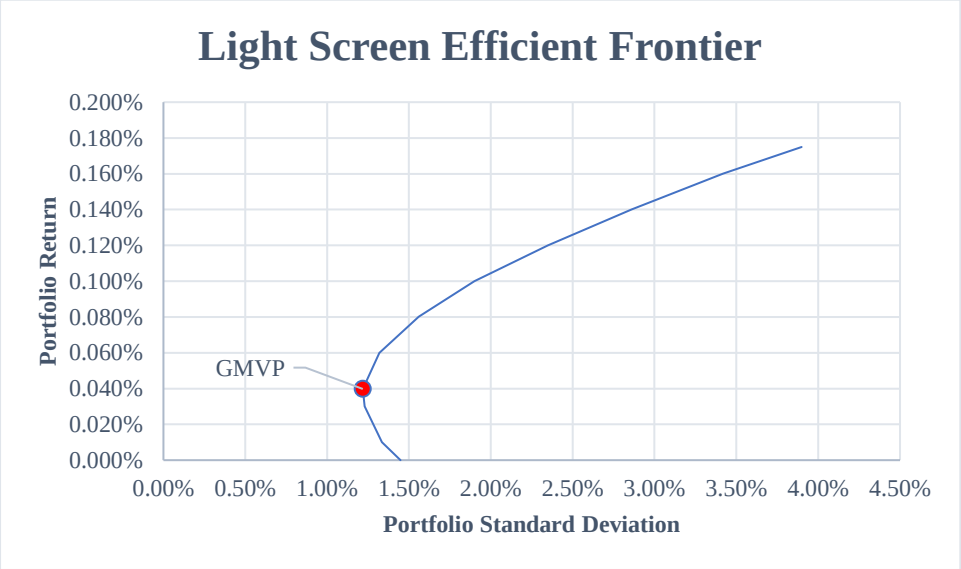
Of the twelve companies within this analysis, three of them are not present within the GMVP due to either their return being too low or their risk being too high. While these assets were within the pool of available assets for constructing this portfolio, they are not included at the GMVP. From this portfolio, AIB, Bank of Ireland, and Ryanair have all been excluded. AIB and Bank of Ireland have been excluded due to their negative mean return over the period, with -0.08% from 2018 – 2020 for AIB and -0.03% for Bank of Ireland over the same period. While Ryanair has positive earnings over the period with a return of 0.04%, it is the third riskiest asset with a standard deviation of 2.7%, behind only Bank of Ireland with 3.34% and AIB with 3.58%.

AIB GROUP PLC	BANK OF IRELAND GP	CRH PLC ord	FBD HOLDINGS PLC	FLUTTER ENTERTAIN	GLANBIA PLC
0.00%	0.00%	5.64%	10.19%	4.16%	7.97%
GLENVEAGH PROP.PLC	**IRISH CONT. GP.**	**KERRY GROUP PLC**	**RYANAIR HOLD. PLC**	**SMURFIT KAPPA GP**	**TOTAL PRODUCE PLC**
9.25%	4.75%	35.66%	0.00%	2.92%	19.46%

(Fig. 11)

