Atte Hjerppe

Passive Growth, Exchange Traded Funds, and the Limits of Arbitrage: Effects on Market Efficiency in the U.S. Stock Market

School of Accounting and Finance
Bachelor's Thesis, Finance
Accounting and Finance

Vaasa 2026

UNIVERSITY OF VAASA
School of Accounting and Finance
Author: Atte Hjerppe
Title of the thesis: Passive Growth, Exchange-Traded Funds, and Limits of Arbitrage: Effects on Market Efficiency in the U.S. Stock Market
Degree: Bachelor of Science in Economics and Business Administration
Degree Programme: Accounting and Finance
Supervisor: Alamgir Hossain
Year: 2026 **Pages:** 49

ABSTRACT:

Tämä kandidaatintutkielma tarkastelee passiivisen sijoittamisen kasvun ja pörssinoteerattujen rahastojen (ETF) yleistymisen yhdistettyjä vaikutuksia markkinoiden tehokkuuteen Yhdysvaltojen osakemarkkinoilla. Tutkimus perustuu olemassa olevaan rahoitusteorian kirjallisuuteen ja empiiriseen tutkimukseen markkinoiden mikrorakenteesta ja keskittyy erityisesti siihen, miten siirtyminen aktiivisesta passiiviseen sijoittamiseen on muuttanut arbitraasin ja hinnanmuodostuksen edellytyksiä. Passiivinen sijoittaminen on kasvanut marginaalisesta strategiasta hallitsevaksi rahastosijoitusmuodoksi viimeisten kolmen vuosikymmenen aikana, ja tämä kasvu on läheisesti sidoksissa ETF-rahastojen nousuun, jotka ovat tuoneet mukanaan uusia ominaisuuksia, jotka välittävät selkeitä vaikutuksia markkinoiden tehokkuuteen.

Teoreettinen viitekehys perustuu tehokkaiden markkinoiden hypoteesiin ja arbitraasin rajoitteita käsittelevään kirjallisuuteen, jotka yhdessä osoittavat, että markkinoiden tehokkuus ei ole kiinteä ehto, vaan tasapaino, jota ylläpitävät informoidut kauppiaat, joiden kyky korjata hinnoitteluvirheitä riippuu heidän kohtaamistaan riskeistä ja kustannuksista. Tämän viitekehyksen avulla opinnäytetyö analysoi, miten passiiviset rahastovirrat ja ETF-toiminta vaikuttavat markkinoihin ja pystyykö markkinoiden jäljellä oleva aktiivinen puoli pitämään markkinat tehokkaana.

Tutkielman keskeinen löydös on, että passiivisen sijoittamisen kasvu ja ETF-rahastojen yleistyminen vaikuttavat markkinatehokkuuteen kahdella tasolla. Makrotasolla markkinat saattavat toimia tehokkaammin systemaattisen informaation välittymisen nopeutuessa, mutta epäsystemaattisella tasolla hinnanmuodostus heikkenee mekaanisen kysynnän, markkinakohinan ja kasvavan volatiliteetin seurauksena. ETF-rahastot lisäävät volatiliteettia lyhyellä aikavälillä ja heikentävät yksittäisten osakkeiden informatiivisuutta, kun taas passiiviset rahastovirrat luovat eifundamentaalista kysyntää, joka nostaa suurimpien indeksiyhtiöiden hintoja suhteettomasti. Arbitraasitoiminta on tässä tutkielmassa läpi käytyyn kirjallisuuteen perustuen enemmissä määrin rajoittunut korjaamaan passiivisten virtojen aiheuttamia hintavääristymiä täysimääräisesti.

KEYWORDS: index funds, exchange-traded funds, investment activities, finance, investors, risk management, stock prices, market research, price development

Contents

1 Introduction

Active strategies have historically been the more widely adopted investment approach among investors, but in recent years, passive funds have increasingly outpaced active funds in terms of assets under management. Passive investing has grown in popularity, especially over the past two decades. This development is mainly based on two factors: first, the failure of active funds to consistently outperform indexes and passive funds, and second, the cost-efficiency of passive investing compared to active investing. Active funds typically have higher management fees and transaction costs, which have been shown to significantly reduce net returns. Because these costs must be offset, active strategies need to generate returns that exceed both the benchmark and the costs of management.

Simultaneously, the rapid growth of exchange-traded funds is closely linked to the growth of passive investing. Large amounts of passive flows today are invested through ETFs, since they have made diversified investing simple and accessible to practically all investors at minimal expense. ETFs have additionally revolutionized markets by introducing features that traditional funds did not previously offer, like trading on stock exchanges without the need for a fund manager's intervention and the ability to trade intraday, which has elevated fund trading volumes to an entirely new level. This all began when the world's first exchange-traded fund was launched on the Toronto Stock Exchange in 1990. This innovation led to the introduction of the first ETF in the U.S. stock market in January 1993, the SPDR S&P 500 ETF Trust, which tracks the S&P 500 index and remains one of the largest and most widely recognized ETFs to this date[1] (State Street, 2026). Since 1993, the number of ETFs available in the U.S. market has rocketed, with a strong concentration on passive funds. The link to passive funds growth here is strong, as passive growth has been observed to concentrate over the last three decades.

[1] State Street. (2026). SPDR S&P 500 ETF Trust. https://www.ssga.com/us/en/intermediary/etfs/spdr-sp-500-etf-trust-spy

While passive investing has become the leading strategy, it may also lead to unintended outcomes considering market efficiency. Large passive flows to stocks raise their valuations, not because fundamentals indicate that stock prices should be higher, but instead because the growing popularity and use of passive investing generate non-fundamental demand. Overvaluation should not be persistent, as the active side response should deal with that. This equation is not as simple as presented in frameworks, and the zero risk-assumption of arbitrage is found to be flawed on many occasions. The constraints of arbitrage are found to be related to the exact risk factors that the growth of passive strategies and exchange-traded funds tends to transmit. Markets are reshaping with increasing constraints and developments for arbitrage, with the questioning of the capability of the active side being in center of this.

1.1 Purpose of the Study

This study examines how passive growth and the popularization of exchange-traded funds have affected market efficiency, with highlight being on the active side's capability to arbitrage in this equilibrium. The text examines passive investing as a growing strategy centered around index investing. Passive investing is generally implemented through ETFs or mutual funds, and these methods are at the center of this thesis. ETFs as an asset class are addressed separately due to their distinct characteristics and significant impact on the topic. The purpose of the study is to examine whether the growth of passive investing affects market efficiency in terms of arbitrage constraints and whether the operational mechanisms of ETFs have an impact on this relationship. The research question for this thesis is presented as follows:

Does the simultaneous growth of passive investing and exchange-traded funds constrain arbitrage to a degree that undermines stock-level pricing efficiency in the U.S. stock market?

The study is a literature review based on academic publications on passive investing, exchange-traded funds, and market microstructure. This paper synthesizes and evaluates existing theoretical frameworks and empirical findings, without contributing new empirical data. The goal is to identify how the simultaneous growth of passive funds and ETFs affects the conditions for arbitrage and price formation, and to assess whether the active side of the market is capable of retaining sufficient capacity to maintain efficiency in the U.S. stock market.

1.2 Structure of the Study

The first chapter introduces the reader to the topic of this thesis and its purpose and limitations. In the second chapter, this thesis describes the theory related to the topic. The second chapter's purpose is to familiarize readers with fundamental financial research that the markets and asset pricing models, and subsequently, the core for passive strategies are built upon. The division and principles of passive and active strategies are presented as well. Arbitrage is in key role in this paper, so its operational principles, risks, and constraints are also discussed in chapter two. In the third chapter, the market shift towards passive investing and the key drivers for this development are examined. Similar timelines and coincidences of the emergence and popularization of exchange-traded funds and the growth of passive investing are reviewed as well in the third chapter. In the fourth and fifth chapters, this paper examines the effects of passive growth and familiarization of ETFs on market efficiency. In the sixth chapter, these findings are comparatively analyzed to build an understanding of the net effect of this market development. Finally, Chapter Seven presents the conclusion of this thesis.

2 Theoretical Background

This chapter presents theories and models used to examine and point out the behavior of markets and market participants. The fundamental principles and theories of investing discussed in this section provide clear causal explanations for the popularity and effectiveness of passive investing. Market efficiency has been observed over time to be partially inefficient, and explanations and theories considering these findings are also examined in this chapter. These limitations are examined in the light of the practicality of the models used to examine market efficiency and arbitrage constraints, to provide an understanding of inefficient behavior in financial markets. Arbitrage mechanism and its limitations are explained as well, since they are in key role when examining price efficiency.

2.1 Investment Risk

Since been introduced by Harry Markowitz (1952), Modern Portfolio Theory (MPT) has become a foundational framework in finance for understanding how investors can construct optimal portfolios. The theory shows that investors can diversify their portfolio and either minimize risk for a given level of expected return or maximize expected return for a given level of risk. Markowitz changed the earlier assumption that investors should simply choose assets with the highest expected return by introducing a new rule based on two variables: expected return and variance of return. Variance explains the investment risk, and investors are assumed to prefer higher returns and lower risk. Both objectives are served by diversification.

