Fund Performance in Stable and Volatile Markets

Swedish Mutual Fund Characteristics and Risk-adjusted Returns, 2018-2024

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Abstract

This thesis investigates how the mutual fund characteristics: fees, fund size, ESG rating, and management style are associated with risk-adjusted returns under different market conditions. This study uses quantitative research design to analyze Swedish equity mutual funds from 2018 to 2024. The period includes both stable market conditions and a phase of significant market volatility. The increased volatility can be attributed to external shocks, including the COVID-19 pandemic and the Russia-Ukraine war. Employing both Ordinary Least Squares (OLS) regression and Generalized Additive Models (GAM), the study explores linear and non-linear associations between fund characteristics and risk-adjusted returns.

The results indicate that fund characteristics do matter, and their associations vary with market conditions. Fund size shows a consistently positive relationship with risk-adjusted returns, whereas fees are negatively associated with risk-adjusted returns. ESG ratings exhibit an inverted U-shaped relationship during the period of heightened volatility, and the association of active management becomes favorable during longer or more volatile periods. These results challenge the assumptions of the Efficient Market Hypothesis (EMH) and provide empirical support for the Adaptive Market Hypothesis (AMH), emphasizing the dynamic nature of market efficiency. This research contributes to the limited literature on the Swedish mutual fund market by offering practical insights for investors and adding to theoretical discussions.

Sammanfattning

Denna uppsats undersöker sambandet mellan fondegenskaperna: fondavgifter, fondstorlek, ESG-betyg och förvaltningsstil med riskjusterad avkastning under skiftande marknadsförhållanden. Denna studie använder en kvantitativ forskningsdesign för att analysera svenska aktiefonder under perioden 2018 till 2024. Tidsperioden omfattar både stabila perioder och en period med hög marknadsvolatilitet. Den ökade volatiliteten kan kopplas till externa chocker såsom Covid-19-pandemin och Rysslands invasion av Ukraina. Studien tillämpar både Ordinary Least Squares (OLS) regression och Generalized Additive Models (GAM) för att identifiera linjära och icke-linjära samband.

Resultaten tyder på att fondegenskaper har betydelse för riskjusterad avkastning, men att sambanden varierar beroende på marknadsläget. Fondstorlek uppvisar ett konsekvent positivt samband med riskjusterad avkastning, medan avgifter har en negativ effekt. ESG-betyg och aktiv förvaltning uppvisar kontextberoende effekter. ESG-betyg följer ett inverterat U-format samband under tidsperioden med högre volatilitet, medan aktiv förvaltning har ett positivt samband under längre perioder och under perioder med högre volatilitet. Dessa resultat utmanar antagandena i den effektiva marknadshypotesen (EMH) och ger empiriskt stöd för den adaptiva marknadshypotesen (AMH), vilket betonar marknadseffektivitetens dynamiska och kontextberoende karaktär. Studien bidrar till den begränsade forskningen om den svenska fondmarknaden och erbjuder praktiska insikter för investerare samt ett bidrag till den teoretiska diskussionen.

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Glossary

This section presents the glossary, providing definitions of key terms and concepts used throughout the thesis.

Mutual fund = An investment structure that collects capital from multiple investors to invest in a diversified portfolio of assets such as stocks, bonds, or other securities. The fund is managed by professional portfolio managers, and investors share in the fund's gains or losses proportionally.

Equity mutual fund = A type of mutual fund that primarily invests in stocks or shares of publicly traded companies.

Fund performance = Refers to how effectively a mutual fund achieves its investment objectives, typically measured by returns over time

Risk-adjusted return = A performance measure that accounts for the amount of risk taken to achieve a given return, a common metric is the Sharpe ratio.

Fund characteristics = Key features that define a fund's structure and strategy, such as management style, risk level, asset allocation, fees, performance etc.

Fund fee = The cost charged by a mutual fund for its management and operations.

Fund size = Typically measured as assets under management (AUM), in a mutual fund.

ESG-rating = A rating that is commonly based on Morningstar's 1–5 scale, where a higher score indicates lower exposure to ESG-related financial risks.

Management style = The method of managing a fund, either actively selecting investments or passively tracking an index.

Volatility = A measure of how much the price of an asset fluctuates over time

1. Introduction

The first chapter of this thesis begins by contextualizing recent periods of market volatility and their impact on global and Swedish mutual fund investing. It then introduces the Swedish mutual fund market, outlining its specific characteristics and relevance to the study. The chapter continues with a review of prior research on fund performance and key fund characteristics, which leads into a critical discussion of the identified research gap. Finally, the chapter presents the study's aim, research questions, and delimitations, setting the stage for the theoretical and empirical analysis that follows.

1.1 Volatile markets

Over the past five years, the global economy has been characterized by significant volatility, driven primarily by the COVID-19 pandemic and the war in Ukraine. These events triggered widespread disruptions that reshaped industries, global supply chains, financial markets, and consumer behavior (Wang, Waris, Adamiak, Adnan, Hamad & Bhatti 2024, Alicke, Barriball & Trautwein, 2021, Bradley & Stumpner 2021, J.P. Morgan 2020). Naseer, Khalid, Parveen, Abbass, Song and Achim (2023) describe the COVID-19 pandemic as the most significant crisis since World War II, leading to a synchronized global economic collapse. The World Bank (2023) has identified it as the most severe global recession in over a century.

Between 2018 and 2024, the global financial landscape alternated between periods of relative calm and heightened uncertainty (Bradley & Stumpner, 2021, J.P. Morgan 2020). The period began with a phase of economic stability in 2018–2019, characterized by steady global growth, low inflation, and modest financial market fluctuations (World Bank 2023, OECD 2020). However, this was dramatically disrupted in early 2020 by the outbreak of the COVID-19 pandemic (Naseer et al. 2023). Unlike earlier crises such as the 2008 Global Financial Crisis, the downturn was caused by an external health shock rather than systemic failures within the banking system (Marcu 2021). In the beginning of 2022, the war in Ukraine further intensified the economic uncertainty (Mykhailova, Yatsenko, Zavadska, Afanasieva & Haas 2023, Wu, Zhan, Zhou & Wang 2023).

The pandemic not only halted economic activity but also led to major shifts in investor behavior (Ortmann, Pelster & Wengerek 2020). With heightened volatility and uncertainty, capital was reallocated across sectors and asset classes, including a surge of interest in mutual equity funds (Himanshu, Nikhat & Ratan 2021).

At the same time, economic lockdowns, travel bans, and social distancing measures have triggered dramatic changes in household consumption and investment behavior. With traditional spending constrained, individuals increasingly redirected savings into financial markets, particularly via online brokerages and mutual funds (Baraniuk 2025, Pagano, Sedunov, Velthuis 2021, TT 2020). This shift was especially pronounced in Sweden, where mutual equity funds received 88 percent of net new fund savings in 2020, amounting to SEK 75.9 billion (Fondbolagens Förening 2021). Trading volumes on Swedish retail platforms surged, with some brokers reporting trading volumes soared 20 percent higher than in the same period of 2019 (Johansson 2020, Nordnet 2020).

From 2023 onward, global markets began to stabilize. Market conditions improved overall, and indicators such as the VSTOXX signaled a general decline in market uncertainty, suggesting a return to more stable financial environments (STOXX n.d 2024, J.P. Morgan 2024). However, the long-term effects of the pandemic, particularly shifts in household saving and investment behaviors continue to shape global financial markets (OECD 2020, World Bank 2023). In this context, mutual funds have gained importance as accessible and diversified investment vehicles, particularly among retail investors responding to economic uncertainty (Fondbolagens Förening 2021, Baraniuk 2025). Sweden stands out in this regard, with a uniquely mature mutual fund market and a long-standing tradition of private investing (Fondbolagens Förening 2021). This makes the Swedish case especially relevant for understanding broader trends in fund-based household savings.

1.2 The Swedish mutual fund market

Mutual funds play a central role in household savings in Sweden (Fondbolagens Förening n.d). They provide individuals with an accessible way to invest in financial markets and achieve diversification (Nordea n.d). By pooling capital from multiple investors, mutual funds offer access to professionally managed portfolios consisting of various financial assets, such as equities, bonds, or other securities (Avanza n.d). There are several different types of mutual

funds, depending on their investment focus and asset composition. These include, for example, bond funds, mixed funds, and index funds (Avanza 2016). However, the most common type in Sweden is equity mutual funds, which primarily invest in stocks (FI 2024, Flam & Westman 2017).

The Swedish mutual fund market distinguishes itself from other mutual fund markets through strong consumer protection, high transparency, low fund fees, and a well-developed focus on sustainable investing (Nordström n.d). In addition, mutual fund savings are also more widespread in Sweden than in many other countries (OECD 2025, Nordström n.d). Seven out of ten adults engage in voluntary fund savings, and when including pension related savings, almost the entire Swedish population has some form of mutual fund investment (Nordström n.d).

The popularity and broad use of mutual funds in Sweden is the result of a long historical development. Since the introduction of the first Swedish mutual funds in the 1950s, various policies and tax incentives have encouraged fund savings (Fondbolagens förening n.d). Initiatives such as tax-favored funds in the 1970s, the Allemansspar programme in the 1980s, and the integration of mutual funds into the public pension system in the 2000s have contributed to this development (Fondbolagens förening n.d). Together, these measures have helped establish mutual fund saving as a natural part of private financial planning in Sweden. In recent years, new saving forms such as the investment savings account (ISK), introduced in 2012, have further facilitated fund saving for private investors (Fondbolagens förening n.d).

In parallel with these institutional developments, the Swedish mutual fund market has also experienced substantial structural growth. According to the OECD (2025), the market value of investment funds in Sweden has quadrupled since 2012, with equity funds accounting for nearly two-thirds of total fund assets. Furthermore, Swedish households allocate approximately 10 percent of their total financial assets to investment funds, one of the highest proportions in Europe (OECD 2025). These figures highlight the maturity and financial significance of the Swedish mutual fund sector in the broader capital market (Nordström n.d, Fondbolagens förening n.d).

While mutual funds have become an important part of household savings in Sweden (Nordström n.d), their widespread use also places higher demands on investors (Fondbolagens förening n.d, Fisch & Wilkinson-Ryan 2014). Most retail investors in equity mutual funds typically have limited knowledge about the underlying assets and mainly seek exposure to the stock market. As a result, they often rely on recommendations from experts or past fund performance when selecting funds (Flam & Westman 2017, Fisch & Wilkinson-Ryan 2014). However, navigating the mutual fund market is not always easy, and understanding the factors that influence fund performance remains a challenge for private investors (Flam & Westman 2017).

1.3 Previous mutual fund research

Mutual funds have been studied for decades and remain a prominent topic within the fields of business and economics (Sheng, Simutin & Zhang 2023, Babbar & Sehgal 2018, Carhart 1997, Ellis 1975, Jensen 1968). Scholars have continuously sought a deeper understanding of mutual fund performance and the various factors that influence it over time (O'Neill, Sun, Warren & Zhu 2024, Vidal-García, Vidal, Boubaker & Hassan 2018, Anderson & Schnusenberg 2005, Dahlquist, Engström & Söderlind 2000, Gruber 1996). Babalos, Caporale, and Spagnolo (2021), and Pástor and Vorsatz (2020) examined these relationships in the context of financial crises, turbulent markets, and periods of heightened volatility, aiming to explore how different market conditions affect fund performance. These scholars differ in their approaches. Pástor and Vorsatz (2020) focus exclusively on the crisis period itself, while Clare, O'Sullivan, Sherman, and Zhu (2019) examine the post-crisis performance of bond mutual funds. In contrast, Samarbakhsh and Shah (2021) take a broader view by analyzing fund performance across all phases, before, during, and after financial crises to capture the evolving nature of market conditions.

Babalos et al. (2021) studied American mutual fund flows during the 2008–2009 financial crisis. While using a broader time frame (2000–2015) to include pre-crisis, crisis, and post-crisis phases. Their findings indicate that fund performance is influenced by market movements, especially in the aftermath of crises (Babalos et al. 2021). Additionally, Babalos et al (2021) found that fund flows tend to follow market return, which may lead to many funds buying when prices are already rising and selling during downturns.

Flam and Westman (2017) examined the performance of Swedish mutual funds and the presence of manager skill during the period 1993–2013. Their findings showed no evidence of stock-picking abilities among fund managers (Flam & Westman 2017). In fact, many of the top performing funds of a period were among the worst performers after a three to five year period (Flam & Westman 2017). The study was divided into two periods (1993-2001, 2002-2013). This split reflects structural changes in the Swedish mutual fund market, including increased competition and pension system reforms around 2001–2002. While also capturing several episodes of heightened market volatility, such as the dotcom bubble, the global financial crisis, and the euro crisis (Flam & Westman 2017).

Pástor and Vorsatz (2020) found that American actively managed mutual funds underperformed the S&P 500 index during a 10-week period in the early phase of the Covid-19 pandemic This contradicts previous research by Kacperczyk, van Nieuwerburgh, and Veldkamp (2014) who found that fund managers exhibit better stock picking skill and market timing during recessions. Furthermore, Pástor and Vorsatz (2020) found that funds with higher Morningstar sustainability (ESG) ratings performed better during the Covid-19 crisis. [1]

Ferriani and Natoli (2021) studied Morningstar's ESG-rating and the relationship with investor behavior and fund performance during the early stages of the Covid-19 pandemic. Funds with low ESG risk had increased fund flows, whereas funds with high ESG risk had a decrease in fund flows (Ferriani & Natoli 2021). Moreover, funds with lower ESG risk had better performance and with 5 percent better return compared to funds with higher ESG-risk (Ferriani & Natoli 2021). Fang and Parida (2022) also found that high-sustainable funds outperformed low-sustainable funds. This difference in performance increased significantly during the Covid-19 pandemic (Fang & Parida 2022).

Prior research (O'Neill et al. 2024, Sheng et al. 2023, Fang & Parida 2022, Pástor & Vorsatz 2020, Flam & Westman 2017) as illustrated above highlights an ongoing debate about whether

[1] Morningstar ESG ratings are widely used as a proxy for sustainability in mutual fund research. The rating reflects how effectively a fund's underlying holdings manage environmental, social, and governance (ESG) risks compared to peer funds within the same category (Hasnaoui 2025).

there are systematic relationships between fund characteristics and risk-adjusted returns. By extension, these findings raise questions about which theoretical perspective EMH or AMH better explains these associations. Results vary depending on the context, with some studies (Babalos et al. 2021, Pástor & Vorsatz 2020) suggesting that active management can create value during crises, while others (Flam & Westman 2017) find evidence of long-term underperformance. These mixed findings illustrate the complexities of fund performance and raise questions about the validity of the Efficient Market Hypothesis (EMH) static view of market efficiency (Ţiţan 2015, Fama 1970) compared to the more adaptive view offered by the Adaptive Market Hypothesis (AMH) (Lim & Brooks 2011, Lo 2004).

1.4 Problem discussion

Understanding the relationship between mutual fund performance and fund characteristics is particularly important in the Swedish context, where mutual funds account for a significant share of household savings (OECD 2025, Fondbolagens förening 2021). Furthermore, retail investors often face challenges in navigating complex financial markets and may make costly mistakes, such as buying high, selling low, or paying excessive fees (Fisch & Wilkinson-Ryan 2014). Simultaneously, regulatory developments have shifted more responsibility onto individuals, requiring them to make well-informed investment decisions independently (Fondbolagens förening n.d., Fisch & Wilkinson-Ryan 2014). In this environment, easily accessible and observable fund characteristics are commonly used as decision-making tools. Investors frequently rely on features such as fees, size, and past performance when selecting funds (Ferreira, Keswani, Miguel, Ramos 2013). These characteristics are not only easy to access, but also tend to attract investor attention, especially when they are highly visible or emphasized through marketing or short-term performance (Barber, Odean & Zheng 2005).

Among the characteristics most frequently relied upon in academic research are fund fees, fund size, ESG ratings, and management style (Sheng et al. 2023, Steen, Moussawi & Gjolberg 2020, Cremers, Fulkerson & Riley 2019, Ferreira et al. 2013, Gil-Bazo & Ruiz-Verdú 2009, Dahlquist et al. 2000). These variables are not only prominently featured in fund disclosures and platforms like Morningstar but are also commonly assumed to signal potential future performance (Sheng et al. 2023, Steen et al. 2020, Cremers et al. 2019, Ferreira et al. 2013, Gil-Bazo & Ruiz-Verdú 2009, Dahlquist et al. 2000). For instance, fund fees are often seen as

a proxy for skill, with the expectation that higher costs reflect higher returns (Sheng et al. 2023, Babbar & Sehgal 2018, Gil-Bazo & Ruiz-Verdú 2009). However, studies often show a negative association between fees and net performance (Vidal-García, Lean, and Uddin 2015, Cummings 2010, Carhart 1997).

Similarly, larger funds are often expected to benefit from economies of scale (Malhotra, Martin & Russel, 2007), but evidence is mixed. Ferreira et al. (2013) find positive effects outside the U.S. While both Ferreira et al (2013) and Chen, Hong, Huang and Kubik (2004) report diseconomies of scale in U.S. funds. Swedish data show a similar decline in performance with size (Dahlquist et al. 2000). ESG ratings, used as a measure of sustainability, have produced mixed results. Some studies report that ESG-conscious funds outperform (Fang & Parida 2022, Steen et al. 2020), while others find underperformance, particularly when adjusted for fees (Raghunandan & Rajgopal 2022). Furthermore, active management is often assumed to provide an advantage in volatile markets, yet results vary. Some studies support this view (Cremers et al. 2019, Kacperczyk et al. 2014, Kosowski 2011), while others suggest that active managers underperform even in turbulent conditions (Pástor & Vorsatz 2020, Malkiel 2011).

These conflicting findings may be partly explained by differing theoretical assumptions about how markets process information and adapt to shocks. Particularly as framed by the EMH (Fama 1970) and the AMH (Lo, 2004). According to the EMH, markets are consistently efficient. Where prices always reflect all publicly available information (Fama 1970). From this standpoint, fund characteristics such as fees, size, ESG ratings, or management style should not systematically influence risk-adjusted returns. In contrast, the AMH posits that efficiency is not fixed but evolves in response to changes in the market environment, including investor behavior, innovation, and macroeconomic shocks (Lo 2004). This suggests that the relevance of certain fund traits may vary depending on whether markets are calm or volatile. Babalos et al. (2021) supports this by finding significant differences in mutual fund flows and performance across pre-crisis, crisis, and post-crisis periods surrounding the 2008 financial crisis. Similarly, Samarbakhsh and Shah (2021) observed that fund behavior varied across different stages of the same crisis, suggesting that the association of fund characteristics may shift depending on the market condition.

This view gains further relevance in light of recent financial shocks. Unlike earlier crises that stemmed from structural failures within the financial system. Instead, recent volatile periods, such as the Covid-19 pandemic and the war in Ukraine, originated outside the financial sector and introduced uncertainty on a global scale (Wang et al. 2024, Wu et al. 2023, Marcu 2021). These events may have altered how specific fund characteristics, such as fees, size, ESG-rating, or management style associate to performance. As a result, they offer a timely context in which to re-examine whether the assumed effects of these characteristics hold under different market conditions.

1.5 Research gap

Despite decades of academic interest in mutual fund performance, most of the research has focused on the U.S. market, leaving other national contexts underexplored (Sheng et al. 2023, Reuter & Zitzewitz 2021, Gil-Bazo & Ruiz-Verdú 2009, Gruber 1996, Jensen 1968). The Swedish mutual fund market in particular, has received limited academic attention, despite its substantial growth in recent years (OECD 2025). While some studies have examined aspects of the Swedish market, such as Carlsson Hauff and Nilsson (2022), who analyzed investor perceptions of ESG strategies, and Flam and Westman (2017), Asal (2016), and Dahlquist et al. (2000), who investigated fund performance. These studies focus on either long-term or specific historical events, with little emphasis on how fund characteristics are associated with different phases of market volatility.

Moreover, recent years have witnessed market fluctuations due to events such as the Covid-19 pandemic and the war in Ukraine (Wang et al. 2024, Mykhailova et al. 2023, Alicke et al. 2021, Bradley & Stumpner 2021). Unlike earlier crises it was caused by an external health and geopolitical shock rather than systemic failures within the financial system (Wang et al. 2024, Alicke et al. 2021, Bradley & Stumpner 2021, Marcu 2021). These disruptions may represent a structural departure from other crisis patterns and create a unique context in which to revisit assumed relationships between fund characteristics and performance. Particularly as such assumptions may hold differently under stable versus volatile market conditions (Babalos et al. 2021).

While international research (Babalos et al. 2021, Samarbakhsh & Shah 2021, Pástor & Vorsatz 2020, Vidal-García et al. 2018, Ferreira et al. 2013) has begun to explore mutual fund behavior

across different market conditions, similar studies are lacking for the Swedish market. Swedish studies tend to focus on ESG strategies (Carlsson Hauff & Nilsson, 2022), or on performance persistence and manager skill (Flam & Westman 2017). However, they have not examined the association between fund characteristics and performance during different market conditions caused by an external shock. Consequently, there is still no clear consensus on whether EMH or AMH better describes fund performance on the Swedish market.

This study seeks to contribute to addressing this gap by examining how mutual fund characteristics are associated with risk-adjusted performance in the Swedish equity mutual fund market during a recent and highly dynamic period (2018–2024). By including both stable and volatile years, the study describes potential shifts in these relationships across different market conditions, shaped by external shocks rather than financial system failures. Furthermore, by exploring these context-dependent associations through both linear and non-linear models, it also seeks to shed light on whether EMH or AMH better explains mutual fund performance in the Swedish market.

1.6 Aim and research question

In response to the research gap in empirical research on Swedish mutual fund performance in volatile market environments, the aim of this thesis is to examine how fund characteristics are associated with risk-adjusted returns across different market conditions. Specifically, the study analyzes these relationships during stable periods and during phases of heightened market volatility caused by external shocks such as the COVID-19 pandemic and the war in Ukraine. By focusing on Swedish mutual funds, the study aims to contribute to the understanding of how fund characteristics associate under shifting market conditions, a topic that remains underexplored in the existing literature.

Thereby, the study's research questions are:

1. To what extent are fund characteristics associated with risk-adjusted returns?
2. What are the differences in the association between fund characteristics and risk-adjusted return in volatile and stable market conditions?

1.7 Delimitations

This study is delimited to Swedish equity mutual funds during the period 2018 to 2024, covering both stable market phases (2018–2019, 2023–2024) and a period of heightened volatility (2020–2022). This allows for a comparative analysis of how fund characteristics are associated with risk-adjusted returns across different market conditions. The analysis is restricted to four fund characteristics: fund fees, fund size, ESG-rating, and management style. These have been selected for their theoretical and empirical relevance in explaining fund performance. The study excludes other potentially influential characteristics and factors such as fund age, portfolio turnover, macroeconomic indicators, separate measures of risk, as well as portfolio composition and specific asset holdings.

Moreover, this study does not examine investor behavior and thus does not utilize any theories related to behavior. It also excludes other fund types such as bond or mixed funds, thus only mutual equity funds registered in Sweden are included. The analysis is based solely on quantitative data and uses risk-adjusted return as the single performance metric, without examining unadjusted returns or alpha. Finally, while statistical associations are explored, the study does not aim to establish causal relationships.

