ERASMUS UNIVERSITEIT ROTTERDAM
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Investing in different macroeconomic regimes

ABSTRACT

In this study, from 1990-2022, the U.S. stock market is analyzed, dissecting equity returns and nine factors, including MKT-RF, SMB, HML, RMW, CMA, MOM, TSMOM, BAB, and QMJ, against shifting economic regimes: inflation, VIX volatility, and market variations. During high inflation periods, equities have positive nominal (2.43%), but negative (-1.24%) real returns. All the factors show positive returns in high inflation regimes. The multi-factor equity (MFE) performs well (0.74%) in high inflation and has significant variation in returns in the different inflation regimes. The QMJ has high returns (1.36%) in high inflation. For the period, from 1930-2022 MOM changes from sign (-0.03 to 0.55%) in low inflation regimes. RMW, CMA, and QMJ (defensive factors) perform strong in high VIX periods in absolute terms. CMA and BAB have significant variations in returns for the different VIX regimes.

Keywords: *equities, factor investing, inflation, VIX, bull markets*

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1. Introduction

In recent years, factor investing has increasing attention in academic and financial communities. Numerous scholars have cast doubt on the validity of the efficient market hypothesis, leading to an intensified examination of factor investing and the potential for alpha generation (Fama & French, 1992). Interestingly, while literature is abundant on the outperformance associated with factor investing, there remains a conspicuous gap in research regarding understanding this performance across varying macroeconomic conditions.

Macroeconomic conditions significantly impact factor performance, with, for example, growth and momentum factors excelling during bull markets and low volatility or quality factors outperforming in down markets (Ang, 2014). Understanding the macro-environment enables investors to favor factors that outperform in that regime.

This study assesses the performance of different factors during diverse economic regimes: periods of high versus low inflation, periods of high versus low VIX, and down and up markets. The aim is to research whether macroeconomic determinants play a role in influencing factor returns and whether specific factors exhibit heightened resilience or sensitivity in distinct macroeconomic conditions.

In the equity market, certain factors have been identified as potent indicators of alpha or excess return. One example is the momentum factor, the trend investing paradigm (Jegadeesh & Titman, 1993). This strategy advocates allocating to outperforming stocks, termed 'winners'—while concurrently selling underperformers or 'losers.' This strategy operates on the assumption that the performance of stocks, be it upward or downward, persists for intervals spanning three to twelve months. However, this approach is not without vulnerabilities. Take for example the 2008 financial crisis: leaders of the financial sector, such as Goldman Sachs and Morgan Stanley, were categorized as 'losers.' The momentum strategy shorts positions in these ‘losers. However, unforeseen governmental interventions in the form of bailouts significantly undermined this strategy, leading to substantial losses for momentum investors.

Furthermore, empirical evidence underscores the importance of macroeconomic variables and momentum-driven gains. While a predominant segment of scholarly literature attributes momentum profits to behavioral underreactions to firm-specific events, an alternative school of thought asserts that these returns are underpinned by risk-associated factors (Liu & Zhang, 2008).

Their seminal work asserts that the anticipated growth trajectory of industrial production can clarify over half of the returns derived from the momentum strategy.

The low-risk effect is another anomaly within the equity (Blitz & van Vliet, 2007). This phenomenon posits that equities characterized by lower volatility tend to yield superior risk-adjusted returns in contrast to their high-volatility counterparts. This effect is within the U.S. and across Japanese and European markets. Empirical studies suggest that equity market participants may disproportionately allocate premiums to higher-risk assets.

Historically, the foundational economic logic underpinning such market behaviors was encapsulated in the Capital Asset Pricing Model (CAPM). This model predicates that elevated risk leads to higher returns. However, the very essence of the low-volatility anomaly challenges this long-standing precept.

Furthermore, the CAPM operates on certain foundational assumptions, prohibiting short-selling and leverage constraints. However, in the empirical realm of market operations, participants either encounter prohibitions against or harbor deep-seated aversions toward short-selling and leverage. Such constraints may impede arbitrageurs, rendering them unable to rectify pricing anomalies efficiently. Additionally, while the CAPM postulates a frictionless environment without taxes and transaction costs, the practical reality of equity markets invariably involves such considerations.

Within market factors, the size effect suggests that small-cap stocks outperform large-cap stocks (Banz, 1981). This outperformance can be attributed to several risk factors. Specifically, small-cap firms face lower profitability, unpredictable cash flows, limited liquidity, and higher volatility, and underperform in tough economic times (Jensen & Mercer, 2002).

Furthermore, the risk premium associated with these stocks fluctuates based on monetary policy. There is a positive correlation between small-cap stock returns during expansive monetary periods and a negative one during contractionary phases. Notably, the Federal Reserve's tendency to lean towards accommodating monetary policies often leads to increased capital costs, evident through higher interest rates, intensifying the default risk for smaller firms.

The potential for securing excess returns is recognized in factor investing. Yet, academic inquiries predominantly focus on annual alpha, not considering the various macroeconomic situations.

Unfavorable macroeconomic climates invariably yield adverse outcomes for the investor (Ang, 2014). Examining the details of economic growth, large-cap equities have been observed to yield returns of 12.4% during expansionary phases, this contracts to 5.6% in recessions. Concurrently, the volatility associated with these stocks shifts from 14.0% during expansions to 23.7% during recessions. Small-cap stocks' difference between expansionary and recessional returns is even stronger, 16.8% and 7.8%, respectively.

Elevated inflationary regimes similarly present challenges to the equity market. Specifically, on average, large-cap equities returns of 14.7% in low inflation regimes, compared against a more modest 8.0% in high inflation regimes. The volatility index, or VIX, also emerges as a pivotal metric influencing stock returns. A pronounced leverage effect is evident, with VIX fluctuations and stock returns sharing a correlation coefficient -0.39. An uptick in a firm's financial leverage can be traced back to diminishing stock returns, as the static nature of debt contrasts with declining equity values, thus amplifying equity risks. This dynamic accentuates equities as intrinsically more volatile instruments in comparison to bonds. The financial turbulence of bygone days, characterized by soaring volatility and plummeting stock returns, exemplifies this. To contextualize, large stock returns averaged -4.6 % during heightened volatility phases while returning a robust 24.9% in more stabilized environments.

A fluctuating risk premium emerges as a focal point when researching market dynamics. As market volatility rises, discount rates similarly increase, leading to a decline in stock prices. As the CAPM postulates, this adjustment ensures enhanced stock returns in subsequent periods.

Consequently, this study aims to dissect the performance of various market factors, encompassing market beta, size, value, momentum, low-risk, profitability, investment, (time-series) momentum, betting against beta, and quality against diverse macroeconomic regimes. Specifically, how do these factors perform during high and low inflation, high and low VIX periods, and bull (up) and bear (down) market cycles? The central research question is: "To what degree do equity returns and factors vary across distinct macroeconomic environments?"

Exploring equity dynamics, a negative link exists between equity returns and macroeconomic climates (Fama & Schwert, 1977; French et al., 1987). The effects on individual factors, however, remain less defined. This study aims to discern these relationships, focusing on 1990-2022, and performing robustness tests for 1930-2022. The analysis covers portfolios across the U.S. equity market.

The investigation probes market anomalies in varied macro environments using data from the Fama-French library, AQR library, CRSP, CBOE, and the U.S. Bureau of Labor Statistics. During favorable macro conditions, aggressive factors like size and momentum might outperform defensive ones like value and low volatility. These insights deepen theoretical asset valuation understanding and, when researched against diverse macroeconomic contexts, provide valuable guidance for stock market investors.

The paper's structure is structured as follows: The subsequent chapter dives into the theoretical foundation, followed by chapters outlining data sources and methodologies. The next chapter presents the results of our analysis, followed by a discussion of these results. The last section presents the conclusion, leading to a final summary of the study's main findings.

2. Literature review

2.1 Efficient Market Hypothesis (EMH)

The EMH is a foundational concept in contemporary financial theory (Fama, 1970). It posits that markets are consistently efficient, implying that consistently outperforming the market via predictive strategies or specific stock selections is a challenging endeavor. This theory, however, is not exempt from scrutiny. Certain investors, e.g., Peter Lynch and Warren Buffett, have demonstrated consistent market outperformance. Does this phenomenon merely boil down to luck?

The EMH can be dissected into three distinct forms of informational efficiency:

1. **Strong Form**: This suggests that every piece of information, public or confidential, is instantaneously factored into stock prices.
2. **Semi-strong Form**: Stock prices adjust rapidly in response to publicly available information. However, those possessing insider information may have a potential advantage in achieving returns that surpass the average.

3. **Weak Form**: In this scenario, stock prices are primarily influenced by their historical patterns. Integrating public and private information is lacking, thus offering an avenue for informed investors to potentially achieve superior returns.

2.2 CAPM

Market exposure is the primary factor influencing a stock's return. Therefore, we briefly examine the widely recognized Capital Asset Pricing Model (CAPM).

A framework that links a portfolio's risks and anticipated returns was first introduced by (Markowitz, 1952). Scholars then deduce that a stock's risk consists of two main categories: company-specific risk (unsystematic risk) and risk arising from broader economic uncertainties evident in the market (systematic risk). As diversification can mitigate all unsystematic risks, only market risk should warrant compensation through higher expected returns.

The CAPM model was initially presented by Treynor in 1961 and later expanded by other researchers (Lintner, 1965; Mossin, 1966; Sharpe, 1964; Treynor, 1961). During the 1960s, CAPM became the standard framework for predicting future returns.

In the CAPM framework, risk and return determine a single factor: the market beta. This beta represents how sensitive the risk of a stock, portfolio, or mutual fund is relative to the overall market risk.

The expected performance of a portfolio within the CAPM is:

$$E(R_i) = R_f + \beta * \left(E(R_m) - R_f\right),$$

$E(R_i)$ is the expected return of a stock.

R_f denotes the risk-free rate, commonly represented by a 10-year U.S. government bond.

β measures the stock's volatility or its systematic risk. The market itself has a beta of 1.0. A stock with a β greater than 1.0 suggests it is more volatile than the market.

$E(R_m) - R_f$ represents the market risk premium, which is the additional return an investor expects for bearing systematic risk.

2.3 Inflation

Inflation denotes the increase in the overall price level of an economy's goods and services, which diminishes the buying power of money. The Consumer Price Index (CPI) assesses the average price of a selection of essential consumer goods and services. The Federal Reserve (FED) targets a 2 percent inflation rate in the long term. Stock returns are, in general, lower during high inflation periods (Lintner, 1975). During this period, there was a high inflation period and a common belief that equities were a good hedge against inflation. Lintner uses CPI for measuring inflation. Using regression analysis, he shows that stocks were not a good hedge against inflation because of increasing wages and the difficulty of entirely passing on the higher costs to consumers. High inflation was also bad for the bond returns because the purchasing power of bondholders decreased by inflation. Fama and Schwert found similar results for 1953-1971 (Fama & Schwert, 1977). The authors used the CPI to measure inflation, and they decomposed inflation into two parts: expected and unexpected. Expected inflation is based on historical inflation, and unexpected inflation is the difference between actual and expected inflation. Using regression analysis, they found that real returns on stocks tend to decrease during periods of high inflation and that the relationship does not vanish when controlling for the level of real activity and term structure of interest rates.

Momentum strategies on equities, bonds, and commodities excel during periods of high inflation, providing notable protection (Neville et al., 2021). They categorize high inflation as an inflation rate above 5%. Other factor strategies afford a certain level of hedging. Even though the average advantage might be modest, such as a 3% real return for a quality strategy compared to -1% for the value strategy, these factor portfolios outperform passive investments in stocks or bonds. In situations of moderate inflation, returns are the highest across various assets and factor premiums (Baltussen et al., 2023).

Their findings closely align with those of Neville et al. (2021), although they use a different method to measure inflation. For the period 1875-2021, they categorized their sample into four inflation regimes: (1) under 0%, termed as deflation, (2) ranging from 0% to the prevailing central bank target of 2%, (3) mild inflation, falling between 2% and 4%, and (4) high inflation, exceeding 4%. Their portfolios consist of 40% bonds and 60% equities. They find that the real returns remain positive while deflationary periods yield lower nominal returns. However, during high inflation, both equity and bond returns in real terms are decreasing. Factor premiums can mitigate some of the real capital losses in such challenging periods. During low inflation regimes, the value factor yields an excess return of 3.0%, while it stands at 4.5% during high inflation periods. The momentum factor produces an excess return of 6.1% in low-inflation periods and 7.7% in high-inflation periods. On the other hand, the quality factor offers an excess return of

3.3% in low inflation times, but this decreases to 2.0% during high inflation periods. Thus, it is evident that factor returns vary across different factors based on inflation levels.

Various studies highlight that the relationship between inflation and factor returns is complex. Notable variations in factor performance arise depending on the inflationary environment. Recognizing these differences prompts further exploration into the underlying reasons. Thus, the first hypothesis is: inflation considerably influences the dynamics of factor returns.

2.4 VIX (Volatility Index)

The VIX, utilized as this thesis's primary measure of volatility, represents the market's 30-day anticipated volatility, reflecting traders' and investors' sentiments. Originating in 1993 based on the S&P 100 options, its calculation methodology was enhanced in 2003 in partnership with Goldman Sachs, expanding to include a wider array of S&P 500 options. The VIX and perceived market volatility tend to spike during higher market anxieties.

Research indicates a positive correlation between stock market volatility and the market risk premium from 1928 to 1984, when the relationship between expected stock returns and volatility was ambiguous.

While the VIX pertains to the S&P 500's volatility, implied volatility (IV) encompasses a broader spectrum, including individual stocks, ETFs, currencies, and commodities. A notable study found that IV was a superior predictor of realized volatility in futures prices compared to historical volatility. This research, distinguishing itself by examining futures options across diverse asset classes in various markets, underscored the predictive potency of IV.

When the stock market shows higher expected volatility, the reward for choosing stocks over bonds will increase (French et al., 1987). The riskier the stock market seems, the higher the expected returns for investors.

After analysing various models, they found that the connection between average returns and their variance or standard deviation is not robust (Baillie & DeGennaro, 1990). Investors might prioritize other risk measures over the variance of portfolio returns.

Between 1963 and 2009, the observed relationship between past volatility and anticipated returns was negative, with an average quintile return difference of -3.7% (van Vliet et al., 2011). By excluding small-cap stocks, this relationship is reduced by 2%. However, this negative correlation intensifies by an additional 3% when considering compounding effects.

There is a negative relationship between idiosyncratic volatility and the expected returns of stocks (Ang et al., 2006). This negative relation intensifies during challenging macro-environments, such as recessions and periods of higher market volatility.

The authors calculate FF-3 alphas by comparing quintile portfolios 5 and 1, specifically during periods that fall within the lowest or highest 20% of market return movements. These periods represent instances of either low or high market volatility. In stable times, the difference in FF-3 alphas between the fifth and first quintile portfolios is -1.71% monthly. Conversely, this difference is -0.89% per month during volatile periods. The alpha differences in stable and volatile regimes are statistically significant at the 5% level.

High QMJ stocks are resistant to recessions and outperform low QMJ stocks during times of high volatility (C. S. Asness et al., 2019). They split their sample into the bottom and top 30% regarding the change in one-month volatility. The high QMJ stocks have an excess return of 0.43% per month in high volatile periods and an excess return of 0.13% in low volatile periods.

The role of volatility is vital in market behaviours. The VIX has evolved to capture market anxieties more effectively. Numerous studies highlight the interplay between stock returns, the market risk premium, and volatility. Additionally, specific stocks respond uniquely during volatile periods. These consistent findings highlight a crucial insight into the market's underlying dynamics. Given all this evidence, the second hypothesis is: VIX significantly impacts the dynamics of factor returns.

2.5 Recession

A recession indicates a significant, prolonged downturn in the economy. The definition is two back-to-back quarters of negative GDP growth. A key signal before the 10 U.S. recessions since 1955 was an inverted yield curve, though not all inversions led to a recession. Normally, short-term yields are lower than long-term due to the extended risk. Inversions, where long-term yields drop below short-term, can hint at an upcoming recession, as traders might anticipate economic slowdowns, leading to decreased interest rates. Historically, the U.S. has experienced 34 recessions since 1854, with only five after 1980. The aftermath of the 2008 and the early 1980s downturns were notably intense.