Central to the theory is the distinction between systematic and unsystematic risk. Systematic risk affects the whole market simultaneously and arises from factors beyond the control of individual investors or companies, such as geopolitical events, inflation, and interest rates. Unsystematic risk is specific to a particular company or industry and can be generated from events like bankruptcy, financing problems, or labor strikes (Sharpe, 1964). Unsystematic risk can be eliminated through diversification, while systematic risk

is always present. Systematic risk is also known as the market risk, which is commonly regarded as the only relevant risk in finance theory since rational investors are assumed to eliminate unsystematic risk through diversification.

This framework matters for the present thesis as it implies that the market portfolio is the theoretically optimal holding for the diversified investor. It is important to understand that Modern Portfolio Theory focuses on the benefits of diversification without fully addressing how efficiently markets price securities. MPT concentrates on how an investor can construct an efficient portfolio by optimizing the risk-return trade-off between assets, but it does not directly take a position on whether market prices themselves fully reflect all available information. Active deviation from market weights requires a separate justification that depends on whether markets misprice assets in ways that skilled investors can make excess returns. That question is the subject of the next section.

2.2 Efficient Market Hypothesis

Theoretical reasoning for passive investing rests on the Efficient Market Hypothesis (EMH). Similar ideas and assumptions about market efficiency had existed in finance before Eugene Fama (1970), who was the first to formally define and present the Efficient Market Hypothesis as a theoretical framework. This hypothesis concentrates on the idea that in an efficient market, asset prices always fully reflect all available information. In fully efficient markets, market anomalies should not exist, and beating the market consistently should be impossible, consequently market return is the optimal benchmark that investors should aim for.

The model has three different levels of efficiency, which indicate the level of information that stock prices reflect: Weak form states that current asset prices reflect all past data. Semi-strong form extends the former by asserting that prices adjust rapidly and unbiasedly to all publicly available information, and active management should not consistently outperform the market, as any new information is quickly incorporated into prices.

The strong form reflects all information, including public and private information, and even insider knowledge, which should not lead to achieving higher returns. Short-term mispricing is not inconsistent with the efficient market hypothesis, and when this happens, arbitrage by informed investors should ensure that prices remain closely aligned with fundamental values. The markets, as we know them, are generally considered to operate at a semi-strong level of efficiency.

Consistent with this consideration, Samuelson (1965) showed independently of Fama that in a market with rational and competitive traders, properly anticipated prices move randomly and therefore active management cannot systematically beat the market. Grossman & Stiglitz (1980) then proved perfect efficiency to be impossible. They showed that in equilibrium with costly information, as in reality, prices cannot be fully efficient, because otherwise no investor would have an incentive to acquire information. Since information acquisition is costly and not freely available for everyone, some degree of mispricing, in other words, noise, must persist in equilibrium to compensate investors who bear costs to acquire and process information.

This equilibrium logic is important regarding this thesis as it establishes that market efficiency is a balance maintained by the active sides' informativeness. The equilibrium changes if the pool of informed traders shrinks or if the costs of correcting mispricing rise. The growth of passive investing and the popularization of ETFs affect both sides of this balance simultaneously.

2.3 Evolution of Asset Pricing: Recognition of Limitations and Anomalies

The development of foundational pricing models began to emerge concurrently with the development of the efficient market hypothesis. Capital Asset Pricing Model (CAPM) is an asset pricing model in finance first introduced by Sharpe (1964), John Lintner (1965), and Jan Mossin (1966). This model is built upon Modern Portfolio theory principles and offers a method to price assets and portfolios in an efficient market, where anomalies and limitations do not exist. The model suggests that all assets should be priced based

on their beta. Assets' beta measures their sensitivity to movements subject to the overall market. An asset with a beta of one should offer a return equal to the market's return, while assets with a beta greater than one are expected to generate returns exceeding the market return.

The limitations of the CAPM received early responses when Jensen (1968) extended this line of work by creating a risk-adjusted measure based on the Capital Asset Pricing Model, later and more widely known as Jensen's Alpha. This model calculates the excess return generated over the expected return predicted by the CAPM. Jensen introduced alpha as a contrast to the assumption of an efficient market where mispricing does not exist, and returns are always built upon an asset's beta. This led to the central distinction that is relevant for this thesis: capturing beta through passive exposure versus generating alpha through active skill. These findings also pointed out the rigidity of the EMH framework, because if markets were perfectly efficient, alpha would not exist. Yet empirical research began documenting return patterns that the CAP-Model could not explain.

Fama's (1991) formal response to evidence challenging earlier assumptions redefined EMH into a more conditional framework. This version acknowledges that some anomalies may reflect risk factors rather than inefficiency, and more importantly, other anomalies may reflect genuine mispricing that arbitrage has failed to eliminate. This clarification is crucial for the thesis since the debate over market efficiency is no longer whether anomalies exist but whether arbitrage is powerful enough to correct them. Since anomalies exist, the question is now around the matter of what may prevent arbitrageurs from trading the anomalies away. The pricing models reviewed here are not as important as valuation tools, considering this thesis. Their relevance is more profound as frameworks that enable researchers to identify when and where mispricing persists, including mispricing potentially driven by passive investment flows.

2.4 Passive and Active Investing

Investing can be divided into passive and active strategies. This distinction is central to this thesis because the balance between these two determines the market's capacity for index-based demand and active price correction.

Passive investing is characterized by well-diversified and non-actively managed investing. It focuses on achieving market returns by investing in market indexes rather than picking individual stocks. Passive investing is typically a long-term approach that emphasizes profiting from diversification and holding a broad basket of assets over time. The purpose is to benefit from the growth of the index itself by passively holding it, rather than engaging in more costly strategies aimed at outperforming the index. Theoretical justification for this strategy comes directly from Fama's (1970) and Samuelson's (1965) proposals that attempting to forecast individual stock movements is unlikely to lead to excess profits. Passive investors can therefore be considered as investors who view markets as efficient enough that capturing the market beta is the rational strategy (Sharpe, 1991). Even though passive investing does not require active stock-picking, maintaining a portfolio that accurately tracks a certain benchmark requires ongoing alignment and rebalancing as the markets evolve. Passive investing is usually implemented by investing in a mutual fund or exchange-traded fund that mimics a certain market index and does this ongoing balancing for you.

In contrast to passive investing, active strategies have the idea where portfolio managers attempt to outperform their benchmark by actively managing their portfolio. The underlying premise of active management is that financial markets are not perfectly efficient and that skilled investors can exploit mispricing and informational inefficiencies to generate superior returns (Carhart, 1997). Active strategies require well-reasoned trading based on the investor's view of where the markets or individual securities prices are going. Active investing can be carried out either independently by investors or through professionally managed active funds, which aim to outperform market benchmarks on behalf of investors.

2.4.1 Mutual Funds and Exchange-Traded Funds

In today's market, both strategies are more often carried out through mutual funds and exchange-traded funds. Both asset classes serve the same benefits of allowing investors to gain a diversified portfolio through a single purchase. The differences are in the way they operate. Understanding these mechanical differences is important because this thesis argues in Chapters 4 and 5 that the two fund types transmit distinct effects on market efficiency.

Mutual funds operate on a subscription and redemption model. This means that investors buy and sell shares directly from the fund provider at the net asset value calculated at the end of the day. The fund manager must purchase the underlying securities in proportion to the index or benchmark the fund tracks when the fund receives invested capital. Similarly, when investors redeem their shares from the fund, fund managers must sell their shares. This mechanism has two characteristics that are important for this thesis. The price settlement occurs once a day, and secondly, the fund manager must physically trade the underlying stock, and this creates direct price pressure on the shares.

ETF shares are listed and traded on a stock market throughout the day, just like regular shares. Investors buy and sell ETFs from one another on the secondary market. This means that the fund provider does not need to be a part of the transaction or trade the underlying asset every time an investor buys or sells ETFs. Instead, a specialized set of institutional participants known as Authorized Participants (APs) is the only entity allowed to create and redeem ETF shares directly with the fund provider. In the creation process, an AP exchanges a basket of underlying stocks for newly issued ETF shares. The redemption process is reversed, and AP returns ETF shares to the provider and receives the underlying stocks. This provides adjustment that keeps the number of ETF shares in circulation responsive to investor demand and creates an arbitrage channel that keeps

ETF's market price aligned with the net asset value of its underlying stocks (Ben-David et al., 2018).

ETFs intraday tradibility is a key feature in this thesis as they are accessible to a wider range of strategies, such as short-horizon liquidity trading, and affects the composition of who trades ETFs and why. Another important feature is the unique arbitrage mechanism that keeps prices aligned to underlying assets in large volume, but does not take a stance on the absolute valuation of underlying assets.

2.5 Arbitrage and Its Limits

Arbitrage is the core mechanism for keeping the markets efficient. Understanding the key factors, considering the theoretical role and risks of this practice is essential to this thesis. The research question of this thesis reduces to a question about whether arbitrage can counterbalance the distortions that ETFs and passive flows introduce. This section defines the theoretical framework for this assessment.

Arbitrage can be described as the simultaneous purchase and sale of the same security in two different markets, allowing a trader to buy at a discount and sell at a premium in another. Ross (1976) determines arbitrage as a situation in which the investor can construct a portfolio that requires zero net investment, does not contain systematic risk, and has a positive expected return. Relying on the same principles, Fama (1965; 1970) demonstrates arbitrage to be riskless since markets are efficient and the world relies on perfect competition for information. When prices deviate from their values, a vast number of small individual arbitrageurs should move the prices quickly back to their fundamental values, making short-term profits without taking any risks. Theoretically, this means that arbitrage possibilities should always be profitable to act on and therefore prices quickly revert to their true value.