2. Theoretical framework

The second chapter of this thesis presents the theoretical framework that guides the study. It begins with a discussion of the EMH, which serves as a baseline theory for evaluating how fund characteristics may or may not influence performance in informationally efficient markets. The chapter then introduces the AMH as an alternative perspective, allowing for the possibility that market efficiency varies across time and conditions. Following this, each of the four selected fund characteristics, fund fees, fund size, ESG-rating, and management style is examined in relation to previous empirical research and theoretical expectations. The chapter concludes with a summary of the study's hypotheses, derived from the theoretical frameworks and prior research, which serve as the basis for the subsequent analysis.

2.1 Efficient Market Hypothesis

A vital concept in finance theory that influences both investor behavior and regulatory measures is market efficiency. When market prices fully reflect all available information, the ability to earn abnormal returns consistently is greatly diminished (Fama 1991, 1970). This idea forms the foundation of neoclassical finance, where the EMH, as introduced by Fama (1970), is one of the most extensively researched theories (Monga, Aggrawal & Sing ,2024, Leković 2018, Naseer & Tariq 2015, Titan 2015, Malkiel 2005). According to EMH, asset prices incorporate all known information, making it impossible to consistently outperform the market through information-based strategies (Péon, Antelo & Calvo 2019, Fama 1991, 1970, Samuelson 1965).

EMH provides a clear and influential framework for understanding how information is reflected in asset prices, and it has played a central role in shaping investment theory and financial research (Leković 2018, Malkiel 2005, Fama 1991, 1970). As Leković (2018) and Fama (1991) highlights, EMH offers a practical benchmark for evaluating how well markets process information, even when perfect efficiency is not assumed. Moreover, empirical studies suggest that many observed anomalies tend to diminish over time, supporting EMH's relevance as a guiding principle in understanding market behavior (Leković 2018, Naseer & Tariq 2015, Ţiţan 2015).

EMH is commonly divided into three forms, each defined by the extent of information assumed to be incorporated into asset prices (Monga et al. 2024, Leković 2018, Fama 1970). The weak form suggests that security prices reflect only historical data, such as past prices, returns, and trading volumes (Raquib & Alom 2015, Nisar & Hanif 2012). The semi-strong form builds upon this, arguing that prices adjust not only to historical data but also to all publicly available information, including financial statements, earnings reports, and corporate announcements (Akkoc, Kayali & Ulukoy 2009, Fama 1991). The strong form asserts that prices reflect all available information, both public and private (Leković 2018, Naseer & Tariq 2015, Fama 1991). Accordingly, no investor should be able to achieve abnormal returns, regardless of their access to information (Monga et al. 2024, Leković 2018, Fama 1991).

This assumption leads to implications for how mutual fund performance is understood and interpreted. From an EMH perspective the performance of actively managed mutual funds, regardless of manager skill or strategy, should not consistently outperform passively managed funds (Leković 2018). If markets are efficient, any attempts at stock selection or market timing by fund managers should be, at best, random or temporary (Malkiel 2005, Fama 1970).

In this context, publicly available fund characteristics such as fees, size, ESG-rating, or management style are not expected to offer a systematic advantage in predicting future returns (Ang, Goetzmann & Schaefer 2011). This reflects the assumption that asset prices fully incorporate all publicly available information relevant to valuation (Malkiel 2005, Fama 1970). As a result, any performance advantage linked to these traits would already be reflected in the pricing of the underlying assets, eliminating the possibility of consistently gaining from such information (Leković 2018, Ţiţan 2015). Consequently, investors should not be able to achieve persistent excess returns simply by selecting funds based on such observable characteristics. From this standpoint, consistent differences in fund performance driven by publicly known traits are considered unlikely in an informationally efficient market (Leković 2018, Ţiţan 2015, Ang et al. 2011, Fama 1991).

This view has been historically supported and validated by early mutual fund performance studies, including Jensen (1968) and Sharpe (1966) both found that active managers failed to generate superior risk-adjusted returns compared to market benchmarks. Subsequent researchers such as Malkiel (2011, 2005) further supported EMH by showing that most active

funds underperform passive benchmarks, particularly long term. He emphasized that top-performing funds in one period rarely maintain their edge, reinforcing the notion that persistent outperformance is statistically unlikely. Malkiel (2011) argued that the most direct test of market efficiency lies in evaluating professional mutual fund managers' ability to achieve abnormal returns. Furthermore, Malkiel (2011) argued that the evidence consistently shows that few outperform, even when strong incentives are present.

Despite the theoretical and empirical support, the validity of the EMH has been questioned (Degutis & Novickyte 2014, Lo 2004). Several studies show that some actively managed funds outperform their benchmarks on a risk-adjusted basis. For instance, Ippolito (1993), in a review of mutual fund data from 1962 to 1991, found that certain actively managed mutual funds generated consistent returns and outperformed benchmarks, contradicting earlier support for the EMH. Similarly, Grinblatt & Titman (1992), Goetzmann & Ibbotson (1994), and Sheng et al. (2023) observed performance persistence in select funds, suggesting that managerial skill or other characteristics might contribute to excess returns. Kosowski (2011) and Cremers et al. (2019) found that actively managed funds tend to perform better during recessions, when market inefficiencies increase.

Beyond mutual fund performance, researchers have also questioned whether the assumptions of EMH, particularly the idea of market efficiency being universal and constant, hold true over time (Siegel 2010, Ball 2009, Shiller 2003). Shiller (2003) documented persistent market anomalies, including overreaction, underreaction, and speculative bubbles, which suggest that asset prices often deviate from fundamental values. Even Malkiel (2005), a strong proponent of EMH, acknowledged that market prices do not always fully reflect available information. Due to widespread irrationality, excess volatility, seasonal return patterns, and historical events such as the dot-com bubble (Degutis & Novickytė 2014, Malkiel 2005). Research also indicates that efficiency may vary depending on market structure and conditions smaller or less liquid markets, for example, often exhibit systematic mispricing (Borges 2010, Dockery & Kavussanos 1996, Samuelson 1965).

The above mentioned findings challenge the notion that markets function with a stable and consistent level of efficiency. In response to such limitations, alternative frameworks have emerged, most notably the AMH which redefines efficiency as dynamic rather than fixed. For

example, Rönkkö, Holmi, Niskanen and Mättö (2024) found that AMH provides a more accurate explanation of market behavior in the Finnish stock market than EMH, reinforcing the idea that efficiency is not constant but influenced by time, context, and adaptation. This evolving perspective will be further explored in the following section (2.2).

By integrating the EMH perspective, this study establishes a theoretical baseline for analyzing whether mutual fund characteristics such as fees, size, ESG rating, and management style systematically influence risk-adjusted returns. According to EMH, such characteristics should not have persistent explanatory power. Instead, any observed differences in fund performance would be attributed to chance rather than structural advantages. In this way, the study addresses the research questions and aim presented in Sections 1.5 and 1.6 through the lens of EMH.

This leads to the formulation of the following hypothesis based on EMH assumptions:

H1: Fund characteristics: fund fees, fund size, ESG-rating, and management style have no statistically significant association with risk-adjusted returns

2.2 Adaptive market hypothesis

In response to the criticism of the limitations of the EMH, particularly its assumption of static market efficiency (Nyakurukwa & Seetharam 2023, Degutis & Novickyte 2014, Lo 2012, 2005, 2004 alternative perspectives have emerged. Moreover, as financial markets have proven to be more volatile and less predictable than previously assumed and explained by EMH, alternative theories such as the Adaptive Market Hypothesis (AMH) have been developed. AMH, introduced by Andrew Lo (2004), aims to better capture this fluctuating behavior. While AMH builds on the foundational ideas of EMH, it offers a more flexible perspective by integrating insights from behavioral finance and evolutionary theory (Bassiouny, Kiryakos & Tooma 2023, Nyakurukwa & Seetharam 2023, Lo 2012, Lim & Brooks 2011, Lo 2004).

Unlike EMH, which assumes that market efficiency remains stable over time, AMH suggests that efficiency is dynamic and evolves in response to changing market environments (Xiong, Meng, Li & Shen 2019, Dyakova & Smith 2013, Lo 2012, Lim & Brooks, 2011). AMH is shaped by forces such as competition, innovation, investor learning, and adaptation to changing market environments (Lo, 2012, 2005, 2004). From this perspective, financial markets function

more like adaptive systems than perfectly rational systems. Informational efficiency is not fixed but depends on how well market participants respond to external changes. The external changes include technological advances, regulatory changes, crises, or macroeconomic developments (Adaramola & Obisesan 2021, Kim, Shamsuddin & Lim 2011). As conditions change, the effectiveness of specific investment strategies may rise or fall. Inefficiencies in pricing may appear temporarily, but be eliminated through trading activity, and then appear in new variations. Thus, market efficiency is not binary but exists along a spectrum that fluctuates over time (Lo 2012, 2005).

AMH is also supported by empirical findings that show cyclical patterns in market efficiency (Mallikarjunappa, Saldanha & Hawaldar 2025, Gyamfi 2018). Moreover, Okorie and Lin (2021) provide empirical support for AMH by analyzing how market efficiency responded to the COVID-19 pandemic across four major stock markets (USA, Brazil, India and Russia). Using non-linear methods, Okorie and Lin (2021) found that informational efficiency varied significantly across countries and over time. These findings confirm the central premise of AMH (Lo 2004), that market efficiency is dynamic and context-dependent rather than constant (Okorie & Lin 2021). These findings are further supported by Urquhart and Hudson (2013), who also provide evidence for the AMH by demonstrating that market efficiency fluctuates across time and regions. They studied market efficiency using long-term data and tested for non-linear effects in the US, UK, and Japanese stock markets. Their results showed that efficiency changes depending on the market context, which gives further support to AMH (Urquhart & Hudson 2013).

One key implication of AMH is that asset returns may be predictable during certain periods, as inefficiencies appear and disappear with changing market conditions (Lo 2005, 2004). Gruber (1996) suggests that mutual fund performance can be predicted, allowing informed investors to spot outperforming funds before this is reflected in prices. Building on this notion of predictability, Urquhart, Gebka and Hudson (2015) examine whether the predictive power of the moving average (MA) rule has weakened over time. Their findings show that the MA[2] rule

[2] The moving average (MA) rule is a trading method that uses past price averages to signal when to buy or sell. A buy signal happens when a short-term average moves above a long-term average, and a sell signal when it drops below. This rule is often used to test whether market prices can be predicted and how efficient markets are (Urquhart, Gebka & Hudson 2015).

used to be profitable but became less effective after 1986 because investors seemed to adjust their behavior in advance of its signals. These findings align with the Adaptive Market Hypothesis (AMH) proposed by Lo (2004), which argues that markets evolve over time and may allow temporary inefficiencies to be exploited. According to Nyakurukwa and Seetharam (2023), predictable patterns in fund performance challenge the EMH, which assumes that markets are always efficient (Malkiel 2005, 2011). Instead, such patterns support the AMH view that market efficiency can vary over time depending on changing conditions (Okorie & Lin 2021, Urquhart & Hudson 2013, Lo 2004).

Similarly, Monga et al. (2024) tested the efficiency of the Indian equity market using both linear and non-linear statistical methods to see whether the results supported EMH or AMH. Their study found that efficiency varies over time, suggesting that AMH gives a better explanation of how the Indian market works. Zhou and Lee (2020) also examined how volatility and uncertainty affect market efficiency in the American real estate market. They used an automatic variance ratio test and found that efficiency levels change over time. In addition, they concluded that regulatory changes had a strong impact on market efficiency. This supports Lo's (2012, 2005, 2004) view that outside factors can influence how efficient markets are. Together, these studies suggest that AMH can explain how both efficient and inefficient periods may exist in the same market at different times. This contrasts with EMH, which assumes that markets are always efficient in a more consistent way.

Other studies have used AMH as the theoretical framework to better understand how markets behave under different market conditions. Rönkkö et al. (2024) used both linear and non-linear statistical tests to examine market efficiency in the Finnish stock market. Based on their results, they concluded that AMH explains efficiency better than EMH. Nyakurukwa and Seetharam (2023) conducted a literature review and analyzed existing research on market efficiency. Based on their findings, they argue that AMH provides a more detailed and accurate view of how market efficiency shifts in response to changing market conditions. Their findings are supported by Tran and Leirvik (2019) and dos Santos et al. (2024), who both used linear and non-linear statistical methods to examine how market efficiency evolves. Their results show that efficiency changes over time, across different asset classes, and between regions. These findings support the idea that market efficiency is not constant, but shifts depending on time and context.

If certain fund characteristics are linked to higher performance during volatile periods but not during stable ones, this may point to temporary inefficiencies in the market. However, this does not mean that EMH is fully rejected. Instead, AMH builds on EMH by suggesting that market efficiency is not constant. It depends on the context and can change over time. AMH offers a more flexible way to understand how fund characteristics affect performance in different market conditions.

By integrating the AMH perspective, this study examines whether fund characteristics (fees, size, ESG-rating, and management style) have different relationships with risk-adjusted returns depending on whether the market is stable or volatile. Thereby directly addressing the research questions and aim presented in sections 1.5 and 1.6.

Finally, drawing on the assumptions of AMH, which holds that the effect of financial variables may change under different market conditions. The following hypothesis has been developed to test whether fund characteristics influence performance differently over time:

H2: There is a statistically significant difference in the association of fund characteristics: fund fees, fund size, ESG-rating, management style, and risk-adjusted return across volatile and stable market periods.

2.3 Fund characteristics

This section presents the four fund characteristics selected for analysis: fund fee, fund size, ESG-rating, and management style. These variables have been selected based on their frequent use in previous research, theoretical relevance within both EMH and AMH frameworks. Each characteristic is examined in relation to empirical findings and its potential association with risk-adjusted performance.

2.3.1 Fund fee

The relationship between mutual fund fees and risk-adjusted performance has long been a central topic in financial research, yet findings remain inconclusive and often contradictory (Sheng et al. 2023, Gil-Bazo & Ruiz-Verdú 2009, Dahlquist et al. 2000, Gruber 1996). While some studies point to a clear negative impact of fees on performance, others argue for more nuanced interpretations depending on methodology, market context, and fund characteristics

(Sheng et al. 2023, Bessembinder, Cooper & Zhang 2023, Vidal-García et al. 2018, Carhart 1997).

Early studies such as Gruber (1996), using U.S. data from 1985 to 1994, and Carhart (1997) U.S. funds from 1962 to 1993, documented that higher fees tend to be associated with lower net returns. Carhart (1997) used linear regression and notably found that each percentage point increase in mutual fund expenses corresponded to an average decrease of 1.54 percentage points in annual performance, indicating a direct cost to the investor. These findings were later reinforced by broader reviews, such as Cummings (2010), which emphasized that expense ratios negatively affect investor returns and that lower-fee funds typically outperform high-fee counterparts on a risk-adjusted basis. Since Gruber (1996), Carhart (1997) and Cummings (2010) found that higher fund fees are linked to lower net returns, these findings challenge EMH and support AMH's idea that market efficiency can change over time (Mallikarjunappa et al. 2025, Lo 2004).

This pattern has been confirmed in the Swedish market as well. Dahlquist et al (2000), analyzing Swedish mutual fund data from 1993 to 1997 using linear regressions, found that funds with lower fees tended to outperform their more expensive counterparts on a risk-adjusted basis. Their results suggest that higher fees are not necessarily associated with higher skill or value creation and may in fact erode net returns for investors (Dahlquist et al 2000). Gil-Bazo and Ruiz-Verdú (2009), analyzed U.S. equity funds from 1997 to 2004 by using linear OLS-regression. Gil-Bazo and Ruiz-Verdú (2009 found that funds with lower performance often charged higher fees. They attributed this to operational cost structures and strategic fee-setting aimed at performance-insensitive investors. Thus, Dahlquist et al. (2000) challenge EMH by showing that publicly available information, such as fees, is not fully reflected in fund prices. Instead, their findings support AMH by suggesting that investor behavior and market frictions can lead to temporary inefficiencies.

Unlike Dahlquist et al. (2000), who focused on the Swedish mutual fund market, Vidal-García et al. (2018) adopted a broader, global perspective by analyzing fund data across 35 countries. Vidal-García et al. (2018) found that standard regressions showed a negative relationship between fees and risk-adjusted returns. However, non-parametric methods like DEA suggested

that high-fee funds may operate more efficiently under certain conditions (Vidal-García et al. 2018). Furthermore, Vidal-García et al findings. (2018) primarily support AMH, as their results show that the relationship between fees and performance is conditional and method dependent. This challenges EMH, which assumes stable and universal market efficiency (Naseer & Tariq 2015, Fama 1991.

Sheng et al. (2023), using U.S. data from 2000 to 2018, offer a methodological critique of earlier literature. They argue that previous studies fail to account for structural investment style differences between high- and low-fee funds. Sheng et al. (2023) show that high-fee funds are more likely to invest in high-growth, low-profitability firms, which are typically associated with lower returns by using linear OLS-regression. When adjusting for this using the Fama-French five-factor model, they find that high-fee funds do not underperform after fees, challenging the notion that low-cost funds are always superior. Sheng et al. (2023) primarily support EMH by showing that high-fee funds do not underperform once investment style differences are properly adjusted for. However, their findings also align partially with AMH, as they highlight that market efficiency depends on how information is interpreted and modeled (Sheng et al 2023).

Bessembinder et al. (2023) examine the long-term relationship between fund fees and the performance of U.S. mutual equity funds over horizons of 10 to 20 years. Using linear comparisons to the SPY index, they find that most funds underperform the benchmark, both before and after fees (Bessembinder et al 2023). Only a minority of funds outperform SPY after adjusting for risk, and fees worsen this gap. These findings primarily support EMH, as they indicate that mutual fund managers are generally unable to generate consistent excess returns, even over extended periods (Bessembinder et al 2023). The fact that higher fund fees correlate with worse performance underscores EMH's implication that paying more does not guarantee superior results, since prices already reflect all known information (Leković 2018).

The findings from Vidal-García et al. (2015) further complicate the picture by showing that mutual fund fees can be predictive of future returns by using linear regression. However mostly in a negative direction. Funds charging higher fees tend to deliver lower future performance, and only a small portion of underperforming funds adjust their fees downward in response,

suggesting weak fee discipline in practice (Vidal-García et al 2015). The findings contradict EMH by suggesting that mutual fund fees contain predictive information not fully priced in by the market. Instead, they support AMH by highlighting persistent inefficiencies and behavioral factors in fee-setting practices (Vidal-García et al 2015).

Taken together, the existing literature reveals a complex relationship between mutual fund fees and risk-adjusted performance. While more recent contributions emphasize methodological nuance and strategic fee-setting, the majority of empirical studies, especially those using large U.S., European and Swedish data report a negative association between fees and returns (Vidal-García et al. 2015, Gil-Bazo & Ruiz-Verdú 2009, Dahlquist et al. 2000, Carhart 1997). This pattern suggests that higher fees tend to reduce performance and thus align with AMH by indicating that such inefficiencies persist across different market contexts. Therefore, the following directional hypothesis is proposed:

H3: Fund fees have a statistically significant negative association with risk-adjusted returns.

2.3.2 Fund size

The influence of fund size on mutual fund performance has been widely studied in financial literature, yet results remain inconclusive and often contradictory (Babbar & Sehgal 2020, Dariusz 2018, Basso & Funari 2017, Ferreira et al. 2013, Chen et al. 2004). Fund size, typically measured as assets under management (AUM), is commonly assumed to influence performance through mechanisms such as economies of scale or liquidity constraints (Ferreira et al. 2013, Malhotra et al. 2007, Chen et al. 2004). However, the direction and strength of this relationship vary across studies, countries, and methodological approaches (O'Neill et al. 2024, Farid & Wahba 2022, Singh & Tandon 2022, Reuter & Zitzewitz 2021, Busse et al. 2020, Dariusz 2018, Babbar & Sehgal 2018, Dahlquist et al. 2000).

Ferreira et al. (2013) used linear regression and found that fund size had a positive and statistically significant effect on performance among non-U.S. equity funds but a negative effect in U.S. markets. This duality suggests that market context and structural differences play a role in the size and performance relationship. Similarly, Dariusz (2018), using linear regressions to investigate Polish equity mutual funds, reported a consistently positive relationship between size and performance, with larger funds generating higher Sharpe ratios.

Reinforcing the idea that size-related operational efficiencies may enhance risk-adjusted performance in less saturated markets (Dariusz 2018). These findings (Dariusz 2018, Ferreira et al 2013) indicate support for AMH, since AMH argues that market efficiency depends on market context and location (Nyakurukwa & Seetharam 2023, Urquhart & Hudson, 2013).

In contrast to these previously mentioned studies reporting a positive association between fund size and performance, other contributions suggest the opposite. Farid and Wahba (2022), analyzed Egyptian mutual funds using linear regressions, and found a significant negative effect of fund size on performance. Using the Sharpe ratio as the dependent variable, they concluded that larger funds tend to underperform, likely due to diseconomies of scale such as liquidity constraints (Farid & Wahba 2022). Similarly, Dahlquist et al (2000) conducted a linear regression-based study of Swedish mutual funds and found a negative relationship between fund size and performance among Swedish equity funds. Dahlquist et al (2000) showed that larger funds underperformed smaller ones. Although Farid and Wahbas (2022) and Dahlqvist et al (2000) found a negative relationship between fund size and fund performance. Their results still question EMH, since no fund characteristic should not affect returns (Monga et al. 2024, Leković 2018, Fama, 1970). Thus, once again being in line with AMH, which gives a more nuanced view on market efficiency (Lo 2012, 2005, 2004).

This view is reinforced by O'Neill et al. (2024), who conducted a cross-market study of global, emerging, and Australian equity funds. Using linear and non-linear regressions, they found that larger funds consistently underperform relative to benchmarks, even though they relied on excess returns rather than formal risk-adjusted ratios. O'Neill et al. (2024) suggest that as fund size increases, capacity constraints such as reduced flexibility can increasingly hinder active managers' ability to generate excess returns. These limitations are particularly evident in smaller or less liquid markets, such as Australian small caps, where scale diseconomies are most pronounced (O'Neill et al., 2024). Like the research by Farid and Wahbas (2022) and Dahlqvist et al (2000), O'Neill et al. (2024) found a negative relationship between fund size and fund performance. These results reinforce the arguments by AMH (Lo 2012, 2005, 2004) that different market conditions and characteristics affect fund performance.

Angelidis, Babalos, and Fessas (2021) examine the impact of fund size on the performance of U.S. actively managed mutual equity funds from 1991 to 2017. Using linear regressions and a

within-fund comparison based on the Carhart four-factor model, they compare returns when funds are small versus when they become large. They find that funds underperform by 7.08 percent annually after growing into the largest size decile, with the decline becoming significant once funds enter the top 30 percent by size. These findings primarily support AMH, as they suggest that fund performance adapts to changing market conditions and organizational constraints, rather than remaining constant as predicted by EMH.

Further support for this negative relationship comes from Singh and Tandon (2022), who examined Indian equity funds by using linear regression. Using Jensen's alpha and the Treynor ratio, they also found that larger funds perform worse. This could be explained by the fact that larger funds, as noted by Busse et al. (2020), experience lower percentage transaction costs compared to smaller funds. Busse et al. (2020) also found that smaller funds generated better gross return than larger funds. Pastor, Stambaugh and Taylor (2015) found similar results, as the size of active mutual funds increase, their ability to outperform passive benchmarks decreases.