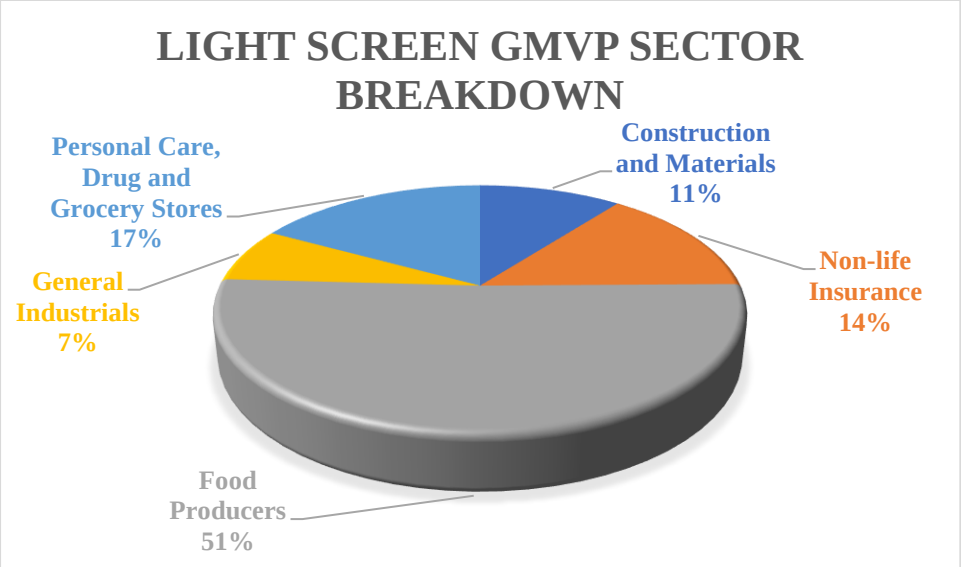
4.2 Light Screened Efficient Portfolio

Of the three scenarios which filter for environmental ratings, scenario 1 is the lightest touch, as it only excludes companies rated F on the ratings provided by the CDP. This removes two assets from the portfolio, bringing the total number of assets in this portfolio to 10. The GMVP for this portfolio falls considerably higher than the unscreened portfolio, with a standard deviation of 1.22% and an expected return of 0.0398%. this represents an increase in risk of 7% for an increase in return of 114% from removing F rated companies from the unscreened portfolio.



(Fig. 12)

As the number of assets within the portfolio has decreased, the allocation to each sector has become more concentrated. The two companies which have been removed fall into the travel and leisure sector, and the industrial transportation sector. This has caused an over representation of all other sectors from the original unscreened portfolio.



(Fig. 13)

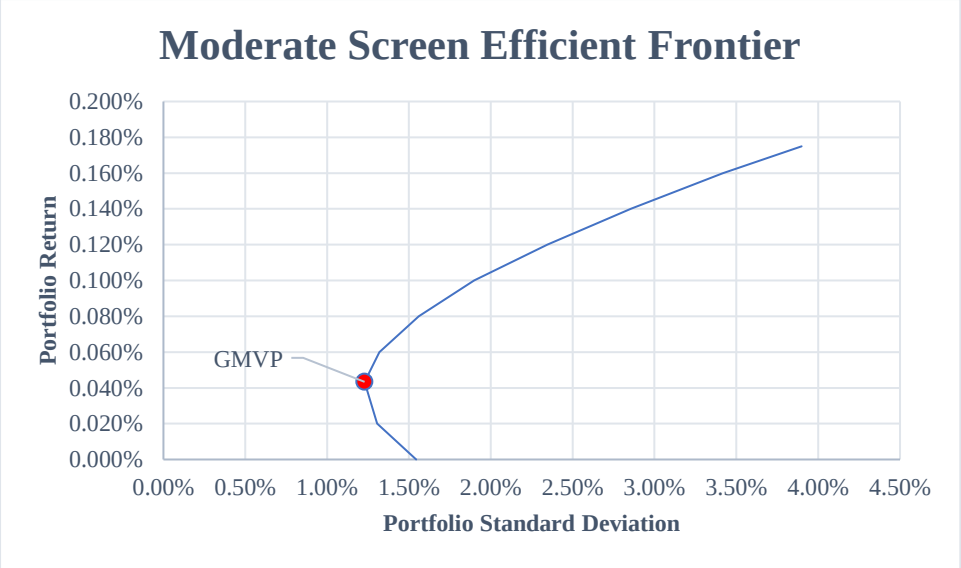
This portfolio follows a similar trend to the unscreened portfolio, with AIB, Bank of Ireland and Ryanair excluded due to their risk/return profile not being in line with the GMVP. Glenveagh Property has also been excluded from the GMVP, due to their F environmental rating in 2018 and 2019, which excludes their performance from these years, and brings their overall risk profile up from 2.25% to 3.06%. There is 10% increase in the allocation to Kerry group, which comes predominantly from the decrease in allocation to Glenveagh. Kerry group has the lowest risk of all assets in this analysis with a standard deviation of 1.57%, so it does make sense for an increased allocation to Kerry group given the decreasing diversity in the portfolio.

AIB GROUP PLC	BANK OF IRELAND GP	CRH PLC ord	FBD HOLDINGS PLC	GLANBIA PLC
0%	0%	10%	14%	6%
GLENVEAGH PROP.PLC	**KERRY GROUP PLC**	**RYANAIR HOLD. PLC**	**SMURFIT KAPPA GP**	**TOTAL PRODUCE PLC**
0%	45%	0%	7%	17%

(Fig. 14)