2.5.1 Framework for Arbitrage Limits

Contrary to the founding theory, risks and constraints have been observed concerning the exercise of acquiring and maintaining the arbitrage position. Classical arbitrage theory (Fama, 1965; Friedman, 1953) suggests that arbitrage should not be affected by behavioral biases and should rely on the perfection of the markets. Shleifer and Vishny (1997) provided the foundational framework for understanding why arbitrage fails in practice. They show that, in opposition to arbitrageurs being a large number of individual investors, they are more commonly a small group of very talented investors who manage the capital on behalf of less-informed investors. This performance-based arbitrage, where investors and arbitrageurs have different goals and expectations, poses an agency problem between the investors' goal to make profits and the arbitrageurs' goal to restore prices. Investors are commonly not interested in anything other than the return on their investments, which they naturally compare to returns available elsewhere in the market, while arbitrageurs only work to restore prices. This framework provides the organizing reasoning for the rest of this section and is also highly relevant within the empirical analysis in chapters four and six.

The Shleifer-Vishny framework identifies the conditions where arbitrage is either too risky, too costly, or too slow to correct mispricing. Based on this framework, arbitrage limits can be labeled into three categories. First one being the risk that makes arbitrage position uncertain, second being the costs and frictions that make arbitrage more expensive, and finally, capital constraints that limit how much risk arbitrageurs can bear. These categories are also overlapping, as when risk increases, cost and increased cost put pressure on capital, and capital shortage increases risk. This interaction between risks makes limits to arbitrage binding instead of being individual risks.

2.5.2 Fundamental Risk and Noise Risk

De Long et al. (1990) changed the assumption of arbitrage being risk-free and introduced two risks that arbitrageurs face: fundamental risk and noise risk. Fundamental risk is the

risk of the underlying asset moving in a not-wanted direction because of unpredicted news about company's cash flows or economic conditions while the arbitrage position is still open. Classical theory acknowledges this risk and proposes that arbitrageurs can hedge this risk by taking a position on another company within the same industry and with similar cash flows characteristics. In practice, perfect substitutes are usually not available and arbitrageurs who are willing to hedge fundamental risk must rely on imperfect hedges (Shleifer & Vishny, 1997). Another approach proposed by Ross (1976) is to eliminate market risk by taking positions on broader factors such as inflation and interest rates. Although these methods might be sufficient, hedging increases the overall costs of maintaining the arbitrage position.

Noise trader risk is the more important constraint for this thesis. It is the risk of irrational traders being present and moving the stock prices without regard to fundamental values. Friedman (1953) argues that even though speculative and irrational trading was present, it would not be a risk factor since nonfundamental price movement would be quickly corrected, and noise trading should lead to inevitable financial losses. In contrast, De Long (1990) found noise traders to be able to survive and to pose a real risk for arbitrage. Noise trading risk is the risk that these irrational noise traders are present and act unpredictably, pushing an asset's price away from fundamentals after the arbitrage position has been obtained. The unpredictability of noise traders makes the arbitrage position riskier and slows down the price adjustment even when the position is based on strong fundamentals. Since noise traders delay price corrections, there is also a greater window for unexpected news regarding the company's cash flows to arise and undermine the trade.

If arbitrageurs had infinite capital and time, noise trader risk wouldn't matter since arbitrageurs would just wait for the eventual correction, considering that the fundamental risk would not be realized. Noise trader risk is directly related to the shortage of capital and time arbitrageurs face. This problem is not unambiguous and comes from the constraint that arises between arbitrageurs and external investors who finance the arbitrage.

Shleifer & Vishny (1997) argue that because professional arbitrageurs manage external capital, they face performance pressure from their investors. Investors may withdraw capital when an arbitrage position moves against the fund in the short term, even if the position is fundamentally correct. Closing an arbitrage position and realizing returns can take longer time than expected, while investors generally prefer short-term returns. In addition, a traditional investor may be unaware of the type of investment strategy in which their money is tied up when investing in hedge funds performing arbitrage. Prolonged returns and setbacks can cause cash withdrawals from the fund and force them to liquidate its positions. Consistent with the noise trader risk and agency problem in arbitrage, Gromb & Vayanos (2002) argue that to survive these withdrawals and potential noise trader shocks, arbitrageurs must maintain external wealth to use as a liquidity buffer against market volatility. Funds must have enough excess capital to manage temporary losses caused by noise traders without hitting their margin limits because of the agency problem. Unfavorable price movement can cause margin calls if the liquidity buffer is not enough to cover these setbacks. In this situation, worst case scenario would be that scared investors withdraw their capital, subsequently leading to forced liquidation of the arbitrage positions. Brunnermeier and Pedersen (2009) provide empirical evidence that these capital constraints bind in practice. An increase in volatility makes margin requirements rise. This subsequently leads to weakening liquidity, and arbitrageurs' capability to hold their positions shrinks precisely when mispricing is at its worst. The result is what Brunnermeier and Pedersen calls a "margin spiral". This is a self-reinforcing cycle where falling prices trigger margin calls, which force liquidations, which push prices further down.

2.5.3 Short-Sale Constraints

Short selling plays a foundational role in arbitrage. Short selling means borrowing a stock and selling it with the expectation of buying it back at a lower price. This requires a search process to find a lender who holds the share in need and is willing to lend it. Once a counterparty is found, the two must bargain over the lending fee. D'Avolion (2002) finds that even though most of the stocks are usually easy and cheap to borrow, stocks

most in need of price correction are often most expensive to acquire. This is due to strong optimism surrounding the stock which causes the stock to be overvalued and in need of correction. Differences in investors' opinions cause the short-selling demand to skyrocket, which simultaneously drives the fees to levels that make the arbitrage less profitable. Subsequently, overpriced stocks are found to reflect the view of optimistic investors and not the ones trying to short these stocks. Shorting is more expensive and more difficult than going long, and arbitrageurs may be unable to short when optimism is high (Jones & Lamont, 2002). Investors with intensions to short might be prevented from short selling a stock due to high costs or lack of available shares.

Research by Duffie et al. (2002) extend this analysis by modeling the search and bargaining process inherent in securities lending. Even when a counterparty is found, the process of finding counterparty and negotiation causes costs in terms of time and capital. For illiquid and low-volume stocks the search process is particularly difficult, and the specialness of the stock constrains the speed and profitability of arbitrage This difficult acquiring process is also consistent with D'avilio's (2002) findings considering high demand stocks but the friction in the searching part is highlighted when discussing low volume stocks. Subsequently, the classical assumption of instantaneous trade execution does not hold, and prices can move against the arbitrageur during the time to seal the position. These delays increase risk since prices can shift to unwanted direction before the deal goes through.

2.5.4 Synchronization Risk and Volatility

The constraints described above interact with volatility and are amplified by it. Research on arbitrage risks and constraints redefine volatility as structural risk element that is largely driven by noise trading rather than just uncertainty considering the price movements when the position is open.

Constraint considering volatility was found by Abreu & Brunnermeier (2002) They find volatile markets to create synchronization risk amongst rational investors. This risk arises from the fact that price adjustment usually requires investors to act at the same time,

since single traders rarely have enough capital to move prices alone. Each individual arbitrageur faces uncertainty about when other arbitrageurs will act. Timing the market and knowing exactly when other traders will step in to fix the same mistake is difficult. This uncertainty is amplified in volatile markets where no trader knows whether the current prices represent the peak of mispricing or does prices diverge further before active traders step in. Bubbles and mispricing are found to last longer periods because of this uncertainty, and to maximize returns, this forces arbitrageurs to withstand and "ride the bubble" instead of trying to pop it. This finding implies active traders may consider taking action too risky because of this coordination problem and therefore decide not to correct prices.

Volatility is also noted as a risk factor, considering limitations of the lending markets. Duffie et al. (2002), focusing on search and bargaining frictions, document that the search for counterparties becomes more difficult in volatile conditions. D'Avolio (2002) finds that recall risk increases in volatile periods and is more frequent when investors are divided. Brunnermeier & Pedersen (2009) complete the picture by showing that volatility raises collateral requirements for arbitrage. This tightens capital constraints, which reduces the arbitrageur's capacity to hold positions through periods of volatile price movement.

The cumulative effect can be described as a feedback loop where volatility increases costs and risk of arbitrage. An increase in costs and risk reduces arbitrage activity because of capital constraints. This allows mispricing to persist, which can generate further volatility. This feedback mechanism is central to the thesis because both passive mutual fund flows and ETF activity are documented to increase volatility in the stocks they affect, as chapters four and five will further demonstrate.

3 Market Development and Growth of Passive

This section demonstrates the development and the major reasons for the growth of passive investing relative to active. The section describes this elevation based on evidence gathered through empirical research on active management. Subsequently, data is presented showing the scale of this shift between passive and active in the U.S. stock market. Lastly, the growth of exchange-traded funds and their relevance in this matter is addressed.