However, not all studies find a significant effect. Reuter and Zitzewitz (2021) used a linear regression discontinuity design to examine changes in fund size among U.S. equity funds. While Phillips, Pukthuanthong and Rau (2018) applied an instrumental variable approach to control for endogeneity. Both studies found no statistically significant impact of fund size on performance, suggesting that the relationship may be overstated in traditional models and depends on institutional context (Reuter & Zitzewitz 2021, Phillips et al. 2018). These results support EMH, as both Reuter and Zitzewitz (2021) and Phillips et al. (2018) found no statistically significant effect of fund size on performance. According to the logic of EMH, if markets are efficient, specific fund characteristics such as size should not have a systematic impact on returns.

Similarly, Babbar and Sehgal (2018) found no statistically significant relationship between fund size and risk-adjusted performance. Using the linear Carhart four-factor model, they concluded that fund size had no explanatory power for predicting returns. These results are consistent with EMH, which holds that individual fund characteristics should not systematically influence performance (Leković 2018, Malkiel 2005, Fama 1970). In the same way, Basso and Funari (2017) found that fund size did not significantly affect performance.

Their findings also support EMH (Leković 2018, Malkiel 2005, Fama 1970), as they suggest that fund size does not provide a reliable advantage in predicting future returns.

The variation in findings may be driven by methodological differences such as data frequency, model choices, and the specific risk-adjusted return metric applied. Ferreira et al. (2013) used Carhart alpha on a global dataset, while others like Dariusz (2018), Singh and Tandon (2022), and Farid & Wahba (2022) employed Sharpe or Jensen's alpha based on monthly or annual data. In the context of this thesis, which focuses on Swedish mutual equity funds the literature offers no universal conclusion. However, evidence from structurally similar or comparable markets such as those in Europe, Australia, and the U.S. more frequently points to diseconomies of scale, especially in highly regulated, liquid markets (O'Neill et al. 2024, Angelidis et al. 2021, Ferreira et al. 2013, Dahlquist et al. 2000). This is also reflected in the Swedish context, where Dahlquist et al. (2000) found a negative relationship between fund size and performance.

Based on the pattern of findings in structurally similar markets and these theoretical considerations, the following directional hypothesis is proposed:

H4: Fund size has a statistically significant negative association with risk-adjusted returns.

2.3.4 ESG-rating

The research field of sustainable investments and mutual funds is relatively new but has gained significant popularity in recent years (Hasnaoui 2025, Papathanasiou & Koutsokostas 2024, Raghunandan & Rajgopalm 2022, Fang & Parida, 2022, Steen, et al. 2020). Driven in large part by increasing investor demand for ethical and environmentally responsible financial products (Papathanasiou & Koutsokostas 2024, Steen et al. 2020). Morningstar ESG ratings are commonly used as a proxy for sustainability, and all studies referenced in this section rely on Morningstar ESG ratings to evaluate the relationship between sustainability and fund performance (Hasnaoui 2025, Papathanasiou & Koutsokostas 2024, Raghunandan & Rajgopalm 2022, Fang & Parida 2022, Steen et al. 2020). However, the findings remain inconsistent whether higher ESG-rating results in worse or better fund performance.

Papathanasiou and Koutsokostas (2024), using linear statistical tests, found that lower-rated ESG funds outperformed higher-rated ones, potentially due to differences in expense ratios.

This finding is in line with Raghunandan and Rajgopal (2022), who also reported that highly rated ESG funds tend to charge higher fees and underperform compared to traditional funds. Their results, based on linear OLS regressions with fixed effects at the fund level, suggest that ESG-related characteristics do not consistently lead to better performance. While ESG ratings aim to capture sustainability, some investors assume they may also reflect lower risk or better long-term prospects (Hasnaoui 2025, Papathanasiou & Koutsokostas 2024, Steen et al., 2020). From the perspective of EMH, fund characteristics such as ESG ratings should not systematically influence mutual fund performance (Leković, 2018, Fama, 1970). The fact that highly rated ESG funds underperform, despite the public availability of ESG data, suggests that markets may not be fully efficient. Thus, this outcome aligns more closely with AMH which allows for changing levels of efficiency depending on market conditions (Lo 2012, Lim & Brooks 2011).

On the other hand, Hasnaoui (2025) and Fang and Parida (2022) who both used linear regression, found that funds with higher ESG ratings consistently outperformed those with lower ratings. Although ESG data is public, these results suggest that ESG characteristics may become more important under specific circumstances, such as in certain sectors or during periods of market stress. These results also question EMH as publicly available information like ESG ratings should not exhibit a systematically predictable relationship with performance (Leković 2018, Fama 1991, 1970). Instead, the findings support AMH, which argues that market efficiency is not fixed but can change depending on investor behavior and external conditions (Lo 2004). Hasnaoui (2025) shows that ESG may have greater value in technology-focused funds, while Fang and Parida (2022) find that ESG ratings were more relevant during the COVID-19 crisis.

Steen et al. (2020) add further nuance by showing that the link between ESG ratings and fund performance varies depending on geographical context. Using linear statistical methods, Steen et al. (2020) found no significant relationship in Norwegian funds, which supports the assumptions of EMH (Leković 2018, Fama 1970). However, in their analysis of EU-based funds, higher ESG-rated funds did outperform. This suggests that the effect of ESG on returns may depend on market structure or investor preferences, which is more consistent with AMH (Lo 2012, Lim & Brooks 2011).

These conflicting results suggest that the relationship between ESG-ratings and fund performance is complex (Hasnaoui 2025, Papathanasiou & Koutsokostas 2024, Raghunandan & Rajgopalm 2022, Fang & Parida 2022, Steen et al. 2020). It may depend on factors such as geography, time period, or market conditions (Hasnaoui 2025, Papathanasiou & Koutsokostas 2024, Raghunandan & Rajgopalm 2022, Fang & Parida, 2022, Steen et al. 2020), factors that AMH accounts for (Urquhart & Hudson 2013, Lo 2012, 2005, 2004). Since Steen et al. (2020) argue that geography influences whether ESG is positively or negatively associated with fund performance, this study aims to test that assumption in a Swedish context. Given that Steen et al. (2020) found no statistically significant relationship in Norwegian mutual funds, and that Sweden shares similar geographic characteristics, it is relevant to investigate whether the Swedish funds may exhibit a different pattern.

Therefore, this study contributes by examining how ESG ratings relate to fund performance in the Swedish market over a more recent and turbulent time period, while also considering other potentially influential factors. Based on this, the following hypotheses are proposed:

H5: ESG-ratings have a statistically significant negative association with risk-adjusted returns.

2.3.5 Management style

Early research on actively managed versus passive mutual funds, beginning with Jensen (1968), followed by Ellis (1975), and Carhart (1997) found that actively managed funds tend to underperform passive funds. There is also a debate whether fund managers are effective and possess superior stock-picking skills (Harvey & Liu 2022, Cremers et al. 2019, Flam & Westman 2017, Fama & French 2010, Berk & Vans Binsbergen 2015). To place the debate in the context of EMH, the existence of active management may seem to suggest that there are information inefficiencies in the market. These inefficiencies could create opportunities for professional investors to earn above average returns, which would support Lo's (2004) theory of AMH. However, Malkiel (2011) argues that this is not the case. According to Malkiel's (2011) review of previous research, active managers do not consistently achieve higher returns than the market. This supports the view that asset prices already reflect all publicly available information, as proposed by EMH (Leković 2018, Ţiţan 2015, Malkiel 2011).

Jensen (1968) conducted one of the earliest studies on mutual fund performance. By analyzing U.S. equity funds from 1945 to 1964 using linear statistical methods to test whether fund managers could deliver returns exceeding market expectations after adjusting for risk. Jensen (1968) found no evidence of consistent outperformance, concluding that the few funds that did better than expected likely benefited from luck rather than skill. Decades later, Fama and French (2010) reached similar conclusions using more recent data (1984–2006) and a larger sample. Applying linear regressions, Fama and French (2010) found that most active managers failed to outperform the market after fees.

Malkiel (2011) builds on Jensen's findings from 1968 and argues that they support the EMH. Furthermore Malkiel (2011) maintains that the inability of professional managers to consistently outperform the market suggests that asset prices already reflect all publicly available information. According to Malkiel (2011), the presence of active managers does not contradict EMH. Instead, their combined activity contributes to keeping the market efficient, even if most managers do not consistently outperform it (Malkiel 2011).

Ellis (1975) found that investment managers have not outperformed the market represented by the S&P 500 in the past and are unlikely to do so in the future, supporting Jensen's (1968) findings. Furthermore, Ellis (1975) argues that active management has fundamentally altered the market structure but has also become a self-defeating strategy due to higher trading costs and increased competition. While Ellis (1975) attributed the failure of professional investors to structural market limitations. Later research by Kim et al. (2011) shows that market efficiency may fluctuate over time but is generally consistent with EMH during stable periods. Similarly, Ajadi (2024) used linear regression to show that actively managed Nigerian equity funds did not outperform passive alternatives, suggesting limited benefits of active management in stable markets. This supports the notion of EMH that persistent outperformance is difficult, especially when markets function under normal conditions (Leković 2018, Malkiel 2005, Fama 1970).

Carhart (1997) used linear statistical tests to examine U.S. mutual funds from 1962–1993, assessing whether active managers delivered consistent excess returns. The results show that most funds did not outperform after adjusting for risk, fees, and trading costs (Carhart 1997) While earlier studies suggested that strong past performance was due to manager skill (Goetzmann & Ibbotson 1994, Hendricks, Patel & Zeckhauser, 1993, Grinblatt & Titman

1989). Carhart (1997) on the other hand found that it was mainly explained by momentum. Furthermore, Carhart (1997) concluded that consistent outperformance among mutual funds was rare, and that observed performance differences were more likely due to risk exposures and costs than to stock-picking ability. Cuthbertson, Nitzsche and O'Sullivan (2010) also provide evidence that challenges the notion that active fund managers consistently add value beyond their fees. Using OLS regression, they found that about 75 percent of active funds failed to generate positive net returns after fees, with only a small minority showing persistent outperformance (Cuthbertson et al. 2010). Malkiel (2011) interprets Carhart's findings from 1997 as strong support for EMH. Malkiel (2011) argues that the inability of active managers to outperform, even over long periods and after controlling for risk, reinforces the idea that prices already reflect available information.

More recent research by Cremers et al. (2019) challenges the traditional view that active management is inherently ineffective. They find that while many active funds underperform, some skilled managers persistently generate excess returns, particularly during recessions when market inefficiencies increase. Similarly, Cremers, Ferreira, Matos and Starks (2016) show that funds with high active share can outperform, but they note that this advantage depends on market conditions and can be limited by increased competition among active funds. Kosowski (2011) also supports the view that traditional models may underestimate the value of active management during downturns. These results challenge the assumptions of EMH, which holds that markets are consistently efficient over time (Malkiel 2011, 2005, Fama 1970). However, they are in line with AMH (Nyakurukwa & Seetharam 2023, Kacperczyk et al. 2014, Lo 2004), which proposes that efficiency changes with market conditions and that investor skill becomes more relevant in periods of instability.

Research by Matallín-Sáez, Soler-Domínguez, and Tortosa-Ausina (2018) also highlights that active fund performance varies with market circumstances. They analyzed U.S. equity funds from 2001 to 2011, using linear regressions with quadratic terms to capture non-linear effects. Their analysis revealed a U-shaped link between active management and performance. Matallín-Sáez et al (2018) argue this arises because active funds take bigger bets, leading to either large gains or significant losses. The study concludes that active management creates both extreme under- and outperformance, challenging EMH and supporting AMH's view of

time-varying efficiency driven by market conditions and manager choices (Urquhart & Hudson 2013).

In addition to these insights on market conditions and fund performance, other studies have focused on the role of luck and skill in explaining mutual fund returns. Andrikogiannopoulou and Papakonstantinou (2019) and Harvey and Liu (2022) both used simulation-based methods to assess whether mutual fund outperformance reflects skill or luck. They found that traditional linear frameworks like the False Discovery Rate[3] (FDR) or common bootstrapping [4]methods often misclassify skilled managers, either understating or overstating their presence. By improving simulation approaches, both studies reveal more evidence of true skill, challenging EMH's view of persistent market efficiency (Fama 1991) and supporting AMH's notion that market conditions and methodology influence fund performance (Nyakurukwa & Seetharam 2023, Lo 2004).

As described above, previous research shows mixed results on whether active or passive management leads to better performance. Several studies (Ajadi 2024, Kim et al. 2011, Fama & French 2010, Carhart 1997 report a negative relationship between management style and fund performance indicating support for EMH (Leković 2018, Naseer & Tariq 2015, Ţiţan 2015). While more recent studies report a positive relationship (Harvey & Liu 2022, Cremers et al. 2019, Kosowski 2011) more in line with AMH (Nyakurukwa & Seetharam 2023, Degutis & Novickyte 2014, Lo 2012). Since Dahlquist et al. (2000) found that actively managed Swedish equity funds often outperform passive funds. Additionally, most recent research argues that management style has a positive relationship with fund performance (Cremers et al. 2019, Andrikogiannopoulou and Papakonstantinou 2019, Kosowski 2011), this study will test this finding on the Swedish mutual fund market.

The following hypothesis is proposed:

H6: Management style has a statistically significant positive association with risk-adjusted returns.

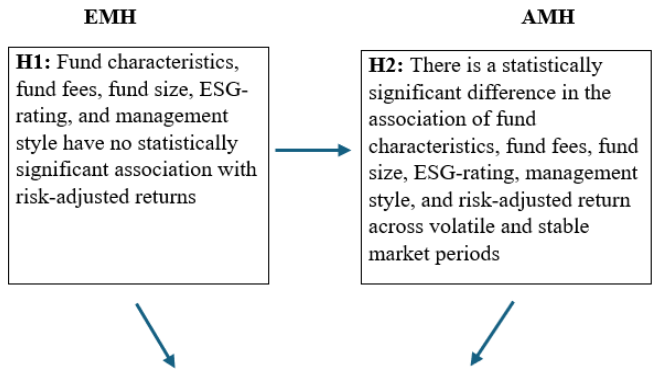
[3] The False Discovery Rate (FDR) is a statistical method used to control for multiple testing errors, estimating the expected proportion of false positives among all significant findings (Barras, Scaillet and Wermers 2010).

[4] Bootstrap is a method that makes new samples from the original data to check the reliability of results, even when normal assumptions don't hold (Harvey and Liu 2022).

2.4 Summary of Hypotheses

Figure 1 below presents a summary of the study's hypotheses, structured around both theoretical reasoning and prior empirical research. The model is divided into two levels: theoretical hypotheses (H1–H2) and hypotheses based on previous research (H3–H6).

Figure 1 – Summary of Hypotheses



Based on Previous Research Findings

H3: Fund fees have a statistically significant negative association with risk-adjusted returns

H4: Fund size has a statistically significant negative association with risk-adjusted returns

H5: ESG-ratings have a statistically significant negative association with risk-adjusted returns.

H6: Management style has a statistically significant positive association with risk-adjusted returns.

Source: Figure compiled by the authors.

At the top, H1 and H2 represent contrasting predictions derived from two key financial theories. H1, based on EMH, assumes that fund characteristics, fees, size, ESG rating, and management style, should not systematically influence risk-adjusted returns. H2, grounded in AMH, proposes that these relationships are context-dependent and may vary across different market conditions, such as stable versus volatile periods. Below this, H3–H6 tests the same fund characteristics, but with explicit directional expectations. These hypotheses are theoretically relevant to both EMH and AMH, but the predicted directions of the associations (negative or positive) are drawn from prior empirical findings.

By integrating theoretical and empirical foundations, the hypothesis enables the study to assess not only whether fund characteristics matter, but also how their association may shift

depending on broader market conditions, a central feature of the AMH. This approach allows for a nuanced evaluation of both static efficiency (EMH) and adaptive, time-varying market behavior (AMH).

3. Method

This chapter outlines the approach used to investigate the relationship between mutual fund characteristics and risk-adjusted performance under varying market conditions. It begins by presenting the research design, including the study period, data sources, and criteria for fund selection. The operationalization of both dependent and independent variables.

Subsequently, the chapter details the statistical procedures employed, including descriptive statistics and the application of both linear (OLS) and non-linear (GAM) regression models, and model diagnostics. The chapter also addresses the quality of the study, with a discussion on reliability, validity, source credibility, ethical considerations and method limitations.

3.1 Research design

This study adopts a deductive, quantitative approach based on secondary numerical data. To answer the research question and address the aim of this study OLS regression, is applied to test the hypotheses. This is done by examining the relationship between risk-adjusted returns and fund characteristics. Furthermore, GAM is used to detect non-linear relationships that OLS cannot capture, thus providing a more nuanced analysis of how fund characteristics are associated with risk-adjusted returns.

This methodological approach is well-suited for hypothesis-driven research based on structured numerical data (Saunders, Lewis & Thornhill 2023, p. 182, Hair, Page & Brunsveld, 2020, pp. 122–123). It is also commonly employed in empirical studies on mutual fund performance (Asal 2016, Vidal et al. 2018, Gil-Bazo & Ruiz-Verdú 2009, Dahlquist et al 2000).

Building on established financial theory and previous research, the study adopts a deductive approach by formulating hypotheses tested through quantitative methods. This approach is appropriate when research is grounded in existing theoretical frameworks and aims to empirically test specified relationships (Bryman, Bell & Harley, 2024, Ghauri, Grønhaug & Strange, 2020). The research design applies a descriptive approach across four periods, 2018–2019, 2020–2022, 2023–2024, and 2018–2024. Each period is analyzed separately, enabling comparisons across different market conditions. This allows the study to examine whether the association of fund characteristics with risk-adjusted returns vary under different market conditions.

3.2 Time frame

This study examines Swedish equity mutual funds over the period 2018–2024. This timeframe was selected for its inclusion of both stable and volatile market conditions. Thereby enabling a comparative analysis of how fund characteristics relate to risk-adjusted returns under different market conditions. This approach is particularly relevant in the context of the AMH, which posits that market efficiency evolves over time in response to changing market environments (Xiong et al. 2019). This stands in contrast to the EMH, which assumes a static and consistently efficient market where fund characteristics should not systematically influence returns (Leković 2018).

The time frame covers three different market conditions. The years 2018–2019 represent a relatively stable period with low volatility reflected in a VSTOXX [5] average of 13.5 (STOXX n.d). This was followed by a sharp shift in 2020–2022, triggered by an external shock in the form of the COVID-19 pandemic and the Ukraine war. This shock led to widespread uncertainty and elevated volatility, with VSTOXX peaking above 85 and averaging 32.1 (STOXX n.d). In contrast, 2023–2024 indicates a return to calmer conditions, as market confidence improved and the VSTOXX dropped to an average of 15.2.

This categorization enables the study to explore whether the fund characteristics, fees, size, ESG-ratings, and management style show varying associations with performance, as implied by AMH. The full period from 2018 to 2024 is also analyzed to identify overarching trends that persist across different market environments.

The design of this timeframe is consistent with prior research examining fund behavior across distinct market phases, such as pre-crisis, crisis, and post-crisis conditions (Babalos et al. 2021, Samarbakhsh & Shah 2021). By capturing both volatile markets due to external shocks and periods of relative calm. This study seeks to evaluate whether the relationships between fund characteristics and returns shift in response to changing levels of market volatility, thus testing the basic ideas behind EMH and AMH.

[5] The VSTOXX is a volatility index that measures expected market volatility in the Eurozone, similar to the VIX for the US market. It is based on options on the Euro Stoxx 50 Index. A VSTOXX level above 30 is considered very high and indicates significant market uncertainty (STOXX n.d.)

3.3 Population and sampling

The population in this study refers to all Swedish equity mutual funds, in line with the definitions by Bryman, Bell and Harley (2024 pp. 186–187) and Saunders et al. (2023, p. 292), who define a population as the entire group from which a sample is drawn. To ensure data availability and comparability, a sample of 419 Swedish equity mutual funds was selected through a multi-step filtering process (see Table 1). First, only funds listed on Morningstar were considered, given its reliability and standardization in mutual fund research (Hasnaoui 2025, Fang & Sitikantha 2022, Reuter and Zitzewitz 2021, Steen et al. 2020, Basso & Funari 2017). This yielded an initial pool of 39,364 mutual funds. The scope was then limited to funds registered in Sweden (1,788), and further to equity funds (1,046). Finally, only funds with complete data for 2018–2024, including return, fees, size, ESG rating, and management style were retained.

The final sample thus consisted of 419 funds. As inclusion was based on specific criteria, resulting in unequal probabilities of selection rather than random, the study employs a non-probability sampling strategy (Saunders et al., 2023, p. 294).

Table 1 - Illustration of the sampling process

Criteria	Number of mutual funds
Available on Morningstar	39 364
Registered in Sweden	1 788
Equity Mutual Funds	1 046
Available data during 2018-2024	419

Source: Table compiled by the authors.

3.4. Data gathering

The empirical data in this study is based on secondary sources from Sveriges Riksbank and Morningstar. The data collection followed eight structured steps (see Table 2). First, funds were filtered by registration country (Sweden), asset class (equity), and management style (active and passive). A dataset was then compiled including relevant fund attributes.

In step four, funds lacking full coverage for the period 2018–2024 or missing key variables (return, fees, size, ESG-rating) were excluded. The refined dataset included only funds meeting all inclusion criteria.

Following this, the dataset was manually extracted from Morningstar and organized in Excel, since the platform lacked export function. The sixth step involved retrieving data from Sveriges Riksbank, the 3-month Treasury bill, which represents the risk-free rate in this study. These values were manually exported to Excel and integrated into the dataset for use in the performance evaluation metric, the Sharpe ratio.

Finally, to ensure the accuracy and completeness of the dataset, a systematic manual verification process was conducted. First, the number of observations in Excel was cross-checked against the Morningstar database to confirm that all selected funds and variables were correctly included. Second, both authors independently repeated the collection process and compared them with the original dataset to identify potential discrepancies. Lastly, a random sample was manually verified against the Morningstar platform. This minimized the risk of table error or data loss and inaccuracies resulting from manual handling.

Table 2 - Illustration of the data gathering

Step 1	The dataset was filtered to include only funds registered in Sweden.
Step 2	The dataset was filtered to include only equity funds.
Step 3	The dataset was filtered to include both active & passive managed funds.
Step 4	The dataset was filtered to include funds that did meet the selection criteria (operating during 2018-2024, available data on fund return, fund fee, fund size, ESG-rating.
Step 5	The dataset was extracted manually from Morningstar to Excel.
Step 6	The dataset was systematically organized in excel by mutual fund name corresponding variables.
Step 7	Data on 3-month Treasury Bills were collected and extracted to Excel.
Step 8	The dataset underwent multiple manual verifications.

Source: Table compiled by the authors.

3.5 Variables

In this section the operationalization of the selected fund characteristic is presented, starting with the dependent variable and followed by the independents.

3.5.1 Dependent variable

Risk-adjusted return has been operationalized as the dependent variable and serves as a metric for evaluating mutual fund performance, see Table 3 (Ali, Aqil, Alam Kazmi & Zaman 2023, Farid & Wahba, 2022, Dariusz 2018). Risk-adjusted return is widely adopted in academic research, as it accounts for the level of risk undertaken by a fund relative to its returns. Allowing for a more fair and comparable comparison across funds with varying risk profiles (Ali et al. 2023, Reuter & Zitzewitz 2021, Dariusz 2018, Ferreira et al. 2013). This operationalization is consistent with previous research who studied the relationship between risk-adjusted return and fund characteris (Papathanasiou & Koutsokostas 2024, Singh & Tandon 2022, Fang & Parida 2022, Steen et al. 2020, Gil-Bazo, Ruiz-Verdú & Santos 2010).

