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ESG Investing and Investment Returns

Evidence from the Asia-Pacific market

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ABSTRACT

In this thesis, I investigate whether actively managed ESG portfolios based on ESG scores can achieve consistent abnormal returns above the market benchmark in the Asia-Pacific (Australia, Hong Kong, Singapore, and New Zealand) market. 835 publicly listed companies with disclosed ESG score data in the specified market for the time period of 2010-2022 are studied in Ordinary Least Squares time-series regression in which high, low, and high-low value-weighted ESG portfolios regressed against Carhart's four-factor asset pricing model. I find that the portfolio composed of securities with high ESG scores (75-100) has a statistically significant and positive alpha, providing an abnormal return of 0,996% per month above the market benchmark. Notwithstanding, I find that the monthly returns of low and high-low ESG portfolios are mostly in line with the overall market. The results indicate investors can expect an abnormal return of 11,95%, on average, per annum by managing a high-ESG portfolio in the specified market.

Keywords: ESG, environmental social governance, portfolio performance, sustainable finance, Asia-Pacific market

JEL codes: G11, G12

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CHAPTER 1 Introduction

While making an investment decision, investors often evaluate the expected investment return either to decide whether the investment is feasible or to compare the given investment with other feasible investment opportunities. Investment return is a crucial criterion for investors as it provides the expected profitability benchmark of an investment and measures the expected return of the investment over time. Thus, the end goal of investors is intuitively finding an investment strategy that could optimize the investment return. Today, there is a strategy gaining rapid popularity that could possibly shed light on optimizing investment return, which is ESG screening. This strategy features the use of the ESG score, which provides the unbiased performance of a company with regard to ethical and sustainable concerns of ESG (Miller, 2022). This score is a percentage metric for how well a company addresses ESG concerns relative to its respective industry. In academia, the study of ESG scores on investment returns is increasingly gaining a matter of interest due to increasing data availability on ESG scores and potential findings (Chang et al., 2022). Likewise, in practice, 89% of investors are found to be taking ESG concerns as an additional factor while making an investment decision while the Asia Pacific market experienced the highest increase in terms of ESG adoption by investors within the last two years (Capital Group, 2022).

There have been many academic studies focusing on whether and how ESG investing affects investment returns in the financial market. The importance of these studies originates from the relationship of ESG investing with risk management, value creation, and legal and regulatory requirements. For example, the study of Halbritter and Dorfleitner (2015) demonstrates that in the United States with data spanning from 1991 to 2012, there is a statistically insignificant difference in returns in high ESG score performing portfolios compared to low ESG score performing portfolios. The paper uses Carhart's 4-Factor Model and 20% high and 20% low strategy in ESG portfolio construction and creates cross-sectional regressions for the comparison between these portfolios. However, in a similar study by Eccles et al. (2014), which was also conducted in the United States with data spanning from 1993 to 2010, the high ESG score-performing portfolio was shown to outperform the low ESG score-performing portfolio, following the same asset pricing model while using a high-low strategy on both value-weighted and equal-weighted bases. The results of both studies were shown to be robust. Similar to the contradicting results of these studies, there is no consensus in the academic literature on the effect of ESG screening on investment returns.

In this study, I replicate the study conducted by Halbritter and Dorfleitner (2015) in the Asia-Pacific market mainly focusing on four countries: Australia, Hong Kong, New Zealand, and Singapore. Studying the ESG investing on investment returns in these four Asia-Pacific countries is interesting for

testing the robustness of Halbritter and Dorfleitner's (2015) findings due to the fundamental difference in policy for ESG reporting requirements between the Asia-Pacific market and the United States. The US-based stock exchange markets such as NYSE and Nasdaq were used to have a voluntary basis at the time of the study and still largely have a voluntary basis for the ESG reporting and disclosure for the listed companies; however, the aforementioned four Asia-Pacific markets have either 'comply or explain' policy or have a partially mandatory basis for the ESG reporting and disclosure for the listed companies. Stock Exchanges of Hong Kong (HKEx) and Singapore (SGX) have been maintaining a 'comply or explain' basis since 2016 and both began holding mandatory reporting for certain listed companies. Similarly, New Zealand and Australia have implemented laws on ESG reporting requirements which shifted various aspects of ESG reporting from a voluntary basis to a mandatory basis. The New Zealand government enforced a law, making environment related ESG reporting obligatory for large companies listed on New Zealand's Exchange (NZX). Likewise, the Australian Securities Exchange (ASX) currently has several mandatory ESG reporting requirements as imposed by the Australian government. The 'comply or explain' policies and laws on enforcing ESG reporting of these Asia-Pacific market reveals the ESG performances of listed companies that perform poorly on ESG reporting and previously didn't volunteer to disclose their ESG performance. Thus, the difference in the ESG reporting and disclosure requirements between the US and Asia-Pacific markets might imply differences in the effect of ESG scores on investment returns. Therefore, in this thesis, the research question I aim to answer is: how do ESG scores affect investment returns in the Asia-Pacific market?

This study examines how ESG scores affect investment returns. Following the previous studies, I will focus on data from the Asia-Pacific market, spanning from 2010 to 2023. The sample size will yearly vary from 200 to 850 companies over the timeframe of this study. I will use the databases of Bloomberg Terminal and Refinitiv Eikon for the ESG ratings (scores) which are reported as percentile scores with the range of 0-100 where scoring 100 (0) is the highest (lowest) ESG score. The stock return performances and factors used for the Carhart 4-Factor model will be gathered using the databases of FactSet, Bloomberg Terminal, and the website of Professor Kenneth French Data Library. For the methodology of this study, I will use best-in-class and worst-in-class ESG screening strategies where I will create two yearly re-evaluated value-weighted portfolios in which I will choose best and worst-performing ESG stocks in terms of ESG scores. Moreover, I will also create a high-low ESG difference portfolio to compare the results of the two aforementioned value-weighted portfolios. In order to assess the performance of these three ESG portfolios on stock returns, I will use OLS time-series regressions based on the Carhart 4-factor model, which augments the momentum factor into the three-factor (market premium, size, value factors) Fama-French Model.

Prior to performing this analysis, I expect to find that the ESG score affects investment returns. Given the different regulatory ESG reporting and disclosure settings of the Asia-Pacific market relative to the US market, the effect of ESG scores on investment returns might offer significant results due to the strong interrelated nature of these differences with ESG scores. While expecting to see a statistically significant result for high-ESG score portfolios outperforming low-ESG score portfolios, the unique characteristics of each market, in this case Asia-Pacific, might leave sufficient variance unexplained.

The remainder of this paper is structured as follows. Section 2 discusses the relevant literature ranging from the portfolio theory and asset pricing model to ethical and sustainable investing and ESG screening. Section 3 informs on the sample data set, its collection method, and practical summary statistics. Section 4 discusses the statistical methodology process to conduct this research. Sections 5 and 6 focus on the results and conclusions of this research paper, respectively.