When the business environment improves, expected returns often decrease (DeStefano, 2004). By segmenting the business cycle, he noticed that stocks usually drop in value during growth periods, decline at recession beginnings, but rise towards recession ends. This fluctuation is tied to changing profit expectations in different business phases.

High-quality stocks, or QMJ, do well during market declines (C. S. Asness et al., 2019). It is because quality companies usually have strong financials, steady profits, and consistent cash flow, acting as a safety net in tough markets.

There seems to be a strong correlation between momentum investment returns and the business cycle (Griffin et al., 2003). Notably, these returns often peak in rising markets and can drop substantially, sometimes even becoming negative, in down markets.

Several factors account for the varied momentum returns across different business cycles (Hong & Stein, 1999). In a rising market, investors can capitalize on trends, especially when information disperses gradually among the population, causing prices to react slowly. This delayed response allows momentum traders to benefit from pursuing these trends. Nonetheless, if they rely solely on these basic strategies, their efforts to exploit discrepancies might result in overreactions over extended periods.

Drawing upon these studies and the inherent market dynamics patterns, we focus on a more pointed inquiry. From DeStefano's analysis of the business cycle's impact on expected returns to the resilience of high QMJ stocks in volatile markets, and the behaviour of investors that lead to the momentum effect, the research shows a clear pattern of how markets behave, influenced by changing business conditions and what investors are feeling. With this in mind, we dive deeper and put forward our third hypothesis: there is a difference in performance between factors in different market conditions.

2.6 Size factor

The size factor, also known as SMB (Small minus Big), is the difference between the returns of small-cap stocks and those of large-cap stocks. This factor originates from a portfolio strategy that goes long on small-cap stocks and short on large-cap ones (Banz, 1981). He observed that from 1931 to 1975, small-cap stocks yielded higher risk-adjusted returns than large-cap stocks, challenging the predictions of the (CAPM). Interestingly, when taken long against the largest cap stocks being shorted, the smallest stocks produced average excess returns of 19.8% yearly or 1.52% monthly. Going long on medium-sized firms and short on large firms gave just 0.21% monthly excess returns.

Fama and French also found evidence for the small-cap anomaly (Fama & French, 1992, 1993).

They incorporated the size factor in the three-factor model, including the market risk premium and the value factor. In their study, from 1963 to 1991, NYSE stocks on CRSP were annually ranked by size in June. Using the median NYSE size, stocks from NYSE, Amex, and NASDAQ, categorize stocks into 'small' (S) or 'big' (B) groups. They showed average returns of 1.64% per month for the smallest stocks and 0.90% for the largest. Their findings show that while a clear relationship exists between stock size and returns, the correlation between beta and returns vanishes once controlling for size.

However, contrasting research suggests the absence of any size effect (Alquist et al., 2018; Shumway, 1997). They argue that the seemingly impressive returns of smaller stocks are high due to the exclusion of delisted stocks, which often belong to smaller firms. When adjusting for market beta, the size premium's significance vanishes. Additionally, they find the size anomaly mostly apparent in January, with negligible or even negative returns in subsequent months. Over the long term, from 1926 to 2017, SMB yielded a 2.1% return in January. However, for the more contemporary window of 1976 to 2017, this drops to just 1.0% monthly, leading to speculations on the diminishing size effect.

2.7 Value factor

The value effect refers to undervalued stocks outperforming overvalued ones. Since the 1930s, value investing was born by Graham and Dodd. Later findings revealed a negative link between P/E ratios and risk-adjusted returns (Basu, 1977). Some believe this happens because investors irrationally expect more from growth stocks than value stocks. On average, stocks with low past returns yield higher future returns (De Bondt & Thaler, 1987). It is attributed to investors' tendency to overreact to news, thus mispricing stocks based on past performance.

The value effect is the High minus Low factor in Fama and French's three-factor model. Instead of the P/E ratio, they used the B/M ratio to measure value. They find a consistent positive relationship between the value factor and returns. They attribute this to economic distress (Fama & French, 1995). Investors demand a higher risk premium for stocks with distressed traits. During economic crises, this risk grows, leading to a larger premium for value stocks. Some believe the distress theory is unconvincing (Novy-Marx, 2013). He finds that value stocks paired with a quality strategy perform better, contradicting the distress theory, as quality firms usually show fewer distress signs. As neither behavioral bias nor risk premium theory fully explains the value effect, it suggests both have some validity (C. Asness et al., 2015).

2.8 Momentum factor

The momentum factor reflects excess returns from short-term winners over short-term losers (Jegadeesh & Titman, 1993). Stocks with recent gains outperform over 3-12 months, but this effect diminishes and even reverses. They investigate the momentum effect from 1965-1989. They select stocks based on their 6-month returns, and holding them for another 6 months, they achieve an average compounded alpha of 12.01% per year.

This momentum strategy implies high transaction costs due to frequent portfolio changes. Numerous studies confirm the momentum investing's return premium. Carhart adds the momentum factor to the Fama and French three-factor model (Carhart, 1997). This factor is the primary reason for the persistence in mutual fund performance.

Most scholars in the field typically use the cross-sectional definition, but this has changed (Moskowitz et al., 2012). These authors introduce an alternative approach. They present evidence suggesting that a security's previous returns, irrespective of its peers, can predict its future returns.

The time series momentum (TSMOM) strategy is effective for roughly a year but experiences partial reversals over extended durations. They evaluate TSMOM against the Carhart four-factor model. TSMOM yields a significant alpha, registering 1.58% monthly and 4.75% quarterly. The strategy predominantly loads on the cross-sectional momentum factor (UMD). TSMOM's peak returns occur during intense market fluctuations. It adopts a long position during significant market upswings and goes short during sharp downturns. Despite this, UMD and TSMOM exhibit a high correlation across all assets. Specifically, the beta of TSMOM with respect to cross-sectional momentum is 0.66, supported by a t-statistic of 15.17 and a R-squared value of 44%. As the intercept suggests, cross-sectional momentum does not entirely account for TSMOM, which displays a positive and significant monthly alpha of 76 basis points.

The TSMOM is expanded by (Ehsani and Linnainmaa, 2022). Their results closely align with those of (Moskowitz et al., 2012). Their research indicates that the time-series methodology produces an average annual return of 3.9%, in contrast to the 2.4% by the cross-sectional approach.

Efficient market theories struggle to explain the momentum factor, but behavioral finance offers insights. Theories suggest stock prices overreact or underreact due to investor biases.

There is typically an under-reaction in the short term, while the long term frequently sees a delayed overreaction.

Short-term underreaction (1-12 months) leads to gradual price incorporation of news, while long-term (3-5 years) consistent news trends decrease expected returns (Hong & Stein, 1999). Biases like irrational conservatism and disposition effect, which involve selling 'winners' and holding 'losers,' contribute to this (Frazzini, 2006). The prolonged overreaction links to the overconfidence bias (Daniel et al., 1998).

Another theory highlights the influence of 'herding behavior' in shaping price trends, resulting in the momentum effect. This tendency to follow the herd is a strategy managers use to protect their reputations (Dasgupta et al., 2011).

2.9 Low risk factor

Low-volatility stocks outperformed the market between 1972 and 1989 in their study. Contrarily, the CAPM theory suggests that riskier stocks should yield higher returns due to their higher beta. Due to leverage restrictions, particularly for institutional investors, there is an inclination towards high-beta stocks, elevating their prices and reducing expected returns (Frazzini & Pedersen, 2014). The anomaly is especially strong in down markets. In these periods, it loses less than its riskier counterparts.

From 1986 to 2006, the annual alpha difference between the global portfolios of the lowest and highest volatility deciles was 12% (Blitz & van Vliet, 2007). This volatility pattern can be observed distinctly in the US, European, and Japanese markets. Moreover, this volatility influence is unique and is not because of other well-known effects such as size and value. The low volatility approach is marked by minimal drawdowns, a low beta, outperformance in declining markets, underperformance in rising markets, and resilience against bubbles.

The volatility premium's impact is well-established. However, it varies based on market conditions (Bender et al., 2013). They found that the spread between low and high-beta portfolios is larger in bear markets, implying lower losses.

A behavioral explanation for the low volatility premium is the 'lottery demand' theory. It suggests that some investors view the stock market as a chance game, favoring riskier stocks for potential high yields (Bali et al., 2017). So, this leads to overvaluation.

An alternative interpretation of the reluctance to adopt this strategy stems from the psychological challenges it presents. In bull markets, the strategy's returns, while positive, often lag those of higher-risk portfolios. However, during bear markets, the losses are significantly lower. Given the contemporary trend of frequent portfolio monitoring, underperformance can exert significant psychological pressure, potentially deterring sustained commitment to the strategy.

Moreover, the professional landscape for asset managers, who benchmark against indices such as the MSCI World, complicates matters. Their performance evaluations are predicated on outperforming these benchmarks. Thus, during bullish phases, asset managers might face institutional disincentives for its adoption when this strategy tends to underperform, rendering it less appealing for institutional investment (Christoffersen & Simutin, 2017).

2.10 Quality minus junk factor

The quality factor, a recent new factor in academic literature, underscores the superior performance of firms exhibiting strong profitability, growth, safety, and efficiency. Its definition varies across studies. For instance, low accruals could drive quality and higher stock returns (Sloan, 1996). Meanwhile, Fama and French tied quality to operating profitability (Fama & French, 2015). The 'quality minus junk' was introduced by (C. S. Asness et al., 2019). This metric stresses the outperformance of quality stocks, especially during crises, due to investor inclination towards safer assets. Quality stocks are those that exhibit profitability, growth, and safety characteristics. They were categorized into ten deciles based on their quality ratings. The QMJ factor represents the mean return of the top two quality deciles minus the mean return of the bottom two groups. This research is from 1957 to 2016. The findings indicate that quality is a consistent trait—current high-quality status predicts future high quality. The difference between high and low quality is 3.07% now and 1.14% in ten years from now. These results are statistically significant at the 1% level. They compare the QMJ factor against the CAPM, the Fama-French three-factor model, and Carhart's four-factor model. In the U.S. sample, the QMJ factor yields abnormal returns of 64, 88, and 105 basis points monthly against each model, respectively.

Moreover, superior-quality firms yield higher risk-adjusted returns than their inferior counterparts. The Sharpe ratio for high minus low quality is 0.33. Notably, there is almost a monotonically increase in excess and risk-adjusted returns as we move from the lowest quality portfolios to the highest.

In their sample, profitability remains the most consistent, whereas growth and safety, though relatively stable, are the least consistent.

The observations were consistent not just in the U.S. but also in 24 countries worldwide. It challenges the widely held notion that greater risk necessarily yields higher returns.

Merging value and quality has proven beneficial, exemplified by renowned investors like Warren Buffet. Buffet's notable returns become less remarkable when adjusted for specific factors (Frazzini et al., 2013).

High-quality stocks often outperform during market downturns, casting doubt on traditional risk-based explanations. While analysts assign premium valuations to high-quality companies, they paradoxically anticipate greater returns from low-quality stocks. Moreover, despite their projected higher earnings for these junk stocks, investors underestimate the valuation of high-quality stocks.

2.11 Profitability factor

Being profitable indicates that a company's revenues surpass its expenses. You can compute it in various ways, such as through gross profit (revenues minus the cost of goods sold) or net profit (revenues minus all expenses). Firms with high profitability yield much greater returns than those that are not profitable, even though they have higher valuation ratios (Novy-Marx, 2013). When they account for gross profitability, the efficacy of value-based strategies noticeably improves, particularly for the largest and most liquid stocks. The profitability premium was 4.4% for the U.S. These outcomes challenge commonly accepted theories about the value premium since profitable companies are less likely to face financial distress, enjoy prolonged cash flow durations, and operate with reduced leverage.

Fama and French reached similar conclusions, though they employed a distinct profitability metric: operating profitability (Fama & French, 2015). The average excess return of the profitability factor is 17 basis points per month.

The profitability premium, potentially influenced by mispricing, is more evident in firms, which are harder to arbitrage and with greater information uncertainty (Wang & Yu, 2013). Firms with attributes like smaller size and higher return volatility show a 1% higher monthly profitability premium. Much of this premium from ROE is from low-ROE firms' inferior returns, suggesting challenges in correcting overpricing. The premium is not due to later overreactions but rather an initial underreaction to profitability, leading to high-ROE firms being underpriced and their low-ROE counterparts overpriced.

2.12 Investment factor

The Investment factor measures the differential returns between firms that pursue aggressive investment strategies versus those that adopt more conservative investment approaches. While evidence suggests that aggressive investments do not yield higher returns in the immediate term, it remains a topic of debate whether such investments may lead to superior returns in the long run. Empirical findings indicate an alpha of 22 monthly basis points for the CMA factor (Fama & French, 2015).

In the study by Titman et al. (2003), they observe that firms with higher capital expenditures often experience subsequent declines in their stock returns, while firms with more restrained investment strategies see an increase in returns (Titman et al., 2003). The authors suggest this phenomenon is because of an initial market overreaction for substantial investments, potentially inflating stock prices temporarily. However, as the market recalibrates, these inflated values correct downwards. Additionally, the research posits that some managerial decisions to invest heavily may be suboptimal, particularly when there is a desire to expand the company's reach without clear strategic benefit or in environments with limited market competition.

3. Data & Methodology

The monthly inflation data series starts in January 1990 for the United States. The U.S. stock market is the largest and most influential globally, offering diverse investment opportunities, regulatory oversight, and significant global impact. The study is from January 1990 to December 2022; we perform robustness checks for some factors for 1930-2022. We retrieve data for excess market return, size, value, profitability, investment, momentum, and risk-free rates from the Kenneth French data library. We retrieve the monthly data for the factors' time-series momentum, betting against beta, and quality from the AQR Capital Management data library.

The monthly data to define down and bear markets for the S&P 500 is collected from the CRSP database. The recession data is from the National Bureau of Economic Research. The data for inflation is collected from the U.S. Bureau of Labor Statistics, and the data for the VIX is from the Chicago Board Options Exchange (CBOE).

Table 1: Factor Formulations

Factor	Calculation
SMB(B/M)	1/3 (Small Value + Small Neutral + Small Growth) - 1/3 (Big Value + Big Neutral + Big Growth)
SMB(OP)	1/3 (Small Robust + Small Neutral + Small Weak) - 1/3 (Big Robust + Big Neutral + Big Weak)
SMB(INV)	1/3 (Small Conservative + Small Neutral + Small Aggressive) - 1/3 (Big Conservative + Big Neutral + Big Aggressive)
SMB	1/3 (SMB(B/M) + SMB(OP) + SMB(INV))
HML	1/2 (Small Value + Big Value) - 1/2 (Small Growth + Big Growth)
RMW	1/2 (Small Robust + Big Robust) - 1/2 (Small Weak + Big Weak)
CMA	1/2 (Small Conservative + Big Conservative) - 1/2 (Small Aggressive + Big Aggressive)
MOM	1/2 (Small High Mom + Big High Mom) - 1/2 (Small Low Mom + Big Low Mom)
TSMOM	1/2 (High TSMOM) - 1/2 (Low TSMOM)
BAB	1/2 (Low Beta) - 1/2 (High Beta)
QMJ	1/2 (High QMJ) - 1/2 (Low QMJ)
MFE	EW (SMB + HML + RMW + CMA + MOM + TSMOM + BAB)

Notes: The methodologies are derived from Fama-French and AQR Capital Management. The table shows how the factors are computed.

Table 1 shows how the equity factors are computed. The SMB factor is the difference between the average returns of nine small stock portfolios against nine large-caps. The HML factor quantifies the return disparity between a pair of value portfolios and their growth-oriented peers. RMW is the variance in returns between a portfolio with robust profitability against one with weak profitability. CMA is the average return difference between conservative and aggressive investing companies.