To evaluate risk-adjusted return for mutual funds, this study employs the Sharpe ratio. The Sharpe ratio measures the excess return earned per unit of total risk, measured by the standard deviation of returns, and reflects how much additional return an investment provides relative to the volatility incurred compared to a risk-free asset (Dariusz 2018, Eling 2008). The Sharpe ratio is also widely recognized and applied in mutual fund research, supporting its use in this study (Malhotra et al. 2023, Farid & Wahba 2022, Singh & Tandon 2022, Ali et al. 2023, Asal 2016).

Since Morningstar did not provide pre-calculated standard deviation values for the selected time periods, standard deviation was manually calculated for each mutual fund based on annual returns. This was done for the four time periods, 2018–2019, 2020–2022, 2023–2024, and the full period 2018–2024. The standard deviation was computed using the formula (see Figure 2), where S denotes the standard deviation, x represents each annual return, $\bar{x}$ is the average annual return, and n is the number of observations.

$$S = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

Figure 2- Standard deviation. Source: Compiled by the authors.

Using the manually derived standard deviations, the Sharpe ratio was then calculated for each mutual fund and period. The formula applied is shown in Figure 3, where Rp refers to the annual return of the mutual fund, Rf is the annualized risk-free rate, approximated by the 3-

month Treasury bill, and σp is the standard deviation of the fund's return as defined above. This approach allows for a consistent and risk-adjusted comparison of mutual fund performance across different time frames and market conditions.

$$S = \frac{R_p - R_f}{\sigma_p}$$

Figure 3- Sharpe ratio. Source: Compiled by the authors.

3.5.2 Independent variables

This study examines four constant mutual fund characteristics as independent variables to analyze their relationship with risk-adjusted return. The operationalizations are consistent with previous research. A summary of these variables is presented in Table 3 below.

Fund fees are measured using the annual fixed percentage fee, excluding performance-based fees. This approach is commonly used in studies such as Sheng et al. (2023), Singh and Tandon (2022), Farid and Wahba (2022), Reuter and Zitzewitz (2021), Ferreira et al. (2013), Gil-Bazo and Ruiz-Verdú (2009), and Gruber (1996).

Fund size is measured as assets under management (AUM), following the methodology used in studies by O'Neill et al. (2024), Farid and Wahba (2022), Singh and Tandon (2022), Reuter and Zitzewitz (2021), Dariusz (2018), Basso and Funari (2017) and Ferreira et al. (2013).

ESG rating is based on Morningstar's 1–5 scale, where a higher score indicates lower exposure to ESG-related financial risks. This variable has been applied in studies by Steen et al. (2020), Papathanasiou and Koutsokostas (2024), Fang and Parida (2022). In this study, scores of 1–2 are classified as low ESG ratings, a score of 3 as moderate, and scores of 4–5 as high.

Management style is included as a dummy variable, with 1 representing actively managed funds and 0 representing passively managed funds. This binary classification follows methods used in Lind, William & Wathen 2023 p. 535) and has been analyzed in relation to fund performance by Sheng et al. (2023), Cremers et al. (2019), Gil-Bazo and Ruiz-Verdú (2009), Carhart (1997), Gruber (1996), and Jensen (1968).

Table 3 - Illustration of operationalization

Variables	Characteristics	*Measurement*
Dependent variable	Fund performance	Risk-adjusted return
Independent variable	Fund fees	Annual fixed percentage fee
Independent variable	Fund Size	Assets under management
Independent variable	ESG-rating	Morningstar rating (1-5)
Independent variable	Management style	Active/Passive

Source: Table compiled by authors.

3.6 Data Processing and Analysis

This section describes the procedures for data compilation, processing, and analysis. It also outlines how the statistical models, both linear and non-linear, were applied and interpreted to examine the relationship between mutual fund characteristics and risk-adjusted return.

3.6.1 Descriptive statistics

Following data aggregation in Excel, including the creation of a dummy variable, standard deviation, and Sharpe ratio, the dataset was imported into R-Studio for statistical analysis. Descriptive statistics were then conducted to gain an overview of the data, identify patterns, and detect irregularities, as recommended by Lind et al. (2023, p. 4).

The analysis began with a final check for missing values to ensure data integrity, as missing data can bias statistical results (Lind et al. 2023, pp. 19–20). No missing values were detected. Central tendency (mean and median) was then examined, followed by the identification of outliers, as extreme values can distort regression results (Mishra, Paney, Singh, Gupta, Sahu & Keshri 2019). Ninety extreme Sharpe ratio values were removed, reducing the dataset from 419 to 329 observations per variable.

Next, the distribution of each variable was assessed to evaluate normality, which is a key assumption in linear regression (Ho & Yu, 2015, Lind et al. 2023, p. 464). Particular attention was given to detecting deviations from normality, such as skewness, that could bias regression estimates or invalidate statistical inference (Mishra et al. 2019). In cases where strong skewness was identified, such as in the fund size variable, a logarithmic transformation was applied to

approximate a more normal distribution and reduce the influence of extreme values (Farid & Wahba 2022, Sainani 2012).

3.6.2 Linear and Non-Linear Models

Given the conflicting evidence in previous studies and the theoretical insights from both EMH and AMH, the study employed both linear (OLS regressions) and non-linear (Generalized Additive Models, GAM) methods.

The linear models (OLS regressions) are included to directly test traditional linear relationships between fund characteristics (fees, size, ESG rating, management style) and risk-adjusted return. Although many previous studies have predominantly relied on linear models to examine these relationships (Papathanasiou & Koutsokosta 2024, Bessembinder et al. 2023, Reuter & Zitzewitz 2021, Cremers et al. 2019), the data analysis revealed multiple indications of non-linear relationships.

Therefore, to capture these non-linearities and provide a more nuanced understanding of how fund characteristics interact with risk-adjusted return, the linear models are complemented with GAMs. GAMs allow for flexible, data-driven estimation of smooth, non-linear relationships without imposing a strictly linear form, making them particularly suitable for investigating complex patterns that linear models might miss (Wood 2025, Hunsicker et al. 2016).

The use of GAM models to capture non-linear patterns in Swedish mutual fund data is comparable to research by Andrikogiannopoulou and Papakonstantinou (2019), who used simulation and diagnostic tests to show that traditional linear approaches often miss important performance drivers. Similarly, Harvey and Liu (2022) used improved bootstrap simulations to investigate whether active management demonstrates skill that traditional methods fail to capture. While these studies rely on simulations and diagnostic tests, this study directly applied GAM to fund data and compared model diagnostics, finding that GAM substantially improved explanatory power compared to linear OLS models. This approach is consistent with previous research (Monga et al. 2024, O'Neill et al. 2024, Okorie & Lin 2021, Tran & Leirvik 2019, Matallín-Sáez et al. 2018) that has used non-linear models to capture how fund characteristics relate to performance. In this study, while both OLS and GAM models are used to explore these relationships, the formal hypotheses are based solely on the OLS results. The GAM

models serve as a complementary tool to identify potential non-linear dynamics that may enhance the interpretation of the findings, without forming the basis for hypothesis testing.

Thus, by integrating both linear and non-linear methods, this study aims to provide a more comprehensive and accurate analysis of how fund characteristics relate to risk-adjusted returns in both calm and volatile market conditions.

3.6.3 Model diagnostics

To ensure the robustness of the statistical analysis and verify that the assumptions underlying both linear and non-linear regression models are fulfilled, a series of diagnostic tests were conducted. These diagnostics aimed to evaluate multicollinearity, homoscedasticity, autocorrelation, normality of residuals, and specifically for the OLS models, linearity.

Multicollinearity among the independent variables in the OLS models was assessed using the Variance Inflation Factor (VIF). According to Lind et al. (2023 p. 507), VIF values exceeding 10 may indicate problematic multicollinearity, suggesting that one predictor can be largely explained by others and should be considered for exclusion. This evaluation was conducted to ensure that the regression coefficients remained interpretable and statistically valid. As GAM is a non-parametric modeling approach, multicollinearity diagnostics were not applicable in that context.

Homoscedasticity was tested in the OLS models using the Breusch–Pagan test. A statistically significant p-value would indicate heteroskedasticity, which may bias the standard errors and reduce the reliability of significance testing (Olvera Astivia & Zumbo 2019). Where necessary, robust standard errors were prepared to address potential violations. In the GAM models, homoscedasticity was assessed visually using residual vs. fitted plots to detect patterns in the spread of residuals across predicted values.

Autocorrelation was tested using the Durbin–Watson statistic for both model types. The test statistic ranges from 0 to 4, with a value near 2 indicating no first-order autocorrelation (Lind et al. 2023, pp. 691–692). Additionally, p-values were used to assess the statistical significance of any autocorrelation, a p-value below 0.05 suggests the presence of significant autocorrelation, whereas a p-value above 0.05 indicates no such evidence. Normality of residuals was examined using histograms and Q–Q plots for both theOLS and GAM models.

This is used for verifying that residuals approximate a normal distribution, which is an underlying assumption of OLS regression. Particular attention will be given to the shape and symmetry of the residuals to detect skewness or kurtosis that could compromise the validity of the model. If substantial deviations from normality are observed, data transformations such as logarithmic transformation will be applied to improve residual distribution and model fit (Farid & Wahba 2022, Sainani 2012).

Finally, linearity, an explicit assumption in OLS regression, was assessed by comparing the results from the OLS models to those generated by the more flexible GAM approach. The use of GAM enabled the identification of potential non-linear relationships between fund characteristics and the dependent variable, complementing the insights provided by the OLS analysis.

3.6.4 OLS- Multiple regression

This study employs OLS multiple regression analysis to examine the relationship between mutual fund risk-adjusted return and selected fund characteristics. This method allows for the inclusion of multiple independent variables simultaneously, enabling the isolation of each variable's associated effect on the dependent variable, the risk-adjusted return (Lind et al. 2023, p. 512). This method provides an understanding of how each characteristic associates to risk-adjusted return while holding other variables constant (Lind et al. 2023, pp. 512–513).

The model also allows for predicting the dependent variable based on the values of the independent variables (Pandey 2020). This is particularly useful for this study as it enables an analysis of the relationship between mutual fund risk-adjusted return and fund characteristics. Furthermore, multiple regression analysis provides several key measurements to describe the relationship between variables and ensure the model's reliability (Lind et al. 2023, p. 512).

This study specifically examines B-coefficients to determine the impact of each independent variable on the dependent (Lind et al. 2023, pp. 512), see Figure 5 for the multiple regression equation. In this model, a represents the intercept, and b^1 to b^4 are the estimated effects of fund fee, fund size (log-transformed), ESG-rating, and management style on the Sharpe ratio.

$$SharpeRatio = a + b^1(FundFee) + b^2(FundSize) + b^3(ESGRating) + b^4(ManagementStyle)$$

Figure 4- Multiple regression OLS equation. Source: Compiled by the authors.

To assess the statistical significance of the results, p-values are used to evaluate whether each independent variable has a meaningful effect on the dependent variable when controlling for the other variables in the model. Additionally, the overall model significance is tested to determine whether the regression model as a whole provides a statistically valid explanation for variations in mutual fund risk-adjusted return (Lind et al., 2023, pp. 524–525). A confidence level of 95%* is applied in this study, meaning that confidence levels below will not be accepted.

3.6.5 Generalized Additive Model

Following the OLS regression, this study applies a Generalized Additive Model (GAM) to further examine the relationship between mutual fund risk-adjusted return and fund characteristics. Unlike traditional regression, which assumes linear relationships, GAM allows for non-linear effects by estimating smooth, data-driven functions for each independent variable (Wood 2025). This flexibility is especially valuable when the functional form of the relationship is unknown or complex (Wood 2025). GAM extends the linear model by replacing fixed coefficients with smooth terms that adapt to the data (Wood, 2025). As Wood (2025) explains, this enables GAMs to capture intricate patterns while maintaining a balance between flexibility and explanatory power. In this study, GAM is used to evaluate whether variables such as fund fee, fund size, ESG rating, and management style exhibit non-linear effects on risk-adjusted return. Each independent variable's effect is estimated while controlling for the others, offering a more nuanced understanding of how specific fund characteristics influence risk-adjusted returns.

The complexity of each smooth term is quantified using its estimated degrees of freedom (edf), which reflects the extent of non-linearity in the fitted function. As Hunsicker et al. (2016) explain, an edf equal to 1 corresponds to a linear relationship, values between 1 and 2 indicate weak non-linearity, and values above 2 suggest strong non-linearity. This measure allows us to assess whether each variable exhibits a simple or more complex association to risk-adjusted return.

In addition to interpreting edf numerically, each estimated effect is also examined visually using partial effect plots. This complements the statistical output by allowing inspection of possible non-linear patterns across the range of each variable. This visual assessment is inspired by the approach used in Hunsicker et al. (2016), who categorized GAM output into forms such as monotonic, U-shaped, or other non-linear patterns, based on the curvature and turning points of the smoothed functions. In the analysis, these graphical diagnostics are used to identify context-dependent variations that may inform the interpretation of each independent relationship to risk-adjusted return.

$$SharpeRatio = a + f_1(FundFee) + f_2(FundSize) + f_3(ESGRating) + b^4(ManagementStyle)$$

Figure 5 - Multiple GAM regression equation. *Source: Compiled by the authors.*

In this model, a represents the intercept, and the terms f_1, f_2 and f_3 represent smooth, data-driven functions estimated for fund fee, fund size (log-transformed), and ESG rating, respectively. These functions allow for potential non-linear effects, meaning the relationship between each variable and the Sharpe ratio can change across different values of the variable.

The term b^4 (ManagementStyle) is a linear coefficient, as management style is a binary variable (active vs. passive) and is therefore modeled parametrically. This allows GAM to capture both linear and non-linear relationships depending on the nature of each independent variable. By estimating these effects simultaneously, the model accounts for their individual contribution to risk-adjusted return while holding the others constant.

3.6.6 Adjusted Coefficient of Determination

In this study, the coefficient of determination (R^2) is used to evaluate how well the OLS regression model and GAM explains the variation in risk-adjusted return and to assess the model's overall fit. The R^2 value represents the proportion of variability in the dependent variable that can be explained by the independent variables, and it ranges from 0 to 1. A value close to 0 indicates a weak association, while a value near 1 suggests a strong relationship (Lind et al. 2023, p. 520).

However, R^2 has limitations, as it tends to increase automatically when additional independent variables are added to the model. Even if those variables do not contribute meaningfully to the

prediction. This can lead to an overestimation of the model's explanatory power (Lind et al. 2023, p. 521). Therefore, this study uses the adjusted R^2 instead, which corrects for the number of independent variables and provides a more accurate and reliable measure of the model.

3.7 Research quality and Ethical Considerations

This section outlines the measures taken to ensure quality and transparency of the study, including considerations of reliability, validity, source credibility, and ethical responsibility, followed by a critical reflection on the methodology.

3.7.1 Reliability

To ensure reliability, this study consistently applied the same type of OLS and GAM regressions across four time periods (2018–2024), enabling comparison between volatile and stable market conditions (Bryman, Bell & Harley 2024, p. 172). Although results may vary due to market differences, the identical methods support consistent measurement throughout.

Data collection, processing, and analysis were transparently documented to facilitate replication. Data was sourced from Morningstar and the Swedish Riksbank, two well-established and publicly accessible sources. All variables were defined and operationalized using standardized, widely accepted definitions (Bryman, Bell & Harley 2024, pp. 172–173).

The Sharpe ratio was calculated using annual return data, with standard deviation manually computed based on annual returns for each fund and period. While this differs from the more common use of daily or monthly data (Lo 2002), the same calculation approach was used throughout. To ensure internal consistency, extreme Sharpe ratios were excluded based on predefined thresholds, supporting data quality and integrity. Together, these measures enhance the reliability of both the method and the findings.

3.7.2 Validity

To ensure measurement validity this study followed previous research and employed theories (EMH & AMH) when selecting both variables and methods. The research questions and hypotheses were also carefully formulated to align with how the theories have been defined and measured in earlier studies, as suggested by Bryman, Bell and Harley (2024, p. 63).

Furthermore, in this study associations between variables are examined, which means it is not possible to establish causality. While the regression models reveal statistically significant relationships, this does not imply that one variable directly causes changes in another (Bryman, Bell & Harley, 2024, p. 176). Although the study uses a structured research design and variables based on previous research, the data is observational, and some control variables are not included. Therefore, the findings should be interpreted as associations rather than causal effects.

External validity in this thesis is supported by a consistent focus on Swedish mutual equity funds during 2018–2024, capturing both stable and volatile periods (Bryman, Bell & Harley 2024, p. 63). However, the findings are limited to this specific market and may not be fully generalized to other countries or fund types due to differences in regulation, investor behavior, and the exclusive focus on equity funds.

3.7.3 Credibility of sources

The sources used in this study are considered highly credible, both in terms of the secondary data and the literature. The primary data source is Morningstar, a globally recognized independent provider of financial information on mutual funds and investments (Morningstar, n.d.). Morningstar's database is widely used in academic research, including by Hasnaoui (2025), Steen et al. (2020), Fang and Sitikantha (2022), Basso and Funari (2017), Reuter and Zitzewitz (2021), and Malhotra et al. (2023). Additional data on treasury bills was obtained from Sveriges Riksbank, which is responsible for managing and disseminating information regarding treasury bills, consequently, regarded as a highly credible source.

In addition to these quantitative data sources, the study is supported by a robust body of academic literature. This literature was collected through established academic databases such as Google Scholar, SöderScholar, and Web of Science.

Furthermore, the credibility of the literature is underpinned by three key criteria, firstly, all articles are peer-reviewed, ensuring academic rigor and accuracy (Parse 2024). In cases where non-peer-reviewed sources are used, such as institutional reports, or other academic articles, they have been included based on their credibility, relevance, and contribution to the research context. These sources are clearly identified and used with caution, primarily to complement

peer-reviewed literature or to provide timely insights where academic research may still be emerging. Secondly, all journals have been assessed through Kanalregister, a Norwegian platform that ranks academic journals from Level 0 (non-scientific) to Level 2 (leading scientific journals). This study includes only articles from journals ranked Level 1 or higher. Finally, publication recency has been prioritized, with a general focus on research from the past ten years. Older studies are included selectively to provide historical context.

3.7.4 Ethical approach

Although this study is based solely on secondary numeric data and does not involve personal information or human subjects, ethical considerations remain essential. As Bryman, Bell, and Harley (2024, pp. 132, 135) note, the use of online data introduces new ethical challenges, particularly regarding copyright and data usage. This study adheres to all relevant copyright restrictions, including Morningstar's terms of use, which allow non-commercial academic use but restrict reproduction and distribution without explicit consent. Since this research is conducted for educational purposes, it complies with these conditions.

The ethical approach in this study is grounded in transparency, integrity, and objectivity. These principles guide the documentation of data sources, the analytical process, and the responsible handling of data. This aligns with Wedderkopp and Rutz (2024), who argue that transparency and objectivity are fundamental to credible research. Similarly, Haven et al. (2022) emphasize that a clear and detailed account of the research process allows readers to independently evaluate its credibility.

Lastly, the authors declare no conflicts of interest. Objectivity has been maintained throughout, ensuring the study is free from selective reporting or confirmation bias, in line with academic standards for transparency and ethical integrity.

3.7.5 Method criticism

This study is subject to certain limitations, primarily due to constraints in data availability. Due to the absence of monthly or daily return data, standard deviation could not be calculated using conventional methods. Instead, Sharpe ratios were estimated based on annual return data, which may affect precision, particularly for low-volatility funds (Lo 2002). To ensure consistency, this method was applied consistently across all funds and time periods.

Given the limitations in data availability, the independent variables were held constant across all periods. While this may reduce the model's ability to capture dynamic relationships or structural changes within individual funds over time, it does not prevent the study from fulfilling its aim. Since risk-adjusted returns are not constant, the design still allows for meaningful comparisons of how risk-adjusted returns vary in relation to fund characteristics under both stable and volatile market conditions. This means that the analysis captures variation between funds, not within them over time.

Another limitation concerns survivorship bias, as the sample includes only funds that remained operational throughout the study period. Funds that were closed, merged, or liquidated are excluded, which may result in an upward bias in average performance.

Lastly, due to the use of specific inclusion criteria, resulting in non-probability sampling the generalizability of the study's findings is reduced. This is because the sample does not provide each unit in the population with an equal chance of being selected, which restricts the ability to make inferences about the broader population of Swedish equity mutual funds.

However, despite these limitations, the study offers a consistent and structured analysis that contributes to the understanding of how fund characteristics relate to risk-adjusted return across different market conditions. Particularly during volatile periods driven by external health shocks rather than traditional financial distress.

4. Results

This chapter presents the empirical results regarding the relationship between fund characteristics and risk-adjusted return. It begins with descriptive statistics and data diagnostics, providing an overview of variable distributions and ensuring alignment with model assumptions. The results from both the linear OLS regressions and the non-linear GAM models are then reported across four time periods, allowing for comparisons under different market conditions. The chapter concludes with a hypothesis testing section, evaluating the study's six hypotheses based on the regression outcomes.

4.1 Descriptive statistics

Table 4 below presents summary statistics for the key variables in the dataset. The risk-adjusted return, measured across four market periods, shows clear variation in both average level and distribution shape. In Periods 1 and 2, the mean returns are relatively low (0.58 and 0.34), and the positive skewness (1.67 and 1.07) indicates that most funds delivered modest returns, with a few outliers pulling the distribution to the right. Period 3 stands out with a significantly higher mean return of 2.09 and lower skew (0.38), indicating both improved and more evenly distributed risk-adjusted return. This sharp increase in risk-adjusted returns may be partially explained by a lower and more stable standard deviation in returns during this period, meaning that volatility was lower, thus improving the risk-adjusted return even if returns were not dramatically higher. Period 4 returns to a lower mean (0.58), with a near-symmetric distribution (skew 0.36), suggesting a relatively balanced return spread.

Fund fees are highly consistent across funds, with both the mean and median at 0.01 and very low variability, indicating similar pricing structures. Fund size has been log-transformed as mentioned above, to reduce skewness and improve interpretability in regression models. As a result, the values (mean = 8.95, median = 9.32) do not represent actual fund size in millions, but rather a compressed scale reflecting relative differences in size between funds. The slight negative skew (-0.26) indicates that larger funds are somewhat more common in the sample.

The ESG-rating variable shows a mean of 3.13 on a 1–5 scale, with negligible skew, indicating an even distribution of sustainability scores. Finally, management style (1 = active, 0 = passive)

has a mean of 0.71 and skew of -0.94, showing that actively managed funds are more common in the sample, though passively managed funds are still present in notable numbers.

Table 4 - Descriptive statistics for All Variables

Variable	n	Mean	SD	Median	Skew
Risk-adjusted return	329	0.58	0.24	0.54	1.67
Period 1 (2018–2019	329	0.34	0.23	0.33	1.07
Period 2 (2020–2022)	329	2.09	1.21	1.75	0.38
Period 3 (2023–2024)	329	0.58	0.20	0.54	0.36
Fund fee	329	0.01	0.01	0.01	– 0.07
Fund size	329	8.95	1.51	9.32	– 0.26
ESG-rating	329	3.13	1.18	3.00	– 0.01
Management style	329	0.71	0.45	1.00	– 0.94

Descriptive statistics for the full sample (n = 329). Risk-adjusted return is represented by the Sharpe ratio. Skewness values greater than ±1 may indicate substantial deviation from normality.
Source: Table compiled by the authors.