CHAPTER 2 Theoretical Framework

2.1 Portfolio Theory & Asset Pricing Model

The theoretical framework of this study originates from the modern portfolio theory and Carhart's four-factor asset pricing model. In the academic literature, numerous studies have been conducted on whether it is possible to consistently achieve abnormal returns and outperform the market by actively managing a portfolio such as incorporating ESG screening strategies into the stock selection process instead of passively managing the portfolio. Any portfolio with a return exceeding the market index is considered to be beating the market and bringing in additional value for the investors.

2.1.1 Portfolio Theory

However, investing strategies with the pretension to offering consistently outperforming the market tend to be approached with vigilance due to the assumptions under an efficient capital market, in which a price of a security provides all relevant information and indications about the respective security. Therefore, under Efficient Market Hypothesis (EMH), Roberts (1959) asserts that it is not feasible to maintain abnormal returns and keep outperforming the market benchmark. Later, Fama (1970) classified three different forms of EMH: weak form efficiency, semi-strong efficiency, and strong form efficiency. Each degree of efficiency affirms that the market is efficient to some extent, and an investor cannot achieve abnormal returns and consistently beat the market on a risk-adjust basis with an actively managed portfolio.

Based on the weak form of the EMH, the historical data information is assumed to be already reflected in the security price. This implies that the past price and volume of a security are neither indicative nor informative about the future price prediction of a security. Under the weak form, the investors cannot benefit from only historical data analysis to achieve abnormal returns. The semi-strong form of the EMH builds on the weak form efficiency by dictating that a security price incorporates not only historical data but also all publicly published information about the company. This publicly available information includes financial statements, company news and announcements, regulatory filings, and corporate governance information. The semi-strong efficiency suggests that the investors cannot generate any abnormal returns through fundamental analysis based on all publicly available information. The strong form of the EMH further expands on two previous points by asserting that all relevant (public and private) information about the company is fully priced in the security price. This strong form efficiency implies that even if an investor held insider information, the advantage of this privileged information would not yield any abnormal returns to the investor. In brief, as three forms of

the EMH point out, when the capital market is efficient - regardless of its efficiency degree - it is not possible for an investor to maintain consistent abnormal returns.

Given the context of the efficient market hypothesis, the identification of underlying factors for portfolio performance has been a focus of interest in the academic literature. In this sense, accurately assessing the performance and value of assets and followingly deciding on the optimal asset allocation are essential determinants to interpret the portfolio performance. For the latter, Markowitz (1952) developed the Modern Portfolio Theory (MPT) which closely aligns with the market efficiency assumption of the EMH. In his theory, Markowitz (1952) emphasized the principles of risk-return tradeoff and diversification and introduced the concept of the efficient frontier for optimal asset allocation. The risk-return tradeoff denotes the positive nature between expected return and risk level, in other words, higher expected returns are associated with higher risk levels and vice versa. To reduce the volatility and downside risk of the portfolio, Markowitz (1952) also highlights diversification as a crucial element of asset allocation. Diversification proffers to spreading the investment on different asset classes that have a negative correlation with each other. This strategy is expected to eliminate the idiosyncratic risks of a portfolio with effective diversification and correlation analysis. In accordance with the two aforementioned aspects of MPT, Markowitz (1952) pioneered the concept of the efficient frontier which provides a series of optimized portfolios with the highest expected return for a predetermined degree of risk. This efficient frontier illustrates the advantages of diversification and risk-return optimization. Based on the insights from MPT, Sharpe (1992) underscored that asset allocation can make up for the large variation in a portfolio and is crucial for the expected returns of a portfolio.

The expected performance and value of an asset are other crucial factors for portfolio performance. In this regard, analysts often seek to find only a set of undervalued assets in order to go long in their portfolios. However, some papers advocate the use of long-short portfolios instead to perform doubling the returns of long-only portfolios (e.g., Bruce and Levy, 1993 and Bender et al., 2010). The addition of short-selling into the portfolio strategy yields an opportunity for investors to capitalize on overvalued stocks (Bruce and Levy, 1993). Contrary to the optimistic findings regarding the long-short strategy, Michaud (1993) alerts that the long-short strategy's increased expected return is accompanied by its increased level of portfolio risk which can be conflicting with the purposes of long-term investors due to fixed costs associated with managing long-short portfolios. Based on the efficient frontier, investors are required to take an above-normal active risk with long-short portfolios in order to perform better than long-only portfolios. Likewise, Huij et. al. (2014) explains that even though the long-short strategy seems to be "superior" theoretically, their practical findings demonstrate the long-only strategy to be performing better in most cases.

2.1.2 Asset Pricing Model

Prior to the process of portfolio creation and management, accurately pricing each asset is the backbone of achieving optimal asset allocation. In this regard, using an appropriate asset pricing model constitutes great importance for the accuracy of the results. Based on findings from the modern portfolio theory, in the 1960s, Sharpe (1964) and Linter (1965) introduced Capital Asset Pricing Model (CAPM). This one-factor model relies solely on the beta coefficient, which provides an asset's sensitivity to the market risk, to account for the expected return of the asset. The beta coefficient informs on the relationship between the systematic risk and the expected return of the asset similar to the risk-return tradeoff mentioned in the MPT. This positive linear risk-return tradeoff explained by the CAPM formula is illustrated as the Security Market Line (SML) that could be used as a benchmark to assess whether an asset is undervalued or overvalued. To compare the actual returns of a portfolio and the predicted returns made by CAPM, Jensen (1968) proposed a risk-adjusted performance metric, called alpha. When incorporated into the CAPM formula as the intercept, alpha is used to interpret whether the actual return of an investment outperformed or underperformed relative to the prediction made by CAPM. Besides, using the SML as the benchmark, alpha calculates the deviation from the SML to provide the risk-adjusted performance of an investment.

To increase the explanatory power of the CAPM on cross-sectional variance in stock returns, Fama and French (1992) expanded on the CAPM by incorporating two new factors, namely size and value, into the model. The implication of the three-factor model was that the size factor suggested small-cap stocks having higher average returns than big-cap stocks, and in a similar sense value factor suggested value stocks (high B/M ratio stocks) having higher average returns than growth stocks (low B/M ratio stocks). Despite the improvements attained by the three-factor Fama-French model, Fama and French (1996) show that the three-factor model is still unable to account for the cross-sectional variance in returns of momentum-sorted portfolios. Besides, the momentum effect was found to be robust across different timelines and countries (Jegadeesh & Titman, 1993 and Asness et. al., 1997). Given these findings, Carhart (1997) introduced a four-factor model that builds on the three-factor model by incorporating the momentum factor from Jegadeesh & Titman's (1993) one-year momentum anomaly into the model. Carhart (1997) defines the momentum factor as the difference between the equal-weight averages of the firms with the highest 30% 11-month returns lagged by 1 month and the firms with the lowest 30% 11-month returns lagged by 1 month.