MOM is the variance in returns between high-momentum portfolios and their low-momentum counterparts. Time-series Momentum (TSMOM) is the difference between portfolios with high positive time-series momentum and shorting those with the lowest TSMOM. Meanwhile, BAB is the return difference between portfolios with low betas and those with high betas. QMJ is the difference between portfolios with high quality versus those with low quality, also called junk stocks. Lastly, MFE is the equal-weighted factor of all the factors premiums, except Quality.

Central to our research is an exploration of these factors' profitability across various macroeconomic regimes. While measurements for inflation do vary, initially, segments categorized as 'High inflation' exceed mean inflation rates and ‘Low inflation’ segments inflation below the mean. In subsequent analyses, inflation gets bucketed into 0-2%, 2-3%, and above 3%, drawing inspiration from (Baltussen et al., 2023). This way, we try to get deeper insights into factor performance across inflation regimes.

VIX classifications start with 'High VIX' for values above the mean and 'Low VIX' for below the mean. Later, this categorization evolves into quantiles of 0-20%, 20-40%, 40-60%, 60-80%, and 80-100%, to get deeper insights.

Since 1990, there have been four recessions according to NBER (National Bureau of Economic Research), resulting in a mere 36 observational instances of recessions. To amplify the robustness of our insights, we have also tapped into the dynamics of bear and bull markets, denoting downward and upward market trajectories, respectively, as represented by the S&P 500. And we perform another robustness analysis for a longer time horizon, starting in 1930.

Our portfolio is composed of 60% equity (S&P 500) and 40% US bonds, which reflects a balanced allocation commonly used in investment frameworks. This approach is like that of (Baltussen et al., 2023). As we continue with our exploration, we will be conducting a regression analysis.

$$Portfolio\ return - R_f = \alpha + \beta_1(Mkt - R_f) + \beta_2(SMB) + \beta_3(HML) + \beta_4(RMW) + \beta_5(CMA) + \beta_6(MOM) + \beta_7(TSMOM) + \beta_8(BAB) + \epsilon,$$

Portfolio return: return on the 60/40 portfolio.

The risk-free rate (R_f) is the return on a risk-free investment, the one-month U.S. government treasuries. Alpha (α) is the abnormal return of the portfolio that cannot be explained by exposure to risk factors. Mkt-Rf is the additional return expected from the market over the risk-free rate. Coefficients β1 to β8 indicate the portfolio's sensitivity to each factor. SMB represents the return difference between small and large market cap stocks, while HML represents the return difference between stocks with high and low book-to-market values. RMW represents the return difference between stocks with strong and weak profitability, while CMA represents the return spread between conservatively and aggressively investing firms. MOM is the continuation of stock price trends based on past performance relative to others, while TSMOM is momentum derived from a security's own past returns. BAB represents the return spread between stocks with high and low beta, and ε is the error term.

Our research aims to research differences in returns of various factors across different macroeconomic periods. We use dummy variables to explore this, data subsets are based on specific economic situations. For example, when analyzing inflation, a dummy variable is ‘1' when inflation exceeds the mean and '0' otherwise. We then tailor the regression to each economic backdrop, whether it is a surge in inflation, higher VIX, or bullish market.

To evaluate the robustness of our findings, we divide the data into two distinct periods: 1990-2007 and 2008-2022. It enables us to identify differences because of the financial crisis in 2007. We also conduct tests to detect multicollinearity issues, using the Variance Inflation Factor (VIF) as a diagnostic tool. It is worth noting that all VIF values are below the commonly accepted threshold of 5, indicating no significant multicollinearity concerns.

However, our analysis reveals heteroskedasticity and autocorrelation problems, as the Breusch-Pagan and Durbin-Watson tests indicate. To address these issues, we use the Heteroskedasticity-Consistent Covariance Matrix Estimator (HC3) and Newey-West standard errors as robustness checks, enhancing the reliability of the results.

4. Results

In the results section, we will examine how different asset classes perform in various economic conditions. Then, we will research the performance of a portfolio comprising 60% bonds and 40% equities. Table 2 shows the annual returns of equities and the multi-asset portfolio across different economic conditions.

Table 2: The Evidence on Asset Class Returns

A. Inflation	All	Low inf.	Moderate inf.	High inf.	ANOVA
Years	33	11.58	11.25	10.17	-
Likelihood (%)	100	35.09	34.09	30.82	-
Inflation (%)	2.65	1.39	2.52	3.88	-
A1. *Asset classes (nom.)*					
Equities	9.00	13.35	11.77	2.43	17.19***
60/40	7.51	10.08	9.17	3.59	14.65***
A2. *Asset classes (real)*					
Equities	6.29	11.77	9.02	-1.24	23.60***
60/40	4.81	8.56	6.49	-0.15	24.29***
B. VIX	All	Low VIX	Moderate VIX	High VIX	
Years	33	11.00	11.00	11.00	-
Likelihood (%)	100	33.33	33.33	33.33	-
VIX	19.67	13.01	18.07	27.94	-
B1. Asset classes (nom.)					
Equities	9.00	12.39	12.86	1.74	35.81***
60/40	7.51	9.55	10.20	2.77	20.37***
B2. Asset classes (real)					
Equities	6.29	9.77	9.88	-0.77	18.19***
60/40	4.81	6.98	7.29	0.16	18.55***
C. Market cond.	All	Down Market	Up Market		
Years	33	12.00	21.00	-	-
Likelihood (%)	100	36.36	63.64	-	-
C1. Asset classes (nom.)					
Equities	9.00	2.47	12.73	-	35.81***
60/40	7.51	3.71	9.68	-	29.03***
C2. Asset classes (real)					

Equities	6.29	-0.27	10.04	-	35.90***
60/40	4.81	0.91	7.04	-	29.35***

Notes: This table shows historical nominal and real returns for the period 1990-2022. Equities are based on the market returns of the S&P 500. 60/40 is a 60% equity and 40% bond portfolio. The bonds consist of U.S. treasuries. Panel A shows the returns for inflation, Panel B for VIX, and Panel C for the market regimes. Inflation and VIX are divided into three buckets to get deeper insights. For the main analysis, we divide every economic condition into two buckets. Significant average returns at the 5% level are denoted with **, and significance at the 1% level with ***. An ANOVA test is used to test for significance variations in average returns across different macroeconomic regimes.

Table 2A shows the asset class returns in different inflation regimes. For the sample period 1990-2022, there have been 11.58 years of low inflation and 10.17 years of high inflation. We will examine equity and portfolio returns (60 % equities and 40% bonds). The monthly data includes equities and a 60/40 portfolio. Table 2 shows the average returns of equities and the portfolio for 1990-2022. The nominal U.S. equity returns have been 9.00% per year; this number is significant at the 1% level (t value = 3.22). The 60/40 portfolio's returns have been 7.51% per year and are also highly significantly different from zero.

We want to research the effect of inflation on equity returns and the 60/40 portfolio returns. Panels A1 and A2 of Table 2 show these assets' nominal and real returns for the period and the three different inflation regimes. Equities returned 9.00% nominal per year and 6.29% in real terms. The Multi-asset portfolio comprising 60% equities and 40% bonds returned 7.51% nominal per year and 4.81% in real terms.

High inflation periods have equity returns of 2.43%. In high inflation regimes are, the returns for the portfolio higher (3.59%); this is because of the higher return of bonds in this period. The real returns are negative for equities and the 60/40 portfolio, -1.24% and -0.15%, respectively. In other words, investors see a drop in purchasing power in high inflation regimes; this is in line with (Fama & Schwert, 1977). The periods with low (0-2%) and moderate inflation (2-3%) are good for equities with nominal returns of 13.35% and 11.77%, respectively.

The same pattern applies to the 60/40 portfolio; low inflation periods yield the highest nominal returns. The real returns are also performing the best in low inflation regimes for equities and the 60/40 portfolio, with real returns of 11.77% and 9.02%, respectively. Real equity returns in low inflation periods have a more substantial magnitude. The returns are almost twice the average real returns; the portfolio has a similar pattern. In short, low inflation is good for nominal and real returns, this is in line with (Lintner, 1975).

The final column of Table 2 presents the outcomes of the ANOVA analysis, which assesses the statistical significance of the variations in returns across different economic regimes. Nominal and real equity, and portfolio returns vary significantly for the different inflation regimes. This is statistically stronger for the real returns, but both are significant at the 1% level.

Table 2B shows the asset class returns in different VIX regimes. For the sample period 1990-2022, there have been 11 years for every VIX bucket. The VIX only from 1990 is researched, because there is no earlier data available. Panel B1 and B2 of Table 2 show these assets' nominal and real returns for the whole period and the three different VIX regimes.

High VIX periods have equity returns and portfolio returns of 1.74%, and 2.77%. The real returns are negative (-0.77%) for equities and slightly positive for the 60/40 portfolio (0.16%). Also, for the VIX do investors see a drop in their purchasing power in high VIX states.

Periods with low VIX and moderate VIX are good for equities with nominal returns of 12.39% and 12.86%, respectively. We see a similar pattern for the multi-asset portfolio, low-moderate VIX periods give the highest returns. The real returns are performing the best in moderate VIX periods, with real returns of 9.88% for equities and 7.29% for the 60/40 portfolio. In conclusion, the stock market does not exhibit higher returns with increased volatility, diverging from the findings of French, Schwert, and Stambaugh (1987), yet in line with the conclusions drawn by (van Vliet et al., 2011).

The last column of Table 2B shows the statistical differences across varying VIX regimes. Nominal and real equity, and portfolio returns vary significantly for the different VIX regimes. This is statistically less significant for the real returns, because the differences are smaller for the nominal returns.

Table 2C shows the average returns for equities, the multi-asset portfolio in up- and down markets. Equities have high returns (12.73%) when the market has positive returns, and low returns (2.47%) in down markets. The real returns are negative in down markets (-0.27%) for equities and slightly positive (0.91%) for the 60/40 portfolio. In other words, there are differences in asset returns in different economic conditions, this is in line with (Ang et al., 2006; Baltussen et al., 2023).

4.1 Inflation

The focus is on the two inflation regimes (low inflation, and high inflation) as defined earlier. We want to research the effect of inflation on factor premiums.

Table 3: Investment Returns by Inflation Regime, 1990-2022

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	MFE
A. (Low inf.)									
Mean	1.14***	0.19	-0.14	0.01	0.16	-0.03	0.62	0.68***	0.21
Std dev.	4.45	2.96	2.96	2.11	1.90	4.84	7.66	3.74	1.95
t-Statistic	3.74	0.92	-0.68	0.05	1.22	-0.08	1.18	2.66	1.59
Sharpe ratio	0.26	0.06	-0.05	0.00	0.08	-0.01	0.08	0.18	0.11
B. (High inf.)									
Mean	0.13	0.07	0.54**	0.82***	0.36**	1.11***	1.41**	0.85***	0.74***
Std dev.	4.41	3.14	3.53	3.09	2.44	4.44	7.76	3.83	1.95
t-Statistic	0.38	0.31	2.06	3.56	1.98	3.39	2.46	2.98	5.10
Sharpe ratio	0.03	0.02	0.15	0.26	0.15	0.25	0.18	0.22	0.38
ANOVA	1.60***	0.94	1.16	0.89	1.18	0.92	1.14	1.05	1.26*

Notes: This table shows the historical returns, standard deviations, t-statistics, and Sharpe ratios for the period 1990-2022 for the equity factors in two different inflation regimes: 0-2.65% (low inflation) and >2.65% (high inflation). MFE is an equal-weighted combination of all the equity factor premiums (besides the excess market return). All results are in percentages per month. Significant average returns at the 10% level are denoted with *, at the 5% level with **, and at the 1% level with ***. An ANOVA test is used to test for significance variations in average factor returns across different inflation regimes.

Table 3 shows the factor returns in different inflation periods. During periods of high inflation, most factors show a decline in their monthly average returns. HML performs badly (-0.14%) in low inflation regimes and a lot better (0.54%) in high inflation periods. RMW also performs badly (0.01%) in low inflation regimes and better (0.82%) in high inflation regimes, with the highest t-statistic (3.56). The Sharpe ratio of 0.26 emphasizes their relatively high risk-adjusted performance in such periods. Momentum also performs better in high inflation regimes, with an average monthly return of 1.11%, the high Momentum returns are in line with (Neville et al., 2021). TSMOM performs the best in absolute returns (1.41%). In risk-adjusted terms, it performs worse with a Sharpe ratio of 0.18 due to its higher volatility. BAB yields a return of 0.85%, offering resilience in inflationary periods with a Sharpe ratio of 0.22. The MFE, the equal-weighted combination of all the factors (except Quality), has the highest t statistic (5.10) in high inflation and gives robust (0.74%) outperformance. The Sharpe ratio (0.38) is the highest, and the ANOVA test shows that there are significant returns differences at the 10% level for the MFE. These results are different compared to Baltussen et al. (2023), because they use less factors and another definition of high inflation.

To test for significant variations in average returns the ANOVA test shows that only the excess market return and the MFE have significant variation in returns between the different inflation regimes, and no other factors. In other words, there are return differences between different inflation regimes, but there are no significant results for all the factors, besides the market factor and MFE.

To get a deeper insight into the data, inflation is divided into three different buckets, Table 4 shows the different statistics.

Table 4: Investment Returns by Inflation Regime in Three Different Buckets, 1990-2022

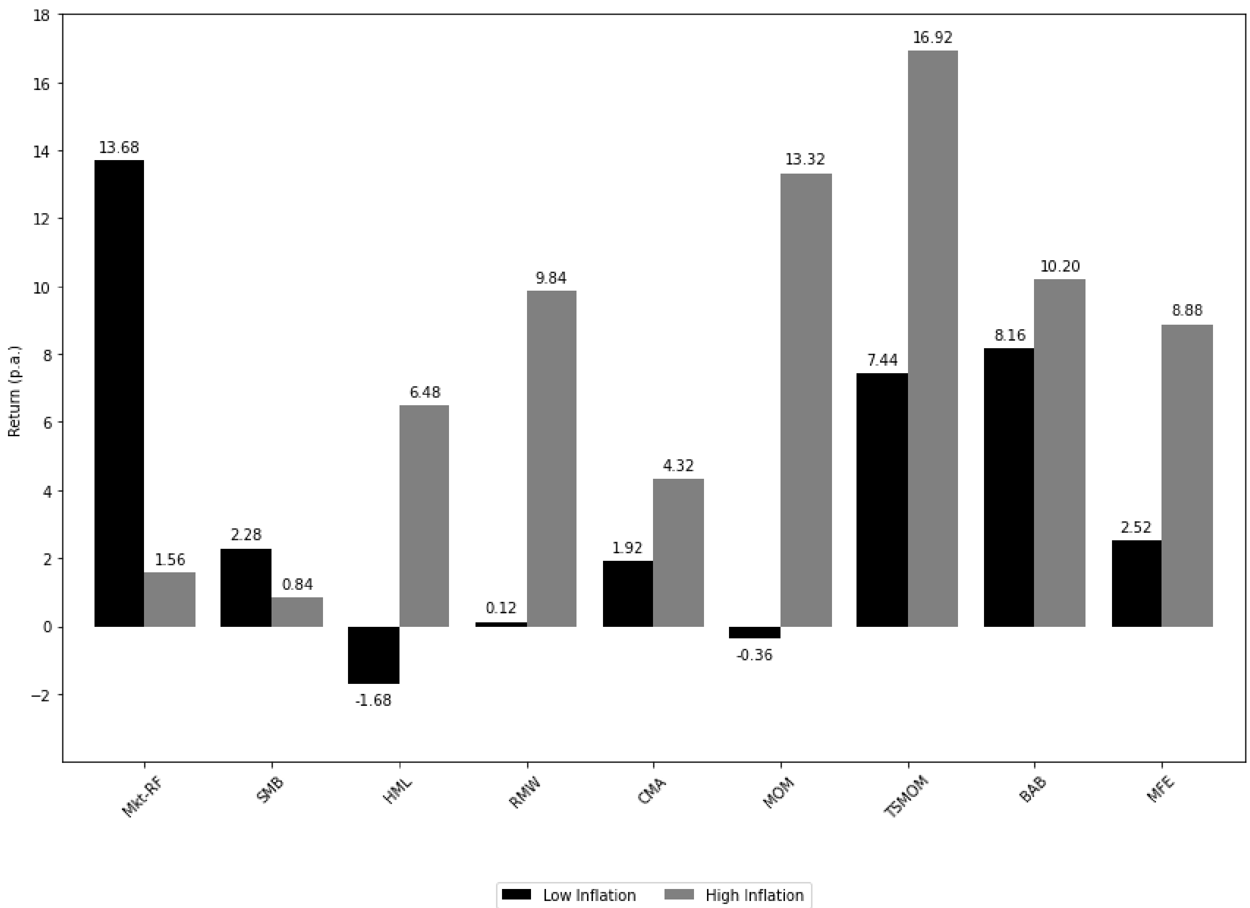
	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	MFE
A. 0-2%									
Mean	1.02**	-0.08	-0.33	0.23	0.14	0.59*	0.92	0.95***	0.35**
Std dev.	4.89	2.95	3.12	1.99	1.96	3.87	7.20	3.64	1.87
t-Statistic	2.30	-0.29	-1.16	1.29	0.80	1.67	1.42	2.90	2.05
Sharpe ratio	0.21	-0.03	-0.11	0.12	0.07	0.15	0.13	0.26	0.19
B. 2-3%									
Mean	0.79**	0.46*	0.03	0.06	0.21	0.56	1.24*	0.83***	0.16
Std dev.	3.55	2.78	2.60	2.34	1.92	3.96	8.10	3.55	2.04
t-Statistic	2.57	1.91	0.14	0.29	1.25	1.64	1.78	2.71	0.89
Sharpe ratio	0.22	0.16	0.01	0.03	0.11	0.14	0.15	0.23	0.08
C. >3%									
Mean	-0.01	-0.04	0.75**	0.92***	0.47**	0.90**	1.03	0.51	0.65***
Std dev.	4.81	3.37	3.85	3.40	2.60	4.83	7.88	4.09	2.05
t-Statistic	-0.03	-0.12	2.17	3.01	2.03	2.09	1.47	1.40	3.55
Sharpe ratio	0.00	-0.01	0.19	0.27	0.18	0.19	0.13	0.12	0.32
ANOVA	1.15	1.19	3.83**	3.24**	0.56	0.16	0.13	0.56	0.27