4.2 Model Diagnostics

In line with the procedures outlined in Section 3.6.2, a series of diagnostic tests were conducted to assess the validity and robustness of both the OLS and GAM regression models. These diagnostics assessed key assumptions, including multicollinearity, homoscedasticity, normality of residuals, autocorrelation, and linearity (for OLS).

Normality of residuals was evaluated using histograms and Q–Q plots (see Appendix B.1-B.4). In the OLS models, residuals were approximately normally distributed across all time periods. The earlier applied log-transformation of fund size (see Section 4.1) contributed to improved symmetry. In the GAM models, normality assumptions were reasonably met in the later periods, though the 2018–2019 model exhibited moderate skewness and heavier tails.

Homoscedasticity was tested in the OLS models using the studentized Breusch–Pagan test. No heteroskedasticity was detected in the first three time periods—2018–2019 ($p = 0.1361$), 2020–

2022 (p = 0.1276), and 2023–2024 (p = 0.6953). However, the full-period model (2018–2024) showed mild heteroskedasticity (p = 0.0224) (see Appendix C.1). To address this, robust standard errors were applied in all OLS models. In the GAM models, homoscedasticity was assessed through visual inspection of residuals. Most periods displayed relatively constant variance, though mild dispersion patterns were noted in 2023–2024.

Multicollinearity was examined using the VIF in the OLS models. The results from the VIF test exhibited no indications of multicollinearity. All variables exhibit VIF values well below the conventional threshold of 10. The highest recorded VIF was 2.19, and most values fell below 1.5 (see Appendix C.2). These results suggest that the independent variables are not highly correlated and that multicollinearity does not compromise the reliability of the coefficient estimates (Lind et al. 2023, p. 507). Since GAM uses a non-parametric method, this diagnostic was not tested.

Autocorrelation was tested using the Durbin–Watson statistic in both model types. Values ranged between 1.83 and 2.12, indicating no significant first-order autocorrelation. The lowest value (1.83) occurred in the 2023–2024 model, with a p-value of 0.06 (see Appendix C.4), remaining within acceptable bounds and indicating residual independence.

Linearity, an assumption specific to OLS, was tested by comparing the OLS estimates to the results from the GAM models. The GAM models identified non-linear relationships for variables such as fund size and ESG rating, suggesting that OLS may not fully capture the complexity of these effects. This comparison supports the use of GAM as a complementary modeling approach.

In summary, the diagnostic tests support the statistical validity of both OLS and GAM models. While minor assumption violations were observed, such as mild heteroskedasticity and residual skewness. These were addressed using robust standard errors and logarithmic transformation. No diagnostics suggested violations severe enough to undermine the robustness or interpretability of the regression results.

4.3 Ordinary Least Square (OLS)

The linear regression results are summarized in Table 5 and Table 6. Table 5 presents the detailed OLS regression outputs for each time period, while Table 6 visualizes these findings by the direction, strength, and significance of the associations.

Table 5 – OLS Regression Results Across Time Periods

Year	2018 – 2019		2020 – 2022		2023 – 2024		2018 – 2024	
	1		2		3		4	
Variables	**Estimate**	**P-Value**	**Estimate**	**P-Value**	**Estimate**	**P-Value**	**Estimate**	**P-Value**
Intercept	0.353	0.001***	0.121	0.309	1.061	0.086	1.030	0.197
Fund Fee	-1.579	0.679	-7.809	0.008**	-58.823	<0.001***	-7.408	0.003**
Fund Size	0.027	0.005**	0.025	0.015*	0.178	0.001***	0.052	<0.001***
ESG-Rating	-0.016	0.094	-0.005	0.550	-0.036	0.533	0.013	0.097
M Style	0.079	0.053	0.118	<0.001***	0.191	0.333	0.069	0.017*
Adjusted R^2	0.026		0.040		0.128		0.184	
F-test P-value	0.0128*		0.002**		<0.001***		<0.001***	

*Ordinary Least Squares (OLS) regression results for Sharpe ratio across four time periods. All values are rounded to three decimal places. P-values are reported in parentheses. Significance levels: *** p < 0.001, ** p < 0.01, * p < 0.05, . p < 0.10.*
Source: Compiled by the authors

The most consistent and statistically significant positive association is observed for fund size. Across all four time periods, fund size demonstrates a statistically significant positive relationship with risk-adjusted return (see Table 5). In 2018–2019, this is significant at the 99% confidence level (β = 0.027, p = 0.0050 **), meaning that a one-unit increase [6]in fund size is associated with a 0.027 increase in the risk-adjusted return. The relationship remains significant at the 95% confidence level in 2020–2022 (β = 0.025, p = 0.0148 *), and becomes notably stronger in 2023–2024 (β = 0.178, p < 0.001 ***), where a one-unit increase corresponds to a 0.178 increase in risk-adjusted return. In the full-period model (2018–2024), the association remains positive and significant (β = 0.052, p < 0.001 ***). This consistent pattern across both stable and volatile periods points to the fact that the relationship between fund size and risk-adjusted return is not driven by temporary market fluctuations (see Table 6). Instead, the repeated statistical significance over time indicates a robust and stable association.

[6] Fund size is log-transformed (natural log), so a one-unit increase in log(fund size) approximates a tripling of the actual fund size. Reported coefficients thus represent the change in risk-adjusted return associated with this increase.

In contrast to fund size, fund fees exhibit a consistently negative and statistically significant relationship with risk-adjusted return in three of the four observed periods, 2020–2022, 2023–2024, and the full sample period 2018–2024 (see Table 5, 6). During the volatile 2020–2022 period, higher fees were negative associated with lower risk-adjusted returns ($\beta = -7.809$, $p = 0.0075$ **). This was significant at the 99% confidence level, indicating that a one-percentage-point increase[7] in fees corresponded to an average decrease of approximately 0.078 in the risk-adjusted return. The effect intensifies in 2023–2024 ($\beta = -58.823$, $p < 0.001$ ***), which was also significant at the 99.9% level, although the larger coefficient may partly reflect reduced variance in risk-adjusted return during that period. Despite this, it indicates a strong negative association between fees and risk-adjusted return.

Across the full period, the negative association remains statistically significant ($\beta = -7.408$, $p = 0.0030$ **). This was significant at the 99% confidence level, reinforcing the pattern that higher-fee funds are associated with lower risk-adjusted returns. In contrast, the relationship is not statistically significant in the earlier, more stable period of 2018–2019 ($\beta = -1.579$, $p = 0.679$), suggesting that the effect of fees may be more pronounced during or after periods of increased market volatility.

However, ESG rating does not display a statistically significant effect on risk-adjusted returns in any of the four examined time periods (see Table 5,6). In 2018–2019, the estimated coefficient is slightly negative ($\beta = -0.016$, $p = 0.094$ ·), approaching marginal significance at the 90% confidence level. In 2020–2022 and 2023–2024, the coefficients are close to zero ($\beta = -0.005$, $p = 0.550$ and $\beta = -0.036$, $p = 0.533$, respectively), indicating an almost negligible relationship between ESG ratings and risk-adjusted return. For the full period (2018–2024), the coefficient shifts slightly positive ($\beta = 0.013$, $p = 0.097$ ·), but again remains statistically insignificant. Overall, the results suggest that ESG ratings, as currently measured, have little to no explanatory power for variations in risk-adjusted return. The near-zero coefficients across multiple periods point to the absence of a meaningful relationship.

[7] Fund fee is expressed as a decimal. Therefore, a one-unit increase in fund fee corresponds to a 100-percentage-point increase, while a one-percentage-point increase (0.01) in fund fee would translate to a 0.078 decrease in risk-adjusted return (-7.809×0.01).

The relationship between management style and risk-adjusted return is less consistent over time. The association is positive across all time periods but varies in magnitude and statistical significance (see Table 5,6). During the volatile period of 2020–2022, active management is associated with a statistically significant increase in the risk-adjusted return compared to passive management ($\beta = 0.118$, $p < 0.001$ ***). This result is significant at the 99.9% confidence level, indicating a stronger relationship under these conditions. A similar association is observed in the full-period model (2018–2024), where active funds are associated with a risk-adjusted return that is 0.069 [8]higher ($\beta = 0.069$, $p = 0.017$ *). This was significant at the 95% confidence level. In the more stable periods, however, the relationship is weaker. In 2018–2019, the coefficient remains positive ($\beta = 0.079$) but is only marginally significant ($p = 0.053$), while in 2023–2024, the coefficient increases ($\beta = 0.191$) but is statistically insignificant ($p = 0.333$). Although the direction of the relationship is consistently positive, the lack of significance in the stable periods indicates that the association between management style and risk-adjusted return is context-dependent, with stronger effects observed during periods of elevated market volatility.

In summary, despite relatively low adjusted R^2 values exhibited in the OLS models, ranging from 2.6% to 18.4%, all F-tests were statistically significant ($p < 0.05$), as shown in Table 5. This indicates that the models explain a statistically significant portion of the variation in risk-adjusted returns, even if their overall explanatory power remains modest. The results show that the observed associations between fund characteristics and risk-adjusted return are not due to random variation but reflect underlying consistent relationships. Fund size and fund fees consistently contributed to model fit, showing statistically significant coefficients in the majority of periods examined.

Moreover, several alternative model specifications were tested, including the exclusion of the non-significant ESG rating variable, the addition of interaction terms, and mean-centering of variables. However, none resulted in meaningful improvements in explanatory power, coefficient magnitude, or statistical significance. These findings support the robustness and stability of the final model structure.

[8] Management style is a dummy variable (0 = passive, 1 = active). Thus, the coefficient represents the difference in risk-adjusted return between active and passive management.

Table 6 - Linear Associations Between Fund Characteristics and Risk-Adjusted Returns (OLS)

Variable	2018–2019	2020–2022	2023–2024	2018–2024	Trend Over Time
Fund Fee	↔ (No effect)	↓ (Significant negative)	↓↓↓ (Peak negative significance)	↓ (Significant negative)	Increasingly negative association
Fund Size	↑ (Significant positive)	↑ (Significant positive)	↑↑ (Peak positive significance)	↑↑ (Highly significant)	Consistently positive
ESG-Rating	↔ (Not significant)	↔ (Not significant)	↔ (Not significant)	↔ (Not significant)	No significant association
M. Style	• (Marginal)	↑ (Significant positive)	↔ (Not significant)	↑ (Significant positive)	Most relevant during volatility

Associations are based on OLS regression coefficients and p-values. ↑/↓ indicate statistically significant linear relationships ($p < 0.05$), while arrows with more repetition (↑↑/↓↓↓) denote increasing strength. A dot (•) indicates marginal significance ($p < 0.1$). "↔" represents non-significant associations.
Source: Compiled by the authors.

4.4 Generalized Additive Model (GAM)

The results from the GAM are summarized in Table 7 and Table 8. Table 7 presents the output for each time period, including parametric estimates and smooth terms used to capture non-linear effects. Table 8 complements these results by illustrating the shape, direction, and range of the non-linear associations between fund characteristics and risk-adjusted return based on the relationship curve (see Appendix D.1-D.12). Since management style is a binary variable, it is included in the GAM models as a parametric (linear) term rather than a smooth function. As such, non-linear patterns cannot be assessed for this variable in the same way as for the continuous variables. Its effect is therefore analyzed and interpreted within the linear OLS framework presented in Section 4.4.1.

Fund size exhibits the most statistically significant and consistent association with risk-adjusted return across all four periods in the GAM models, with all results significant at the 99% confidence level. In 2018–2019, the effect is linear and statistically significant at the 99% confidence level (edf = 1.000, p = 0.00491 **), indicating a steady positive slope (see Appendix D.5). During the more volatile 2020–2022 period, the relationship becomes non-linear (edf = 3.047, p = 0.00276 **), corresponding to the 99% confidence level forming a U-shaped curve

where both small and large funds achieve higher risk-adjusted returns than mid-sized funds. Among them, large funds perform best, while mid-sized funds exhibit the lowest returns (see Table 8; Appendix D.6). This non-linear association indicates that the relationship between fund size and risk-adjusted return is not constant across all fund sizes (see Table 8).

Table 7 – GAM Regression Results Across Time Periods

Year	**2018 – 2019**		**2020 – 2022**		**2023 – 2024**		**2018 - 2024**	
	1		**2**		**3**		**4**	
Parametric Coefficients	**Estimate**	**P-Value**	**Estimate**	**P-Value**	**Estimate**	**P-Value**	**Estimate**	**P-Value**
Intercept	0.053	<0.001***	0.239	<0.001***	1.981	<0.001***	0.529	<0.001***
M Style	0.082	0.055	0.138	<0.001***	0.156	0.418	0.074	0.013*
Smooth Terms	**edf**	**P-Value**	**edf**	**P-Value**	**edf**	**P-Value**	**edf**	**P-Value**
Fund Fee	1	0.692	1	0.058.	1	0.004**	1	0.029*
Fund Size	1	0.004**	3.047	0.003**	3.739	<0.001***	2.559	<0.001***
ESG-Rating	1.775	0.223	2.774	<0.001***	2.934	<0.001***	2.951	<0.001***
Adjusted R^2	0.030		0.123		0.25		0.312	
Deviance Explained (%)	4.44		14.3		27		32.8	

*Generalized Additive Model (GAM) regression results for Sharpe ratio across four time periods. All values are rounded to three decimal places. P-values are reported in parentheses. Significance levels: *** p < 0.001, ** p < 0.01, * p < 0.05, . p < 0.10.*
Source: Compiled by the authors.

In the following period, 2023–2024, the relationship becomes more pronounced and reaches the 99.9% confidence level (edf = 3.739, p < 0.001 ***), showing an upward-curving pattern (see Table 7,8). For this period, risk-adjusted returns increase progressively with fund size, with large funds again performing best. In contrast to the previous period, smaller funds performed worse, while mid-sized funds fell in between. The full-period model (2018–2024) confirms this trend (edf = 2.559, p < 0.001), showing an accelerating increase in risk-adjusted return with size, significant at the 99.9% confidence level. These two periods, 2023–2024 and 2018–2024, present the most significant evidence of a positive and non-linear size effect, with fund size positively associated with risk-adjusted return, particularly among the largest funds (see Appendix D.7-8; Table 8).

The estimated effects of fund fees in the GAM models are linear across all time periods (edf = 1.000), indicating that the relationship between fees and risk-adjusted return follows a straight-line pattern without evidence of non-linearity (see Appendix D.1-D-4). As such, the GAM findings align closely with those from the OLS regressions. Statistically significant negative effects are observed in 2023–2024 at the 99% confidence level (p = 0.00393 **) and in the full-period model (2018–2024) at the 95% confidence level (p = 0.0285 *). These results suggest a

stable linear association in which higher fund fees are consistently linked to lower risk-adjusted returns. The corresponding OLS estimates are discussed in Section 4.4.1.

Table 8 - Non-linear associations of Fund Characteristics on Risk-Adjusted Returns (GAM)

Variable	2018–2019	2020–2022	2023–2024	2018–2024	Trend & Range Insight
Fund Fee	~ (No association)	↓ (Weak at all levels)	↓↓ (Sharp ↓ from 0.01+)	↓ (Linear, mild)	Stronger negative association for higher fees.
Fund Size	↑ (Linear)	∪ (Best > log 8.5)	Non-linear increasing (Best ≈ log 12+)	Increasing (Peak ~ log 12–14)	Positive trend throughout fund size range.
ESG Rating	~ (No association)	∩ (Best ≈ 3.0–3.5	**S**-shaped (peak ≈ 3.0–4.0)	**S**-shaped (peak ≈ 3.5)	Weak at extremes, peak around mid-range ESG.
M. Style	↑ (Marginal)	↑↑ (Strongest positive.)	~ (No association)	↑ (Modest effect)	Association peaked during volatile period.

*Associations are based on generalized additive model (GAM) smooth terms. Arrows (↑/↓) indicate consistently increasing or decreasing associations; ∩ and ∪ denote non-linear inverted-U or U-shaped relationships, while S indicates a non-linear **S**-shaped pattern. The final column summarizes where in the predictor range the strongest associations occur, based on visual inspection.*
Source: Compiled by the authors.

ESG rating stands out in the GAM model as the variable with a consistent and statistically significant non-linear association with risk-adjusted return in the three most recent periods. In 2020–2022 (edf = 2.774, $p < 0.001$ ***), 2023–2024 (edf = 2.934, $p < 0.001$ ***), and the full period 2018–2024 (edf = 2.951, $p < 0.001$ ***), the estimated degrees of freedom are close to 3, indicating a complex non-linear effect at the 99.9% confidence level in all cases (see Table 7).

Among these, the 2020–2022 period stands out in terms of curve shape, which follows an inverted U-pattern (see Table 8, Appendix D.10), with mid-range ESG scores associated with the highest risk-adjusted return. Both low and high ESG ratings are linked to lower returns, although funds with high ratings generally associate with higher risk-adjusted returns than those with low ratings. In 2023–2024, the curve flattens somewhat but retains the same structure, continuing to show relatively better risk-adjusted return among mid-range ESG-rated

funds.

The full-period model reveals a similar but more uneven pattern (see Appendix D.12), with the highest associated risk-adjusted returns concentrated among funds with moderate to slightly higher ESG scores. These findings indicate that the relationship between ESG rating and risk-adjusted return varies across different levels of ESG ratings. In contrast, the earliest period, 2018–2019, does not show a statistically significant effect (edf = 1.775, p = 0.223), and the relationship is less clearly defined (see Table 7).

In summary, the GAM analysis highlights variation in the form and strength of associations between fund characteristics and risk-adjusted return across time periods. While fund fees display a consistent linear pattern, fund size and ESG rating show statistically significant non-linear relationships in several periods. These results offer a complement to the OLS models and provide a basis for the comparative evaluation presented in Section 4.4.2.

4.5 OLS- Regression & GAM Model Fit

When comparing the OLS and GAM models, both identify similar key relationships. However, the primary distinction lies in how these relationships are modeled. While OLS assumes linear effects, GAM captures more complex, non-linear patterns that offer additional nuance. Particularly for ESG ratings and fund size. The GAM results largely support the patterns observed in the OLS regressions but extend the analysis by revealing shapes and turning points in the relationships that linear models cannot detect.

GAM confirms the consistency of fund size, showing a positive relationship that is often non-linear and upward-curving. In 2020–2022, both small and large funds were associated with higher risk-adjusted return than mid-sized funds. While in 2023–2024 and over the full sample period, larger funds displayed the strongest positive associations with risk-adjusted return. Fund fees, by contrast, exhibit a consistent negative linear effect in both modeling approaches, further reinforcing their role as a key determinant of risk-adjusted return.

A notable divergence is exhibited for ESG rating. OLS finds no significant linear association, while GAM reveals a non-linear pattern in recent periods. Specifically, funds with moderate ESG scores tend to achieve higher risk-adjusted returns than those with either low or high ESG

ratings.

In summary, although both OLS and GAM highlight the stable associations of fund size and fees, GAM provides a more detailed understanding by uncovering non-linearities that OLS is unable to detect. Even though explanatory power remains modest overall, the results show that structural fund characteristics are associated with mutual risk-adjusted return over time.

4.6 Hypothesis testing

To evaluate the theoretical and empirical expectations outlined in Section 2, hypotheses H1–H6 were tested using the OLS regression results [9]. Each hypothesis is assessed below based on these findings.

H1: *Fund characteristics: fund fees, fund size, ESG rating, and management style have no statistically significant association with risk-adjusted returns.*

This hypothesis, rooted in EMH, is rejected. In all examined time periods, at least one fund characteristic shows a statistically significant relationship with risk-adjusted return. Notably, fund size demonstrates consistent significance across all periods, and other variables (such as fees and management style) are significant in multiple time frames. These results contradict EMH's prediction that fund characteristics should not explain risk-adjusted return differences, and H1 is therefore rejected.

H2: *There is a statistically significant difference in the association of fund characteristics: fund fees, fund size, ESG-rating, management style, and risk-adjusted return across volatile and stable market periods.*

This hypothesis, rooted in the AMH, is accepted. The results reveal that the statistical significance of fund characteristics varies depending on the market context. For example, management style is significant during the volatile period (2020–2022) and across the full period (2018–2024), but not in the more stable intervals (2018–2019 and 2023–2024). Similarly, fund fees are significant in 2020–2022, 2023–2024, and 2018–2024, but not in 2018–

[9] As noted in Section 3.6.3, hypotheses are tested using OLS. Whereas GAM results are used to describe non-linear patterns.

2019. These shifts in significance suggest that the association of certain variables is conditional upon market volatility, supporting the premise of H2.

H3: *Fund fees have a statistically significant negative association with risk-adjusted returns.*

This hypothesis is partially accepted. While no significant association was found during the 2018–2019 period, a statistically significant and negative relationship between fund fees and risk-adjusted return was observed in the periods 2020–2022, 2023–2024, and 2018–2024. These findings are in line with prior research and support the notion that higher fees may erode risk-adjusted return, especially under volatile conditions.

H4: *Fund size has a statistically significant negative association with risk-adjusted returns.*

This hypothesis is rejected. In contrast to what some prior studies suggest, the regression results show a positive and statistically significant association between fund size and risk-adjusted return across all periods. This indicates that larger funds tend to achieve higher risk-adjusted returns, possibly due to scale advantages or better resource allocation capabilities.

H5: *ESG ratings have a statistically significant negative association with risk-adjusted returns.*
This hypothesis is rejected.[10] In no period does ESG-rating exhibit a statistically significant negative association with risk-adjusted return. While some coefficients are negative, they do not reach significant thresholds. In the full-period model, the coefficient even turns slightly positive, though still insignificant. These findings suggest that ESG ratings do not systematically explain differences in risk-adjusted returns.

H6: *Management style has a statistically significant positive association with risk-adjusted returns.*

This hypothesis is partially accepted. A significant positive effect of management style is observed in the 2020–2022 period and the full sample (2018–2024), aligning with the notion that active management can add value during volatile phases. However, in the stable periods of 2018–2019 and 2023–2024, management style does not show a significant relationship with

[10] The hypothesis decision is based solely on OLS results to ensure consistency with the study's theoretical framework and research questions. While GAM models were used to explore potential non-linear patterns, they were not used for formal hypothesis testing.

risk-adjusted returns, indicating that its impact may be context-dependent rather than universally present.

5. Analysis

This chapter outlines the analysis of the results presented in Chapter 4. The discussion is divided into two main parts. The first part evaluates Hypotheses H1 and H2, which directly test the theoretical assumptions of the EMH and the AMH. The second part of the chapter focuses on Hypotheses H3 to H6, which build on prior empirical findings and theoretical frameworks related to the specific fund characteristics.

The analysis is guided by the aim of the thesis: to investigate how these characteristics are associated with risk-adjusted return in Swedish mutual equity funds, particularly under different market conditions. In doing so, the chapter addresses two key research questions: (1) To what extent are fund characteristics associated with risk-adjusted returns? and (2) What are the differences in the association between fund characteristics and risk-adjusted return in volatile and stable market conditions? By testing six hypotheses across four distinct time periods the analysis provides a structured response to these questions and situates the findings within broader theoretical and empirical debates.

5.1 EMH and AMH in the Swedish Mutual Fund Market

From the perspective of EMH, especially in the semi-strong form, fund characteristics should not provide an advantage in predicting future returns (Monga et al. 2024, Akkoc et al. 2009). Any attempt to select funds based on these characteristics is therefore unlikely to result in consistent outperformance. As a result, generating abnormal, risk-adjusted returns becomes difficult, if not impossible, within an informationally efficient market (Leković 2018, Malkiel 2005, Fama 1991).