2.2 Ethical and Sustainable Investing: ESG Screening

The ESG principle, originating from socially responsible investing, is a "framework system" that incorporates environmental, social, and corporate governance criteria into the investing process (Li et al., 2021). These criteria of ESG are defined by the European Banking Association (2021) as the matters that might potentially have favorable or adverse effects on the financial performance of a

company. Thus, the ESG principle is a common consideration for investors to assess corporate behavior toward the aforementioned matters and to forecast the long-term financial performance of a company. Since the ESG concept was initially introduced in 2004 by the United Nations to incorporate ESG factors into the capital market, it has become one of the most popular investment strategies among investors. In this regard, Bloomberg (2021) predicts ESG-related assets in the global capital market to reach a third of assets under management by 2025.

2.2.1 Ethical and Sustainable Investing

Investors were previously thought to be solely interested in businesses that would maximize their investment returns. Even though this notion of self-interest is still evident and prevalent, an increasing number of investors were found to be incorporating environmental and societal factors into their investment process (Sparkes & Cowton, 2004 and Humphrey et. al., 2016). Through these factors, investors aim to gather information about companies' policies toward environmental issues, workforce-related practices, human rights, community involvement, management, and shareholders (Camilleri, 2021). On this matter, the three pillars of the ESG score come into effect as they address all the concerns of an investor from environmental to societal and to corporate governance in 186 different metrics. Intending to shun unethical and unsustainable stocks as well as negative externalities, investors utilize the ESG screening strategy in their portfolio management. Notwithstanding, investors also use this strategy with the purpose of increasing their average returns while reducing their portfolio risk (Camilleri, 2021).

Despite its positive influence on promoting responsible and sustainable business practices, ethical and sustainable investing has still mixed findings on stock return in the literature. Before ESG practices were consolidated, the literature mainly focuses on the effect of sin stocks on stock returns. The sin stocks were mostly defined as gambling, defense, tobacco, alcohol, and adult entertainment firms (Fabozzi, Ma, and Oliphant, 2008; Hong and Kacperczyk, 2009). The underlying reason for considering firms in these industries as sin stocks was their questionable immoral and controversial business structures. Regarding the performance of sin stocks, Hong and Kacperczyk (2009) conclude that sin stocks outperform ethical stocks with similar characteristics by 3 to 4% annually. Using U.S. stocks for the time span from 1926 to 2006, the study regresses the equal-weighted sin stock portfolio on the value-weighted market portfolio in the three-factor Fama-French model. They explain the high returns of sin stocks through the argumentation of Merton (1987) that sin stocks are usually disregarded by investors due to the idiosyncratic risks and ethical considerations which lead to the undervaluation of sin stocks. Recently, Trinks and Scholtens (2017) similarly found that the sin stock outperforms the global market benchmark by 0.91 to 1.04% monthly. Using a total of 1634 stocks in 94 different markets from 1991 to 2012 and regressing value-weighted sin stock portfolio on the global Fama-French four-factor model, the study shows robust results.

2.2.2 ESG Screening

Unlike the performance of sin stock portfolios in the literature, the performance of ESG portfolios, as of yet, does not provide any clear favorable direction to achieve abnormal returns. To investigate the performance of ESG portfolios, the literature mainly uses positive and negative ESG screening methods. These screening methods are based on ESG scores which are released as percentiles scores by the ESG ratings provider firms such as Refinitiv, Bloomberg, and MSCI. Studies that use positive ESG screening methods identify and incorporate firms that display high ESG scores into the portfolio whilst the ones that use negative ESG screening do incorporate those that display low ESG scores into the portfolio. Through these methods, the research studies aim to distinguish the effect of ESG scores on portfolio returns by controlling potentially confounding variables.

Using both positive and negative ESG screening, Kempf and Osthoff (2007) conduct a comparative study in which they compare the performance of high and low-ESG firms through value-weighted long-short (high-low) portfolios. They only incorporate the top and bottom 10% of firms into the portfolio in terms of ESG score performance and use stocks from S&P 500 and MSCI 400 Social Index for the period of 1992-2004 in Carhart's four-factor model. The results of Kempf and Osthoff (2007) present that the high-short portfolio outperforms the market by roughly 5% annually, reaching as high as 8.7% annually. In a similar study, Borgers et al. (2013) revise the study of Kempf and Osthoff (2007) with a more comprehensive data period of 1991-2009. They create high-short portfolios on both value and equal-weighted basis and use Carhart's four-factor model as the benchmark. The findings of Borgers et al. (2013) reaffirm the results of Kempf and Osthoff (2007) that the high-short ESG portfolio outperforms the market during the period of 1991-2004; however, Borgers et al. (2013) emphasize that this abnormal return of the ESG portfolio vanish for the rest of the time period of 2004-2009. They attribute the abnormal returns until 2004 to the market underadjustment.

Following a similar study methodology, Humphrey and Tan (2014) construct two negative and two positive ESG screening portfolios, using MSCI ratings for the time period of 1996-2010 and Carhart's four-factor model. While two negative screening portfolios do not include sin stock industries; however, Humphrey and Tan (2014) emphasize that the excluded stocks do not account for a large loss compared to the market portfolio. The conclusions of Humphrey and Tan (2014) show that while one negative screening portfolio underperforms the market, the other three screening portfolios do not offer any significant results.

To compare the performance difference between high- and low-ESG-scoring firms, Lee, Faff, and Rekker (2013) create a long-short (high-low) ESG portfolio in which they use the U.S. stocks for the

time period of 1998-2007 and Carhart's four-factor model. Lee, Faff, and Rekker (2013) conclude that there is no positive or negative abnormal return of a high-low ESG portfolio on a risk-adjusted basis as they previously predict in their no-linkage hypothesis. Likewise, Eccles et al. (2014) identify a set of 180 US stocks for the time period of 1993-2010 and divide these stocks based into two groups (high and low) based on their respective ESG scores. This paper gathers its ESG score data not only from Refinitiv and Sustainability Asset Management Group (SAM) but also through independent investigation and interviews. Using a long-short (high-low) ESG portfolio and Carhart's four-factor model, the authors demonstrate the ESG portfolio outperforms the market by as much as 4.8% annually.