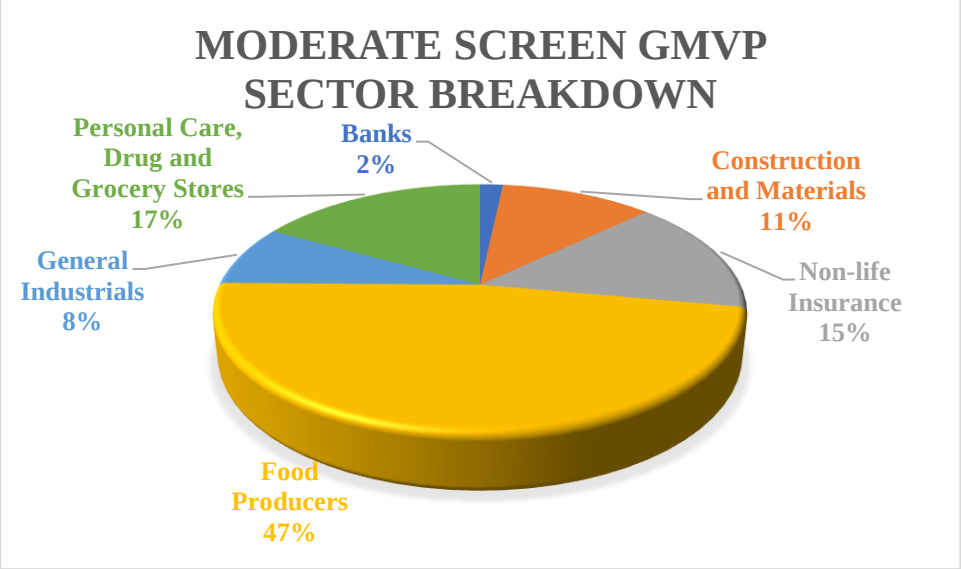
4.3 Moderate Screened Efficient Portfolio

The second scenario applies a moderate screen. In this, both F and D rated companies are removed from the portfolio. There are 9 companies represented in this portfolio in total. The GMVP for this scenario has a Standard deviation of 1.23% and an expected return of 0.043%. Given that there is only one instance of a company receiving a D rating, this portfolio is quite similar in structure to scenario 1. It can be observed that there is only a 0.01% increase from scenario 1, however an increase in return of 0.003%. This represents an increase in standard deviation of 0.89% for an increase in return of 9% over scenario 1, and an increase in standard deviation of 8.16% for an increase in return of 134% from the unscreened portfolio.



(Fig. 15)

The sectoral breakdown continues the trend from scenario 1, whereby the portfolios are becoming increasingly concentrated into assets with a higher environmental score. The removal of Glanbia from this portfolio has caused a shift in allocation towards all other industries, and a decrease in total allocation to food producers.



(Fig. 16)

Following from the trend in scenario 1, we can see a 2% rise in the allocation to Kerry group, which is consistent with offsetting a marginal increase in risk from removing Glanbia from our available pool of assets. There doesn't appear to be any clear 'winner' from the allocation of Glanbia's portfolio share towards the available pool of assets, however AIB has received a 2% allocation. There does not seem to be a clear justification for this inclusion on behalf of the solver. AIB represents the worst available asset in the portfolio, given that it has the highest

risk of 3.58% and the lowest mean return of -0.08%. Glenveagh would likely be a better option over AIB given that it has a positive return of 0.04% and the third highest standard deviation of 3.06%. this allows the portfolio to still maintain the same level of diversity over allocating this 2% of the portfolio into Kerry group, which could increase the risk profile through lack of diversity.

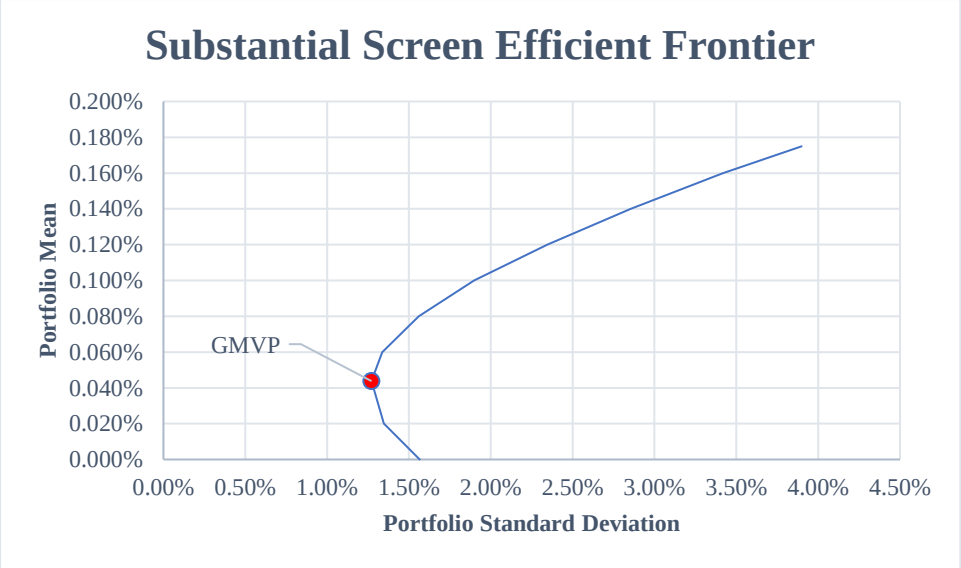
AIB GROUP PLC	BANK OF IRELAND GP	CRH PLC ord	FBD HOLDINGS PLC	GLENVEAGH PROP.PLC
2%	0%	11%	15%	0%
KERRY GROUP PLC	**RYANAIR HOLD. PLC**	**SMURFIT KAPPA GP**	**TOTAL PRODUCE PLC**	
47%	0%	8%	17%	