3.1 Research Supporting Passive Strategies

The theoretical argument that forecasting-based outperformance should be impossible in informationally efficient markets, as demonstrated by Samuelson (1965). This has been tested extensively through empirical research on actively managed fund performance. One of the earliest and most influential pieces of evidence was provided by Jensen (1968), who applied Jensen's alpha model to examine if mutual funds outperform. He found that mutual funds fail to generate positive alpha, and that their performance does not indicate managerial skill beyond what can be explained by mere random change. These results hold even when management expenses are not considered, which highlights the significance of these findings. Consistent with these findings, Sharpe (1991) argues that it is mathematically impossible for active managers as a segment to outperform, as their success is a zero-sum game. In this model, passive investors earn the market return and strictly mirror market-cap weightings without consideration. When an active investor decides to buy a stock more than its market weight indicates, they must buy it from another active investor. Therefore, the active segment, as the only other component of the total market, must earn that same aggregate return. Subsequently, active managers underperform even when earnings are the same, since active management bears higher costs.

Pástor et al. (2015) further argued that active manager skill has in fact increased over time, but their net performances remaining on same levels because of this development in competence and industry size. Each manager's marginal contribution to efficiency shrinks as more skilled managers compete for the same pool of arbitrage opportunities. This finding is consistent with the equilibrium models discussed in chapter four (Coles et al., 2022; Bond & Garcia, 2022), which suggest that the remaining active investors may be more skilled per capita, even as their ability to correct prices is constrained.

3.2 Simultaneous Growth of Passive Funds and ETFs

The growth of passive investing has been concentrated in the past three decades. Between 1993 and 2021, assets managed by passive mutual funds in the United States grew from approximately 23 billion to about 8.4 trillion USD (Jiang et al., 2024). In 2024, passive fund assets surpassed actively managed fund assets for the first time, and by the end of 2025, passive mutual funds and ETFs had reached a combined asset value of 19.1 trillion USD and accounted for roughly 60 percent of total fund assets under management in the U.S.[2] Reasons for this kind of development can be found in active funds' past performance. Data indicate that 65% of actively managed U.S. large-cap funds underperformed the S&P 500 in 2024, and during the period from 2014 to 2024, the average percentage of underperformers was 67%[3]. This lack of sustained outperformance has been discovered to reduce the attractiveness of active investing and encourage investors to shift toward passive strategies. As of December 2025, it is estimated that index funds make up to 52,5% of total combined active and passive fund assets in the U.S. market[4].

---

[2] Morningstar. (2025). Active vs. passive investing: Which categories are more successful? https://www.morningstar.com/business/insights/blog/funds/active-vs-passive-investing

[3] S&P Dow Jones Indices. (2025). *SPIVA U.S. scorecard*. https://www.spglobal.com/spdji/en/research-insights/spiva/

[4] Investment Company Institute. (2026). 2026 Investment company fact book: A review of trends and activities in the investment company industry. https://www.ici.org/system/files/2026-04/2026-factbook.pdf

The trend here is clearly observable. The growth of passive investing and the rise of exchange-traded funds are closely intertwined, as the timelines with ETFs' launch in 1993 aligns with the timeline of the growth of passive investing demonstrated above. A large share of passive capital flows today is channeled through ETFs, and the core reasons for the shift away from active investing have already been discussed and noted, but what are the reasons behind ETFs popularity compared to mutual funds? One major reason behind this development, similar to and aligned with the growth of passive funds, is the cost-efficiency. As described in Section 2.4, ETFs are traded on the stock market without the need for the fund manager to be a part of the transaction. This advantage translates to smaller commission fees and bid-ask spread. Industry concentration of exchange-traded fund assets managed in the U.S. is pushing the costs down as well, as the majority of exchange-traded fund assets are managed by the ten largest complexes (Investment Company Institute, 2024). Trading volume has been discovered to increase overall because of the intraday accessibility, but especially during high volatility periods, since ETFs act as a primary channel for short-horizon liquidity traders and scared investors during market stress. Highly traded ETFs like the SPDR S&P 500 have been known to trade more volume than all S&P 500 stocks combined during volatile periods (Ben-David et al., 2018).

The theoretical framework presented in Chapter Two predicts that this shift has consequences. Mechanical indexing generates non-fundamental demand that must be absorbed by the remaining active side. The capacity of that active side depends on the arbitrage constraints described in Section 2.5. Chapters four and five will examine the evidence of effects on both sides of this equation, first for passive funds and then for active funds.

4 Passive Funds and Efficiency

This chapter examines the effects of passive growth on arbitrage capacity and market efficiency. The evidence is organized around the central research question of whether passive growth enhances or constrains arbitrage.

4.1 Findings Suggesting Reducing Efficiency

Passive funds purchase assets mechanically when capital flows into the funds. Passive investors primarily seek to capture the overall return of the index and do not condition their investment decisions on firm-level information. Strong index performance and low costs have increased the popularity of passive investing. This has led to continuing inflows into index funds with minimal regard to valuation levels or firm fundamentals. This kind of development alone should not be a problem, since active traders should answer these abnormalities. Arbitrage is fundamentally based on the existence of market inefficiencies, and arbitrage opportunities arise when mispricing persists in equilibrium (Grossman and Stiglitz, 1980). Studies on passive investing have been concluded with findings suggesting benchmark-driven demand to affect price informativeness. Bond & Garcia (2022) discovered that growing demand for indexing makes the index less price informative, while Jiang et al. (2024) found the underlying assets of the index to be affected as well. Jiang and others argue that the price distortions are concentrated in the largest firms within the index. This concentration in large companies is explained by the cap-weighted design of most passive funds and the way these funds mechanically allocate more dollars to stocks with larger index weights. Consistent with these findings, Haddad et al. (2025) have similar findings suggesting that the increase in passive investing observed over the past two decades in the U.S. has decreased the sensitivity of demand to prices for individual stocks by about 11%. Haddad et al. estimate this effect using detailed 13F portfolio holdings data for institutional investors in the U.S. stock market from 2001 to 2020. Their methodology measures how investors strategically adjust their demand elasticity in response to the behavior of other investors. The pass-through of passive growth to affect elasticity is estimated at approximately 0.33. This indicates

that only a third of the shift to passive investing translates into reduced demand elasticity after accounting for the active side's strategic response. This implies that the remaining two-thirds are absorbed by active investors trading more aggressively, but the one-third that passes through is still substantial enough to produce measurably more inelastic and volatile prices. Assets are bought because the index is bought, not because companies themself seem profitable. The question then becomes whether the remaining active side can absorb these distortions, given the arbitrage constraints described in Section 2.5.

The equilibrium presented by Bond & Garcia (2022) is consistent with Shleifer & Vishny's (1997) argument of arbitrageurs being a small, very talented group of investors. Since the remaining pool is a small group of investors, they can be assumed to trade with invested capital. Gromb & Vayanos (2002) theoretically proved, and Brunnermeier & Pedersen (2009) subsequently showed empirical evidence that arbitrageurs to be limited by how much collateral they have available and strongly suggest that volatility to increase the collateral needed. Agency problem is present in this equation and proportionally explains why small, talented groups of experts cannot break down index overvaluation or efficiently remove price rigidity. Haddad et al. (2025) provide a structural estimate of this constraint. Their model estimates that the strategic response parameter (χ) would need to be at least 18 for the active side to compensate 90 percent of the elasticity lost when half of the investors become passive. Their actual estimate is approximately 3. This gap confirms that the active side's competitive response falls far short of what would be required to neutralize the effects of passive growth.

All prices affecting market activity that cannot be justified with fundamental values can be referred to as market noise. Haddad et al. (2025) find that the market has become more sensitive to noise and random shocks because the active side cannot cover the price distortions caused by the passive growth. Their research suggests that active investors respond to price distortions by increasing their trading volume by only about two-thirds relative to the passive shift. This deficit indicates that the market's demand curve

has become steeper. Mechanical index flows are discovered to cause large and more persistent price swings that the remaining small pool of experts cannot always counter-balance. Jiang et al. (2024) argues this affects the largest constituents of the index more strongly, and stocks that experience both noise trading and large passive capital flows are documented to experience larger amounts of idiosyncratic volatility and to be avoided by arbitrageurs. The mechanism behind this concentration effect is more specific than general co-movement. Jiang et al. show through both theoretical modelling and empirical testing that passive flows raise the prices of the largest firms through an amplification loop operating specifically through idiosyncratic risk. When passive flows generate additional demand for a large firm that active investors are already shorting to correct overvaluation caused by noise traders, active investors must scale up their short position to absorb the new demand. This exposes them to greater idiosyncratic risk because the firm is large enough that its price movements are non-negligible in absolute terms. The stock price must then rise to compensate active investors for bearing this risk, and as the price rises, the absolute magnitude of idiosyncratic movements grows further still. Empirically, they find that a one-standard-deviation increase in S&P 500 index fund flows is associated with the top 10 firms outperforming the index by 0.687% per quarter, while the effect diminishes monotonically as smaller firms are included. This size gradient is not explained by CAPM beta alone, and it connects directly to Pontiff (2006), arguing that stocks most in need of correction are the ones where the holding cost of arbitrage rises fastest because of the same passive flows that created the mispricing.