The paper of Halbritter and Dorfleitner (2015) investigates the performance of a long-short (high-short) ESG portfolio, using U.S. stocks for the time period of 1991-2012 and Carhart's four-factor model. In the creation of high and low ESG portfolios, the authors use best- and worst-in-class strategies in which they incorporate the 20% highest and 20% lowest ESG scoring firms into their respective portfolios. The results of Halbritter and Dorfleitner (2015) indicate that there is no abnormal return of high-low ESG portfolios. Notwithstanding, Halbritter and Dorfleitner (2015) remarked that the high ESG-scoring firms had lower levels of systemic risk relative to low ESG-scoring firms.

2.3 Hypotheses

In my study, I anticipate finding that ESG scores affect investment returns. The underlying reason behind this expectation would be that the recent academic literature focusing on ESG scores affecting portfolio returns in the United States informs that there is a degree of consensus that ESG investing yields either positive abnormal returns or an average market benchmark. In this regard, given the aforementioned fundamental differences in ESG reporting and disclosure regulations between the Asia Pacific and the United States, the stricter regulations on ESG reporting and disclosure could allow for more accurate ESG screening strategies which in return could allow for even stronger investment returns that could potentially yield abnormal returns. Accordingly, in this research paper, I formulate two hypotheses that investigate the positive and negative ESG screening and the performance of a long-short (high-low) ESG portfolio in which I will go long for high ESG scoring firms and short for low ESG scoring firms. Therefore, the hypotheses of this study are as follows:

Hypothesis 1: In Asia-Pacific, securities with high (low) ESG scores have a positive (negative) alpha.
Hypothesis 2: High ESG-scoring securities have a larger alpha than low ESG-scoring securities in Asia-Pacific.

CHAPTER 3 Data

The sample data set of this paper composes a total of 835 publicly listed companies that have disclosed their respective ESG score across ASX, HKEx, SGX, and NSX between the 1st of January 2010 and the 31st of December 2022. The panel data provide information regarding the yearly ESG scores, end-of-year market capitalization, accumulating annual & monthly total returns, and accumulating annualized monthly returns of each company. This data set is gathered from the database of Refinitiv Eikon (formerly known as Thomson Reuters), which offers the largest ESG database comprising more than 88 percent of the world market cap and 630 distinct ESG measures. In the database, it classifies four different quartiles from first to fourth for ESG scores relative to each respective industry. The first quartile refers to the companies that have inadequate (low) ESG performance and disclosure transparency, while the fourth quartile refers to the companies that have outstanding (high) ESG performance and disclosure transparency. Through its ESG screening tool, I collected the data of all publicly listed companies in the Asia-Pacific market that have available information on their respective ESG scores at any time period of the study and followingly distinguished low and high ESG-scoring companies that are categorized as the first and fourth quartiles, respectively. Subsequently, I use these low- and high-ESG-scoring companies to create the aforementioned portfolios.

ESG score is described as the overall performance of the companies in terms of environmental, societal, and corporate governance aspects with industry and country of incorporation benchmarking. These three equal-weighted pillars of ESG are further categorized into 10 main themes: resource source, emissions, environmental innovation, workforce, human rights, community, product responsibility, corporate management, shareholders, and corporate social responsibility. Among 630 distinct ESG measures, these themes are calculated through the company-specific most relevant 186 ESG metrics to retrieve the ESG scores. Consequently, ESG scores are provided as industry- and country-of-incorporation-relative percentile scores between 0 and 100 where scoring 0 (100) is the lowest (highest) ESG score.

Due to the value-weighted basis on the ESG portfolios, I collected the end-of-year market capitalization of the screened companies from 2009 to 2021 to determine the portfolio weight of each company. Referring to the total market value of all relevant issued share types, the end-of-year market capitalization is calculated by multiplying the calendar-year closing share price and the number of outstanding shares of the respective company. The latter is given as the total number of shares held by both institutional and individual investors. Moreover, I collected data on accumulating annual and monthly total returns, of which the latter is used for OLS time-series regressions against Carhart's

four-factor model. These accumulating annual and monthly total returns incorporate the price change and dividends within the last year and month, respectively.

To compare the performance of each portfolio with the market benchmark and to use ordinary least squares (OLS) regressions, I gathered the annual and monthly returns of Carhart's four-factor model, particularly for the Asia-Pacific market (including only Australia, Hong Kong, Singapore, and New Zealand while excluding Japan), from the 1st of January 2010 to the 31st of December 2022 from Kenneth R. French data library[1]. The annual and monthly returns of the factor model include information on the market risk (Mkt-Rf) of the specified Asia-Pacific market, size (SMB), value (HML), and momentum (WML) factors during the time span of this paper. Furthermore, as the data gathered regarding Carhart's four-factor model is identical in terms of the countries used and retrieves the factor returns in the same currency (USD) as in ESG screening portfolios, it reduces potential biases and provides a corresponding data set to benchmark the returns of ESG portfolios against the market.

In Table 1, I provide information on the number of securities used each year in each respective portfolio. These summary statistics are crucial as they shed light on the diversification level of portfolios. While a total of 835 securities have ESG score information available at any time during the period of 2010-2022 in the specified Asia-Pacific market, the average number of securities with the ESG score information available for each year is 518 securities. The high-ESG portfolio that composes of securities within the ESG score range of 75-100 has, on average, approximately 24 securities, whereas the low-ESG portfolio that composes of securities within the ESG score range of 0-25 has, on average, roughly 148 securities. Additionally, the low-ESG portfolio comprises more securities at any given time during the period of 2010-2022 than the high-ESG portfolio. This difference in the number of securities comprised between the high- and low-ESG portfolios indicates that the high-ESG portfolio has a lower level of diversification relative to the low-ESG portfolio. In this regard, the most diversified portfolio among the three portfolio types is the high-low ESG portfolio, which incorporates the securities within both high and low ESG score range for the given year.

[1] The source of the data library can be accessed through this url:
http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#International

Table 1 The number of securities used in each portfolio type between 2010 and 2022.

Year	*Total Number of Securities*	*High-ESG Portfolio*	*Low-ESG Portfolio*	*High-Low ESG Portfolio*
2010	213	12	79	91
2011	285	14	119	133
2012	357	16	155	171
2013	390	17	166	183
2014	426	17	181	198
2015	467	19	193	212
2016	513	18	195	213
2017	549	19	187	206
2018	579	27	155	182
2019	637	30	139	169
2020	706	34	132	166
2021	777	42	116	158
2022	835	52	102	154
Total	835			
Mean	518	24,38	147,62	172

The second column, the total number of securities, refers to the total number of firms in the data sample with the ESG score information available during the given year in the specified Asia-Pacific market. The third column, High-ESG portfolio, refers to the total number of firms with the ESG score within the range of 75-100. The fourth column, Low-ESG portfolio, refers to the total number of firms with the ESG score within the range of 0-25. The fifth column, High-Low ESG portfolio, refers to the total number of firms in both high and low ESG score range for the given year. Last row, the mean, provides the average number of securities used in each portfolio during the given time span of study.