(Fig. 17)

4.4 Substantial Screened Efficient Portfolio

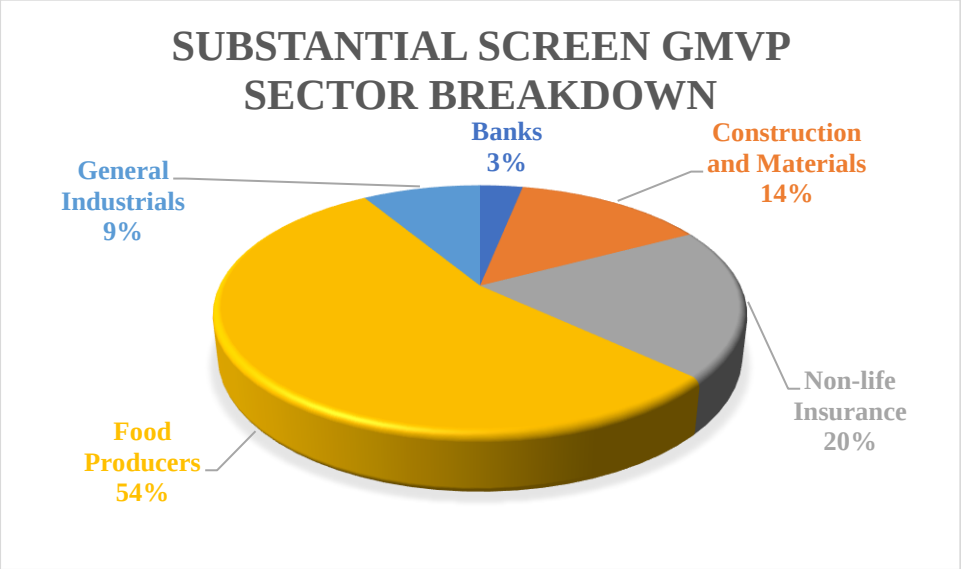
Scenario 3 has the strictest constraints of all portfolios in this analysis. In this scenario, companies rated F, D, and C are disallowed, leaving companies only rated in the range of B to A. As a consequence of this, this portfolio has the lowest number of constituents, with eight companies in total. The GMVP standard deviation is 1.27%, and the expected return is 0.044%. this scenario represents the highest return at the GMVP of all scenarios in this analysis, however the increase in risk is disproportionately higher than the increase in other portfolios when screening.

There is an increase in standard deviation of 11.88% over the unscreened scenario, which increases the expected return of the portfolio by 136%. When compared to scenario 1, there is an increase in standard deviation of 4.36% for an increase in return of 10%. When compared to scenario 2, there is an increase in standard deviation of 3.43% for an increase in return of 0.94%. This indicates based on the screening criteria of this analysis, that there is an increase in overall return generated by investing on environmental screening criteria, however the risk level becomes disproportionally higher than the excess return generated when you screen at this higher threshold.



(Fig. 18)

Given that this portfolio has the strictest screening criteria, this portfolio has the smallest amount of total assets within it, with eight assets in total. The breakdown for this portfolio shows an increased amount of allocation to banks compared to other portfolios. There is also a total exclusion of the personal care, drugs, and grocery store sector.



(Fig. 19)

This portfolio further proves the observation that as the screening criteria become stricter, and the range of assets available become fewer, the portfolio will push more towards the lowest standard deviation asset at its GMVP. Kerry group has gained 7% in this portfolio over the previous level of screening, and an increase of 18.44% in total allocation from the original

unscreened portfolio. Glenveagh, Bank of Ireland, and Ryanair continue to not receive any funding, however AIB has gained a percentage in allocation over the previous portfolio. This seems out of the ordinary given its negative return and high-risk level.