Hypothesis H1 directly tests this assumption. If EMH holds true in the semi-strong form, none of the selected fund characteristics should display a statistically significant relationship with risk-adjusted returns (Titan 2015, Akkoc et al. 2009, Fama 1991). However, findings from both OLS and GAM models indicate otherwise. In all time periods, at least one fund characteristic showed a significant association with risk-adjusted return. Thus, H1 is rejected across all periods. However, it came closest to being supported during the stable 2018–2019 period, where only fund size reached statistical significance.

The near-acceptance of H1 in 2018–2019 reflects the idea of conditional efficiency, as discussed by Malkiel (2005). Malkiel (2005) argues that markets tend to behave more

efficiently in calm and stable environments but may deviate when faced with uncertainty. During 2018–2019, a period marked by lower volatility, the statistical insignificance of most fund characteristics lends limited support to EMH. However, even in this context, the significance of fund size contradicts EMH's notion that publicly known attributes should not be associated with risk-adjusted return (Ang et al. 2011).

Although H1 shows that EMH in its semi-strong form does not fully hold in the Swedish market, there are still many proponents of the EMH, and it remains an important concept in finance (Monga et al. 2024, Leković 2018, Naseer & Tariq 2015, Titan 2015). Péon et al. (2019) argue that EMH remains a valuable framework for understanding market behavior, particularly in how quickly information is reflected in asset prices and the challenges faced by investors seeking to outperform the market. Furthermore, Ball (2009) argues that the EMH often receives undue criticism because many studies rely exclusively on traditional linear models that may not fully capture real market complexities. Consequently, it is not surprising that OLS results from this study also fail to support EMH in the Swedish market. However, to ensure that these findings were not solely a consequence of using linear methods, the analysis was complemented by non-linear GAM models. The GAM results similarly indicated that EMH does not hold in the Swedish context. This difference may be partly explained by structural features of the Swedish market that challenge the assumption of consistently efficient pricing. This is in line with earlier research suggesting that market-specific factors can play a key role in determining how efficient markets are (Borges 2010, Dockery & Kavussanos 1996, Samuelson 1965).

Taken together, these limitations suggest that while EMH remains a foundational framework, its ability to fully explain market outcomes may be limited by structural and market-specific factors. In contrast, the findings of this study align more closely with AMH, which posits that efficiency is not static but context-dependent (Bassiouny et al. 2023), shaped by changing market environments, competition and investor learning (Xiong et al. 2019, Lo 2012, 2005). Viewed through the perspective of AMH, the findings, including the varying significance of fees (Bessembinder et al. 2023, Vidal-García et al. 2018), the advantages of large funds (Ferreira et al. 2013, Malhotra et al. 2007, Chen et al. 2004), the context-dependent impact of ESG ratings (Hasnaoui 2025, Papathanasiou & Koutsokostas 2024, Steen et al. 2020), and the

conditional associations of management style (Cremers et al. 2019, Matallín-Sáez et al. 2018), are more readily explained as adaptive responses to changing market conditions.

This leads to hypothesis H2, which is grounded in AMH and proposes that the association between fund characteristics and risk-adjusted returns varies depending on the underlying market conditions. The results of this study support this assumption. During the volatile 2020–2022 period, fund fee, fund size and management style displayed statistically significant linear associations with risk-adjusted returns, as revealed by the OLS models (see Table 5). In contrast, the non-linear GAM models (Table 7) revealed additional significant non-linear relationships, particularly for fund size and ESG ratings, that were not captured by the linear models. These differences highlight how both linear and non-linear relationships can shift across different market conditions, further underscoring the context-dependent nature of fund performance.

The results of this study show that the ability of fund characteristics to explain risk-adjusted return varies with market conditions. Challenging EMH assumption of stable and consistent market efficiency (Leković 2018, Titan 2015, Fama 1970). The period 2020–2022, marked by heightened volatility due to the COVID-19 pandemic and the Ukraine-Russia war, provides a compelling context to observe these dynamics. Lim and Brooks (2011), Okorie and Lin (2021), and Marcu (2021) all agree that market efficiency changes over time and can be disrupted by big economic shocks and unexpected events like the COVID-19 pandemic. These shocks cause temporary changes in the market and more volatility, which go against the usual idea of steady market efficiency and create situations where fund characteristics can affect performance in different ways (Monga et al. 2024, Rönkkö et al 2024, Bradley & Stumpner 2021, Alicke et al. 2021, Ferriani & Natoli 2021).

Prior studies have documented variation in fund performance across different market conditions, highlighting the importance of context in understanding market efficiency and mutual fund behavior (Babalos et al. 2021, Samarbakhsh & Shah 2021, Pástor & Vorsatz 2020, Clare et al. 2019, Kosowski 2011). Monga et al. (2024) further support a dynamic interpretation of market efficiency consistent with AMH, showing that efficiency varies over time rather than remaining static. This perspective is relevant when considering different types of crises. To illustrate, the 2008 financial crisis involved systemic failures within the financial sector, while

the COVID-19 pandemic was an external health shock outside the financial system (Marcu 2021). Thus, it is important to recognize that crises can take different forms, which can influence how markets react and how fund characteristics impact performance. This distinction helps frame the analysis of market volatility in this thesis. This study demonstrates that the relationship between fund characteristics and risk-adjusted returns varies depending on market volatility, supporting the idea that market efficiency is not constant but adaptive. These findings challenge EMH in its semi-strong form and its assumption of stable and consistent information processing (Leković 2018, Ţiţan 2015, Fama 1970) and align with the evolving market dynamics described by AMH (Monga et al. 2024, Xiong et al. 2019, Lo 2005).

The findings of this study align well with regional literature emphasizing the context-dependent nature of market efficiency in Nordic markets. For instance, Rönkkö et al. (2024) show that AMH provides a better explanation of return dynamics in the Finnish stock market, highlighting the sensitivity of Nordic markets to changing economic and structural factors. Dahlquist et al. (2000), one of the few comprehensive studies of the Swedish mutual fund market, found a negative association between fees and returns and a positive one for active management. However, their negative finding on fund size contrasts with the mixed results in this study. Asal (2016) further investigates the Swedish market and supports the notion of evolving efficiency, while Steen et al. (2020) provide evidence from the Norwegian market that aligns with these adaptive market dynamics. Collectively, these regional studies support AMH's key idea that market efficiency changes over time and context (Rönkkö et al. 2024, Steen et al. 2020, Asal 2016, Dahlquist et al. 2000). While this study does not compare different markets directly, prior research indicates that the relationship between fund characteristics and risk-adjusted return can vary across markets, particularly during volatile periods (Babalos et al. 2021, Steen et al. 2020, Vidal-García et al. 2018, Ferreira et al. 2013).

These insights address the research questions by showing that fund characteristics' relationship with risk-adjusted returns vary with market conditions. In stable periods, their association with returns is often weaker or inconsistent, while in volatile times, these associations strengthen, reflecting the adaptive dynamics described by AMH.

5.2 Fund Characteristics and Risk-Adjusted Returns in Varying Market Conditions

Following the theoretical framing of H1 and H2, the remaining hypotheses (H3–H6) build upon recurring patterns identified in empirical literature. The hypotheses explore whether fees, size, ESG-ratings, and management style are consistently associated with risk-adjusted returns in the Swedish mutual fund market. The aim is to test whether these frequently observed relationships which are often drawn from large American (Bessembinder et al. 2023, Harvey & Liu 2022, Cremers et al. 2019) or European (Hasnaoui 2025, Alicke et al 2021, Bradley & Stumpner 2021, Ferriani & Natoli 2021) datasets are generalizable to the Swedish context, particularly under market conditions driven by external shocks. More importantly, these hypotheses test whether the associations between these variables, identified in prior research, remain consistent or vary depending on market conditions.

Hypothesis H3, which posits a negative and significant relationship between fees and risk-adjusted return, was grounded in the empirical consensus across previous literature (Vidal-García et al. 2018, Vidal-García et al. 2015, Gil-Bazo & Ruiz-Verdú 2009, Dahlquist et al. 2000, Gruber 1996, Carhart 1997). The results of this study largely support this hypothesis. Fund fees exhibited a consistent negative association with risk-adjusted returns across three of the four examined periods. The relationship was especially strong and statistically significant during the volatile 2020–2022 and 2023–2024 periods, but not during the stable 2018–2019 period. This stable phase, characterized by relatively low volatility, resembles periods examined in studies such as Gruber (1996) and Sheng et al. (2023), where fee underperformance was less evident, especially after accounting for structural differences. Additionally, the lack of significance during 2018–2019 is consistent with EMH's predictions that fees should not predict returns in a stable, efficient market.

However, the consistent negative relationship observed during the volatile period supports AMH's view that efficiency is context-dependent and can vary over time with changing market conditions (Nyakurukwa & Seetharam 2023, Lo 2004). This was reflected in the results, where the relationship between fees and risk-adjusted return varied between stable and volatile periods. As argued by Vidal-García et al. (2015) and Cuthbertson et al. (2010), higher fees are more likely to erode net returns under conditions of stress, where pricing inefficiencies may

persist. These results support the interpretation that fees are not merely a cost factor but are consistently associated with risk-adjusted return during periods of heightened uncertainty.

In contrast Sheng et al. (2023) found that high-fee funds did not underperform after controlling for investment style. Vidal-García et al. (2018) found that the link between fees and performance depends on the method used. They observed a negative relationship with OLS but saw hints of a positive connection when using non-parametric methods like DEA. Similarly, Harvey and Liu (2022), Matallín-Sáez et al. (2018), and Andrikogiannopoulou and Papakonstantinou (2019) highlight that flexible, non-linear methods are important for revealing complex patterns that linear models might miss However, this study, which employs both linear (OLS) and flexible (GAM) models across various market conditions, finds a consistent negative association with no evidence supporting positive or context-dependent or non-linear associations. The findings imply that higher fees in the Swedish mutual fund market are not associated with risk-adjusted return gains sufficient to offset the additional costs. These results may reflect structural factors such as Sweden's transparent regulatory framework, relatively homogenous fund offerings, and a retail investor base that is particularly fee-sensitive (Fondbolagens Förening 2021) considerations also noted by Dahlquist et al. (2000).

Hypothesis H4 was tested to determine whether fund size is negatively associated with risk-adjusted return. This hypothesis is grounded in previous research that has found a negative relationship, which is commonly attributed to diseconomies of scale arising from increased fund size (O'Neill et al. 2024, Singh & Tandon 2022, Farid & Wahba 2022, Angelidis et al. 2021, Dahlquist et al. 2000). While previous research reports negative associations, the OLS regressions in this study reveal a consistently statistically significant positive association between fund size and risk-adjusted return across all four periods. Consequently, no support for H4 was found in any examined period, leading to its rejection. This is especially notable as the fund size relationship emerged as the most consistent and robust OLS finding. These results also challenge the diseconomies of scale hypothesis reported in previous studies (O'Neill et al. 2024, Singh & Tandon 2022, Farid & Wahba 2022, Angelidis et al. 2021, Dahlquist et al. 2000), as the findings for the 2020–2022 period do not support the notion that increasing fund size leads to diminished performance.

The GAM models reveal a more nuanced picture, indicating a U-shaped relationship between fund size and risk-adjusted return during the 2020–2022 period, with mid-sized funds underperforming compared to both smaller and larger funds. This finding diverges from previous studies by Reuter and Zitzewitz (2021), Phillips et al. (2018), Babbar and Sehgal (2018), and Basso and Funari (2017), which reported statistically insignificant associations and concluded that fund size lacked explanatory power regarding performance. These results underscore both a significant linear influence of fund size on performance, as indicated by the OLS regressions, and a more nuanced, non-linear relationship revealed by the GAM models, particularly during volatile market conditions. These results also challenge the diseconomies of scale hypothesis reported in previous studies (O'Neill et al. 2024, Singh & Tandon 2022, Farid & Wahba 2022, Angelidis et al. 2021, Dahlquist et al. 2000), as the findings for the 2020–2022 period do not support the notion that increasing fund size leads to diminished risk-adjusted return.

Instead, the findings of this study align with prior research that reports a positive and statistically significant association between fund size and performance (Busse et al. 2020, Pastor et al. 2015, Ferreira et al. 2013). Moreover, Dariusz (2018) reported similar results that larger equity mutual funds consistently generated higher Sharpe ratios. Malhotra et al. (2007) attribute this to economies of scale, superior operational infrastructure, and improved access to market information, advantages that can reduce costs and enhance execution quality.

The difference between this study's findings and many earlier studies, especially those reporting a negative association, may be explained by various methodological and contextual factors. Several authors have studied emerging or capacity-constrained markets, where diseconomies of scale are reported as more common (O'Neill et al. 2024, Farid and Wahba 2022, Singh and Tandon 2022, Angelidis et al. 2021). These studies primarily employ linear models in their analyses (O'Neill et al. 2024, Farid and Wahba 2022, Singh and Tandon 2022, Angelidis et al. 2021). While Dahlquist et al. (2000) also studied Swedish funds and found a negative relationship, their analysis covered a calm pre-crisis period (1993–1997) and relied solely on linear models. In contrast, this research spans both stable and volatile periods, including the external shock caused by COVID-19 and the Russia-Ukraine war. Which, according to Monga et al. (2024) and Rönkkö et al. (2024), may have amplified advantages for larger funds due to shifting market dynamics and investor behavior during periods of

stress.This finding aligns with AMH (Nyakurukwa & Seetharam 2023, Lo 2004), which views market efficiency as evolving with changing environments and shocks.

Hypothesis H5 was tested to determine whether ESG ratings are negatively associated with risk-adjusted returns. This hypothesis is based on prior studies that report that funds with higher ESG-ratings exhibit lower returns (Papathanasiou & Koutsokostas 2024, Raghunandan & Rajgopal 2022, Steen et al. 2020). These studies, primarily based on linear models and fixed-effects OLS regressions, found limited or negative association, particularly in stable market environments (Hasnaoui, 2025, Papathanasiou & Koutsokostas 2024, Fang & Parida 2022, Raghunandan & Rajgopal 2022, Steen et al. 2020). The results from this study, based on OLS analysis across all time periods, reject H5 by finding no statistically significant negative association between ESG ratings and risk-adjusted returns.

However, the GAM analysis revealed a significant inverted U-shaped association between ESG ratings and risk-adjusted returns in 2020–2022, with funds holding mid-range ratings showing stronger associations with risk-adjusted returns than both low- and high-rated funds. For the periods 2023–2024 and the full period 2018–2024, the relationship is more complex and less clearly defined, displaying a more irregular S-shaped pattern rather than a classic inverted U-shape. The results indicate that the relationship between ESG ratings and risk-adjusted returns is more complex than a positive or negative association, as earlier studies relying solely on linear models have suggested (Papathanasiou & Koutsokostas 2024, Raghunandan & Rajgopal 2022, and others).

Steen et al. (2020) highlight geographical variation, reporting no significant relationship between ESG and risk-adjusted returns in Norwegian funds, but a positive one in EU-based funds. This indicates that ESG's impact varies with market structure and investor preferences, aligning with AMH as discussed by Urquhart and Hudson (2013) and Lo (2004). Such geographical differences may partly explain why the results of this study differ from studies like Papathanasiou and Koutsokostas (2024) and Raghunandan and Rajgopal (2022), which reported superior performance among lower-rated ESG funds, primarily attributed to lower fees. However, those studies did not account for non-linear or time-varying relationships, suggesting that the ESG-performance link can differ depending on geographical and institutional contexts.

The difference between the results of this study and previous research (Hasnaoui 2025, Papathanasiou & Koutsokostas 2024, Fang & Parida 2022, Raghunandan & Rajgopal 2022, Steen et al. 2020) may stem from differences in model design and the periods under investigation. By employing both linear and non-linear methods and analyzing a period with heightened volatility due to the COVID-19 crisis and Russia-Ukraine war, this study captured performance patterns that traditional regressions might overlook. Notably, a robust inverted U-shaped relationship was observed only during the 2020–2022 period, while the other periods display more S-shaped associations. This highlights that the relationship between ESG-ratings and risk-adjusted return is dynamic and not static and varies depending on market conditions and context. Thus, these findings are in line with AMH's core proposition that market efficiency evolves over time with external circumstances (Bassiouny et al. 2023, Nyakurukwa & Seetharam 2023, Lo 2012,), challenging the EMH's assumption of fixed market dynamics (Naseer & Tariq 2015, Ţiţan 2015, Malkiel 2005).

Hypothesis H6 assessed whether active management leads to higher risk-adjusted return compared to passive management. This hypothesis was based on more recent contributions to the literature that suggest a conditional benefit to active management, particularly during turbulent market periods (Cremers et al. 2019, Matallín-Sáez et al. 2018, Kosowski 2011). These studies often emphasize the role of skilled managers and shifting market efficiency as outlined in the AMH (Xiong et al. 2019, Lo 2012, Lim & Brooks 2011). In contrast, foundational studies such as Jensen (1968), Carhart (1997), and Fama and French (2010) reported that active managers typically underperform benchmarks after adjusting for risk and fees, findings that align closely with EMH.

The results of this study offer partial support for H6. A statistically significant positive relationship between active management and risk-adjusted return was observed during the turbulent 2020–2022 period as well as across the full sample period (2018–2024). In contrast, no such relationship was identified in the more stable intervals of 2018–2019 and 2023–2024. This pattern shows that the value of active management is not consistently present but instead depends on prevailing market conditions, reflecting AMH, which posits that market efficiency adjusts to external shocks and evolving circumstances (Dyakova & Smith 2013, Lo 2012, Lim & Brooks, 2011)

These findings are consistent with previous research (Cremers et al. 2019, Matallín-Sáez et al. 2018, Kosowski 2011), which underscore that market downturns and crises expose inefficiencies, providing skilled active managers with opportunities to outperform, while also highlighting that active strategies can yield both exceptional gains and losses depending on market conditions. This aligns with the idea that active management can yield variable outcomes based on the opportunity set available in different environments (Harvey & Liu 2022, Cremers et al. 2016).

The results of this study reinforce the findings by Dahlquist et al. (2000), who also studied Swedish mutual funds and documented a positive relationship between active management and returns although during a stable, pre-crisis period. However, their study did not include volatile periods similar to 2020-2022. In contrast, foundational studies such as Jensen (1968), Carhart (1997) and Fama and French (2010), largely based on U.S. data and long-term linear regressions, concluded that active funds typically underperform once risk and fees are accounted for, a finding also reported by Ajadi (2024), Kim et al. (2011) and Malkiel (2011), who emphasize that consistent outperformance by active funds is unlikely in more stable markets. The findings expand on this picture by showing that active managers can indeed deliver higher risk-adjusted returns during periods of market turbulence, however this is not sustained across all periods. These results reinforce the view that active management's effectiveness is context-dependent, aligning with AMH (Mallikarjunappa et al. 2025, Gyamfi 2018, Lo 2004).

6. Conclusion

This final chapter presents the overall conclusions of the thesis. It begins with a summary of the main findings in relation to its aim and research questions. Followed by a discussion of the study's contributions, theoretical as well as practical contributions. The chapter concludes by outlining limitations and suggesting directions for future research.

6.1 Summary of findings

The aim of this thesis was to examine how mutual fund characteristics are associated with risk-adjusted returns across different market conditions. Especially if these relationships shift between stable phases and periods of heightened volatility caused by external shocks such as the COVID-19 pandemic and the war in Ukraine. By combining linear (OLS) and non-linear (GAM) models and analyzing Swedish mutual equity funds from 2018 to 2024, this study has fulfilled that aim and provided clear answers to the two guiding research questions.

- *To what extent are fund characteristics associated with risk-adjusted?*

The results demonstrate that several fund characteristics are meaningfully associated with risk-adjusted returns, although not all in uniform or linear ways. Fund size stands out as the most consistent and statistically significant variable across all four time periods, with a positive association with risk-adjusted return. Based on these results, there is no evidence of diseconomies of scale as previously suggested in the literature. Fund fees exhibited a statistically significant negative relationship with risk-adjusted returns during the three most recent time periods. This reiterates existing critiques that higher fees diminish returns during both stable and volatile market conditions

ESG ratings and management style demonstrate more complex, context-dependent relationships. For ESG, the OLS models do not reveal any meaningful linear association with risk-adjusted returns in any period. However, the GAM models uncover a statistically significant inverted U-shaped relationship during 2020–2022, indicating that funds with mid-range ESG scores achieved higher risk-adjusted returns than those with low or high ratings. Management style also follows a conditional pattern, where active management is associated

with higher risk-adjusted returns primarily during volatile market conditions, reinforcing previous research that active management can add value under volatility.

Based on the results of the study, the Swedish mutual fund market does not exhibit the level of efficiency proposed by EMH. Several of the fund characteristics show statistically significant associations with risk-adjusted returns. This suggests that they use publicly available information about characteristics that may be associated with higher risk-adjusted returns, which contradicts the core assumptions of EMH. These observed relationships challenge two forms of market efficiency, weak and semi-strong. However, since the analysis is based solely on publicly available data, no conclusions can be drawn regarding the strong form of market efficiency. Instead, the findings align more closely with the AMH, which posits that efficiency is not fixed but evolves over time and varies with market conditions.

- *What are the differences in the association between fund characteristics and risk-adjusted return in volatile and stable market conditions?*

The results show that the strength and direction of the associations of fund characteristics vary depending on market conditions. While some relationships remained stable, others shifted depending on the market context. During the full and volatile period marked by the COVID-19 pandemic and the Russia–Ukraine war (2020–2022), several associations became more pronounced such as fund fee and management style, while fund size and ESG-rating exhibited greater complexity. The non-linear patterns identified in the GAM models, such as the U-shape for fund size and the inverted U-shape for ESG ratings, emphasize the importance of modeling flexibility when examining complex market behavior. Moreover, during more stable phases (2018–2019 and 2023–2024), several of these associations remain significant, with fund size consistently showing a positive relationship with risk-adjusted returns. Additionally, fund fee, ESG-rating and management style are significant in the later period. This persistence hints at the presence of structural factors in the Swedish fund market that continue to matter regardless of market volatility.

These findings reinforce the broader insight that mutual fund characteristics do matter, but their association is shaped by the market context in which they operate. By capturing how these relationships evolve across time and conditions, the study lends empirical support to AMH,

which acknowledges that market behavior adapts over time in response to changing conditions. The use of both OLS and GAM proved essential in revealing both general trends and more subtle patterns that would be missed by using only standard regression. Together, this approach enabled a nuanced understanding of how fund characteristics relate to performance.

In sum, this thesis suggests that mutual fund characteristics can matter, but when, how, and why seems to depend on the broader market environment. This perspective adds nuance to the static view of EMH by highlighting that the relevance of fund characteristics may vary across contexts. The findings point to the potential usefulness of combining different methodological approaches when examining the relationship between fund characteristics and performance under varying market conditions.

6.2 Contributions

This thesis contributes to addressing the research gap identified in section 1.5, specifically the limited and context-specific understanding of how mutual fund characteristics are associated with risk-adjusted performance in the Swedish fund market, particularly during crises that did not originate in the financial sector. While much of the existing literature focuses on the U.S. and traditional financial shocks (Sheng, Simutin & Zhang 2023, Reuter & Zitzewitz 2021, Gil-Bazo & Ruiz-Verdú 2009, Gruber 1996, Jensen 1968), this study instead examines the Swedish equity mutual fund market over the period 2018–2024, encompassing both stable periods and external shocks such as the COVID-19 pandemic (Marcu 2021) and the Russia-Ukraine war. This provides a unique opportunity to explore how fees, fund size, ESG rating, and management style relate to risk-adjusted returns across shifting market conditions.