This is consistent with Pontiff's (2006) demonstration that idiosyncratic volatility acts as a holding cost for arbitrageurs. Therefore, stocks most distorted by passive flows are the ones most costly to correct. This connection is empirically supported by Haddad et al. (2025), who confirm in cross-sectional tests that stocks with lower aggregate demand elasticity are connected to higher return volatility and illiquidity.

This evidence is consistent with Shleifer and Vishny (1997), who predict specifically that arbitrageurs will withdraw from positions where short-term losses are most likely to

trigger investor withdrawals. This is precisely the profile of stocks most heavily affected by passive flows, where overvaluation and idiosyncratic volatility are highest. Arbitrageurs tend to avoid too risky investments just because of the risk of losing their funding if a trade goes against them in the short term, even if they are fundamentally correct in the long run. Additionally, Pavlova & Sikorskaya (2024) found inelasticity and mispricing to be apparent as well and found professional investors to be "forced" to buy already overpriced index, and this way making the situation worse. It sharpens this picture analytically alongside Jiang et al. (2024) and Haddad et al. (2025). Haddad et al. document that the active side covers only approximately two-thirds of the distortions passive flows create in aggregate. Jiang et al. provide the micro-level explanation for where this deficit is concentrated. Their results show that the gap between passive flow effects and active correction capacity is largest for the largest firms, where the amplification loop operates most forcefully. The one-third aggregate deficit documented by Haddad et al. is therefore not evenly distributed across the index but concentrated in the largest firms where idiosyncratic risk amplification makes correction most costly. This is linked to the synchronization risk presented by Abreu & Brunnermeier (2002), which stems from this kind of continuous, volatile upward trend and delays arbitrageurs to act. In the same context where prices derive further, and volatility increases, the recall risk for lending markets demonstrated by D'Avolio (2002) is apparent when the opinions of people who want to short and go long diverge. Simultaneously, Brunnermeier & Pedersen (2009) show evidence for raising margin requirements as volatility increases during these upward trends and creates "margin spirals" where an initial shock leads to higher volatility and lower market liquidity.

Together, the findings in this section present a coherent picture where passive growth reduces the sensitivity of prices to information and simultaneously makes arbitrage correction more costly and risky. The stocks most in need of correction are those where correction is found to be most difficult. The evidence from Haddad et al. (2025) is particularly important here because it moves beyond theoretical prediction and quantifies the deficit in the markets directly. A two-thirds active response means that one-third of

passive-induced distortions persist in equilibrium. This persistent fraction is not random noise but systematic mispricing concentrated on the largest and heavily indexed stocks.

4.2 Findings Suggesting Increasing Efficiency

Downsides and limitations are highlighted in research literature examining the development from active towards more passive markets. It is widely agreed that passive growth alters the prices differently and more strongly than before, and requires increased activity from the active side to balance the situation.

While passive growth creates the distortions described above, research also suggests mechanisms that preserve or improve efficiency. Bond & Garcia (2022) find that although passive growth makes the index less price informative, the efficiency of the underlying assets may remain unchanged, or perhaps increase. Price pressure and uninformed trading become concentrated at the index level when more investors trade passively. Remaining active managers have the same returns and incentives to stay informed and ensure that passive investing does not necessarily decrease price efficiency. This equilibrium argument requires scrutiny when placed against the Jiang et al. (2024) mechanism. Bond and Garcia (2022) and Coles et al. (2022) argue that the remaining active pool becomes more skilled per capita as passive investing grows. However, the amplification loop shows that skill alone is insufficient to correct the largest distortions. The barrier is not informational but structural. The idiosyncratic risk that a correction attempt itself generates grows with firm size and position size. A more skilled arbitrageur facing a large short position in a mega-cap firm does not face a smaller idiosyncratic risk. Skill concentration, therefore, improves price discovery for smaller stocks where idiosyncratic risk is negligible, but does not resolve the structural barrier at the top of the size distribution where passive flow effects are strongest. The brain drain from active side to passive is described as a marginal change, because remaining active investors is on average, better informed. Coles et al. (2022) support this equilibrium view. They find that overall information drops as indexing grows, but price informativeness remains stable since higher skill in a smaller pool keeps prices efficient. The investors who barely made

any effort are considered a waste of potential, and their switch to the passive side leads to the remaining talented group being better at extracting meaningful signals from the data that is available. This skill concentration argument connects directly to the Grossman-Stiglitz (1980) equilibrium described in chapter two. The information acquisition costs for the remaining skilled traders are effectively spread over a smaller but more productive pool if passive growth removes the least informed active participants. The equilibrium signal-to-noise ratio for active trading may therefore remain stable or even improve, as long as the remaining active traders retain enough capital to act on their information.

Improvements in market efficiency through passive growth have also observed in changes considering the lending market and reduced costs. The growth of passive funds increases the supply of stocks available for lending. Passive funds are considered ideal and reliable stock lenders for investors wanting to short. This is mainly because passive fund managers usually are large institutions and long-term holders of stocks covering the whole market index. Passive funds maintain index-locked positions, and the risk for selling based on performance needs or noise trading is minimal relative to active managers. This indicates longer loan durations and lower recall risk, which was discovered to be a risk factor for arbitrage. Palia & Sokolinski (2024) describe passive funds to be strategic borrowing channel for the active side since they offer such a stable source for shorting with diminished risks for information leakage. This steady supply is particularly vital for stocks that are otherwise limited since they are harder to borrow and constrained, as Duffie et al. (2002) demonstrate. Short sellers are found to be willing to pay higher lending fees for passive funds in exchange for their stable and diverse supply. Concurrently, passive funds are discovered to be eager lenders because of the premium they earn. Palia & Sokolinski (2024) argue that the rise of passive funds to improve efficiency by making it easier and safer to short. These findings additionally break Sharpe’s (1991) framework's core assumptions, where passive investors do not engage in any activity other than holding the index.

It is important to assess these efficiency improvements critically rather than accepting them at face value. The equilibrium models of Bond & Garcia (2022) and Coles et al. (2022) are theoretically elegant, but they rest on assumptions that the capital available to the remaining active managers is sufficient to correct the distortions passive growth creates. Haddad et al. (2025) provide direct empirical evidence that this assumption does not fully hold in practice. The lending market improvements documented by Palia & Sokolinski (2024) are similarly conditional. They reduce one specific constraint on shorting, but they do not address synchronization risk, margin requirements, or the agency constraints that Shleifer and Vishny (1997) identify as limits in practice. The efficiency improvements in this section, therefore, represent partial offsets rather than full corrections. These improvements lie on the premises of unconstrained capital and sufficient arbitrage activity to benefit from the improved lending market.

4.3 Summary on Passive Growths Effects

Equilibrium models suggest the remaining active side may be more skilled per capita and capable of maintaining price informativeness (Coles et al., 2022; Bond & Garcia, 2022), though these models do not fully account for the capital constraints that arbitrageurs face in practice. Passive growth also improves the lending market and provides a stable and less risky source (Palia & Sokolinski, 2024).

The chapter concludes that passive investing introduces price distortions through mechanical buying and increased noise. Shift to passive decreases the active side in size, but equilibrium models and research suggest the active side to be able to offset forces through more efficient arbitrage and improved lending market. The net effect on arbitrage capacity is negative when evaluated against the research question of this thesis. Passive growth introduces distortions that exceed the active side's documented capacity to correct them, and the improvements in lending markets and active skill concentration are real but insufficient to close the gap that Haddad et al. (2025) found.

5 Exchange-Traded Funds and Efficiency

This chapter examines the effects of ETFs and their growing popularity in financial markets, considering the informational efficiency and arbitrage limits for stock markets.

5.1 Findings Suggesting Reducing Efficiency

The starting point for understanding how ETFs may reduce efficiency is their customer base. ETFs attract short-horizon investors because ETFs offer intraday liquidity and low trading costs. These traders create demand shocks that affect the underlying securities through the AP arbitrage channel. Ben-David et al. (2018) document this using trade-level data and show that institutions holding ETFs have significantly shorter investment horizons and higher churn ratios than those holding the underlying stocks. The key empirical result is that approximately 90 percent of the price impact of ETF flow shocks reverts within 40 trading days, which indicates that demand is non-fundamental. The economic scale is substantial for this. One standard-deviation increase in ETF ownership is found to raise daily stock volatility by approximately 16 percent of a standard deviation. Ben-David et al. establish this effect as causal with using the Russell index reconstitution as a quasi-natural experiment. They find that increased ETF ownership raises stock volatility to a degree where previously average stocks become more volatile than roughly two-thirds of all stocks in the market. Brown et al. (2021) strengthen these findings from the ETF side, showing that high-creation ETFs are predictably overpriced and that a long-short strategy exploiting this reversal generates significant alpha. They find that the mispricing fades over time, suggesting it is not driven by fundamentals. But as both studies point out, the fact that it is temporary does not remove the cost of the volatility it creates. The indirect costs fall on long-term passive investors who bear stronger noise in underlying stock prices without being positioned to capture the reversal profits that arbitrageurs earn.