AIB GROUP PLC	BANK OF IRELAND GP	CRH PLC ord	FBD HOLDINGS PLC
3%	0%	14%	20%
GLENVEAGH PROP.PLC	**KERRY GROUP PLC**	**RYANAIR HOLD. PLC**	**SMURFIT KAPPA GP**
0%	54%	0%	9%

(Fig. 20)

4.5 Efficient Frontier – Discussion

A number of observations can be made based on this analysis of the global minimum variance portfolios of four portfolios screened to increasingly stringent environmental criteria. the first clearly visible observation is that there is an increase in return of over 100% in all screened scenarios over the unscreened portfolio, while providing a disproportionately less increase in risk between the portfolios. This excess return is attained through both the removal of companies with poor environmental performance, and through an increasing allocation of assets into the food production sector as portfolios screening increases.

While these findings do indicate that screening based on environmental criteria does generate excess returns when applied to the ISEQ 20, there does appear to be diminishing returns on how much value is generated between the Moderate and Substantial screen portfolios. This can be observed in the disproportionate amount of risk generated in the Substantial screen portfolio in comparison to the increase in return generated on the moderate portfolio. It is out of the scope of this analysis; however, a follow up area of research could be on where exactly these diminishing returns start to take hold.

These portfolios are constructed to solve for the lowest level of standard deviation based solely on the returns of each asset. This does not factor in risk generated from a lack of diversification. All portfolios contain over 50% allocation to the food production sector at the GMVP. while this GMVP does theoretically provide the lowest risk based purely on the standard deviation and return characteristics, it does not take into account an overallocation into each sector. Analysis is carried out in the next section to construct portfolios of equal diversification, which would allow for this diversification risk to be taken into account.

4.6 Equal Weight Portfolios

The following table has been constructed to highlight the mean standard deviation and return of each year in each portfolio. This analysis assumes equal weighting in each asset, which allows for a more accurate representation of a diversified portfolio over the GMVP when accounting for asset allocation. While the GMVP portfolios may have a lower standard deviation, these equal weight portfolios engage with a wider range of assets.

	No Screen	Light	Moderate	Heavy
Year 1				
Mean	-0.1023%	-0.0852%	-0.0852%	-0.0750%
Standard deviation	1.76%	1.78%	1.78%	1.78%
Year 2				
Mean	0.0787%	0.0603%	0.0875%	0.1060%
Standard deviation	1.92%	1.99%	1.92%	1.76%
Year 3				
Mean	0.0730%	0.0556%	0.0537%	0.0572%
Standard deviation	3.36%	3.33%	3.34%	3.50%
All Years				
Mean	0.0168%	0.0324%	0.0392%	0.0444%
Standard deviation	2.48%	2.72%	2.70%	2.97%

(Fig. 21)

These portfolios follow a similar trend as the GMVP portfolios, however, have a higher average risk, and a slightly lower average return. This would imply that these portfolios are not envelope portfolios, and do not fall along the efficient frontier of the portfolio. Despite these portfolios being less efficient overall than the GMVP portfolios, we can see that each portfolio still operates in a similar way to their respective GMVP portfolio. The unscreened portfolio maintains its place as the lowest performing portfolio overall years, while also having the lowest standard deviation. Both the risk and return increase as portfolios become more sensitive to environmental screening, as was the case with the GMVP portfolios.

An anomaly here however is the overall decrease in risk by 0.02% from the additional screening imposed from the moderate portfolio over the light screened portfolio. This implies that with an equal allocation into all available assets, the moderate screened portfolio is closer to the efficient frontier.

As was the case in the GMVP portfolios, there is a disproportionate increase in risk for the substantially screened scenario compared to the increase in return over the other portfolios.

The return of this portfolio however is slightly higher than the GMVP counterpart, albeit with over double the risk.

We can interpret from these equal weight portfolios that the moderate screened portfolio is the most appropriate scenario to invest in, as it provides a balance between risk and return over the other scenarios, and over the unscreened scenario. The GMVP portfolio would still be less risky overall based on the asset returns, however as previously discussed there is an overemphasis on the food production sector in this GMVP portfolio. Given this, there are clear pros and cons for whether the Moderate screen GMVP portfolio or the Moderate screen equal weight portfolio should be selected.

I have included pie charts of the sector breakdown of each equal weight portfolio in the appendix. These show clearly the increase in diversity from investing in different industries compared to the GMVP portfolios.

4.7 Sharpe Ratio

The Sharpe ratio allows for a risk-free rate of return to use in comparing these constructed portfolios. The tables below show the Sharpe ratio for both the GMVP portfolios and the equal-weight portfolios. These rates allow us to compare how much reward we receive per unit of risk present within the portfolio.