Although previous Swedish studies have made important contributions, they have generally focused on earlier periods or narrower topics. Examples include persistent differences in risk-adjusted returns (Flam & Westman 2017), ESG preferences (Carlsson Hauff & Nilsson 2022), or long-term historical patterns (Dahlquist et al. 2000). However, these studies do not consider recent external shocks or the evolving dynamics of risk-adjusted returns. By addressing this gap, this thesis provides updated empirical insights into a relatively underexplored national context. It also complements international research on mutual fund behavior across market cycles (Babalos et al. 2021, Samarbakhsh & Shah, 2021, Pástor & Vorsatz 2020). In doing so, it adds further support to broader findings, such as the positive association of active

management during crises and the negative association of high fees, within the specific context of the Swedish mutual fund market.

From a theoretical perspective, this thesis also contributes by providing empirical support for the AMH. The results show that the relationship between fund characteristics and risk-adjusted returns varies significantly across market conditions. For instance, active management displayed a statistically significant positive association with performance during the volatile 2020–2022 period. In contrast, this association was absent in more stable phases. Fund fees were significantly negatively associated with performance in 2020–2022 and 2023–2024,but showed no significant relationship in the stable 2018–2019 period. These findings challenge the assumptions of the EMH, particularly in its weak and semi-strong form (Leković 2018, Akkoc et al. 2009). By identifying context-dependent associations through both linear and non-linear models, the study strengthens the empirical case for AMH and illustrates its relevance in the underexplored Swedish mutual fund market. It contributes to a more flexible understanding of informational efficiency by showing how external shocks, such as the COVID-19 pandemic and the Russia-Ukraine war, can influence the associations between fund characteristics and risk-adjusted returns.

Practically, these findings are valuable for retail investors and professional investors. For retail investors, understanding that certain fund characteristics become more or less relevant depending on the broader market environment allows for more informed and adaptive investment decisions. For professional investors, the results highlight the need to adjust strategies in response to market volatility and evolving performance drivers.

6.3. Limitations and Further Research

Several opportunities for future research arise from the limitations and findings of this thesis. Firstly, this study treated the COVID-19 pandemic and the Russia-Ukraine war as examples of external market shocks. However, it remains unclear whether their impact on fund performance and the association between fund characteristics and returns follows the same patterns as traditional financial crises, such as the 2008 global financial crisis. Future research could compare different types of market disruptions to explore whether market behavior and the role of fund characteristics vary depending on the nature of the crisis. Such investigations would

provide valuable insight into the adaptive nature of market efficiency, as suggested by the AMH (Xiong et al. 2019, Dyakova & Smith 2013, Lo 2004).

Secondly, this study used fixed values for fund characteristics across all periods due to data availability constraints. However, fund characteristics such as fees, ESG ratings, and management styles are not necessarily constant and may change over time in response to market developments. Future research should aim to incorporate time-varying data to better capture these changes and to examine whether such adjustments influence performance. This would provide a more dynamic test of the AMH's proposition that market participants continuously adapt to evolving conditions. Finally, due to the lack of monthly or daily return data, Sharpe ratios were estimated from annual returns. With more detailed data, especially for periods of low market volatility, future research could offer a more nuanced understanding of risk-adjusted performance.

In summary, while this study offers important insights into how fund characteristics are associated with risk-adjusted returns under different market conditions, future research could build on these results by comparing crisis types, incorporating more dynamic fund data, and using more precise performance measures.

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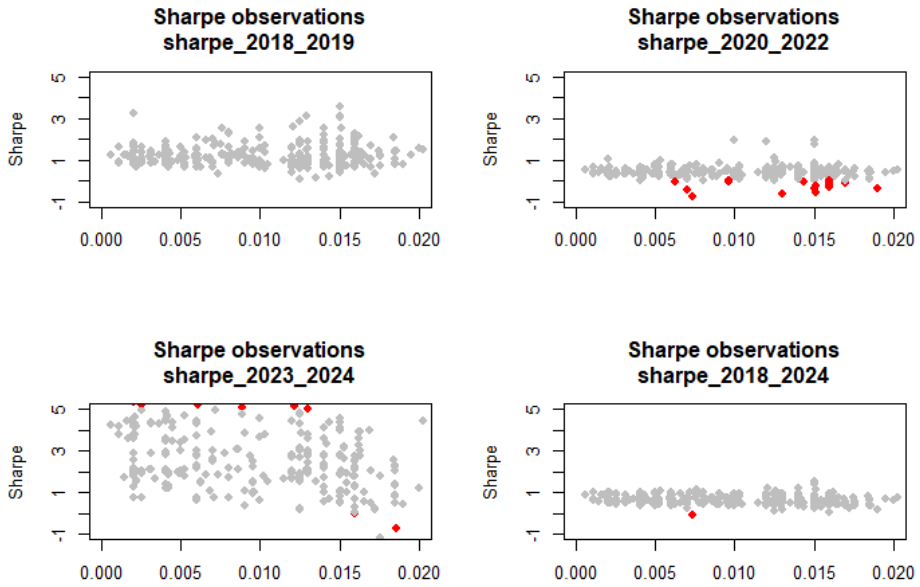
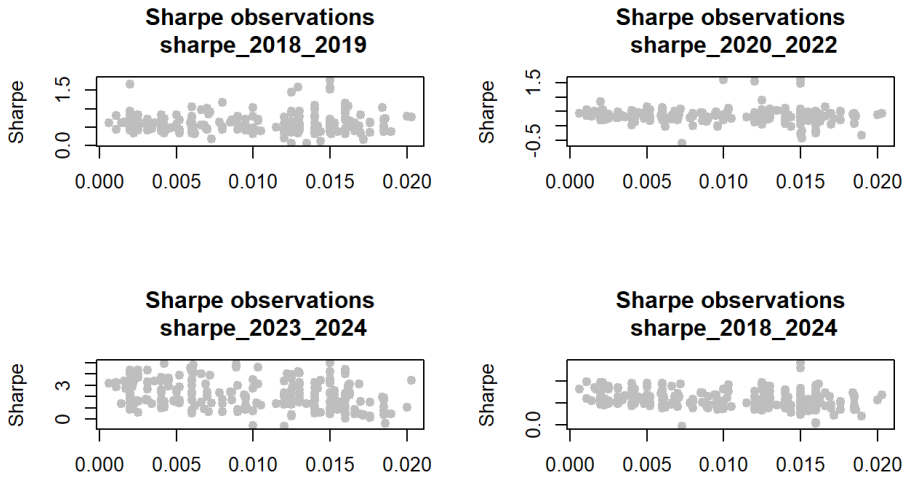
Appendix

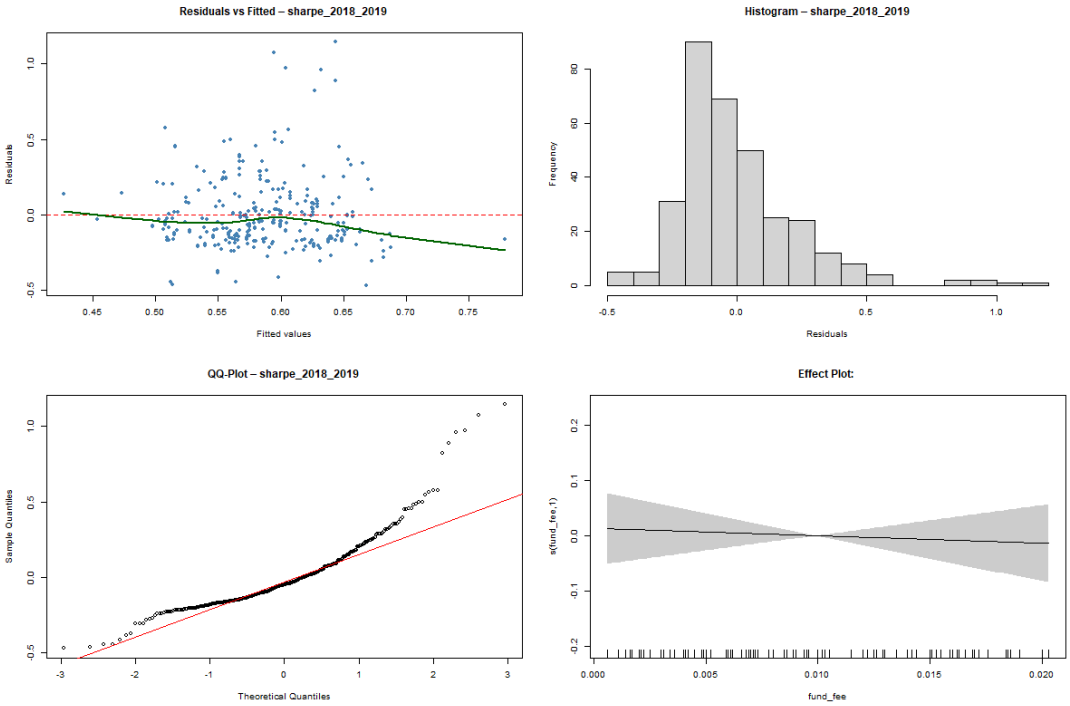
A.1 Sharpe Ratio Before Excluding Extreme Values



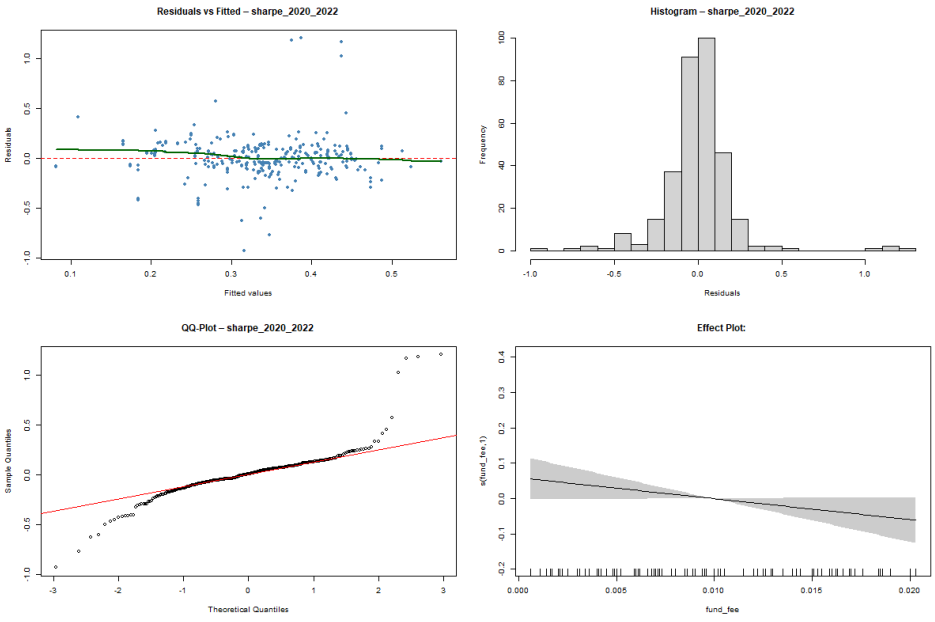
A.2 Sharpe Ratio After Excluding Extreme Values



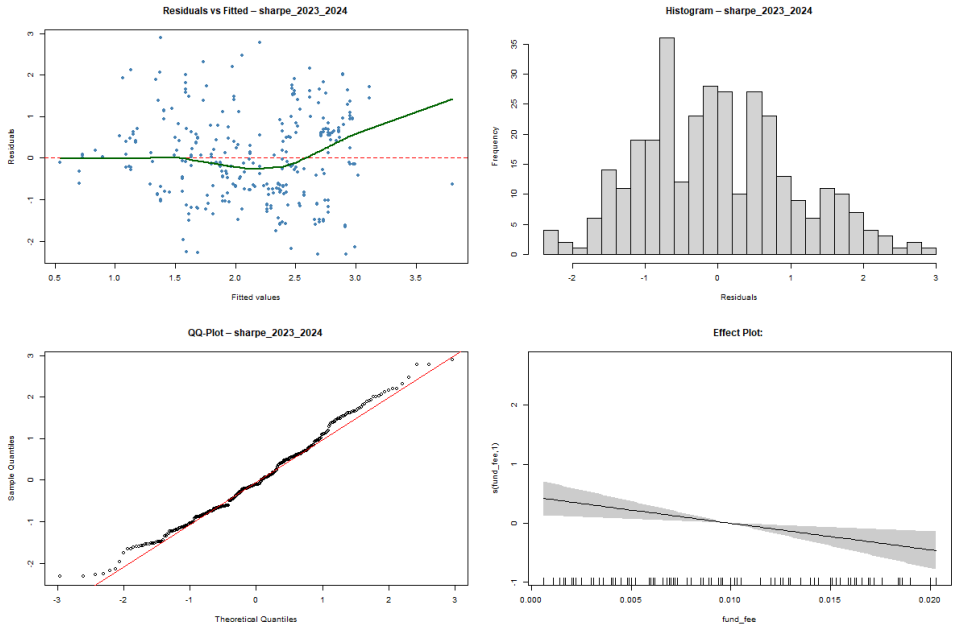
B.1 B.1 Diagnostic Plots: 2018-2019



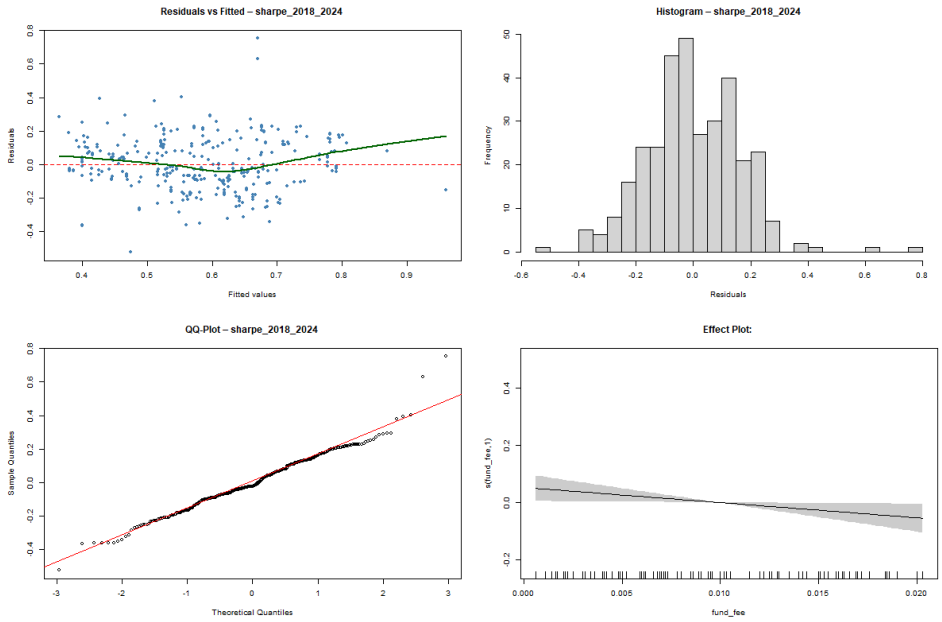
B.2 B.1 Diagnostic Plots: 2020-2022



B.3 B.1 Diagnostic Plots:2023-2024



B.4 B.1 Diagnostic Plots:2018-2024



C1. Breusch-Pagan Test

Breusch-Pagan Test for Heteroskedasticity in OLS Residuals

Model	BP Statistic	P-Value	Interpretation
sharpe_2018_2019	6.996	0.1361	No heteroskedasticity
sharpe_2020_2022	7.161	0.1276	No heteroskedasticity
sharpe_2023_2024	2.221	0.6953	No heteroskedasticity
sharpe_2018_2024	11.400	0.0224	Heteroskedasticity detected

Breusch-Pagan test for heteroskedasticity using studentized residuals. Significance indicator: $p < 0.05$.

C.2 VIF- Test for fund characterics all periods

Appendix C: Variance Inflation Factors

Variable	VIF
Fund Fee	2.165
Fund Size	1.235
ESG-rating	1.008
Management Style	2.175

VIF values below 10 indicate no problematic multicollinearity among the independent variables. Source: Compiled by the authors.

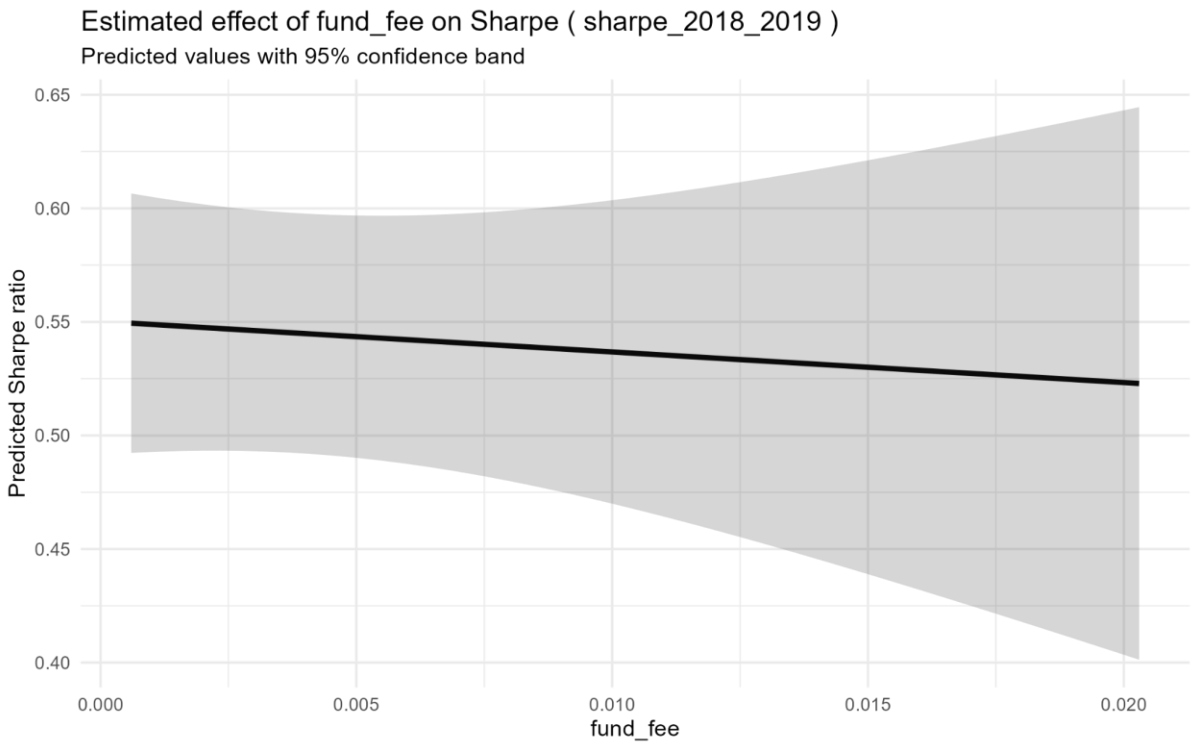
C.4 Autocorrelation Test For All Periods

Durbin-Watson Test for Autocorrelation in Residuals – GAM

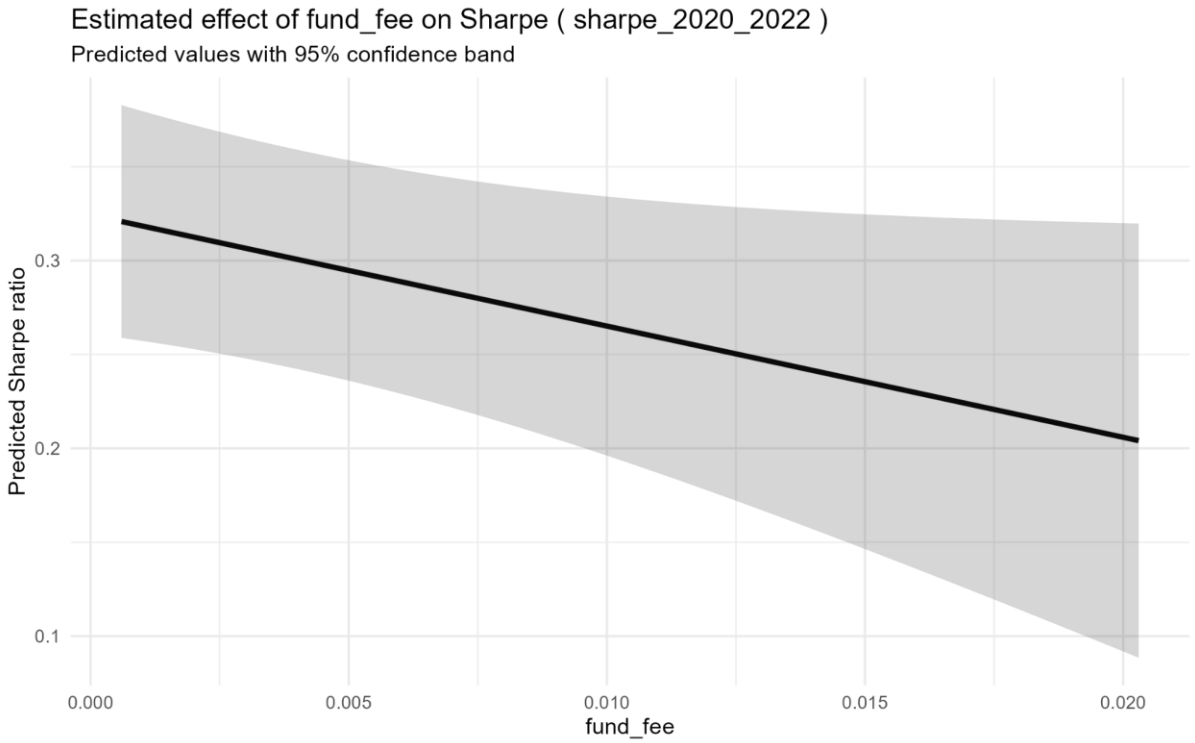
Model	DW Statistic	P-Value	Interpretation
sharpe_2018_2019	2.1176	0.8584	No autocorrelation
sharpe_2020_2022	2.0486	0.6742	No autocorrelation
sharpe_2023_2024	1.8291	0.0604	Not significant
sharpe_2018_2024	2.0872	0.7882	No autocorrelation

Durbin-Watson test for first-order autocorrelation. Significance indicator: $p < 0.05$.