The distinction between relative and absolute arbitrage is central to evaluating the ETF mechanism. Israeli et al. (2017) reach a similar overall conclusion, but through a different

angle. While Ben-David et al. link the loss in efficiency to higher volatility, Israeli et al. focus instead on the information channel. Their argument is that high ETF ownership lowers the informativeness of the underlying stocks by attracting uninformed liquidity traders who would otherwise have traded individual stocks. The effective number of informed traders per stock declines, bid-ask spreads widen, and analyst coverage deteriorates, as these traders migrate to the ETF market. Also, the cost of acquiring firm-specific information rises relative to the returns from doing so. This is a direct application of the Grossman-Stiglitz (1980) equilibrium. When the price of information exceeds the return it generates, rational investors stop acquiring it, and prices become less informative. Israeli et al. document this empirically through a weakening in several measures of stock-level price efficiency as ETF ownership increases. The comparison with Ben-David et al. (2018) is instructive here. Ben-David et al. show that prices move more in response to ETF flows than to fundamentals and then revert. Israeli et al. (2017) show that fundamentals act as a prompt to firm-specific fundamentals in the first place. These are two sides of the same coin, since ETF ownership simultaneously increases the noise component of price movements and decreases the signal component. Together, they imply that the "signal-to-noise ratio" in individual stock prices deteriorates systematically with ETF ownership. The AP mechanism does not resolve this deterioration. APs align the ETF price with the net asset value of the underlying stocks without taking a stance on the absolute valuation of the securities. They have neither the incentive nor the information to correct the firm-specific mispricing of any individual constituent. In practice, when APs carry out trades to absorb ETF-level demand shocks and correct the prices, they add extra price pressure on individual stocks that is not tied to fundamentals. This reinforces the same issue highlighted by Israeli et al (2017). The AP mechanism is therefore best understood as an efficiency improvement at the portfolio level that generates efficiency losses at the stock level. This trade-off is obscured when ETF arbitrage is described generically as a mechanism that keeps prices aligned, because the alignment it delivers is between the ETF and the basket of stocks, not between the fundamental values.

If ETF-induced volatility were purely idiosyncratic to each stock, it could be diversified away and would not create a return premium. Ben-David et al. (2018) show empirically that it cannot be diversified away. A long-short portfolio sorting stocks by ETF ownership quintile earns a statistically significant alpha of approximately 35 basis points per month over the full examination. Alpha was found to rise between 44 and 56 basis points in the post-2007 period when ETF ownership became higher. This premium survives adjustment for up to seven risk factors, including the Pastor-Stambaugh liquidity factor. This rules out the possibility that the alpha reflects compensation for known liquidity or factor exposures. The fact that the premium is larger in the more recent findings directly links its magnitude to the growth of ETFs. The mechanism where the undiversifiable risk arises is also consistent with Israeli et al. (2017). The volatility that ETF flows transmit is correlated across stocks, because most listed stocks are included in multiple ETF baskets as well. Israeli et al. document increased return co-movement because of rising ETF ownership. This is precisely the mechanism that makes the risk systematic rather than idiosyncratic. Yang et al. (2020) extend these findings by showing that the magnitude of the volatility and overvaluation effects is strongly conditional on stock characteristics. Using a sample from 2002 to 2018, they find that the price-inflation and volatility effects of ETF ownership are concentrated in illiquid stocks and in stocks dominantly held by passive rather than active ETFs. This finding connects to the arbitrage constraint framework of Section 2.5 in an important way. Illiquid stocks are precisely the stocks where short-selling is most expensive, and where the search frictions documented by Duffie et al. (2002) are most binding, and where Brunnermeier & Pedersen's (2009) margin spiral mechanism is most likely to operate. The concentration of ETF-induced distortions in the stocks that are hardest to arbitrage is also not a coincidence. It reflects the same stock selection process that Shleifer and Vishny (1997) predict. Arbitrageurs withdraw from positions where the risk of short-term losses is highest and leave mispricing to persist precisely where it is most costly to correct.

The findings from Ben-David et al. (2018), Israeli et al. (2017), and Yang et al. (2020) are consistent and mutually reinforcing. Ben-David et al. establish that ETF ownership raises

stock volatility through non-fundamental demand shocks. Israeli et al. show that this process simultaneously lowers the informativeness of stock prices by crowding out informed trading. Yang et al. show that both effects are amplified where arbitrage capacity is lowest. What makes this picture particularly important for the research question of this thesis is that the three findings are not independent distortions but parts of a single feedback loop. Higher ETF ownership attracts more short-horizon traders, whose flows generate more volatility, which makes informed arbitrage more costly. More costly arbitrage reduces the correction of mispricing and allows overvaluation to persist. This further reduces the return to informed trading relative to passive exposure. This loop does not require any individual actor to behave irrationally. It emerges from the interaction of rational responses to a market structure in which the arbitrage mechanism is both the source of the volatility and the instrument through which that volatility is supposed to be corrected.

5.2 Findings Suggesting Increasing Efficiency

The case for ETFs improving market efficiency rests primarily on two channels. First, the faster incorporation of systematic information and second, the expanded supply of lendable shares. Glosten et al. (2021) provide a comprehensive empirical treatment of both. Using Fama-MacBeth regressions on approximately 70,000 firm-quarters from 2004 to 2013, they find that ETF trading activity strengthens the link between stock returns and earnings news. This effect is driven entirely by the systematic component of earnings. ETF activity predicts faster absorption of systematic information and has no statistically significant effect on them, once total earnings are split into a market-wide component and a firm-specific part. The idea here is straightforward. Investors with information about broad market factors can act on it more cheaply through an ETF than by trading individual stocks because the basket structure reduces transaction costs. Idiosyncratic investors face the opposite incentive, because trading through an ETF weakens any firm-level informational edge across the entire basket. ETF activity, therefore, accelerates macro-level price discovery while remaining neutral on firm-specific information. Glosten et al. further show that ETF activity lowers post-earnings-announcement drift,

with PEAD strategy returns declining from 2.53 percent in the lowest ETF activity quintile to 1.74 percent in the highest. This confirms faster semi-strong-form efficiency for aggregate signals, though not for the stock-level signals most relevant to capital allocation between individual firms.

These findings sit in direct tension with Israeli et al. (2017) findings about ETF ownership increase being associated with weakening across several measures of firm-level pricing efficiency. Their mechanism runs through the Grossman-Stiglitz (1980) equilibrium. The pool of noise trading that compensates informed investors for information acquisition shrinks, as uninformed traders migrate toward ETFs. This leads to lower incentives to gather firm-specific data. Israeli et al. show this themselves by replicating the Glosten et al. result and then showing it reverses once the lag between ETF ownership changes and earnings measurement is extended. The two studies describe different phases of the same dynamic. ETF trading improves the speed with which macro information enters prices in the short run, while the structural growth of ETF ownership weakens incentives to produce firm-specific information. The net effect on what stock prices reveal about individual firms is negative if the efficiency gains are concentrated on systematic information and the losses in idiosyncratic price discovery. This happens even if aggregate responsiveness to macro news improves.

Inclusion of a stock in an ETF basket mechanically expands the supply of shares available for borrowing, because ETFs lend their holdings through standard fund operations. Glosten et al. show that stocks in the highest ETF activity decile experience lending availability increases more than three times larger than those in the lowest. Palia and Sokolinski (2024) extend this finding by arguing that passive funds constitute a strategically valuable borrowing channel for short sellers, because their long-term, index-locked positions carry lower recall risk than those of active managers. This reduces one of the frictions Duffie et al. (2002) identify as central to the search process in the lending market. The efficiency gain is real, but its scope is conditional. Shleifer and Vishny (1997) identify the cost of establishing a short position and the risk of being forced to close

before prices converge, being risks for arbitrage. Cheaper borrowing addresses only the first. An arbitrageur facing a large short position in an ETF-heavy stock may enter the trade at lower cost and still confront higher margin requirements. This is driven by the same ETF-induced volatility that created the mispricing in the first place. Brunnermeier and Pedersen's (2009) margin spiral operates through collateral requirements and is therefore not resolved by expanded lending supply. There is also a mismatch where the benefit is felt. The lending improvement applies broadly, while the most severe ETF-induced overvaluation and volatility, as documented by Yang et al. (2020), concentrates in illiquid stocks where shorting constraints were already most binding before ETF growth. Bhojraj et al. (2020) offer a partial counterexample. They show that homogeneous ETFs tracking closely related indexes can facilitate information transfer across constituent firms. This suggests that the e potential for efficiency improvements for ETFs depends significantly on fund structure. This reinforces the overall conclusion that the gains documented in this section are genuine but conditional. These improvements apply most strongly in circumstances where ETF ownership is still low and the marginal effect of ETF activity on information transmission is largest.

5.3 Summary on Exchange-Traded Funds Effects

ETF inflows are associated with temporary mispricing which generate excess volatility and indirect costs for long-term investors, as demonstrated by Brown et al. (2021). ETFs are also found to increase volatility of underlying assets because of noise traders and Authorized Participants (Ben-David et al., 2018). APs additionally only correct the prices relative to each other and don't take a stance on the underlying assets valuation. Additional evidence shows that higher ETF ownership is associated with increased price levels and volatility which is evident specially among illiquid stocks and those held by passive ETFs (Yang et al., 2020). Simultaneously when investors shift toward ETFs, informational efficiency of individual stocks decreases. (Israeli et al., 2017).

ETFs can enhance efficiency by accelerating the incorporation of systematic information into prices in homogeneous funds and improve capital allocation to hedge funds.