Notes: This table shows the historical returns, standard deviations, t-statistics, and Sharpe ratios for the period 1990-2022 for the equity factors in three different inflation regimes: 0-2% (low inflation), 2-3% (moderate inflation) and >3% (high inflation). All results are in percentages per month. Significant average returns at the 10% level are denoted with *, at the 5% level with **, and at the 1% level with ***. An ANOVA test is used to test for significance variations in average factor returns across different inflation regimes.

During 0-2% inflation periods, the only significant results are the excess market return, the BAB (0.95%) and the MFE (0.35%). The BAB has a monthly return of 0.95%, and a Sharpe ratio of 0.26. The MFE has monthly returns of 0.35%. When inflation rates are higher than 3%, the HML factor performs better with an average monthly return of 0.75% and a Sharpe ratio of 0.19. This trend underscores the tendency for value companies to outperform growth-oriented ones in high-inflation environments, in line with Table 3 and the findings of (Baltussen et al., 2023; Neville et al., 2021). RMW has the highest returns (0.90%) in high inflation regimes, the MFE also performs strong (0.65%) in high inflation periods.

To test for significant variations in average returns the ANOVA test shows that MFE has no significant variations in returns in contrast to Table 3. Interestingly, HML and RMW have significant variations in factor returns for the different inflation regimes.

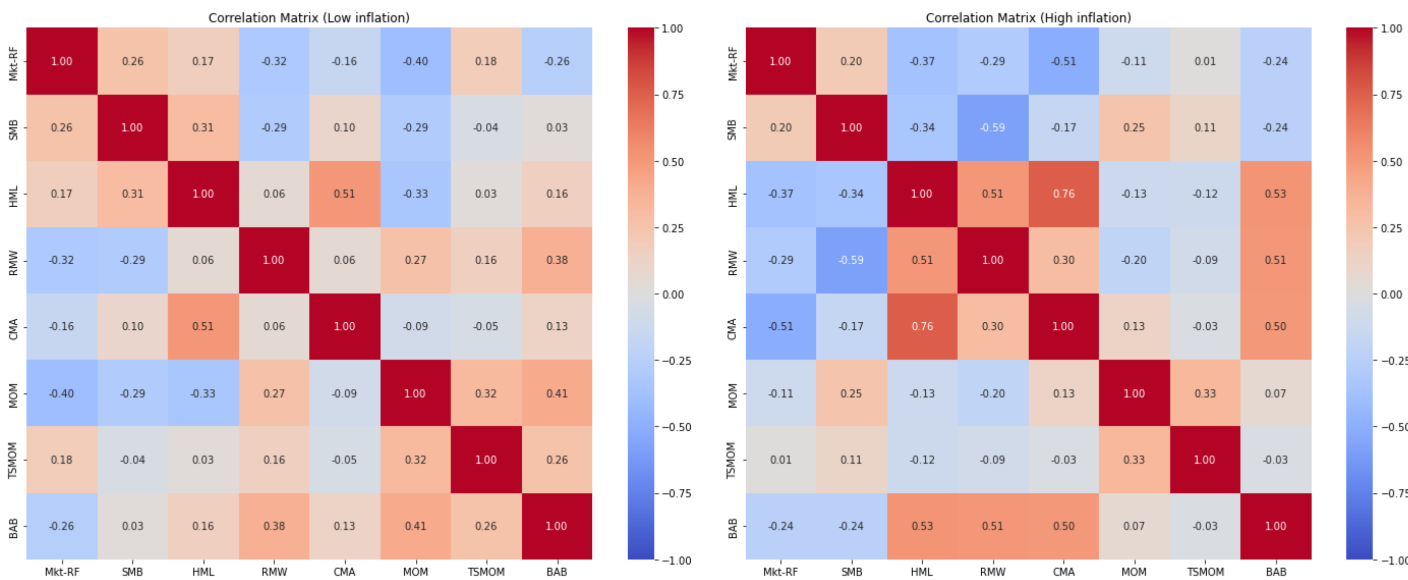
Figure 1: Equity Factor Premiums across Inflation Regimes, 1990-2022



Notes: This figure shows the yearly average return on the factors across the different inflation regimes.

Figure 1 shows the yearly equity factor premiums across the two different inflation regimes. The Size is the weakest stand-alone factor. TSMOM is one of the best performing factors, with returns of 7.44% in low inflation periods and 16.92% in high inflation periods. The low-risk factor (BAB) is also performing strong in both inflation regimes, with the highest (10.20%) return per annum in high inflation periods. Profitability has one of the highest (9.84%) returns per annum. The multi-factor equity (MFE) has also good performance (8.88%) in especially high inflation periods. Interestingly, all factors displayed positive returns even in a high inflation environment, signifying their resilience under inflationary pressures.

Figure 2: Correlation Factors across Different Inflation Regimes, 1990-2022



Notes: The figure shows the correlation between different factors, a higher number means a higher correlation.

During times with low inflation, CMA and HML are highly correlated. In high inflation regimes, defensive factors become more correlated. In times of high inflation, HML's correlation with CMA becomes stronger, reaching a correlation of 0.76. BAB's correlation with HML, RMW, and CMA also becomes stronger. The market tends to move in the opposite direction from factors like RMW and CMA. Interestingly, is that MOM and TSMOM have a relatively low correlation, with correlation values of 0.32 and 0.33.

Table 5: Quality Returns, 1990-2022

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	H-L
Excess return	-0.10	0.26	0.24	0.32	0.47*	0.37	0.50**	0.48**	0.59***	0.59***	0.69***
t-Statistic	-0.29	0.81	0.90	1.25	2.03	1.50	2.13	2.16	2.70	2.72	3.00
Beta	1.44	1.32	1.11	1.09	0.97	1.02	1.00	0.96	0.94	0.91	-0.53
Sharpe ratio	-0.01	0.04	0.05	0.06	0.10	0.08	0.11	0.11	0.14	0.14	0.15
Adjusted R^2	0.78	0.86	0.86	0.89	0.85	0.88	0.92	0.90	0.92	0.88	0.10

Notes: This table shows the excess returns, t-statistics, betas, Sharpe ratios, and R^2 for the period 1990-2022 for the Quality factor. All results are in percentages per month. "H-L" is the difference between the highest (P10) and the lowest (P1) quality portfolios. Significant average returns at the 10% level are denoted with *, at the 5% level with **, and at the 1% level with ***.

Table 5 shows the statistics for the Quality (QMJ) factor. QMJ shows consistency in the Adjusted R^2 for the portfolios throughout the period, ranging from 0.78 to 0.92. It suggests that the QMJ factor significantly influences these movements. The beta is a lot higher for low quality portfolios (1.44) than high quality portfolios (0.91). It means that higher-quality companies also have lower risk, this is in line with (Asness et al., 2019).

High-quality portfolios distinctly outperform lower-quality ones, showing excess monthly returns of 0.69%. With a Sharpe ratio of 0.15 and a difference (-0.53) between high and low-quality betas, it is evident that high-quality companies generally yield higher absolute returns, superior risk-adjusted returns, and a lower beta.

Table 6: Quality Returns in Different Inflation Regimes, 1990-2022

A. (Low inf.)	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	H-L
Excess return	0.86*	1.04**	0.81**	1.01***	0.95***	0.89***	0.93***	1.04***	1.07***	0.98***	0.12*
t-Statistic	1.74	2.32	2.18	2.87	2.97	2.66	2.87	3.39	3.56	3.51	1.76
Beta	1.44	1.36	1.14	1.09	0.99	1.04	1.02	0.97	0.95	0.87	-0.57
Sharpe ratio	0.12	0.16	0.15	0.20	0.20	0.18	0.20	0.23	0.24	0.24	0.12
Adjusted R^2	0.78	0.84	0.87	0.89	0.88	0.89	0.92	0.93	0.92	0.88	0.11
B. (High inf.)											
Excess return	-1.24***	-0.67	-0.43	-0.48	-0.09	-0.25	-0.01	-0.17	0.03	0.12	1.36***
t-Statistic	-2.34	-1.50	-1.13	-1.29	-0.25	-0.71	-0.02	-0.52	0.10	0.37	2.71
Beta	1.43	1.26	1.07	1.07	0.94	1.00	0.98	0.93	0.93	0.96	-0.48
Sharpe ratio	-0.17	-0.11	-0.08	-0.10	-0.02	-0.05	0.00	-0.04	0.01	0.03	0.20
Adjusted R^2	0.78	0.87	0.85	0.89	0.82	0.86	0.92	0.87	0.92	0.87	0.09

Notes: This table shows the excess returns, t-statistics, betas, Sharpe ratios, and R^2 for the period 1990-2022 for the Quality factor in different inflation regimes. All results are in percentages per month. "H-L" is the difference between the highest (P10) and the lowest (P1) quality portfolios. Significant average returns at the 10% level are denoted with *, at the 5% level with **, and at the 1% level with ***.

In high inflation periods, QMJ has even higher returns (1.36%) monthly and a Sharpe ratio of 0.20. In periods of low inflation, there is a lower spread in returns. The lowest quality stocks have monthly returns of 0.86%, while the highest quality (0.98%). Engaging in a strategy of going long on high-quality stocks while shorting the low-quality ones yields an excess return of just 0.12% in these low inflation regimes, which is significant at the 10% level. The beta difference during these periods is -0.57, the difference in betas increases as inflation drops. The results are different to because of the different methodology (Baltussen et al., 2023). In his paper, the excess returns of QMJ drop in high inflation periods.

Table 7: Quality Returns by Inflation Regime in Three Different Buckets

A. 0-2%	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	H-L
Excess return	0.44	0.69	0.51	0.74	0.81*	0.73	0.77*	0.98**	0.97**	1.03**	0.60*
t-Statistic	0.62	1.06	0.96	1.44	1.82	1.50	1.65	2.21	2.25	2.54	1.93
Beta	1.46	1.37	1.13	1.10	0.96	1.04	1.01	0.97	0.95	0.88	-0.58
Sharpe ratio	0.06	0.10	0.09	0.13	0.16	0.14	0.15	0.20	0.20	0.23	0.17
Adjusted R^2	0.82	0.86	0.89	0.89	0.90	0.90	0.93	0.93	0.93	0.92	0.09
B. 2-3%											
Excess return	0.35	0.51	0.46	0.51	0.49*	0.45	0.64**	0.42	0.62**	0.64**	0.28
t-Statistic	0.72	1.30	1.30	1.49	1.65	1.32	2.02	1.33	2.02	2.11	1.39
Beta	1.37	1.19	1.05	1.05	0.88	1.00	0.98	0.98	0.96	0.89	-0.48
Sharpe ratio	0.06	0.11	0.11	0.13	0.14	0.11	0.17	0.11	0.17	0.18	0.12
Adjusted R^2	0.72	0.85	0.82	0.88	0.81	0.82	0.90	0.87	0.89	0.81	0.09
C. >3%											
Excess return	-1.54**	-0.99*	-0.60	-0.61	-0.22	-0.37	-0.16	-0.17	-0.06	-0.09	1.45**
t-Statistic	-2.22	-1.70	-1.20	-1.23	-0.48	-0.83	-0.36	-0.39	-0.14	-0.21	2.01
Beta	1.41	1.26	1.08	1.08	0.99	0.98	0.99	0.92	0.92	0.96	-0.45
Sharpe ratio	-0.20	-0.15	-0.11	-0.11	-0.04	-0.07	-0.03	-0.04	-0.01	-0.02	0.18
Adjusted R^2	0.76	0.87	0.86	0.88	0.85	0.89	0.92	0.88	0.92	0.88	0.12

Notes: This table shows the excess returns, t-statistics, betas, Sharpe ratios, and R^2 for the period 1990-2022 for the Quality factor in three different inflation regimes. All results are in percentages per month. "H-L" is the difference between the highest (P10) and the lowest (P1) quality portfolios. Significant average returns at the 10% level are denoted with *, at the 5% level with **, and at the 1% level with ***.

In the 0-2% inflation bucket, there are good (0.60%) excess returns with a Sharpe ratio of 0.17 and a beta difference between high- and low-quality stocks of -0.58. In the moderate inflation bucket, the excess returns drop. However, in high inflation regimes the QMJ has high (1.45%) returns. Combined with a Sharpe ratio of 0.18, the beta difference is -0.45. In other words, QMJ is performing good in high inflation regimes, this is in line with the results in Table 6.

4.2 VIX (Volatility Index)

The focus is on the two VIX regimes (low VIX, and high VIX) as defined earlier.

Table 8: Investment Returns by VIX Regime

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	MFE
A. Low VIX									
Mean	1.23***	0.00	0.13	0.20*	0.03	0.64***	1.31***	1.19***	0.51***
Std dev.	2.95	2.39	2.35	1.61	1.51	2.71	6.91	2.06	1.30
t-Statistic	6.32	-0.03	0.87	1.92	0.33	3.60	2.89	8.83	5.98
Sharpe ratio	0.41	0.00	0.06	0.13	0.02	0.24	0.19	0.58	0.39
B. High VIX									
Mean	-0.17	0.36	0.27	0.65**	0.57**	0.29	0.36	0.13	0.39*
Std dev.	5.92	3.76	4.23	3.64	2.85	6.59	8.70	5.33	2.66
t-Statistic	-0.36	1.23	0.82	2.26	2.53	0.57	0.52	0.31	1.85
Sharpe ratio	-0.03	0.10	0.06	0.18	0.20	0.04	0.04	0.02	0.15
ANOVA	9.72***	1.48	0.38	3.12*	7.00***	0.41	1.52	6.41**	0.18

Notes: This table shows the historical returns for the period 1990-2022 for the equity factors for two different VIX regimes: 0-19.69 (low VIX) and >19.69 (high VIX). MFE is an equal-weighted combination of all the equity factor premiums (besides the excess market return). All results are in percentages per month. Significant average returns at the 10% level are denoted with *, 5% level with **, and at the 1% level with ***. An ANOVA test is used to test for significance variations in average factor returns across different inflation regimes.