GMVP	Sharpe Ratio	10y Bond Rate
Portfolio 1 Unscreened	28.39%	-0.304%
Portfolio 2 Light screen	28.22%	-0.304%
Portfolio 3 Medium screen	28.27%	-0.304%
Portfolio 4 heavy screen	27.36%	-0.304%

(Fig. 22)

Here we can see there is a marginal decrease when comparing each screened scenario to the unscreened scenario using the Sharpe ratio. This indicates that per each unit of risk, the unscreened portfolio has the highest risk-adjusted performance, with an increase in Sharpe ratio of 0.12% over portfolio 3.

Equal Weight	No Screen Sharpe Ratio	Light Sharpe Ratio	Moderate Sharpe Ratio	Heavy Sharpe Ratio	10y Bond Rate
2018	-57.61%	-55.87%	-55.87%	-55.46%	0.91%
2019	4.78%	3.67%	5.23%	6.77%	-0.01%
2020	11.23%	10.80%	10.69%	10.33%	-0.30%
All	12.95%	12.37%	12.70%	11.74%	-0.30%

(Fig. 23)

The equal weight portfolio Sharpe ratio is even more pessimistic than the GMVP Sharpe ratio. Given that these portfolios are inefficient, it does make sense for them to provide less value per unit of risk than the GMVP portfolios. As these portfolios were structured in such a way as to factor in yearly figures, we can see how 2018 caused negative Sharpe ratios for all portfolios due to a considerably higher 10-year yield over other years, and negative returns for all portfolios within this year.

A Sharpe ratio above 1 would generally be considered 'good' however we can note that in all scenarios above the Sharpe ratio falls considerably short of 1. This is due to the market conditions specified at the start of this finding's subsection. Due to Covid-19, markets are only marginally up over the time period in scope, and the marginal return per risk level shown in the Sharpe ratio reflects this.

5 Discussion

It is clear that investment in the ISEQ over this time period is generally not profitable compared to other markets such as the S&P 500, which averaged a return of 40% over the same time period (Yahoo Finance, 2021). Nevertheless, we can see that using ESG to screen for investments still provides a return which is greater than investing in the broader market, albeit with a higher level of risk. The portfolio which achieved the highest return relative to its risk level was the moderate screened portfolio, for both the GMVP and equal-weight portfolio groups. The lowest risk portfolio for both groups is the unscreened portfolio, which is consistent with Markowitz and Domian et al. which prove that increasing the diversity of your portfolio decreases the overall risk level.

Two forms of screening were discussed in the literature review, the first was an approach which screened out poor performing companies, and the second was an approach which selected the best performers in each market sector. I elected to take a screening approach rather than a 'best of market' approach as the ISEQ has fewer total companies in it compared to the S&P 500, for example. This would not allow for a 'best of market' approach in portfolio construction in the same way that the S&P does.

The findings from this analysis are consistent with research highlighted in the literature review, that screening for ESG has a positive impact on the return profile of the portfolio, and an increased risk profile. The increase in return tends to come from an overallocation of assets into industry leaders, who tend to have above average ESG practices over smaller market

constituents. These findings are also consistent with Markowitz theory which states that as portfolios become less diversified, the risk level and potential for return increases.

We found that allocating assets for environmental factors on Irish markets did not cause a decrease in risk, as was the case with research on Chinese markets, and did not outperform the benchmark index after accounting for risk as noted in research in the Journal of Applied Corporate Finance.

The aim of this paper was to add value to the existing pool of knowledge through applying environmental screening to Irish markets. In researching this field, similar research has been conducted on US, UK, Global Indian, Chinese and markets, however this has not been done on Irish markets. This paper has proven that there is a place for environmental screening in Irish markets, as it allows for investors to achieve a return which is above the returns of a portfolio consisting of the total market, albeit with moderately higher risk.

6 Conclusion

This dissertation conducted a review on twelve of the twenty ISEQ 20 companies with consideration for their environmental performance. A wide breadth of literature was reviewed to inform the steps taken in conducting this analysis. This literature was predominately in the field of ESG rather than strictly in the environmental field, however there is quite a deal of overlap in terms of coverage of these areas given than environmental data takes up a substantial portion of the ESG field.

This research was approached through using efficient portfolios and equal weight portfolios, which allowed for two distinct approaches to be taken towards the analysis of this question. The findings clearly displayed how the efficient portfolios provided a higher return per unit of risk compared to the equal weight portfolios, however the efficient portfolios placed considerable weight in the food production industry, which could cause excess risk in its own right due to this over-reliance.