(Bhojraj et al., 2020; Glosten et al., 2021). ETFs also improve securities lending by expanding the supply of lendable stocks, and their structure provides a transparent setting for observing and studying non-fundamental demand and its consequences (Brown et al., 2021).

Overall, the research suggests that ETFs introduce noise and volatility through non-fundamental demand and high-frequency trading but enhance efficiency through improved information transmission and arbitrage. Although arbitrage is relative and simultaneously increases volatility and therefore limits arbitrage, information transmission is inclusive to certain ETFs and situations. The net effect based on the literature reviewed in this thesis is that ETFs enhance systematic efficiency to some extent but simultaneously negatively alters stock level price accuracy and stability.

6 Comparative Analysis

Research on the growth of passive investing and exchange-traded funds both seems to argue about their growth to increase market noise. For passive investing, this is primarily driven by non-fundamental long-term capital inflows to funds, with similar findings conducted on passive ETFs. It should be noted that a major reason behind the growth of passive investing is the increasing popularity of ETFs. A large share of passive capital flows is channeled through ETFs and generates price pressure in a manner like investments made through traditional mutual funds. The cap-weight bias, where larger companies receive a disproportionately larger share of passive flows, is present in both fund types as it stems from the inherent structure of the indexes themselves. The level of demand is not constrained in either asset class, even when demand is recognized as non-fundamental.

6.1 Volatility and Noise

Passive investing through mutual funds and exchange-traded funds are both found to increase volatility and noise on the index level and for their underlying assets. Passive flows affect both asset classes by pushing prices upward (Brown et al., 2021; Jiang et al., 2024). Additionally, ETFs attract short-horizon trades and noise traders,, which amplify noise through intraday trading. (Brown et al., 2021; Ben-David et al., 2018). Price variation becomes more sensitive to capital flows rather than information in both cases. Subsequently, arbitrage becomes riskier and more expensive as volatility increases.

The nature and speed of volatility differ between ETFs and mutual funds. ETF-related volatility is typically short-term and driven by arbitrage activity. On the other hand, volatility linked to passive mutual funds is more persistent and structural. Passive investing through mutual funds leads to more persistent price movements and inflated valuations, while ETFs generate more immediate but transient noise. Volatility is concentrated unevenly across assets. In passive investing through both asset classes, the largest index constituents experience stronger price pressure due to capitalization-weighting. In ETFs,

volatility effects are also pronounced in illiquid stocks and those with high ETF ownership (Yang et al., 2020).

The distinction matters because the two volatility types compound one another. ETF-related noise is often corrected relatively quickly, while passive-induced distortions may persist longer due to weaker arbitrage capacity. ETFs primarily increase volatility without always reducing long-term price efficiency, whereas passive investing through mutual funds may have more durable effects on price levels and co-movement.

6.2 Arbitrage Constraints

Authorized Participants correct only relative mispricing between ETFs and their underlying assets, not absolute deviations from fundamental value. This means that the fundamental correction still depends on the shrinking and constrained active side. ETFs shift arbitrage activity toward more performance-based investment by allocating capital to hedge funds. (Brown et al., 2021). Performance-based investment decreases risk-taking for arbitrage and creates non-fundamental demand through closet indexing among active managers. (Shleifer & Vishny, 1997). Simultaneously, when passive flows and ETFs create volatility and price pressure, collateral requirements rise as risk of arbitrage losses increases.

The synchronization risk that prolongs arbitrage is more evident as passive flows create mechanical momentum and volatility. This is less relevant for ETF-related arbitrage since Authorized Participants do not need to wait for other APs to act. ETF activity nevertheless affects this risk as well by transmitting volatility to underlying assets. This increases the coordination problem for active arbitrageurs that operate at the stock level (Brunnermeier & Pedersen, 2009).

Research and findings on this topic suggest that passive mutual fund flows and ETFs create arbitrage constraints through different mechanisms. Mutual fund flows generate persistent overvaluation and capital-constraint pressure directly through mechanical

buying. ETFs on the other hand generate these constraints indirectly. This is through volatility transmission, and the AP mechanism's limitation to relative correction, as well as performance-based funding structures. Both channels simultaneously reduce the active side's willingness and capacity to correct mispricing, consistent with Pontiff's (2006) finding that rising idiosyncratic volatility increases the holding cost of arbitrage positions.

6.3 Improvements

ETFs are discovered to respond quickly to new information and to enhance incorporation of systematic information into stocks. Passive growth and ETFs both decrease costs for funds and this mirrors to less capital limited market activity. ETFs enhance liquidity at portfolio level and active ETFs channel capital efficiently for arbitrageurs. For Authorized Participants ETFs offer transparent and observable arbitrage mechanisms to keep prices aligned (Glosten et al., 2021).

Active side is also argued to be more efficient and as the passive side tends to grow (Coles et al., 2022; Bond & Garcia, 2022). Other major benefits are the improvements concerning lending market. Passive ETFs and mutual funds supply of lendable shares increase simultaneously with passive growth. Long-term lending, lowered recall risk and larger pool of lendable shares are all associated with passive funds lending. (Palia & Sokolinski, 2024; Duffie et al., 2002).

The improvements associated with ETF activity and passive growth are concentrated in benefits for systematic efficiency and market functioning. For exchange-traded funds this means faster incorporation of aggregate information and improved arbitrage conditions. For passive growth this indicates improvements in lending markets and perhaps more informed and efficient active side per capita. However, systematic information benefits are limited to certain fund types (Bhojraj et al., 2020) and lending market improvements are only one piece of the puzzle among several arbitrage constraints.

6.4 Informational Efficiency

For ETFs, price movement is ongoingly aligned with net asset values of an underlying asset. This asset class is efficient in terms of price informativeness as prices cannot significantly deviate in practice, given that these instruments do not reflect views on the underlying assets. Even though ETFs on some scale improve incorporation of systematic information, they are more widely recognized to transmit volatility to underlying assets through noise trading and high-frequency trading. ETFs still transmits risks and volatility for other arbitrageurs, even if authorized participants arbitrage was without constraints. It is also important to note the passive price pressure itself, which is increasingly transmitted through ETFs into index-linked investments. Now stocks have the price pressure of passive growth volatility and noise trader risk which arise through both ETFs and mutual funds, but APs have already done their job to align ETFs with underlying assets. Authorized Participants kind of take the easy way out of this equation where price distortions should be answered based on fundamentals, not just price differences.

After Authorized Participants have done their job, the shrunken active side of arbitrageurs should correct the prices relative to their fundamentals. Based on theoretical and empirical evidence reviewed in this study, the possible underperformance of active managers to be reasoned with capital constraints, prolonged returns and increased volatility and noise simultaneously. Arbitrage is increasingly risky in terms of volatility and risks coming from non-fundamental demand. In equilibrium where the active response would be equal to passive side, this would mean that arbitrageurs should be able to take bigger risks with less capitally constrained. The answer to these capital constraints can be proportionally found within the growth of ETFs, as they deliver low-cost capital for arbitrageurs, but still doing that performance based. This reinforces the agency constraints described by Shleifer & Vishny (1997). ETFs are additionally increasing arbitrage risk by transmitting volatility to assets but simultaneously increasing price informativeness on systematic level. Finally, the effects on lending market can be seen as a beneficial impact on market efficiency and to be accomplishment of both growth of exchange-traded funds and passive investing.

Research examined in this thesis suggests arbitrage to be increasingly constrained, especially for the most volatile and overpriced stocks that capital-weighted funds induced with non-fundamental demand create. (Shleifer & Vishny, 1997; Jiang et al., 2024). The constraints that arbitrageurs face push them away from the riskier positions. The incentives of this development are consistent with the Bond & Garcia (2022) framework, where active investors shift toward more beneficial assets. In this case, it means assets that are not too risky and volatile to be in margin limits created by capital constraints. Subsequently, this is consistent with empirical evidence coming from Haddad et al. (2025), suggesting active sides' response to be equivalent to two-thirds of passive sides' strength. The remaining one-third represents mispricing that persists because arbitrage constraints documented throughout this thesis prevent full correction, and not because the active side lacks skill. Similarities and connections between evidence suggesting decreasing efficiency are strongly aligned and are backed by theory discussing arbitrage limits and market development. However, these developments and discoveries are quite new, and evidence showing markets to have become more inefficient or remained efficient has not been conducted on a large scale.

7 Conclusion

Empirical research on this topic indicates that it is quite hard to distinguish non-fundamental risk factors from fundamental ones. It is difficult to directly attribute inefficiency to the growth of passive investing or ETFs, since shifts often alter the entire framework when examining markets as a complex system that involves multiple variables. Research examined in this thesis is consistent with passive growth to increase non-fundamental demand, and noise risk to be larger threat to arbitrage in this scenario. Research papers argue that ETFs and passive growth both induce volatility as well, however, in different ways. Overall, the growth of ETFs increases stock-specific arbitrage risk outside the ETF mechanism and partially enhances efficiency on macro-wide information and capital allocation for arbitrage. Passive investing, on the other hand, makes markets more inelastic, non-fundamental, unpredictable, and riskier to arbitrage. For both, the shift from active side to passive, and from individual stocks to ETFs, shrinks the active side and information acquisition, and subsequently increases the lending market's abilities and activity on fund-level and index-level.