Table 2 further elaborates on the performances of the respective value-weighted portfolios and the market portfolio between 2010 and 2022 by providing descriptive statistics on the average annual returns, standard deviations, standard errors, and potential outliers (as minima and maxima). The market portfolio in Table 2 and Table 3 is fully based on the FTSE All-World Developed Asia-Pacific excluding Japan index. In terms of country breakdown, this index has the highest level of exposure (exceeding 70%) to the specified Asia-Pacific markets (Australia, Hong Kong, Singapore, and New Zealand) relative to any other market index.

Table 2 Descriptive statistics for high, low, and high-low ESG portfolios between 2010 and 2022.

	Mean			*Minimum*		*Maximum*	
Portfolio Type	*Annual Return*	*Standard Deviation*	*Standard Error*	*Annual Return*	*Monthly Return*	*Annual Return*	*Monthly Return*
High-ESG	6,66%	4,53%	0,36%	-12,92%	-12,57%	22,01%	23,01%
Low-ESG	3,71%	4,45%	0,36%	-13,99%	-13,44%	27,90%	13,43%
High-Low ESG	2,95%	3,59%	0,29%	-16,30%	-10,95%	26,99%	9,91%
Market	3,33%	5,51%	0,44%	-17,56%	-18,38%	25,47%	15,78%

The annual and monthly returns in the table are provided in absolute returns aligned with the portfolio value method this study uses. Likewise, the standard deviation and standard errors are calculated through monthly returns of the respective portfolio. The market portfolio fully tracks the accumulating returns of FTSE All-World Developed Asia-Pacific excluding Japan index, which was gathered for the time period of 2010-2022 from the FactSet database.

The average annual return is calculated by dividing the absolute sum of 12-month returns of value-weighted portfolios by the duration of the study in terms of years. In Table 2, this statistic indicates that the high- and low-ESG portfolios with 6,66% and 3,71% average annual returns respectively have higher annual returns than the market portfolio, which has a 3,33% average annual return. The high-low ESG portfolio has the lowest average annual return of 2,95%. Notwithstanding, the standard deviation (shown in Table 2) favors the high-low ESG portfolio with a lower standard deviation and error values of 3,59% and 0,29% relative to other portfolios. Having a relatively more diversified value-weighted portfolio could account for the lower levels of the standard deviation of the high-low ESG portfolio. Moreover, the 5,51% standard deviation of the market portfolio implies the higher volatility and risks of the developed Asia-Pacific market relative to all three ESG portfolios constructed. In this sense, the market portfolio has the largest loss in terms of annual and monthly returns by -17,56% and -18,38%, respectively. Besides, the low-ESG portfolio has by far the highest annual return of 27,90%, and the high-ESG portfolio has the highest monthly return of 23,01%.

Figure 1 illustrates the annual returns, volatility, and comparative performance analysis of the high, low, high-low ESG portfolios, and the market portfolio between 2010 and 2022. In addition, this figure provides insight into whether an ESG portfolio consistently outperforms or underperforms. Among the four portfolio types, the high-ESG portfolio seems to consistently outperform the market portfolio (represented by FTSE All-World Developed Asia-Pacific excluding Japan index) with the exceptions of 2010, 2017, and 2020. Relative to other ESG portfolios, the performance of the high-ESG portfolio does not indicate any outperformance or underperformance. The annual returns of the low-ESG portfolio illustrate that the low-ESG portfolio follows a trend similar to the market portfolio between 2010 and 2022. This positive relationship is also shown in the marginal difference (0,38%) in

average annual returns of the low-ESG and market portfolio in Table 2. Similar to the modest difference (0,38%) in average annual return as depicted in Table 2, the high-low ESG portfolio does not indicate any market outperformance or underperformance. However, unlike the low-ESG portfolio, the high-low ESG portfolio exhibits a dissimilar pattern relative to the market portfolio. Furthermore, Figure 1 points out the relative underperformance of the high-low ESG portfolio due to a significant loss in 2017. This loss can be accounted for the outperformance of the low-ESG portfolio, which was shorted in the high-low-ESG portfolio, by 27,90% as well as the underperformance of the high-ESG portfolio, which was longed in the high-low-ESG portfolio, by 11,60%.

Figure 1 The annual returns of high, low, high-low, and market portfolio between 2010 and 2022.

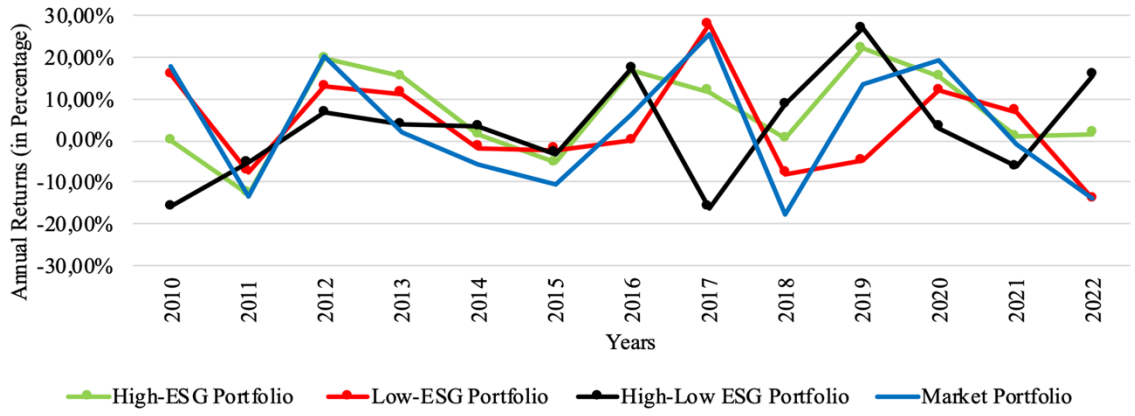

Figure 1 illustrates the annual returns of each portfolio type in the specified Asia-Pacific market from the 1st of January 2010 to 31st of December 2022. The annual returns are provided in absolute terms through the sum of monthly returns of the respective value-weighted portfolios. Market portfolio fully tracks the accumulating monthly returns of FTSE All-World Developed Asia-Pacific excluding Japan index, which was gathered for the time period of 2010-2022 from the FactSet database.

CHAPTER 4 Method

Within the context of ethical and sustainable investing, investors extensively benefit from ESG screening strategies by incorporating reviewing and selection process of potential securities, which is based on environmental, societal, and corporate governance measures. In this regard, ESG portfolio construction is one of the most widely used methods in the literature to examine the relationship between ESG-related aspects and the financial performance of companies (Halbritter & Dorfleitner, 2015). Similar to the aforementioned methodology of Kempf and Osthoff (2007) and Halbritter & Dorfleitner (2015), I use the ESG portfolio construction based on ESG scores (collected from the Refinitiv database) as it enables to transform panel data into single time series for monthly returns of each ESG portfolio as well as enables using Carhart's four-factor asset pricing model.