Table 8 shows the factor returns for two different VIX regimes. In periods with lower VIX levels, most factors show higher returns. The market return is high (1.23%) during low VIX periods; and is negative (-0.17%) in high VIX periods. The market performs better in stable conditions, this is in line with (Ang et al., 2006). RWM performs good (0.65%) in high VIX periods. Conservative investing companies have the highest t-statistic (2.53) and Sharpe ratio (0.20) in high VIX periods. In periods with low VIX, the BAB factor is performing good in absolute terms (1.19%) and in risk-adjusted terms (0.58).

The MFE has highly significant returns (0.51%) in low VIX periods, and significant returns (0.39%) in high VIX periods. The Sharpe ratio (0.39) is particularly high in the low VIX period.

Another observation of the TSMOM and MOM factors: while TSMOM outperforms MOM during low VIX periods, its returns diminish and lose statistical significance during high VIX periods. The ANOVA tests show that there are highly significant differences in returns in different VIX regimes for the market, investment, and low-risk factors. The profitability factor has only significant differences in returns at the 10% level.

Table 9: Investment Returns by VIX Regime in 5 Different Quantiles

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	MFE
Mean (Very Low VIX)	1.66***	0.01	0.16	-0.02	-0.02	0.77***	3.38***	1.41***	0.81***
Sharpe ratio (Very Low VIX)	0.86	0.01	0.08	-0.01	-0.02	0.36	0.55	0.81	0.76
Mean (Low VIX)	1.15***	0.02	0.29	0.16	-0.14	0.13	0.97	0.85***	0.33**
Sharpe ratio (Low VIX)	0.43	0.01	0.12	0.10	-0.09	0.05	0.14	0.40	0.25
Mean (Medium VIX)	0.66*	0.06	0.26	0.60***	0.43	1.10***	-0.44	1.45***	0.42**
Sharpe ratio (Medium VIX)	0.17	0.02	0.09	0.29	0.24	0.38	-0.06	0.55	0.28
Mean (High VIX)	0.58	0.97**	0.31	0.52	0.51*	1.26**	1.21	0.36	0.84***
Sharpe ratio (High VIX)	0.12	0.24	0.08	0.13	0.19	0.23	0.15	0.08	0.38
Mean (Very High VIX)	-0.77	-0.32	-0.06	0.67*	0.48	-0.77	-0.53	-0.29	-0.12
Sharpe ratio (Very High VIX)	-0.11	-0.10	-0.01	0.21	0.16	-0.10	-0.05	-0.05	-0.04
ANOVA	3.35**	2.49**	0.18	1.02	1.64	2.62**	3.54***	2.64**	3.21**

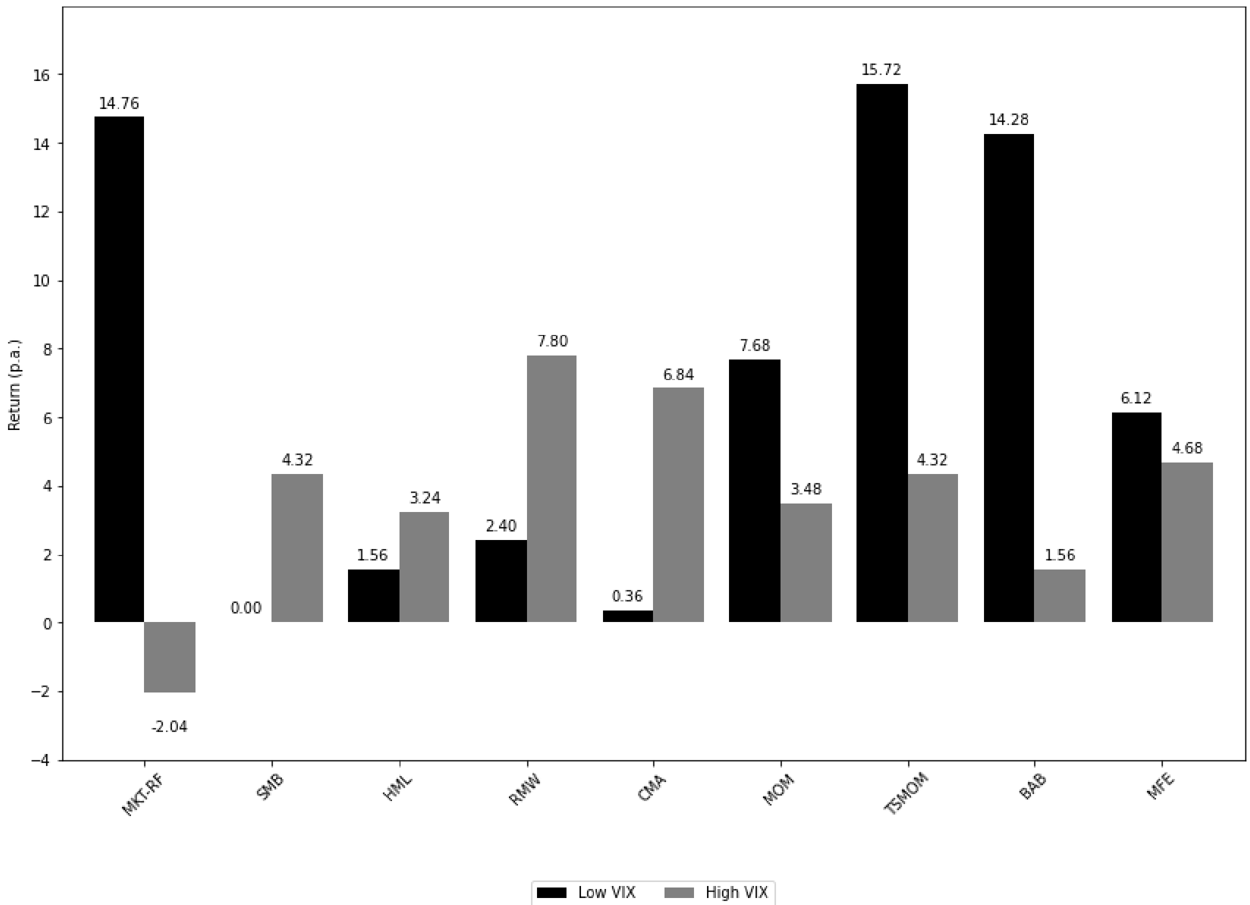
Notes: This table shows the historical returns and Sharpe ratios for the period 1990-2022 for the equity factors for five different VIX regimes: 'Very Low VIX', 'Low VIX', 'Medium VIX', 'High VIX', Very High VIX'. MFE is an equal-weighted combination of all the equity factor premiums (besides the excess market return). All results are in percentages per month. Significant average returns at the 10% level are denoted with *, 5% level with **, and at the 1% level with ***. An ANOVA test is used to test for significance variations in average factor returns across different VIX regimes.

Table 9 shows the factor premiums and Sharpe ratios in 5 quantiles, to get a deeper insight into the results. The table shows an increase in market returns as VIX levels progress from 'Very Low VIX' to 'Very high VIX,' from a high of 1.66% to a low of -0.77% per month, but the returns are only negative in the 'Very High VIX' state. This pattern suggests that increased volatility leads to lower market returns when the VIX is extremely high (van Vliet et al., 2011). The profitability factor is also in this VIX definition robust in terms of returns (0.67%). The multi-factor equity (MFE) is performing as one of the best in risk-adjusted returns (Sharpe ratio: 0.76) in 'Very Low VIX'. It is also one of the best performers in 'High VIX', with (0.84%) absolute returns, and the highest Sharpe ratio (0.38). In extreme VIX periods the MFE outperforms the market with (-0.12%) returns against (-0.77%) of the excess market factor.

Interestingly, Momentum and TSMOM have significance variations in returns when the VIX is divided into 5 quantiles. The MFE has significant variations in returns at the 5% level.

The data shows a negative correlation between volatility and returns, consistent with findings by Ang et al. (2006).

Figure 3: Equity Factor Premiums across VIX Regimes, 1990-2022

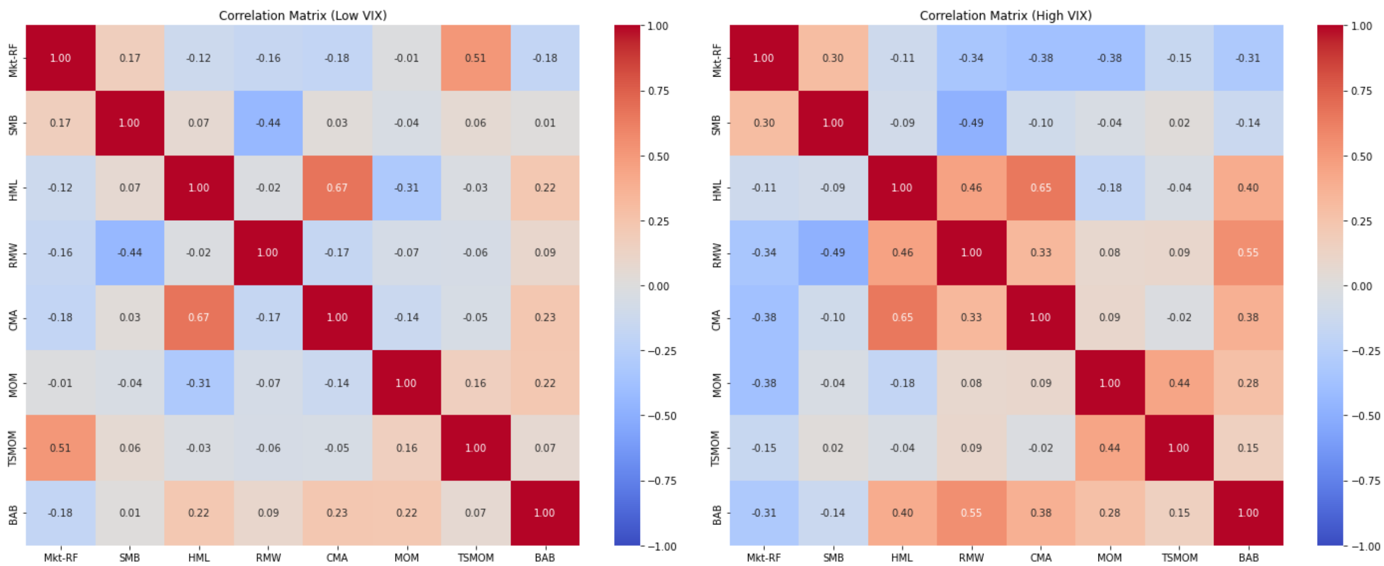


Notes: This figure shows the yearly average return on the factors across the different VIX regimes.

Figure 3 shows the yearly equity factors across two different VIX regimes. Size is again the weakest stand-alone factor. The excess market factor has high returns (14.76%) in high VIX periods. TSMOM is the best performing factor in low VIX periods with 15.72% returns per annum. TSMOM performs better in the ‘positive environment’: low VIX, while it performed better for inflation in the ‘negative environment’: high inflation.

The RMW factor is also performing good in high VIX periods with returns of 7.80% compared to the market (-2.04%), this is like the results in the inflation section. The MFE is in both periods steady with (6.12%) returns in low VIX and (4.68%) returns in high, the multi-factor equity is also resilient in volatile periods.

Figure 4: Correlation Factors across Different VIX Regimes, 1990-2022



Notes: The figure shows the correlation between different factors, a higher number means a higher correlation.

In high VIX periods, Mkt-RF and TSMOM tend to move together, while RMW shows a positive correlation with CMA. In such periods, CMA and RMW are also highly correlated. CMA correlates highly with the HML factor in high and low VIX periods. Interestingly, there is an increasing correlation between RMW and BAB and between HML and BAB during high VIX periods. Defensive factors correlate more during volatile periods than during high inflation periods.

Table 10: Quality Returns in Different VIX Regimes, 1990-2022

A. (Low VIX)	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	H-L
Excess return	0.66**	0.91***	0.97***	1.08***	0.96***	0.96***	1.06***	1.00***	1.05***	1.11***	0.44***
t-Statistic	2.24	3.68	4.42	5.27	4.75	4.83	5.47	5.08	5.54	5.58	3.34
Beta	1.22	1.14	1.06	0.99	0.97	0.97	0.96	0.97	0.95	0.95	-0.27
Sharpe ratio	0.15	0.24	0.29	0.34	0.31	0.31	0.36	0.33	0.36	0.36	0.21
Adjusted R^2	0.61	0.76	0.83	0.83	0.81	0.84	0.87	0.87	0.89	0.83	0.22
A. (High VIX)											
Excess return	-1.14	-0.66	-0.80	-0.70	-0.24	-0.48	-0.23	-0.26	-0.08	-0.13	1.01
t-Statistic	-1.49	-0.99	-1.45	-1.30	-0.51	-0.94	-0.47	-0.56	-0.19	-0.30	1.18
Beta	1.53	1.39	1.12	1.12	0.97	1.05	1.02	0.95	0.94	0.89	-0.64

Sharpe ratio	-0.12	-0.08	-0.11	-0.10	-0.04	-0.07	-0.04	-0.04	-0.01	-0.02	0.09
Adjusted R^2	0.83	0.88	0.87	0.90	0.86	0.88	0.93	0.90	0.92	0.89	0.06

Notes: This table shows the excess returns, t-statistics, betas, Sharpe ratios, and R^2 for the period 1990-2022 for the Quality factor in different VIX regimes. All results are in percentages per month. "H-L" is the difference between the highest (P10) and the lowest (P1) quality portfolios. Significant average returns at the 10% level are denoted with *, at the 5% level with **, and at the 1% level with ***.

Table 10 shows the Quality statistics in different VIX regimes for the period 1990-2022. Observations during varying VIX periods show that the Adjusted R^2 ranges from 0.83 to 0.92 during low VIX periods and between 0.61 to 0.89 in high VIX periods. QMJ explains a larger part of movements in calmer periods.

In low VIX periods, there is a small dispersion in returns between ‘P1’ (0.91%) and ‘P10’ (1.11%). However, the lowest quality portfolio (P1) has a lot lower returns (0.66%). All returns in low VIX are statistically different from zero.

In high VIX periods, the QMJ has higher returns (1.01%) per month than in low VIX periods (0.44%). The returns are for in high VIX periods negative for all portfolios, but the ‘junk’ stocks have a lot more negative returns (-1.14%) than the ‘quality’ stocks (-0.13%). Interestingly, the beta difference in low VIX between ‘P10’ and ‘P1’ is -0.27 and in high VIX -0.64. In other words, there are higher returns and lower risk for high-quality stocks, especially in high VIX periods.

Table 11: Quality Returns by VIX Regimes in 5 Different Quantiles, 1990-2022

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	H-L
Excess return (Very Low VIX)	1.18***	1.42***	1.45***	1.37***	1.40***	1.25***	1.22***	1.32***	1.43***	1.41***	0.23**
Sharpe ratio (Very Low VIX)	0.37	0.62	0.65	0.61	0.67	0.64	0.60	0.59	0.68	0.61	0.24
Excess return (Low VIX)	0.62	0.78**	0.92***	0.99***	0.90***	0.99***	1.01***	0.87***	0.87***	0.97***	0.35**
Sharpe ratio (Low VIX)	0.13	0.23	0.29	0.34	0.32	0.34	0.36	0.32	0.33	0.35	0.22
Excess return (Medium VIX)	-0.11	0.35	0.34	0.73	0.51	0.49	0.78*	0.63	0.65	0.59	0.69
Sharpe ratio (Medium VIX)	-0.02	0.07	0.08	0.18	0.13	0.12	0.20	0.16	0.17	0.14	0.16
Excess return (High VIX)	-0.49	0.23	-0.15	-0.04	0.18	0.17	0.42	0.46	0.49	0.56	1.04*
Sharpe ratio (High VIX)	-0.06	0.04	-0.03	-0.01	0.04	0.03	0.08	0.10	0.11	0.12	0.18
Excess return (Very High VIX)	-1.65	-1.51	-1.38	-1.36	-0.72	-1.09	-0.79	-0.91	-0.55	-0.57	1.08
Sharpe ratio (Very High VIX)	-0.14	-0.14	-0.16	-0.16	-0.10	-0.14	-0.11	-0.13	-0.08	-0.09	0.05

Notes: This table shows the excess returns, t-statistics, betas, Sharpe ratios, and R^2 for the period 1990-2022 for the Quality factor in different VIX regimes. All results are in percentages per month. "H-L" is the difference between the highest (P10) and the lowest (P1) quality portfolios. Significant average returns at the 10% level are denoted with *, at the 5% level with **, and at the 1% level with ***.