Does the simultaneous growth of passive investing and exchange-traded funds constrain arbitrage to a degree that undermines stock-level pricing efficiency in the U.S. stock market? Passive growth and the rise of ETFs have created a more inelastic and volatile market for stocks, where price distortions are more frequent due to mechanical demand, noise, and high-frequency trading. Based on research, the effects are that markets may become more efficient at the macro-systematic level, but increasingly constrained to arbitrage on firm level. Market efficiency depends on a shrinking pool of active managers' capability to correct individual stocks through riskier arbitrage, and empirical evidence arguing that markets have become less efficient has been conducted. The one-third deficit between the active side's response and the passive side's strength documented by Haddad et al. (2025) suggests that current arbitrage capacity is insufficient to fully offset the distortions that passive growth creates.

Additionally, it is notably difficult to separate the reasons for stock price movement into non-fundamental and fundamental, and ETFs are characterized as a unique laboratory for studying the impact of non-fundamental demand shocks (Brown et al., 2021). The ETF market provides a cleaner environment for researchers to observe and measure market noise compared to other asset classes. This is because the arbitrage mechanism between an ETF and its underlying basket allows for the direct observation of non-fundamental demand shocks through creation and redemption activities.

Future research on this topic can point in many directions. Most of the evidence and papers examined on this topic are relatively recent, and the long-term effects of this shift to more passive and ETF centralized markets are still open questions. Capital constraints are in center of this topic, and research and studies examining the effects and the severity of this shift to more performance-based arbitrage have not been conducted at sufficient scale. Research on whether arbitrage constraints are intensifying proportionally as passive flows grow would be valuable. This way, the shrinking active sides adaptation and its efficiency would be more observable. The interaction of passive flows and ETF-specific distortions could be researched as a combined phenomenon as well, since they fuel one another, and investors are exposed to the risks of these two simultaneously.

Finally, the existing research is heavily concentrated on the U.S. stock market and its largest indexes. Evidence from smaller markets and other asset classes is very limited. Market structures and the balance between active and passive participation might differ considerably across markets. It is unclear whether the arbitrage constraints and non-fundamental demand effects documented in U.S. large-cap indexes apply in the same way in other markets. Research in these settings could reveal whether the constraints identified in this thesis are universal or specific to the characteristics of the U.S. market.

References

Abreu, D., & Brunnermeier, M. K. (2002). Synchronization risk and delayed arbitrage. Journal of Financial Economics, 66(2–3), 341–360. https://doi.org/10.1016/S0304-405X(02)00227-1

Ben-David, I., Franzoni, F., & Moussawi, R. (2018). Do ETFs increase volatility? The Journal of Finance, 73(6), 2471–2535. https://doi.org/10.1111/jofi.12727

Bhojraj, S., Mohanram, P., & Zhang, S. (2020). ETFs and information transfer across firms. Journal of Accounting and Economics, 70(2–3), Article 101336. https://doi.org/10.1016/j.jacceco.2020.101336

Bond, P., & García, D. (2022). The equilibrium consequences of indexing. The Review of Financial Studies, 35(7), 3175–3230. https://doi.org/10.1093/rfs/hhab106

Brown, D. C., Davies, S. W., & Ringgenberg, M. C. (2021). ETF arbitrage, non-fundamental demand, and return predictability. Review of Finance, 25(4), 937–972. https://doi.org/10.1093/rof/rfaa027

Brunnermeier, M. K., & Pedersen, L. H. (2009). Market liquidity and funding liquidity. The Review of Financial Studies, 22(6), 2201–2238. https://doi.org/10.1093/rfs/hhn098

Carhart, M. M. (1997). On persistence in mutual fund performance. The Journal of Finance, 52(1), 57–82. https://doi.org/10.1111/j.1540-6261.1997.tb03808.x

Coles, J. L., Heath, D., & Ringgenberg, M. C. (2022). On index investing. Journal of Financial Economics, 145(3), 665–683. https://doi.org/10.1016/j.jfineco.2022.05.007

D'Avolio, G. (2002). The market for borrowing stock. Journal of Financial Economics, 66(2–3), 271–306. https://doi.org/10.1016/S0304-405X(02)00206-4

De Long, J. B., Shleifer, A., Summers, L. H., & Waldmann, R. J. (1990). Noise trader risk in financial markets. Journal of Political Economy, 98(4), 703–738. https://doi.org/10.1086/261703

Duffie, D., Gârleanu, N., & Pedersen, L. H. (2002). Securities lending, shorting, and pricing. Journal of Financial Economics, 66(2–3), 307–339. https://doi.org/10.1016/S0304-405X(02)00226-X

Fama, E. F. (1965). The behavior of stock-market prices. The Journal of Business, 38(1), 34–105. https://doi.org/10.1086/294743

Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. The Journal of Finance, 25(2), 383–417. https://doi.org/10.2307/2325486

Fama, E. F. (1991). Efficient capital markets: II. The Journal of Finance, 46(5), 1575–1617. https://doi.org/10.1111/j.1540-6261.1991.tb04636.x

Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. The Journal of Finance, 47(2), 427–465. https://doi.org/10.1111/j.1540-6261.1992.tb04398.x

Friedman, M. (1953). *Essays in positive economics.* University of Chicago Press.

Glosten, L., Nallareddy, S., & Zou, Y. (2021). ETF activity and informational efficiency of underlying securities. Management Science, 67(1), 22–47. https://doi.org/10.1287/mnsc.2019.3427

Gromb, D., & Vayanos, D. (2002). Equilibrium and welfare in markets with financially constrained arbitrageurs. Journal of Financial Economics, 66(2–3), 361–407. https://doi.org/10.1016/S0304-405X(02)00228-3

Grossman, S. J., & Stiglitz, J. E. (1980). On the impossibility of informationally efficient markets. The American Economic Review, 70(3), 393–408. https://www.jstor.org/stable/1805228

Haddad, V., Huebner, P., & Loualiche, E. (2025). How competitive is the stock market? Theory, evidence from portfolios, and implications for the rise of passive investing. American Economic Review, 115(1), 197–236. https://doi.org/10.1257/aer.20230505

Investment Company Institute. (2026). 2026 Investment company fact book. Retrieved 12.2.2026 https://www.ici.org/investment-company-fact-book-archive

Israeli, D., Lee, C. M. C., & Sridharan, S. A. (2017). Is there a dark side to exchange traded funds? An information perspective. Review of Accounting Studies, 22(3), 1048–1083. https://doi.org/10.1007/s11142-017-9400-8

Jensen, M. C. (1968). The performance of mutual funds in the period 1945–1964. The Journal of Finance, 23(2), 389–416. https://doi.org/10.1111/j.1540-6261.1968.tb00815.x

Jiang, H., Vayanos, D., & Zheng, L. (2024). Passive investing and the rise of mega-firms. Journal of Financial Economics, 163, Article 103922. https://doi.org/10.1016/j.jfineco.2024.103922

Jones, C. M., & Lamont, O. A. (2002). Short-sale constraints and stock returns. Journal of Financial Economics, 66(2–3), 207–239. https://doi.org/10.1016/S0304-405X(02)00224-6

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. The Review of Economics and Statistics, 47(1), 13–37. https://doi.org/10.2307/1924119

Markowitz, H. (1952). Portfolio selection. The Journal of Finance, 7(1), 77–91. https://doi.org/10.2307/2975974

Mossin, J. (1966). Equilibrium in a capital asset market. Econometrica, 34(4), 768–783. https://doi.org/10.2307/1910098

Palia, D., & Sokolinski, S. (2024). Strategic borrowing from passive investors. Review of Finance, 28(5), 1537–1573. https://doi.org/10.1093/rof/rfae012

Pástor, Ľ., Stambaugh, R. F., & Taylor, L. A. (2015). Scale and skill in active management. Journal of Financial Economics, 116(1), 23–45. https://doi.org/10.1016/j.jfineco.2014.12.008

Pavlova, A., & Sikorskaya, T. (2023). Benchmarking intensity. The Review of Financial Studies, 36(3), 859–903. https://doi.org/10.1093/rfs/hhac055

Pontiff, J. (2006). Costly arbitrage and the myth of idiosyncratic risk. Journal of Accounting and Economics, 42(1–2), 35–52. https://doi.org/10.1016/j.jacceco.2006.04.002

Ross, S. A. (1976). The arbitrage theory of capital asset pricing. Journal of Economic Theory, 13(3), 341–360. https://doi.org/10.1016/0022-0531(76)90046-6

Samuelson, P. A. (1965). Proof that properly anticipated prices fluctuate randomly. Industrial Management Review, 6(2), 41–49.

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. The Journal of Finance, 19(3), 425–442. https://doi.org/10.2307/2977928

Sharpe, W. F. (1991). The arithmetic of active management. Financial Analysts Journal, 47(1), 7–9. https://doi.org/10.2469/faj.v47.n1.7

Shleifer, A., & Vishny, R. W. (1997). The limits of arbitrage. The Journal of Finance, 52(1), 35–55. https://doi.org/10.1111/j.1540-6261.1997.tb03807.x

Yang, J. W., May, L., & Gould, J. (2023). Exchange-traded fund ownership and underlying stock mispricing. Accounting & Finance, 63(4), 4053–4084. https://doi.org/10.1111/acfi.13071