Accordingly, as mentioned in the hypotheses of this research paper, I create three value-weighted portfolios (a high-ESG portfolio, a low-ESG portfolio, and a long-short ESG portfolio) over the time period of 2010-2022 across Australia, Hong Kong, Singapore, and New Zealand markets to assess whether these portfolios consistently outperform the market benchmark (based on Carhart's four-factor model) with the use of OLS regression method. To that end, I classify securities with available ESG scores for each quartile based on their ESG score in which first quartile securities (the ones with ESG score in the range of 0-25 for the given year) are assigned to the low-ESG portfolio and fourth quartile securities (the ones with ESG score in the range of 75-100 for the given year) are assigned to the high-ESG portfolio. In the third portfolio, the high-low ESG portfolio, I go long (buying position) for the securities in the high ESG portfolio and go short (selling position) for the securities in the low ESG portfolio for the respective year.

After ESG portfolio construction for each given year, I use OLS regression, which is a basic linear regression method to assess the value of an unidentified parameter(s), based on Carhart's four-factor model's monthly returns for the developed Asia-Pacific market excluding Japan (including only Australia, Hong Kong, Singapore, and New Zealand) in order to analyze the performance of each ESG portfolio relative to the market benchmark. Thus, the equation for the OLS regression is provided as follows:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i\left(R_{m,t} - R_{f,t}\right) + s_i SMB_{i,t} + h_i HML_{i,t} + w_i WML_{i,t} + e_{i,t}$$

(Equation 1)

where, $R_{i,t}$ refers to the value-weighted return of an ESG portfolio in month t; $R_{f,t}$ refers to the risk-free rate which is based on U.S. one-month Treasury bill rate in month t; $R_{m,t}$ refers to the aforementioned

Asia-Pacific market return. Thus, the left-hand side of the equation explains the excess return of an ESG portfolio *i* in month t, while the $R_{m,t} - R_{f,t}$ accounts for the market risk premium (excess return of the Asia-Pacific market relative to one-month U.S. Treasury bill rate) in month t.

The size factor, $SMB_{i,t}$, stands for the difference in returns between small market cap stocks and big market cap stocks in month t. In the specific Asia-Pacific market, the bottom 10% and top 90% of companies in terms of market caps are considered small market cap stocks and big market cap stocks, respectively. The value factor, $HML_{i,t}$, stands for the difference in returns between high book-to-market ratio stocks (value stocks) and low book-to-market ratio stocks (growth stocks) in month t. There are three book-to-market (B/M) breakpoints specified in the Kenneth R. French data library in which the bottom 30% of and top 70% of companies in terms of B/M ratio are considered as growth stocks and value stocks, respectively. The momentum factor, $WML_{i,t}$, denotes the difference in returns between the top 30% performing stocks in month t-2 and the bottom 30% performing stocks in month t-2, in month t.

The beta coefficient, B_i, indicates the sensitivity of a stock return relating to the changes in the specified market return. The coefficients a_i, B_i, s_i, h_i, and w_i in the model are provided to estimate the linear regression, while $e_{i,t}$ refers to the error term in month t. The value of the alpha coefficient, a_i, informs whether an ESG portfolio achieved consistent abnormal returns and outperformed the market benchmark, having a positive significant value implying that there is an abnormal return of the portfolio.

CHAPTER 5 Results & Discussion

Shown as equation 1 in the methodology, the model was estimated by use of Ordinary Least Squares. As both the dependent variable, the excess return of an ESG portfolio, and independent variables are measured in percentage returns, the coefficients of Mkt-Rf, SMB, HML, and WML can be interpreted as the marginal effect of a percentage change in a respective factor on the percentage change in the excess return of an ESG portfolio. Furthermore, the intercept represents the alpha value as the risk-adjusted performance metric of an ESG portfolio. If the intercept is positive (negative) and statistically significant, then it can be interpreted as the outperformance (underperformance) of an ESG portfolio relative to the market benchmark. R-squared, ranging from 0 to 1, represents the goodness-of-fit in OLS regression and is interpreted as the total variation of the excess return of an ESG portfolio explained by the aforementioned four-factor. P-values denote the statistical significance of factors. If the p-value is below 0.05, it can be interpreted as a statistically significant coefficient.

Table 3 OLS time-series regressions of three ESG portfolios based on Carhart's four-factor model between 2010-2022.

	High-ESG Portfolio		*Low-ESG Portfolio*		*High-Low ESG Portfolio*	
Factors	*Coefficient*	*P-value*	*Coefficient*	*P-value*	*Coefficient*	*P-value*
Intercept (α)	0,996**	0,034	0,214	0,624	0,450	0,273
Mkt-Rf	-0,020	0,822	-0,055	0,526	-0,024	0,750
SMB	0,206	0,247	-0.107	0,542	-0,059	0,717
HML	0,069	0,675	-0,086	0,601	0,179	0,246
WML	-0,016	0,918	0,053	0,722	0,048	0,727
N	156		156		156	
R-squared	0,21		0,09		0,36	

In Table 3, Ordinary Least Squares (OLS) time-series regressions of value-weighted high, low, and high-low ESG portfolios between 2010-2022 based on the Carhart's four-factor model is shown. The monthly return of each portfolio is separately regressed against Mkt-Rf, SMB, HML, and WML. High (low) ESG portfolio is composed of securities with the ESG score within the range of 75-100 (0-25) for the respective year. High-Low Portfolio is created by taking long (buying) position for high-ESG portfolio and short (selling) position for low-ESG portfolio for the respective year. Monthly factor returns for the specified Asia Pacific market are collected from Kenneth R. French data library. ** indicates the significance level at 5%. The alpha value is illustrated as the intercept. N denotes the number of observations (months).

ESG portfolios' R-squared on average is approximately 0,22, which implies that 22% of the variance in the excess return of an ESG portfolio can be explained by the market risk, size, value, and momentum factors. R-squared is relatively higher for the high-low portfolio reaching 0,36 while the r-squared of low-ESG indicates lower levels of variance explained by four-factor as shown in Table 3.

As the focus of this paper was to investigate whether an actively managed ESG portfolio could consistently achieve abnormal returns and outperform the market benchmark, this insight is provided as the alpha, or the intercept, in Table 3. The alpha coefficient for the high-ESG portfolio is measured to be 0,996, and its p-value of 0,034 indicates that the alpha coefficient is statistically significant under a significance level of 5%. Carhart's four-factor model and returns of the high-ESG portfolio are on a monthly basis and in percentage terms. Therefore, the finding from the alpha coefficient for the high-ESG portfolio can be interpreted as that the high-ESG portfolio is expected to achieve an abnormal return of 0,996% per month above the market benchmark. In other words, the high-ESG portfolio is expected to achieve an abnormal return of 11,95% above the market benchmark per year. Furthermore, low and high-low ESG portfolios are shown to have no statistically significant alpha values in Table 3, yet the alpha coefficients of both portfolios point out that the alpha of the high-low ESG portfolio roughly doubles the alpha of the low-ESG portfolio.