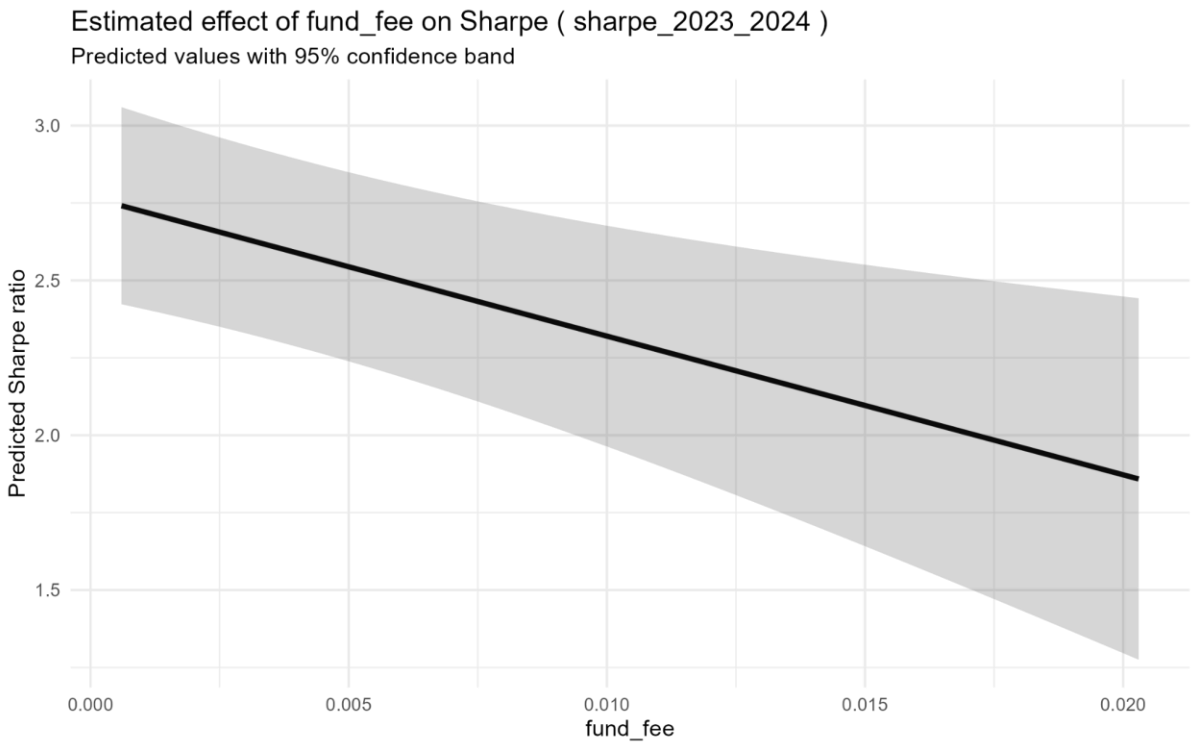
D.1 Relationship Curve for fund fee 2018-2019



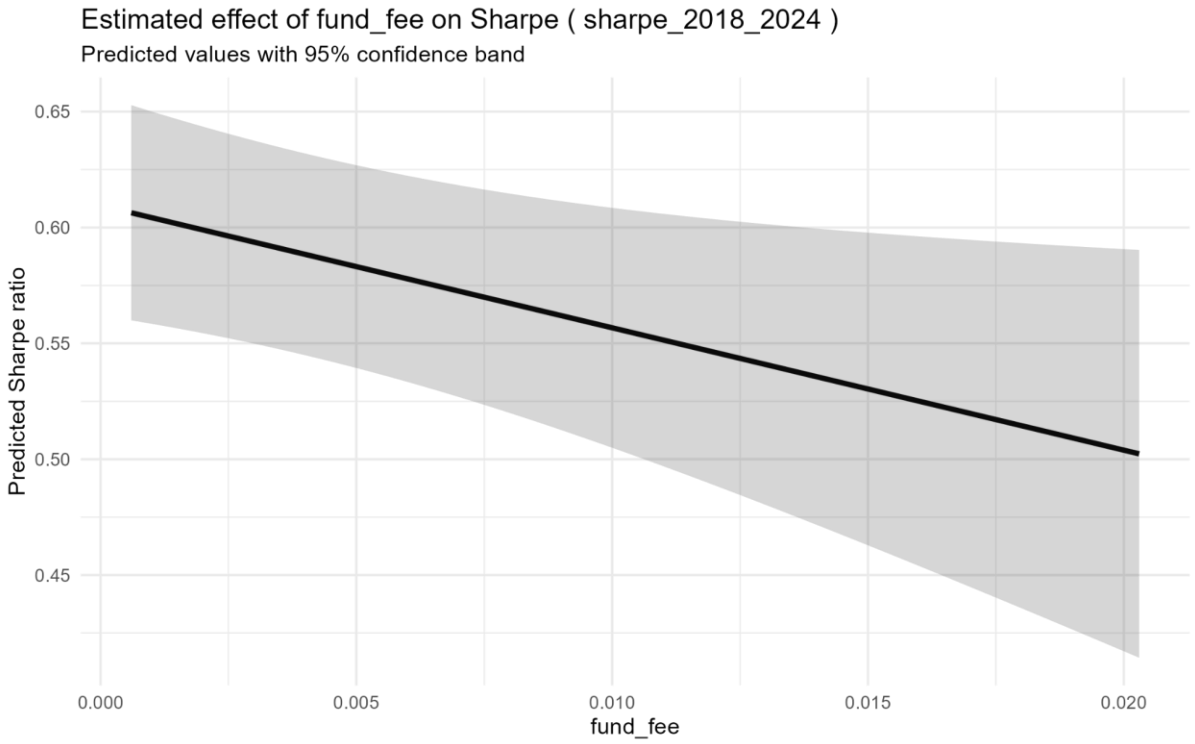
D.2 Relationship Curve for fund fee 2020-2022



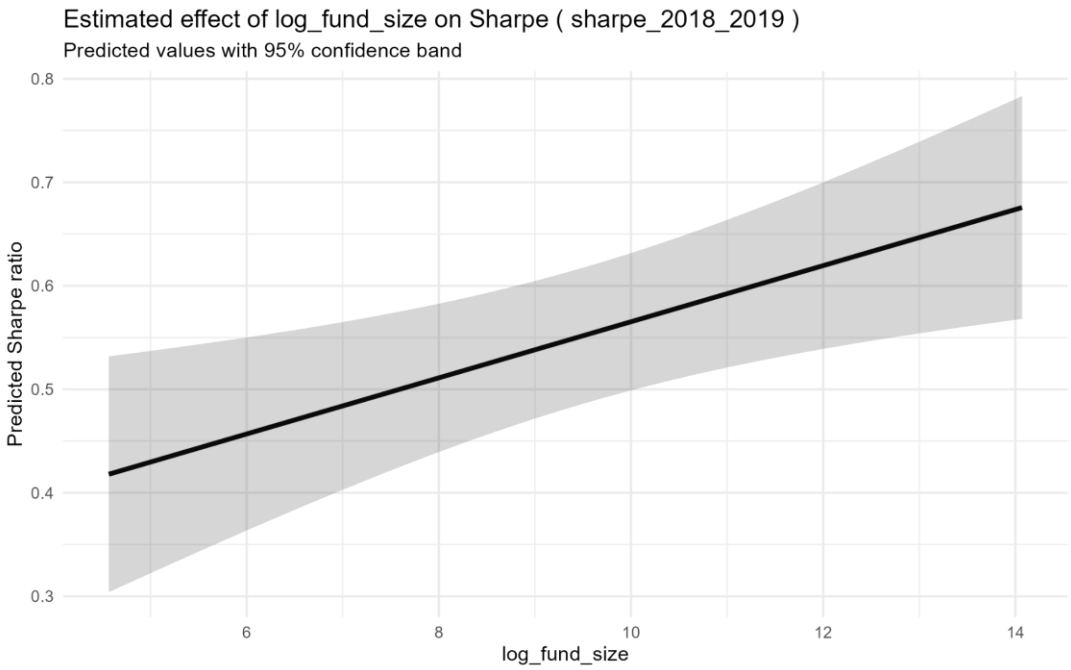
D.3 Relationship Curve for fund fee 2023-2024



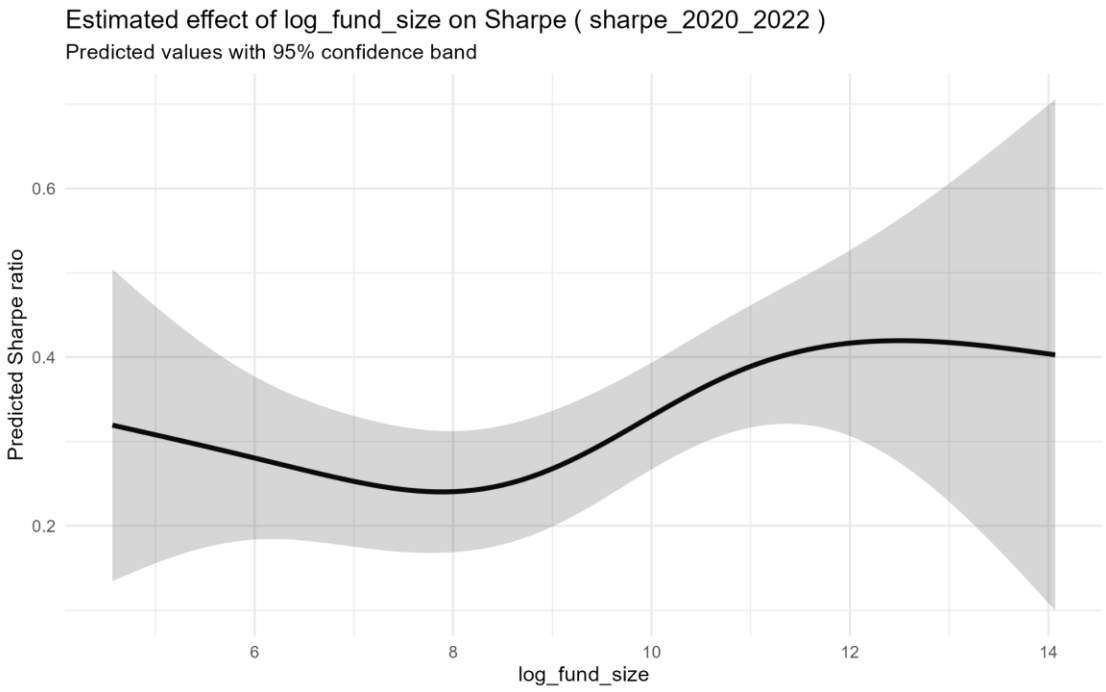
D.4 Relationship Curve for fund fee 2018-2024



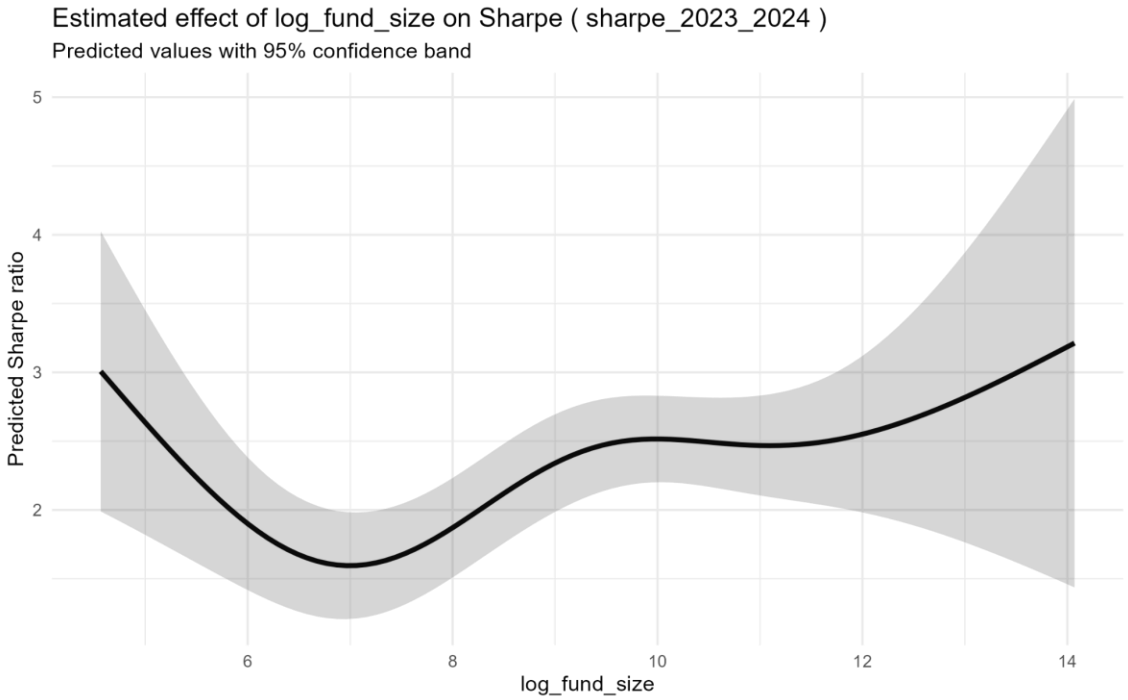
D.5 Relationship Curve for Fund Size 2018-2019



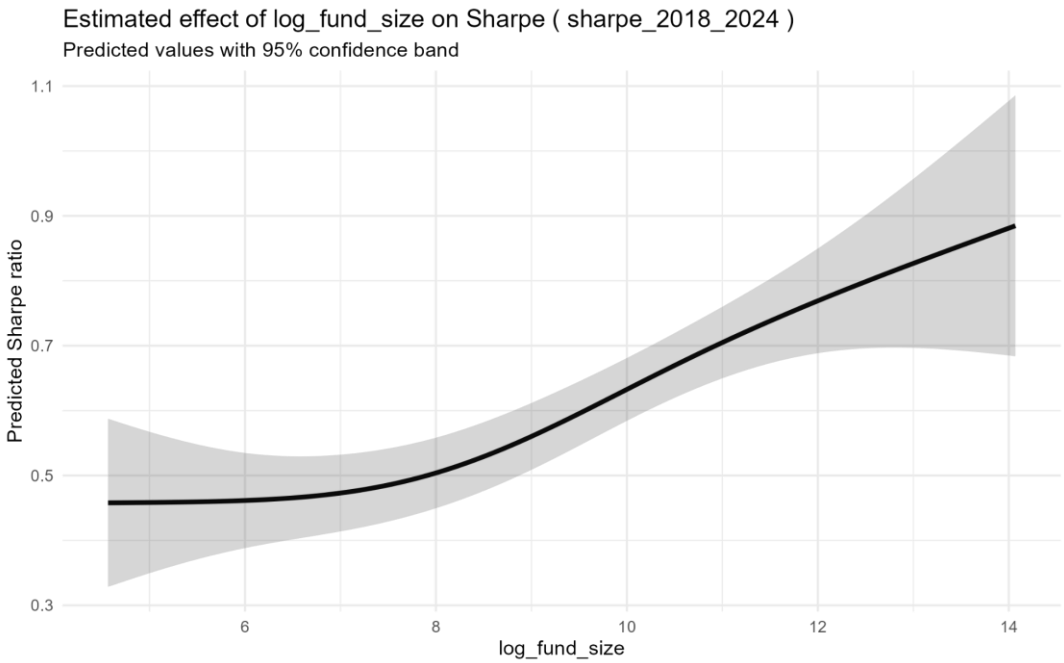
D.6 Relationship Curve for Fund Size 2020-2022



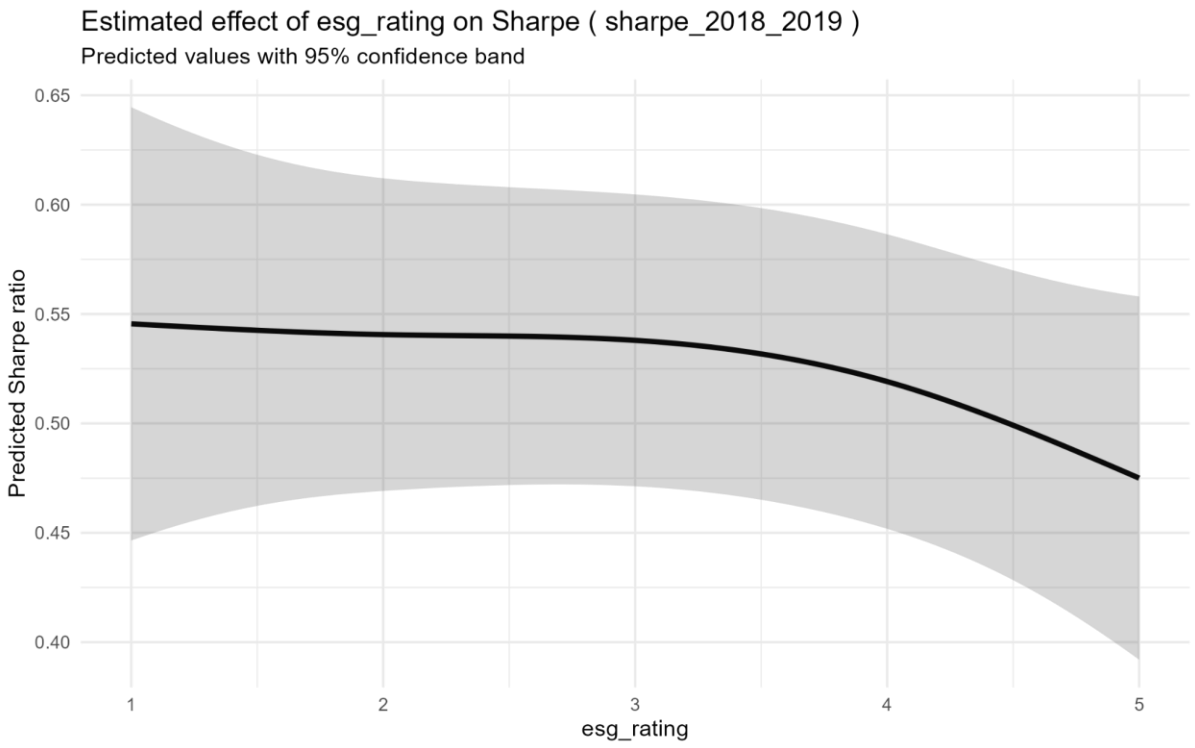
D.7 Relationship Curve for Fund Size 2023-2024



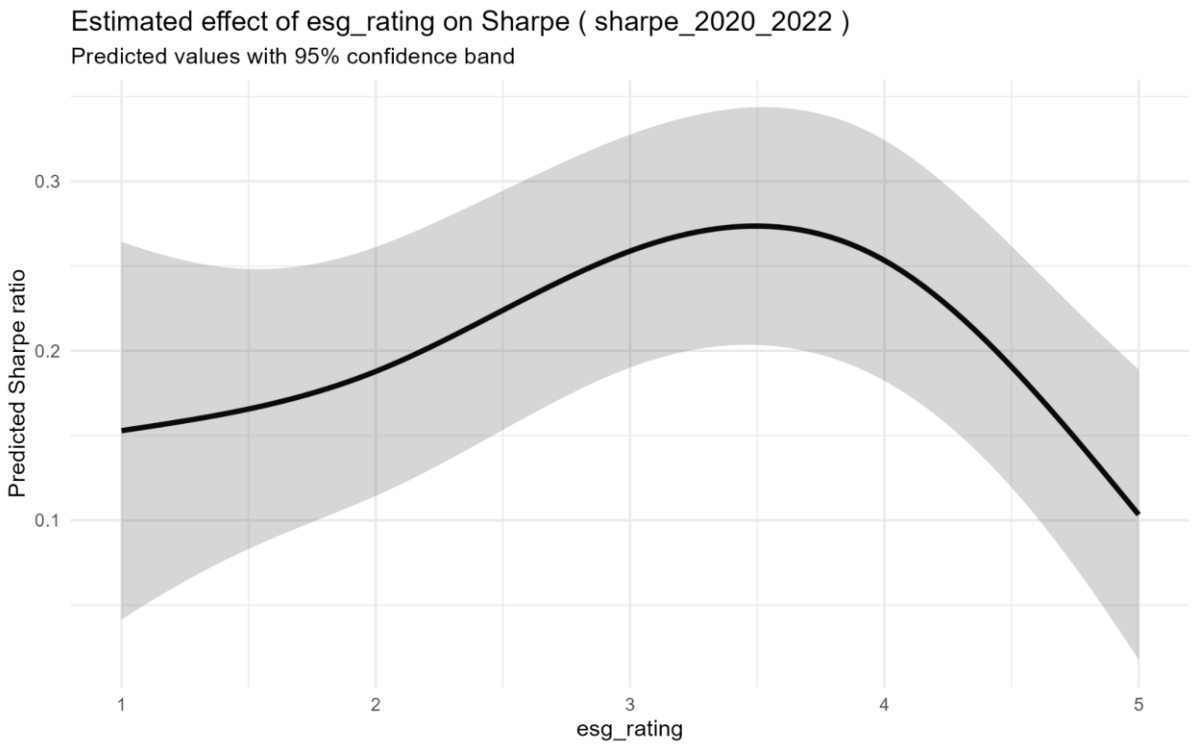
D.8 Relationship Curve for Fund Size 2018-2024



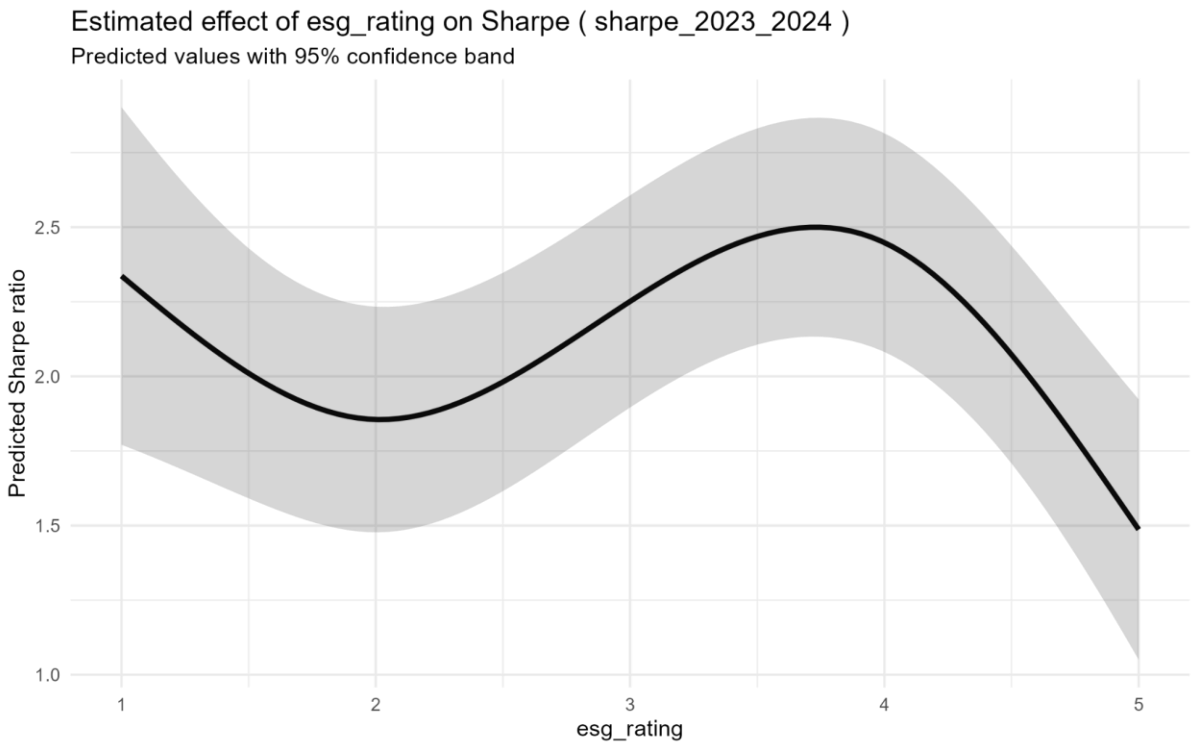
D.9 Relationship Curve for ESG-rating 2018-2019



D.10 Relationship Curve for ESG-rating 2020-2022



D.11 Relationship Curve for ESG-rating 2023-2024



D.12 Relationship Curve for ESG-rating 2018-2024