Table 11 shows the Quality statistics in different quantiles, we see again that the lowest quality portfolio (P1) has a lot lower returns than the other portfolios. The returns become negative in the highest VIX state for all portfolios, but the highest quality outperform the lowest quality, this is in line with Table 10.

In the 'very high VIX' periods, the lowest quality portfolio has monthly excess returns of -1.65% and the highest quality portfolio is -0.57%. The difference between high- and low-quality firms is 1.08%. The results are different compared to Asness et al. (2019), because they used another methodology to measure 'H-L'. The difference between the betas is -0.73; high-quality firms have a much lower risk in highly volatile periods.

4.3 Down and Up Markets

The focus is on the two markets (down markets, and up markets) as defined earlier.

Table 12: Investment Returns by Market Regime, 1990-2022

A. Down	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	MFE
Mean	-3.85***	-0.29	0.42	1.13***	0.93***	1.69***	-1.16	1.49***	-0.37**
Std dev.	3.35	3.37	3.78	3.20	2.31	4.08	8.90	4.18	2.00
t-Statistic	-13.88	-1.04	1.32	4.23	4.73	4.99	-1.56	4.28	-2.24
Sharpe ratio	-1.16	-0.09	0.11	0.35	0.39	0.42	-0.13	0.36	-0.19
B. Up									
Mean	3.26***	0.38***	0.03	-0.05	-0.14	-0.19	2.20***	0.34	0.58***
Std dev.	0.03	0.03	0.03	0.02	0.02	0.05	0.07	0.03	1.40
t-Statistic	20.37	2.12	0.18	-0.36	-1.14	-0.60	5.27	1.55	6.59
Sharpe ratio	1.28	0.13	0.01	-0.02	-0.07	-0.04	0.33	0.10	0.41
ANOVA	569.53***	4.46**	1.32	19.07***	23.69***	15.25***	18.24***	8.68***	30.43***

Notes: This table shows the historical returns, standard deviations, t-statistics, and Sharpe ratios for the period 1990-2022 for the equity factors in two different markets: down and up markets. MFE is an equal-weighted combination of all the equity factor premiums (besides the excess market return). All results are in percentages per month. Significant average returns at the 10% level are denoted with *, at the 5% level with **, and at the 1% level with ***. An ANOVA test is used to test for significance variations in average factor returns across different inflation regimes.

Table 12 shows the investment returns in different markets. In up markets the excess market returns is the highest (3.26%). In down markets the market return (-3.85%) drops. However, the market (S&P 500) has positive returns on average, because there are more positive than negative days in terms of returns.

The RMW factor is a strong performer in down markets, showing a monthly return of 1.13% and a respectable Sharpe ratio of 0.35. The BAB factor, too, demonstrates resilience amidst down markets, showing a mean return of 1.49% each month with a Sharpe ratio of 0.36, this is in line with (Frazzini & Pedersen, 2014). Furthermore, the MOM factor distinguishes itself, yielding high returns of 1.69% and high risk-adjusted return, as denoted by its Sharpe ratio 0.42.

Contrastingly, during market uptrends, the optimism is evident. The market has monthly returns of 3.26%, and a high Sharpe ratio of 1.28. The TSMOM factor performs good in positive markets, showing an exceptional mean return of 2.20% per month. Its Sharpe ratio is 0.33, suggesting decent reward for the associated risk. The MOM factor's performance appears subdued during these positive figures, showing negative returns, albeit statistically insignificant. This is different to the study by (Griffin et al., 2003). The financial crisis has influenced the MOM returns. Observing solely the TSMOM factor, one could infer that a security's historical performance serves as a reasonably good predictor of its subsequent returns during rising markets. The ANOVA tests show that all the factors (except value) have significant variations in returns between the different market periods.

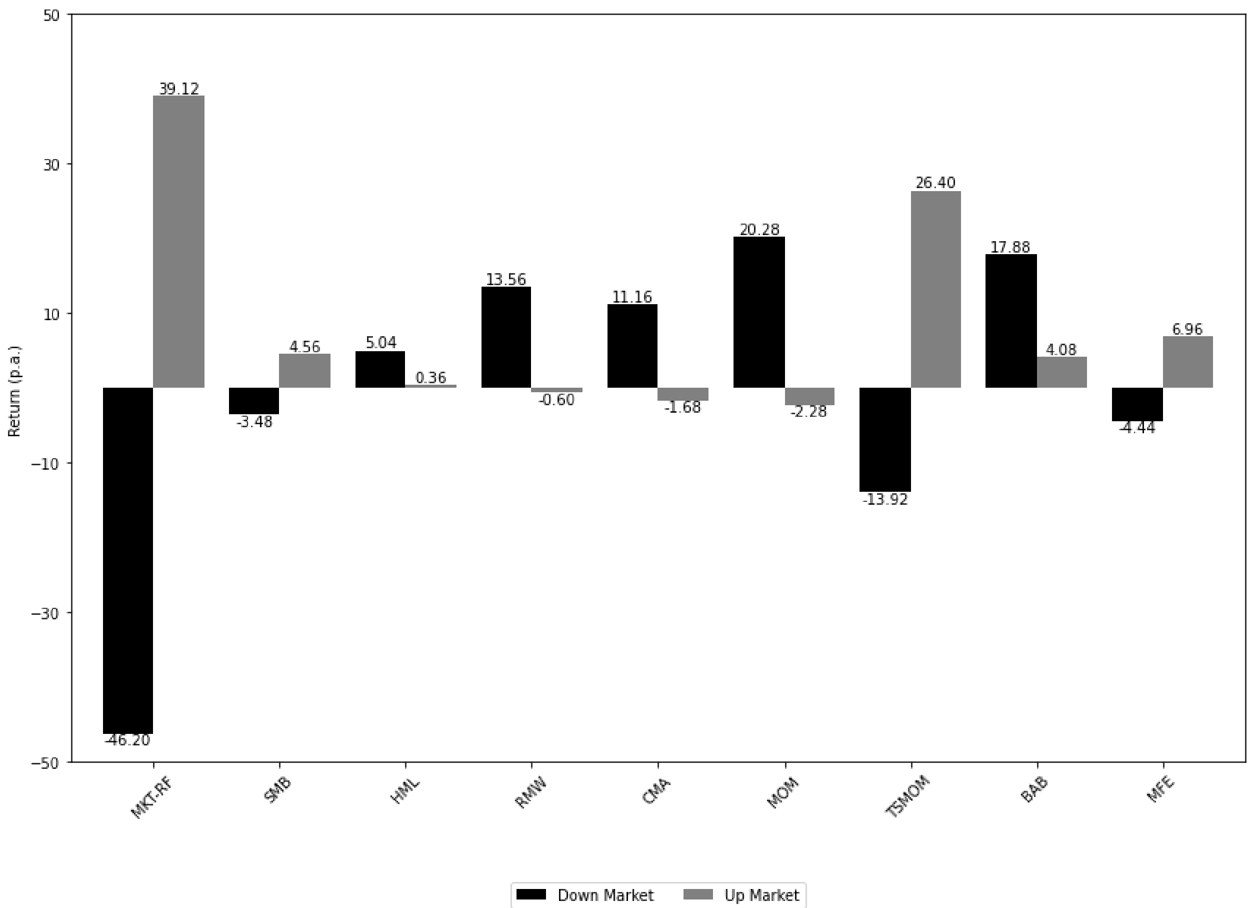
Table 13: Investment Returns in Recessions, 1990-2022

A. Recession	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	MFE
Mean	-2.37**	-0.17	-0.93	0.90**	-0.13	-0.30	0.65	-1.30	-0.33
Std dev.	6.72	3.59	4.56	2.32	2.60	8.72	11.96	5.47	2.66
t-Statistic	-2.11	-0.28	-1.22	2.31	-0.29	-0.20	0.33	-1.43	-0.75
Sharpe ratio	-0.35	-0.05	-0.20	0.39	-0.05	-0.03	0.05	-0.24	-0.13
B. Non-rec.									
Mean	0.75***	-0.07	0.06	0.10	0.06	0.35	0.79**	0.73***	0.29***
Std dev.	4.09	3.00	3.08	2.66	2.13	4.07	7.16	3.54	1.57
t-Statistic	3.47	-0.41	0.34	0.70	0.52	1.62	2.08	3.94	3.50
Sharpe ratio	0.18	-0.02	0.02	0.04	0.03	0.09	0.11	0.21	0.18

Notes: This table shows the historical returns, standard deviations, t-statistics, and Sharpe ratios for the period 1990-2022 for the equity factors in two different markets: recessions, and non-recessions. MFE is an equal-weighted combination of all the equity factor premiums (besides the excess market return). All results are in percentages per month. Significant average returns at the 10% level are denoted with *, at the 5% level with **, and at the 1% level with ***.

Table 13 shows the investment returns in recessions. During recessive market phases, a select few factors show positive numbers. The market, RMW, and TSMOM factors distinguish themselves by showing positive returns. RMW has positive returns (0.90%) and significant. The MFE, the equal-weighted combination of all the factors has 0.29% returns per month in non-recessions, but negative (-0.33%) per month in recessions. However, a word of caution: interpreting results, during recessions is challenging due to the limited observations available.

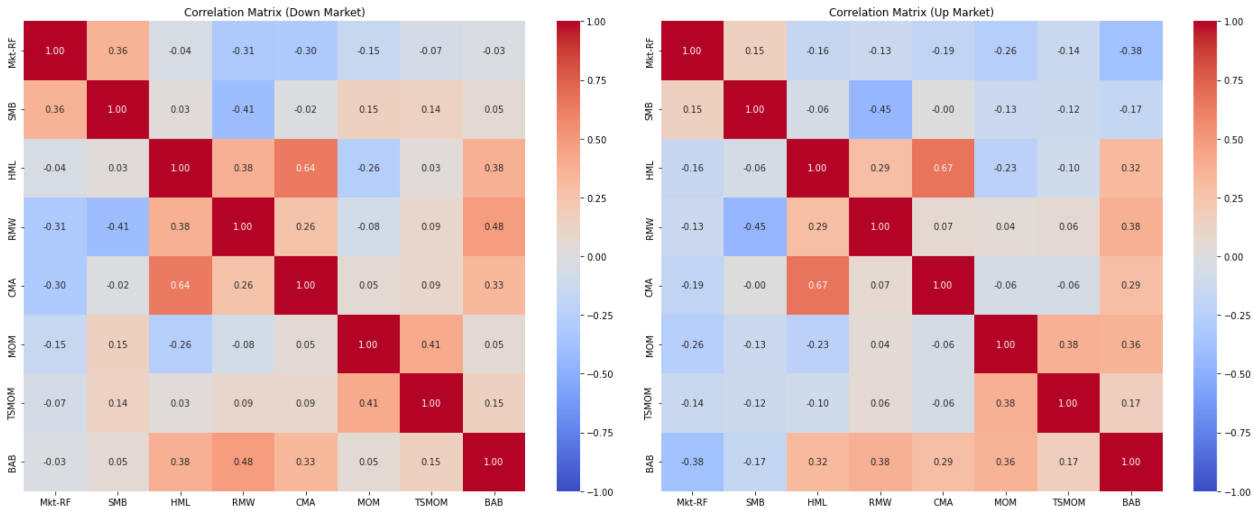
Figure 5: Equity Factor Premiums across VIX Regimes, 1990-2022



Notes: This figure shows the yearly average return on the factors across the different market periods.

Figure 5 shows the yearly equity factors across two different market periods. RMW has high returns (13.56%) per annum in down markets. BAB is also strong with 17.88% returns; the best performer is the MOM factor (20.28%). The MFE has negative returns in the down markets (-4.44%).

Figure 6: Correlation Factors across Different Market Regimes, 1990-2022



Notes: The figure shows the correlation between different factors, a higher number means a higher correlation.

In up markets, factors like HML, RMW, and MOM tend to move in the same direction as the market, while SMB, CMA, MOM, TSMOM, and BAB move in the opposite direction. CMA and HML are in both market conditions the most correlated. Defensive factors correlate more in down markets than in up markets. However, the change is smaller than for the different VIX periods.

Table 14: Quality Returns in Different market periods, 1990-2022

A. Down	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	H-L
Excess return	-6.36***	-5.47***	-4.74***	-4.51***	-3.93***	-4.15***	-3.96***	-3.95***	-3.60***	-3.56***	2.80
t-Statistic	-11.83	-12.10	-12.77	-12.15	-12.95	-12.21	-13.01	-14.06	-13.11	-13.18	-1.35
Beta	1.59	1.47	1.18	1.23	0.95	1.10	1.03	0.92	0.92	0.85	-0.74
Sharpe ratio	0.67	0.81	0.78	0.84	0.74	0.81	0.88	0.81	0.85	0.75	0.08
Adjusted R^2	-0.98	-1.01	-1.06	-1.01	-1.08	-1.02	-1.09	-1.17	-1.09	-1.09	-0.11
B. Up											
Excess return	3.47***	3.53***	3.09***	3.08***	2.99***	2.94***	3.04***	3.02***	2.99***	2.96***	-0.51***
t-Statistic	11.25	13.59	15.08	16.21	15.92	15.37	16.57	17.77	17.10	16.89	5.64
Beta	1.47	1.33	1.06	1.01	0.97	1.02	1.03	0.93	0.99	0.94	-0.53
Sharpe ratio	0.71	0.85	0.94	1.02	0.99	0.96	1.04	1.11	1.07	1.07	0.36
Adjusted R^2	0.57	0.66	0.67	0.71	0.67	0.71	0.79	0.74	0.81	0.73	0.16

Notes: This table shows the excess returns, t-statistics, betas, Sharpe ratios, and R^2 for the period 1990-2022 for the Quality factor in different market regimes. All results are in percentages per month. "H-L" is the difference between the highest (P10) and the lowest (P1) quality portfolios. Significant average returns at the 10% level are denoted with *, at the 5% level with **, and at the 1% level with ***.

The quality factor has higher outperformance in down markets, 2.80% per month. The results are not significant, however. We see a trend that the returns are linearly less negative for higher-quality stocks in down markets. The most significant differences are for ‘P1 to P2’, these results are significant. The betas are also much lower for high-quality stocks, which tend to have lower risk. The lowest quality stocks have a beta of 1.59, and the highest quality stocks of 0.85.

Interestingly, the returns have been higher in up markets for low-quality stocks. Possible reasons are ‘herding behavior,’ lower interest rates, and lottery-seeking behavior (Bali et al., 2017; Dasgupta et al., 2011). The Sharpe ratios are for low- and high-quality portfolios, 0.71, and 1.07, respectively. The risk-adjusted returns are a lot higher for high-quality stocks because of lower volatility for these stocks; we see this also in the declining betas.