Ultimately, the performance of these funds was quite poor compared to other markets such as the S&P 500, regardless of taking environmental considerations into account. This analysis did provide some insight however into how investing in Irish markets using environmental screening does in fact seem to outperform the market, with a moderate approach being most preferable to screening over a light touch or a substantial amount of screening.

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8 Appendix

Matrix Multiplication calculation 1:

Matrix Multiplication of the portfolio correlation matrix, by the transpose of the weighted asset standard deviation row vector created in the step prior above.

Or

=MMult(correlation matrix, transpose(weighted asset standard deviation row vector))

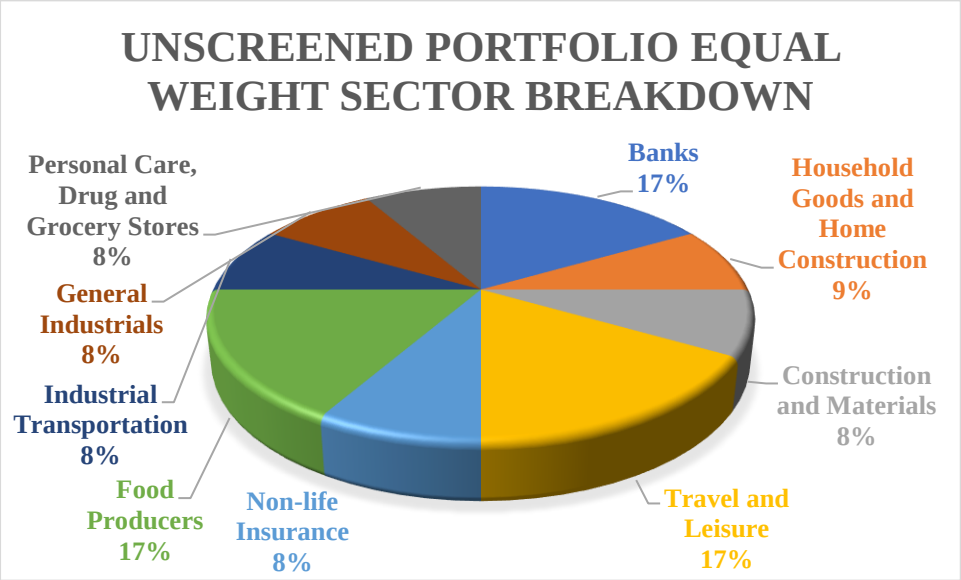
Matrix Multiplication calculation 2:

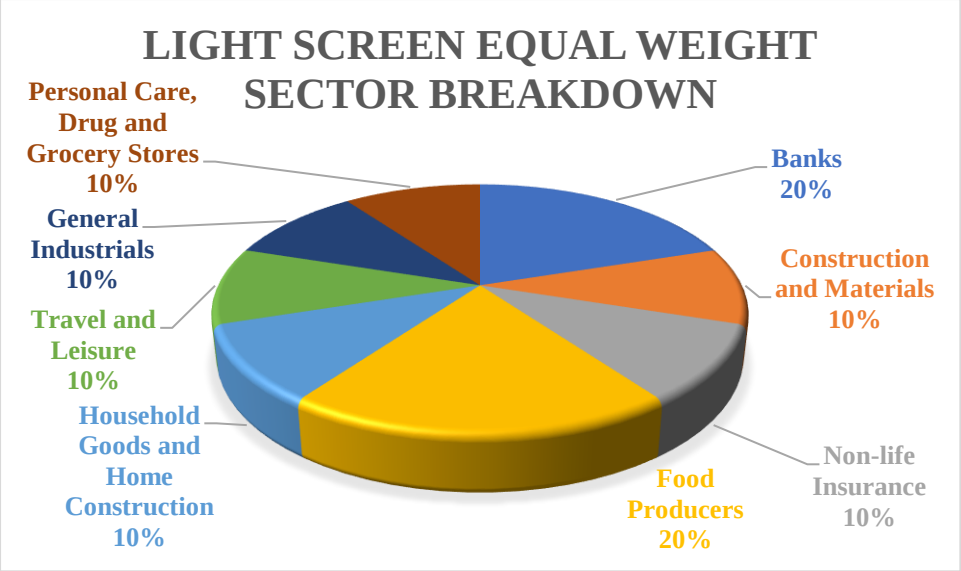
Square root of the matrix multiplication of the weighted asset standard deviation row vector, multiplied by the column vector calculated in the step above.