Given the results in Table 3, I find only partial support for Hypothesis 1 which stated that in Asia-Pacific, securities with high (low) ESG scores have a positive (negative) alpha. The findings reveal solely that the portfolio composed of securities with high ESG scores has a positive alpha, while the portfolio composed of securities with low ESG scores does not indicate any negative abnormal returns.

As I previously discussed that the literature has no consensus on the topic of ESG investing based on ESG scores; even so, the studies conducted for the same region and time period reveal different findings. My results showed that the high-ESG portfolio achieves a consistent abnormal return of 0,996% per month and outperforms the market while the low and high-low ESG portfolios provide no abnormal returns. This finding is relatively different from the study of Halbritter and Dorfleitner (2015), which demonstrated that there were no abnormal returns in high, low, and high-low ESG portfolios. While my results are not in accord with the finding for the high-ESG portfolios, my results for the low and high-low ESG portfolios are similar. In another comparable study by Lee, Faff, and Rekker (2013), my results are similar in terms of the outperformance of the high-ESG portfolio and no abnormal return for the high-low ESG portfolio. Moreover, my finding for the high-low ESG portfolio is different from the study of Eccles et al. (2014), which suggests that there is an abnormal return of 4,8% of the high-low ESG portfolios per year. It is therefore possible that the excess return of an ESG portfolio is related to other characteristics of the market. For instance, in the Asia-Pacific region for the time period of 2010-2022 investigated in this thesis, the market characteristics and ESG-related regulations are fairly different from the United States and European markets. Differences in market characteristics and ESG-related regulations could contribute to a different conclusion in the performances of ESG portfolios.

Additional robustness checks are provided in Appendix A in order to examine the reliability and validity of the results found in Table 3. The OLS time-series regressions of ESG portfolios were checked whether they are in line with the OLS assumptions of stationarity, linearity, independence, homoscedasticity, strict exogeneity, no multicollinearity, and normality of error terms. In Table 4, Augmented Dickey-Fuller test displays that OLS regressions of all ESG portfolios have no unit root; thus, the time-series regressions are stationary. In Table 5, Ramsey RESET demonstrates that all OLS regressions are linear in parameters and have no omitted variables. In Table 6, the Durbin-Watson test shows that the error terms of all OLS regressions have no autocorrelation. In Figure 2, the scatter plots of errors versus predicted values exhibit that the error terms of all OLS regressions have a conditional mean of zero. In Table 7, correlations among factors of Carhart's four-factor model display that there is no multicollinearity between two independent variables. In Table 8, the Shapiro-Wilk test points out that the error terms of high and low ESG portfolios are not normally distributed. Although this is a violation of the OLS regression assumption, a larger sample would eliminate the concerns regarding the normality of error terms. Furthermore, as a solution to mitigate the violation of non-normality of error terms for high and low ESG portfolios, I used a robust OLS regression method for these two ESG portfolios in Table 3. Moreover, in Table 9, White's test demonstrates that the variance of error terms is constant across ESG portfolios implying the existence of homoscedasticity for the error terms. Consequently, robustness checks indicate that the OLS time-series regressions of ESG portfolios adhere to the aforementioned OLS assumptions.

CHAPTER 6 Conclusion

In this thesis, I have investigated the performance of high, low, and high-low ESG portfolios and whether they can achieve consistent abnormal returns. Previous research has demonstrated that high-low ESG portfolios tend to perform better relative to market benchmarks; however, there are some robust studies indicating neither high nor low ESG portfolios offer abnormal returns. Besides, the academic literature has mainly focused on the U.S. and European markets where ESG regulations have recently been recognized or adopted. Despite the ESG regulations being introduced earlier in 2016 in the Asia-Pacific markets such as Hong Kong and Singapore, there has not been much focus in the literature on the implications of these ESG regulations on reporting and disclosure for investment returns. Therefore, the research question that was studied in this dissertation was: "How do ESG scores affect investment returns in the Asia-Pacific market?

To answer this research question, 835 publicly listed companies with available ESG score data in the specified Asia Pacific market (Australia, Hong Kong, Singapore, and New Zealand) for the time period of 2010-2022 are studied in Ordinary Least Squares (OLS) time-series regression in which three value-weighted portfolios (a high-ESG portfolio, a low-ESG portfolio, and a high-low ESG portfolio) regressed against the Carhart's four-factor asset pricing model. The results from the OLS suggested that the high-ESG portfolio provides an abnormal return of 0,996% per month above the market benchmark, while low and high-low ESG portfolios offer no abnormal returns and are on average in line with the market returns.

This study, therefore, concludes that although previous research demonstrates abnormal returns for the high-low ESG portfolios and no abnormal returns for either high or low ESG portfolios in the U.S. and European markets, the high-ESG portfolio in the specified Asia-Pacific market achieves consistent abnormal returns and outperforms the market benchmark while both low and high-low ESG portfolios have no abnormal returns.

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APPENDIX A [Robustness Checks of OLS Regressions]

Table 4 Augmented Dickey-Fuller test for the stationarity in time series assumption.

	High-ESG Portfolio	*Low-ESG Portfolio*	*High-Low ESG Portfolio*
Z-statistic	-12,92***	-13,25***	-12,35***
p-value	0,00	0,00	0,00

The null hypothesis of Augmented Dickey-Fuller test states that there is unit root in the time series, implying non-stationary data. The alternative hypothesis indicates that the there is no observation of unit root in the time series, implying stationary data. *** indicates significance at 1% level.

Table 5 Ramsey RESET test for the linearity assumption.

	High-ESG Portfolio	*Low-ESG Portfolio*	*High-Low ESG Portfolio*
F-statistic	0,29	1,03	1,63
p-value	0,84	0,38	0,18

The null hypothesis of Ramsey RESET states that there is no omitted variable(s) in the regression model. The alternative hypothesis states that there is omitted variable(s).