Table 15: Quality Returns in Recessions, 1990-2022

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	H-L
A. Recession											
Excess returns	-3.86**	-3.76**	-2.77*	-3.36**	-2.49*	-3.03**	-2.15*	-2.34**	-1.83	-1.63	2.22
t-Statistic	-2.21	-2.00	-1.87	-2.33	-1.92	-2.27	-1.83	-2.04	-1.64	-1.64	0.57
Beta	1.48	1.59	1.26	1.23	1.07	1.13	1.02	0.98	0.95	0.86	-0.62
Sharpe ratio	-0.37	-0.33	-0.31	-0.39	-0.32	-0.38	-0.31	-0.34	-0.27	-0.27	0.09
Adjusted R^2	0.91	0.91	0.91	0.92	0.87	0.91	0.97	0.93	0.93	0.95	0.04
B. Non-Rec.											
Excess return	0.27	0.66**	0.54**	0.69***	0.77***	0.71***	0.76***	0.77***	0.83***	0.81***	0.54***
t-Statistic	0.76	2.28	2.18	2.92	3.56	3.12	3.39	3.58	3.98	3.79	3.03
Beta	1.44	1.24	1.07	1.04	0.93	0.99	1.00	0.95	0.94	0.93	-0.51
Sharpe ratio	0.04	0.12	0.11	0.15	0.19	0.16	0.18	0.19	0.21	0.20	0.16
Adjusted R^2	0.74	0.84	0.85	0.88	0.84	0.86	0.90	0.89	0.91	0.86	0.12

Notes: This table shows the excess returns, t-statistics, betas, Sharpe ratios, and R^2 for the period 1990-2022 for the Quality factor in recessions. All results are in percentages per month. "H-L" is the difference between the highest (P10) and the lowest (P1) quality portfolios. Significant average returns at the 10% level are denoted with *, at the 5% level with **, and at the 1% level with ***.

The highest-quality stocks performed much better than the lowest by about 2.22%. High-quality stocks tend to do much better during recessions than low-quality stocks. The results are not significant because there are only 36 observations for recessionary periods. Therefore, outliers can have a significant effect. It is also why the results differ in comparison with (C. S. Asness et al., 2019). They found excess returns of 0.50% for the quality factor in recessions. The high-quality stocks also performed better in non-recessions but by a smaller margin, 0.54%. These results are statistically significant. The difference between high- and low-quality stocks' beta is also higher in recessions.

4.4 Regressions Portfolio

In this section, we will perform a regression analysis of the portfolio against various factors. We will examine inflation, the VIX, and conclude by exploring down and up markets. Our portfolio, which consists of 60% equities and 40% bonds, will be compared against benchmarks like the CAPM, FF3, FF5, and the 8 Factor Model.

Table 16: Portfolio Returns in Different Inflation Regimes, 1990-2022

A. Low	Alpha	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	Adjusted R^2
CAPM	0.0005	0.5347***								0.877
	(0.726)	(38.903)								
FF3	0.0004	0.5607***	-0.1192***	-0.0389**						0.899
	(0.664)	(43.030)	(-5.820)	(-1.966)						
FF5	0.0002	0.5687***	-0.1074***	-0.0493**	0.0556*	0.0078				0.900
	(0.394)	(40.307)	(-5.042)	(-2.061)	(1.916)	(0.222)				
8 Factor Model	0.0003	0.5763***	-0.0985***	-0.0280	0.0546*	0.0073	0.0392**	0.0001	-0.0251	0.902
	(0.582)	(36.546)	(-4.576)	(-1.118)	(1.778)	(0.208)	(2.513)	(0.012)	(-1.375)	
B. High										
CAPM	0.0002	0.5896***								0.875
	(0.261)	(35.350)								
FF3	0.0001	0.6271***	-0.1850***	0.0362**						0.924
	(0.100)	(44.582)	(-9.562)	(-1.991)						
FF5	-0.0006	0.6347***	-0.1465***	0.0043	0.0875***	0.0153				0.929
	(-0.986)	(42.207)	(-6.686)	(0.156)	(3.558)	(0.397)				
8 Factor Model	-0.0004	0.6341***	-0.1453***	-0.0006	0.0864***	0.0182	0.0001	-0.0104	0.0023	0.928
	(-0.702)	(41.729)	(-6.523)	(-0.022)	(3.248)	(0.444)	(0.003)	(-1.355)	(0.118)	

Notes: This table shows the 60/40 (60% equities, 40% bonds) portfolio returns in different inflation regimes against the following benchmark models: CAPM, FF3, FF5, 8 Factor Model. Each coefficient is presented with its t-statistic, significance levels are denoted with: *** for 1%, ** for 5%, and * for 10%.

Table 16 shows the portfolio returns in different inflation regimes. In high inflation, the portfolio has a tilt toward large-cap equities, as shown by a more negative coefficient for the SMB factor (−0.1453 in the 8-Factor Model during high inflation, compared to −0.0985 during low inflation). In low inflation, the value premium is negative and statistically significant at 5% in the FF3 model (−0.0389). This significance diminishes in the 8-Factor Model. Contrarily, under high inflation periods, the HML coefficient transitions to a positive value, albeit statistically insignificant across all presented models, showing an inconsistent value orientation of the portfolio in different inflation periods. The portfolio shows a positive momentum tilt in low-inflation periods, as seen by the significant MOM factor (0.0392 in the 8-Factor Model). The RMW factor has a positive coefficient in low- and high-inflation. Its significance increases during high inflation periods, evidenced by significance in the FF5 and 8-Factor Model.

Table 17: Portfolio Returns in Different VIX Regimes, 1990-2022

A. Low	Alpha	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	Adjusted R^2
CAPM	0.0001	0.5601***								0.782
	(0.152)	(28.777)								
FF3	-0.0002	0.5868***	-0.2104***	-0.0354*						0.857
	(-0.424)	(36.482)	(-10.704)	(-1.756)						
FF5	-0.0003	0.5901***	-0.1994***	-0.0502*	0.0379	0.0378				0.857
	(-0.618)	(36.125)	(-9.114)	(-1.874)	(1.134)	(0.866)				
8 Factor Model	-0.0014**	0.6101***	-0.2004***	-0.0328	0.0389	0.0239	0.0509***	-0.0110	0.0583**	0.866
	(-2.484)	(32.510)	(-9.417)	(-1.199)	(1.188)	(0.562)	(2.724)	(-1.421)	(2.384)	
B. High										
CAPM	0.0004	0.5597***								0.910
	(0.436)	(40.219)								
FF3	0.0009	0.5866***	-0.1368***	0.0156						0.930

	Alpha	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	Adjusted R^2
	(1.181)	(45.529)	(-6.775)	(0.913)						
FF5	0.0002	0.5968***	-0.0972***	-0.0158	0.1016***	-0.0096				0.936
	(0.271)	(42.340)	(-4.469)	(-0.648)	(3.924)	(-0.273)				
8 Factor Model	0.0001	0.5964***	-0.0924***	-0.0088	0.1152***	-0.0118	0.0104	-0.0090	-0.0174	0.935
	(0.151)	(39.962)	(-4.152)	(-0.339)	(4.003)	(-0.327)	(0.757)	(-0.998)	(-1.011)	

Notes: This table shows the 60/40 (60% equities, 40% bonds) portfolio returns in different VIX regimes against the following benchmark models: CAPM, FF3, FF5, 8 Factor Model. Each coefficient is presented with its t-statistic, significance levels are denoted with: *** for 1%, ** for 5%, and * for 10%.

Table 17 shows the portfolio returns in different VIX regimes. In environments characterized by low VIX, the portfolio's alpha within the 8-Factor Model shows a statistically significant deviation from zero, registering at -0.0014. This significant negative alpha suggests that unexplained factors influence the negative returns during periods of low volatility. Furthermore, the HML coefficient changes between low and high VIX conditions. This inconsistency points towards a conditional orientation of the portfolio towards value stocks, dependent on the prevailing market volatility. During periods of higher VIX, specific factors such as RMW become stronger in models like FF5 and the 8-Factor model. The increased significance of the RMW factor during volatile market periods underscores its important role in capturing portfolio returns in such environments. Given the dynamics of the RMW factor, a 1% surge in this factor can lead to an anticipated 11.52% increase in the portfolio's excess return over the risk-free rate.

In the 8-Factor Model, the portfolio leans towards the MOM factor during low volatility periods, evidenced by a coefficient of 0.0509. Additionally, the portfolio shows a positive orientation towards the BAB factor, reflected by a coefficient of 0.0583. These coefficients collectively highlight the portfolio's strategy of capitalizing on momentum and betting against beta during low VIX periods.

Table 18: Portfolio Returns in Different Market Regimes, 1990-2022

A. Down	Alpha	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	Adjusted R^2
CAPM	0.0004	0.5521***								0.889

	(0.547)	(33.422)								
FF3	0.0012	0.5715***	-0.1505***	-0.0125						0.909
	(1.575)	(36.290)	(-5.766)	(-0.584)						
FF5	0.0006	0.5891***	-0.1260***	-0.0497	0.0771**	0.0299				0.912
	(0.774)	(33.391)	(-4.544)	(-1.607)	(2.406)	(0.692)				
B. Up										
8 Factor Model	0.0006	0.5908***	-0.1218***	-0.0548	0.0785**	0.0312	-0.0003	-0.0089	0.0052	0.910
	(0.754)	(30.870)	(-4.286)	(-1.606)	(2.251)	(0.708)	(-0.017)	(-0.862)	(0.228)	
CAPM	0.00004	0.5653***								0.866
	(0.062)	(40.147)								
FF3	-0.0004	0.5983***	-0.1755***	0.0051						0.908
	(-0.739)	(49.708)	(-10.814)	(0.327)						
FF5	-0.0007	0.6016***	-0.1408***	-0.0103	0.0863***	-0.0015				0.912
	(-1.349)	(46.954)	(-7.575)	(-0.487)	(3.623)	(-0.046)				
8 Factor Model	-0.0010**	0.6126***	-0.1468***	0.0082	0.0847***	-0.0146	0.0434***	-0.0118*	0.0075	0.915
	(-1.925)	(46.502)	(-7.913)	(0.374)	(3.428)	(-0.437)	(2.987)	(-1.756)	(0.458)	

Notes: This table shows the 60/40 (60% equities, 40% bonds) portfolio returns in different market regimes against the following benchmark models: CAPM, FF3, FF5, 8 Factor Model. Each coefficient is presented with its t-statistic, significance levels are denoted with: *** for 1%, ** for 5%, and * for 10%.

Table 18 shows the portfolio returns in different market regimes. The portfolio's alpha within the 8-Factor Model during up markets is -0.0010, a statistically significant deviation from zero. Due to its exposure to factors, the portfolio's return is 0.10% less than the expected return per period. The adjusted R^2 values are high in both markets, indicating that the models account for a significant portion of the portfolio's returns. Since the 8-Factor Model captures the highest variance in up markets, incorporating additional factors for bull markets may be advantageous.

A pattern is evident upon closer inspection of the portfolio's interaction with the HML factor. The HML coefficient changes between the bullish and bearish periods. The portfolio is more inclined towards value stocks when the market sentiment is positive. Defensive factors, such as RMW, are crucial in down markets, particularly in advanced models like the FF5 and the 8-Factor Model. The pronounced influence of the RMW factor during down-market episodes underscores its crucial role in capturing portfolio returns when optimism is scarce. Within the 8-Factor Model during bullish periods, the portfolio exhibits a pronounced inclination toward the MOM factor, reflected by a coefficient of 0.0434.

4.5 Robustness

We begin with a thorough check to ensure our data is robust. We first examine the data from 1990-2007 and 2008-2022. By doing this, we can see if there were any changes in factor returns before and after the financial crisis that began in 2007. We use the HC3 and Newey West standard errors.

Tables 19, 20, and 21 in the Appendix show the robustness check for the factors in different economic periods. From 1990-2007 to 2008-2022, the MOM factor switched direction in low inflation periods, moving from a positive mean return of 0.85% to a negative -0.28%. The financial crisis hurts the momentum factor when we look for mean returns. We see the same for the Sharpe ratio for the MOM factor. The HML factor performs especially strongly in the first period in higher inflation periods and loses its significance in 2008-2022. The BAB factor loses significance in the last period and has negative excess returns. The RMW factor seems robust for the different periods in higher inflation periods.

The market excess return has had much higher returns in the last few years. The MOM factor has not been performing as well, especially with lower VIX recently. As we observed during inflation analysis, the TSMOM factor showed negative results in periods with a higher VIX lately. The TSMOM factor has negative returns and loses significance in the last period for higher VIX periods. The results are like the inflation analysis.

The RMW factor remains strong during periods of high volatility in the last period, like periods of high inflation. On the other hand, the HML factor tends to drop during downturns. The RMW factor has not been as consistent in downturns in recent times. Given its earlier correlation with RMW, the CMA factor has also lost its significance lately.

The MOM factor has consistently shown strength and significance throughout both time frames. While the HML factor had negative returns in up markets from 1990-2007, its performance improved in recent years, although it was insignificant. The Time-Series Momentum was notably powerful in the first period when considering risk-adjusted returns. However, its strength diminished in the latter years despite outperforming the standard momentum factor.

In examining portfolio returns during periods of low inflation, applying Newey-West standard errors reveals notable deviations in the significance of certain factors within the FF3 and FF5 models. Specifically, the value factor (HML) does not retain statistical significance within these models, as shown in Appendix Table 22a. Similarly, the profitability factor exhibits a marginal deviation from significance within the 8-Factor Model.

Upon adjusting for high inflation periods and incorporating Newey-West standard errors, the value factor (HML) is statistically insignificant within the FF3 model's framework, as outlined in Appendix Table 22b. In addition, the RMW factor achieves significance at the 5% level within the FF5 and the 8-Factor Model.

The robustness checks show a more pronounced robustness of the MOM and BAB factors in low VIX. The performance of the value factor during low VIX intervals highlights the insignificance of HML within the FF3 model. During such periods, the portfolio had a negative alpha, indicating monthly underperformance of -0.14% compared to the 8-Factor Model's predictions.

In conclusion, during downturn market conditions, the RMW factor's significance diminishes, as emphasized in Appendix Table 22b. It points to the potential existence of heteroskedasticity and/or autocorrelation that could shape this factor's behavior during such market scenarios.

We also performed a robustness check for six factors (Mkt-RF, SMB, HML, MOM, BAB, MFE) a longer period, 1930-2022. Table 25 shows the robustness check for inflation. The factors are chosen because for the six factors there is data since 1930, there is no VIX data before 1990; therefore, we exclude the VIX for this analysis. SMB, MOM and MFE returns contrast with Table 3, and are significantly different from zero. Momentum has in low inflation for the longer sample positive returns (0.55%), in the shorter sample Momentum (-0.03%) negative returns. The MFE, equal-weighted combination of the six factors, has 0.47% returns in low inflation. Coincidentally, it has the same returns in high inflation regimes. The ANOVA tests show that there are significant variations in returns, this contrasts Table 3 (only market showed highly significant variations in returns).

Table 26 shows the results for recessions, in the main analysis we used up and down markets, because there were only a few recessions in the last 32 years. The market has over the longer period less negative (-1.08%) returns in comparison to (-2.37%) for shorter sample. All the six factors are significant different from zero in non-recessions, and all the factors have lower returns in recessions, but still positive in contrast to the market.

5. Conclusion

In this study, we examined the differing returns of equities and nine equity factors under various economic scenarios, during different inflation regimes, VIX regimes, and market regimes. Our research is based on monthly data retrieved from esteemed repositories such as the Fama-French Library, AQR Capital Library, the U.S. Bureau of Labor Statistics, CBOE, and CRSP. By categorizing 'high inflation' periods as those exceeding the mean, we established similar benchmarks for VIX levels and market states, leading us to formulate a 60:40 equity-bond portfolio model (Baltussen et al., 2023).

The methods and findings used helped answer the following research question:

"To what degree do equity returns and factors vary across distinct macroeconomic environments?"

The results show differences in equity and factor returns in different economic conditions. Equities performed better in nominal terms in low inflation (13.35%) than periods with high inflation (2.43%). Investors see a decrease in their purchasing power when inflation rises, the real returns are in low inflation (11.77%) and in high inflation (-1.24%), this is in line with (Fama & Schwert, 1977).

RMW performs badly (0.01%) in low inflation regimes and better (0.82%) in high inflation regimes. QMJ is performing well (1.36%) in high inflation regimes. Momentum also performs better in high inflation regimes, with an average monthly return of 1.11%, the high Momentum returns are in line with (Neville et al., 2021). The multi-factor equity (MFE) performs well (0.74%) in especially high inflation periods. Interestingly, all factors displayed positive returns even in a high inflation environment, signifying their resilience under inflationary pressures. These results differ from Baltussen et al. (2023), because they use less factors and another definition of high inflation. There are return differences between different inflation regimes, but there are only significant results for the market factor and MFE.