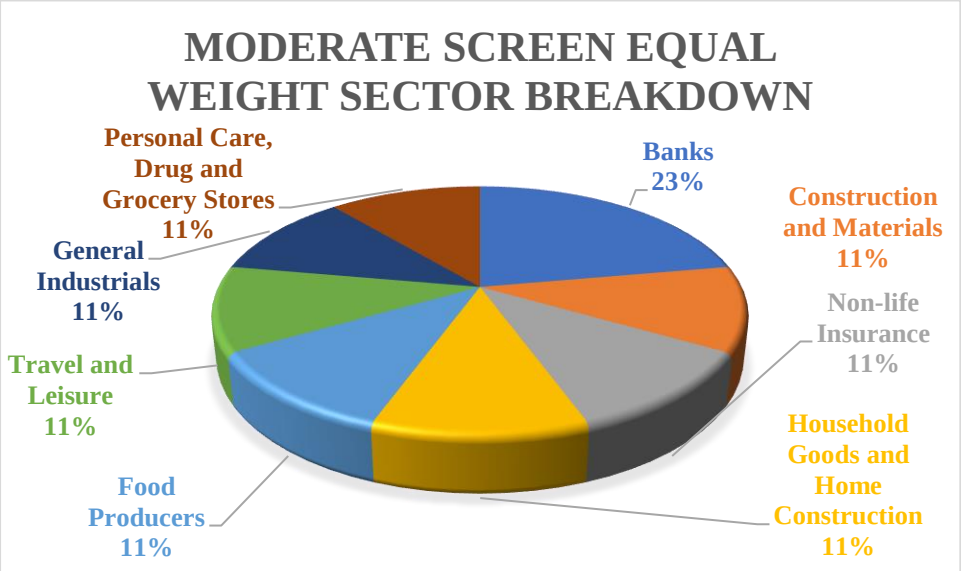
Or

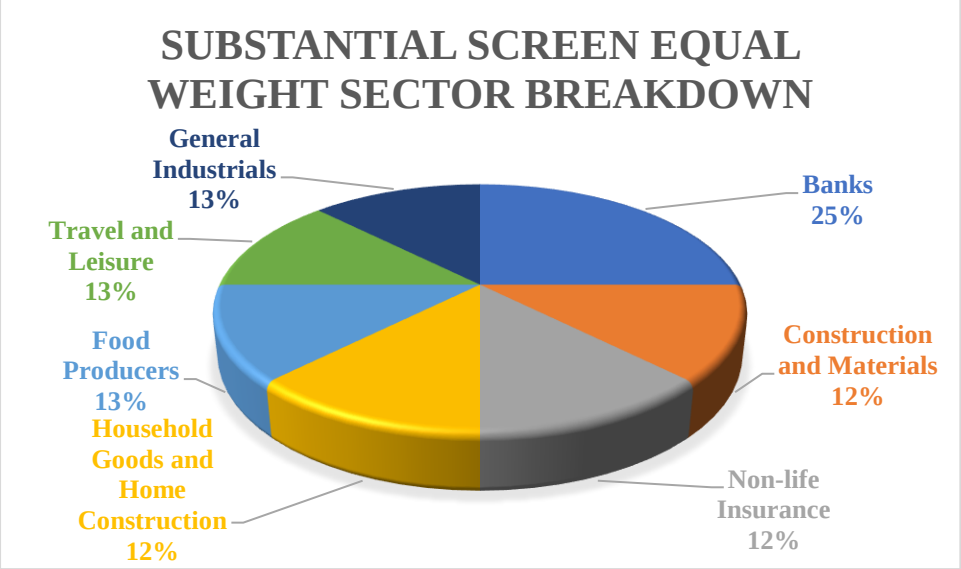
=SQRT(MMult(weighted asset standard deviation row vector, MMult(correlation matrix, transpose(weighted asset standard deviation row vector)))

Equal weight portfolio's sector breakdown




LIGHT SCREEN EQUAL WEIGHT SECTOR BREAKDOWN
Personal Care, Drug and Grocery Stores 10%
Banks 20%
General Industrials 10%
Construction and Materials 10%
Travel and Leisure 10%
Household Goods and Home Construction 10%
Non-life Insurance 10%
Food Producers 20%


MODERATE SCREEN EQUAL WEIGHT SECTOR BREAKDOWN
Personal Care, Drug and Grocery Stores 11%
Banks 23%
Construction and Materials 11%
General Industrials 11%
Non-life Insurance 11%
Travel and Leisure 11%
Household Goods and Home Construction 11%
Food Producers 11%


SUBSTANTIAL SCREEN EQUAL WEIGHT SECTOR BREAKDOWN
General Industrials 13%
Banks 25%
Travel and Leisure 13%
Construction and Materials 12%
Food Producers 13%
Household Goods and Home Construction 12%
Non-life Insurance 12%