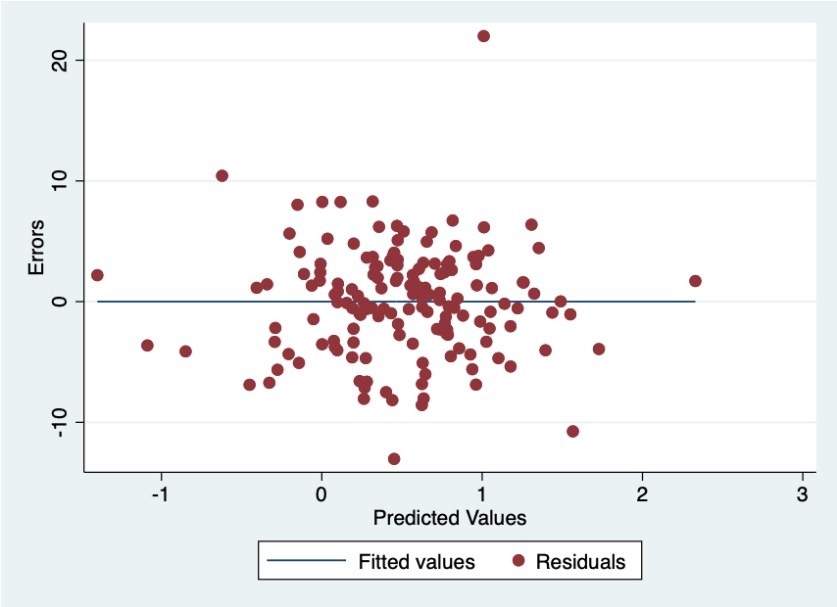
Table 6 Durbin-Watson test for the error term independence assumption.

	High-ESG Portfolio	*Low-ESG Portfolio*	*High-Low ESG Portfolio*
d-statistic	2,09	2,14	2,02

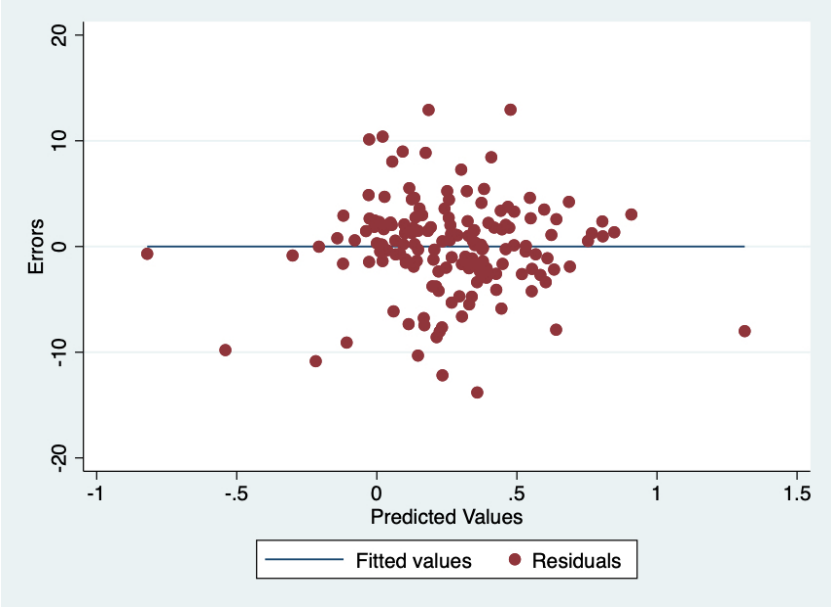
The null hypothesis of Durbin-Watson test states that the error terms of the linear regression are not correlated. The alternative hypothesis states that the error terms of the linear regression are correlated, which would violate the residual independence assumption of OLS regression. The d-statistic varies from 0 to 4, while values above (below) 2 signals positive (negative) autocorrelation of error terms. D-statistic being closer to 2 indicates no autocorrelation of error terms.

Figure 2 Errors vs. predicted values scatter plots of ESG portfolios for the strict exogeneity assumption

Errors vs. predicted values for the high-ESG portfolio



Errors vs. predicted values for the low-ESG portfolio



Errors vs. predicted values for the high-low ESG portfolio

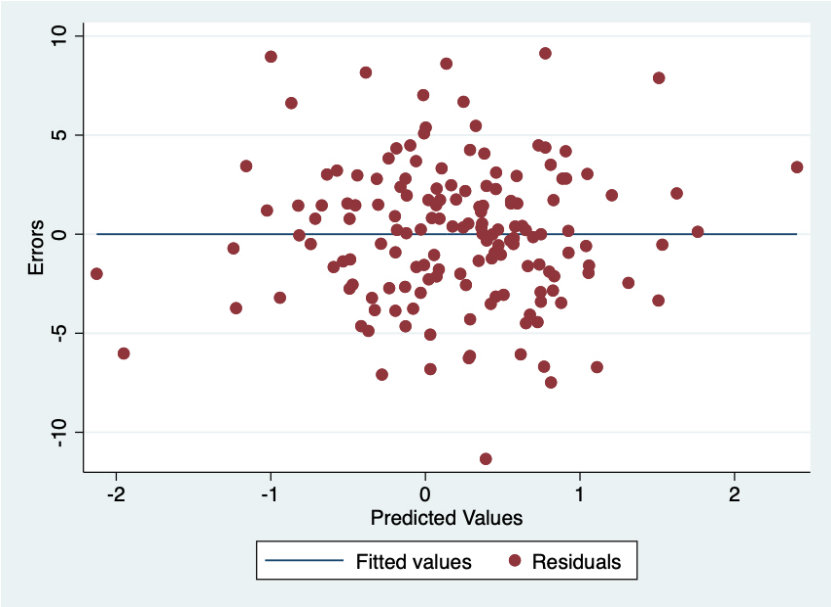


Table 7 Correlations among factors of Carhart's four-factor model for no multicollinearity assumption

	Mkt-Rf	*SMB*	*HML*	*WML*
Mkt-Rf	1	-0,07	-0,21	0,02
SMB	-0,07	1	-0,32	0,23
HML	-0,21	-0,32	1	-0,22
WML	0,02	0,23	-0,22	1

The table illustrates the correlation level between two factors from the 1st of January 2010 to 31st of December 2022 for the specified Asia-Pacific market. Correlation of 0 (1 or -1) implies no correlation (perfect positive or negative correlation) between two factors.

Table 8 Shapiro Wilk test for normality of error terms assumption.

	High-ESG Portfolio	*Low-ESG Portfolio*	*High-Low ESG Portfolio*
W-statistic	0,97***	0,97***	0,99
p-value	0,00	0,00	0,59

The null hypothesis of Shapiro Wilk test states that the error terms in the OLS regression model are normally distributed. The alternative hypothesis states that the error terms are not normally distributed. *** indicates that the w-statistics is significant at the 1% level.

Table 9 White's test for homoskedasticity of error terms assumption.

	High-ESG Portfolio	*Low-ESG Portfolio*	*High-Low ESG Portfolio*
Chi2	4,56	10,04	10,52
p-value	0,99	0,76	0,72

The null hypothesis of White's test states that the variance of error terms is constant implying homoskedasticity of error terms. The alternative hypothesis states that the variance of error terms is not constant.