Equities performed better in nominal terms in low VIX (12.39%) regimes than in high VIX (1.74%) regimes. Investors do not get higher returns when volatility rises, this contrasts French, Schwert, and Stambaugh (1987), but is in line with (van Vliet et al., 2011). QMJ has in high VIX periods higher excess returns (1.11%) than in low VIX periods (0.44%).

In periods with low VIX, the BAB factor is performing well in absolute terms (1.19%) and in risk-adjusted terms (Sharpe ratio: 0.58).

The MFE has highly significant returns (0.51%) in low VIX periods, and significant returns (0.39%) in high VIX periods. RWM performs well (0.65%) in high VIX periods. There are returns differences between different VIX regimes, and only significant for the market, CMA and BAB factors.

When performing the robustness test for the longer period the MOM factor is positive (0.55%) for the longer time-horizon in low inflation. The market has, over the longer period less negative (-1.08%) returns in recessions compared to (-2.37%) for the shorter sample. All six factors have lower returns in recessions but are still positive in contrast to the market.

In conclusion, understanding factor behavior under specific economic regimes can enable investors to achieve optimized (risk-adjusted) returns. Nevertheless, this study has limitations. Firstly, changes in volatility over time can significantly influence factor returns, making certain conclusions potentially less generalizable across different market conditions.

Additionally, the behavior of factors can vary substantially across industries, implying that sector-specific nuances might need to be fully captured. The study's emphasis on the market, rather than individual stock performances, may also dilute idiosyncratic risk effects. Furthermore, while the research adopts a long-short strategy for factor construction, in practical scenarios, portfolios tend to be more heavily weighted towards long positions with fewer short exposures, leading to a disparity between theoretical and real-world outcomes.

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7. Appendix

Table 19a: Descriptive Statistics of Factor Returns (1990-2007)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	0.25	-0.16	0.01	0.05	-0.04	0.55	1.47	0.68
Std dev.	4.09	3.35	3.10	3.09	2.31	4.64*	7.62***	4.36**
t-Statistic	0.88	-0.73	-0.05	0.22	-0.24	1.73	2.84	2.29
Sharpe ratio	0.06	-0.05	0.00	0.02	-0.02	0.12	0.19	0.16

Table 19b: Descriptive Statistics of Factor Returns (2008-2022)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	0.73**	0.03	-0.09	0.32**	0.14	-0.02	-0.06	0.39*
Std dev.	4.86	2.62	3.41	1.96	1.99	4.71	7.70	2.92
t-Statistic	2.01	0.18	-0.35	2.19	0.93	-0.05	-0.11	1.80
Sharpe ratio	0.15	0.01	-0.03	0.16	0.07	-0.00	-0.01	0.13

Table 19c: Descriptive Statistics of Factor Returns During Periods of Below Average Inflation (1990-2007)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	0.88**	0.31	-0.01	0.08	0.25	0.85**	2.30***	0.82**
Std dev.	4.10	3.08	2.50	2.61	2.25	4.28	7.88	4.34
t-Statistic	2.34	1.11	-0.04	0.32	1.21	2.18	3.20	2.07
Sharpe ratio	0.21	0.10	0.00	0.03	0.11	0.20	0.29	0.19

Table 19d: Descriptive Statistics of Factor Returns During Periods of Below Average Inflation (2008-2022)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	1.36***	0.18	-0.23	0.04	0.03	-0.28	0.03	0.66**
Std dev.	4.54	2.73	3.19	1.62	1.58	5.09	7.54	3.02
t-Statistic	3.31	0.73	-0.80	0.26	0.18	-0.60	0.05	2.41
Sharpe ratio	0.30	0.07	-0.07	0.02	0.02	-0.05	0.00	0.22

Table 19e: Descriptive Statistics of Factor Returns During Periods of Above Average Inflation (1990-2007)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	0.22	0.01	0.81**	0.78**	0.37	0.94*	1.20	1.27***
Std dev.	4.08	3.67	3.68	3.58	2.38	5.08	7.29	4.39
t-Statistic	0.54	0.02	2.14	2.12	1.53	1.81	1.61	2.84
Sharpe ratio	0.05	0.00	0.22	0.22	0.16	0.18	0.16	0.29

Table 19f: Descriptive Statistics of Factor Returns During Periods of Above Average Inflation (2008-2022)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	-0.46	-0.13	0.36	1.06***	0.52	0.67	-0.11	-0.02
Std dev.	5.30	2.38	3.83	2.40	2.63	3.75	8.11	2.65
t-Statistic	-0.66	-0.40	0.71	3.37	1.52	1.36	-0.11	-0.06
Sharpe ratio	-0.09	-0.05	0.09	0.44	0.20	0.18	-0.01	-0.01

Table 20a: Descriptive Statistics of Factor Returns During Periods of Below Average VIX (1990-2007)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	1.00***	0.10	0.46**	0.31**	0.13	0.84***	1.62**	1.42***
Std dev.	2.82	2.28	2.12	1.48	1.46	2.38	7.01	2.24
t-Statistic	3.85	0.44	2.35	2.25	0.94	3.84	2.52	6.89
Sharpe ratio	0.35	0.04	0.22	0.21	0.09	0.35	0.23	0.63

Table 20b: Descriptive Statistics of Factor Returns During Periods of Below Average VIX (2008-2022)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	1.49***	-0.06	-0.18	0.09	-0.12	0.31	0.88	0.83***
Std dev.	3.08	2.34	2.60	1.7	1.50	3.09	6.70	1.71
t-Statistic	5.09	-0.28	-0.72	0.54	-0.81	1.07	1.38	5.12
Sharpe ratio	0.48	-0.03	-0.07	0.05	-0.08	0.10	0.13	0.49

Table 20c: Descriptive Statistics of Factor Returns During Periods of Above Average VIX (1990-2007)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	0.01	0.33	0.30	0.52	0.53*	0.96	1.82**	0.53
Std dev.	5.25	4.25	4.02	4.37	3.06	6.46	8.35	6.05
t-Statistic	0.00	0.76	0.72	1.16	1.70	1.45	2.12	0.86
Sharpe ratio	0.00	0.08	0.07	0.12	0.17	0.15	0.22	0.09

Table 20d: Descriptive Statistics of Factor Returns During Periods of Above Average VIX (2008-2022)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	-0.37	0.32	0.18	0.82***	0.67**	-0.43	-1.46	-0.19
Std dev.	6.69	3.03	4.43	2.26	2.53	6.54	8.96	4.13
t-Statistic	-0.46	0.87	0.33	3.01	2.21	-0.54	-1.35	-0.38
Sharpe ratio	-0.05	0.10	0.04	0.36	0.27	-0.07	-0.16	-0.05

Table 21a: Descriptive Statistics of Factor Returns During Down markets (1990-2007)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	-3.94***	-0.41	0.98***	1.18***	1.03***	1.40***	-0.77	2.06***
Std dev.	3.00	3.80	3.38	3.83	2.45	4.40	8.65	4.52
t-Statistic	-11.68	-0.97	2.58	2.74	3.72	2.82	-0.79	4.05
Sharpe ratio	-1.31	-0.11	0.29	0.31	0.42	0.32	-0.09	0.46

Table 21b: Descriptive Statistics of Factor Returns During Down markets (2008-2022)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	-4.22***	-0.61*	-0.73	0.60**	0.35	1.58***	-2.11*	0.33
Std dev.	3.70	2.73	4.06	2.13	2.14	3.67	9.18	3.44
t-Statistic	-9.20	-1.81	-1.45	2.25	1.30	3.48	-1.85	0.77
Sharpe ratio	-1.14	-0.22	-0.18	0.28	0.16	0.43	0.23	0.10

Table 21c: Descriptive Statistics of Factor Returns During Up markets (1990-2007)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	2.66***	-0.02	-0.55**	-0.61***	-0.65***	0.06	2.76***	-0.11
Std dev.	2.30	3.07	2.79	2.36	1.98	4.72	6.66	4.07
t-Statistic	13.51	-0.09	-2.30	-3.01	-3.85	0.14	4.85	-0.33
Sharpe ratio	1.15	-0.01	-0.20	-0.26	-0.33	0.01	0.41	-0.03

Table 21d: Descriptive Statistics of Factor Returns During Up markets (2008-2022)

	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB
Mean	3.52***	0.40*	0.27	0.16	0.02	-0.93**	1.09*	0.43*
Std dev.	2.77	2.50	2.95	1.85	1.89	5.00	6.50	2.59
t-Statistic	13.62	1.72	0.99	0.95	0.12	-1.98	1.80	1.77
Sharpe ratio	1.27	0.16	0.09	0.09	0.01	-0.18	0.17	0.16

Table 22a: Portfolio Return Performance Against Benchmark Models During Periods of Low Inflation with Newey West Standard Errors (1990-2022, N=384 months). Each coefficient is presented alongside its t-statistic, with significance levels indicated by asterisks: *** for 1%, ** for 5%, and * for 10%.

	Alpha	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	Adjusted R^2
CAPM	0.0005	0.5347***								0.877
	(0.682)	(32.866)								
FF3	0.0004	0.5607***	-0.1192***	-0.0389						0.899
	(0.640)	(29.468)	(-4.518)	(-1.222)						
FF5	0.0002	0.5687***	-0.1074***	-0.0493	0.0556**	0.0078				0.900
	(0.404)	(33.316)	(-3.973)	(-1.351)	(2.010)	(0.247)				
8 Factor Model	0.0003	0.5763***	-0.0985***	-0.0280	0.0546	0.0073	0.0392**	0.0001	-0.0251	0.902
	(0.488)	(31.070)	(-3.803)	(-0.670)	(1.601)	(0.248)	(2.197)	(0.009)	(-0.742)	

Table 22b: Portfolio Return Performance Against Benchmark Models During Periods of High Inflation with Newey West Standard Errors (1990-2022, N=384 months). Each coefficient is presented alongside its t-statistic, with significance marked by asterisks: *** for 1%, ** for 5%, and * for 10%.

	Alpha	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	Adjusted R^2
CAPM	0.0002	0.5896***								0.875
	(0.306)	(20.336)								
FF3	0.0001	0.6271***	-0.1850***	0.0362						0.924
	(0.093)	(25.238)	(-6.891)	(1.418)						
FF5	-0.0006	0.6347***	-0.1465***	0.0043	0.0875**	0.0153				0.929
	(-0.816)	(32.909)	(-4.015)	(0.146)	(2.209)	(0.383)				
8 Factor	-0.0004	0.6341***	-0.1453***	-0.0006	0.0864**	0.0182	0.0001	-0.0104*	0.0023	0.928

Model	(-0.614)	(32.573)	(-3.996)	(-0.022)	(2.322)	(0.442)	(0.004)	(-1.774)	(0.111)	

Table 23a: Portfolio Return Performance Against Benchmark Models During Periods of Low VIX with Newey West Standard Errors (1990-2022, N=384 months). Each coefficient is presented with its respective t-statistic, with significance levels annotated by asterisks: *** for 1%, ** for 5%, and * for 10%.

	Alpha	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	Adjusted R^2
CAPM	0.0001	0.5601***								0.782
	(0.150)	(20.376)								
FF3	-0.0002	0.5868***	-0.2104***	-0.0354						0.857
	(-0.444)	(25.872)	(-7.026)	(-1.175)						
FF5	-0.0003	0.5901***	-0.1994***	-0.0502	0.0379	0.0378				0.857
	(-0.641)	(26.736)	(-6.132)	(-1.351)	(0.951)	(0.921)				
8 Factor Model	-0.0014***	0.6101***	-0.2004***	-0.0328	0.0389	0.0239	0.0509***	-0.0110	0.0583**	0.866
	(-2.993)	(28.483)	(-6.310)	(-1.001)	(1.087)	(0.576)	(3.123)	(-1.466)	(3.005)	

Table 23b: Portfolio Return Performance Against Benchmark Models During Periods of High VIX with Newey West Standard Errors (1990-2022, N=384 months). Each coefficient is accompanied by its t-statistic, with significance levels marked by asterisks: *** for 1%, ** for 5%, and * for 10%.

	Alpha	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	Adjusted R^2
CAPM	0.0004	0.5597***								0.910
	(0.412)	(26.293)								
FF3	0.0009	0.5866***	-0.1368***	0.0156						0.930
	(1.076)	(26.667)	(-6.399)	(0.814)						
FF5	0.0002	0.5968***	-0.0972***	-0.0158	0.1016***	-0.0096				0.936

	(0.232)	(28.376)	(-3.858)	(-0.648)	(2.893)	(-0.355)				
8 Factor Model	0.0001	0.5964***	-0.0924***	-0.0088	0.1152***	-0.0118	0.0104	-0.0090	-0.0174	0.935
	(0.126)	(26.208)	(-3.457)	(-0.287)	(3.058)	(-0.403)	(0.605)	(-0.905)	(-0.756)	

Table 24a: Portfolio Return Performance Against Benchmark Models During Up Market Periods with Newey West Standard Errors (1990-2022, N=384 months). Each beta coefficient is concurrently displayed with its respective t-statistic, with significance marked by asterisks: *** for 1%, ** for 5%, and * for 10%.

	Alpha	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	Adjusted R^2
CAPM	0.00004	0.5653***								0.866
	(0.065)	(24.736)								
FF3	-0.0004	0.5983***	-0.1755***	0.0051						0.908
	(-0.640)	(30.042)	(-10.656)	(0.251)						
FF5	-0.0007	0.6016***	-0.1408***	-0.0103	0.0863***	-0.0015				0.912
	(-1.210)	(33.941)	(-5.369)	(-0.326)	(2.787)	(-0.043)				
8 Factor Model	-0.0010*	0.6126***	-0.1468***	0.0082	0.0847***	-0.0146	0.0434***	-0.0118	0.0075	0.915
	(-1.959)	(35.507)	(-6.083)	(0.250)	(3.360)	(-0.412)	(2.992)	(-1.377)	(0.373)	

Table 24b: Portfolio Return Performance Against Benchmark Models During Down Market Periods with Newey West Standard Errors (1990-2022, N=384 months). Each coefficient is displayed with its associated t-statistic, with significance marked by asterisks: *** for 1%, ** for 5%, and * for 10%.

	Alpha	MKT-RF	SMB	HML	RMW	CMA	MOM	TSMOM	BAB	Adjusted R^2
CAPM	0.0004	0.5521***								0.889
	(0.583)	(20.210)								
FF3	0.0012*	0.5715***	-0.1505***	-0.0125						0.909
	(1.673)	(19.582)	(-5.258)	(-0.692)						
FF5	0.0006	0.5891***	-0.1260***	-0.0497*	0.0771*	0.0299				0.912
	(0.768)	(20.437)	(-3.624)	(-1.711)	(1.729)	(0.923)				
8 Factor Model	0.0006	0.5908***	-0.1218***	-0.0548	0.0785	0.0312	-0.0003	-0.0089	0.0052	0.910
	(0.745)	(18.619)	(-3.398)	(-1.593)	(1.608)	(0.896)	(-0.025)	(-0.826)	(0.177)	

Table 25: Investment Returns by Inflation Regime, 1930-2022

	MKT-RF	SMB	HML	MOM	BAB	MFE
A. (Low inf.)						
Mean	1.05***	0.36***	0.25*	0.55***	0.73***	0.47***
B. (High inf.)						
Mean	0.13	0.06	0.57***	0.65***	0.60***	0.47***
ANOVA	2.04***	1.27***	1.61***	1.84***	1.32***	1.36***

Table 26: Investment Returns in Recessions, 1930-2022

	MKT-RF	SMB	HML	MOM	BAB	MFE
A. (Recession)						
Mean	-1.08*	-0.16	0.12	0.39	0.06	0.10
B. (Non-rec.)						
Mean	1.00***	0.31***	0.43***	0.63***	0.79***	0.54***
ANOVA	22.84***	3.16*	1.08	0.56	7.48***	9.52***