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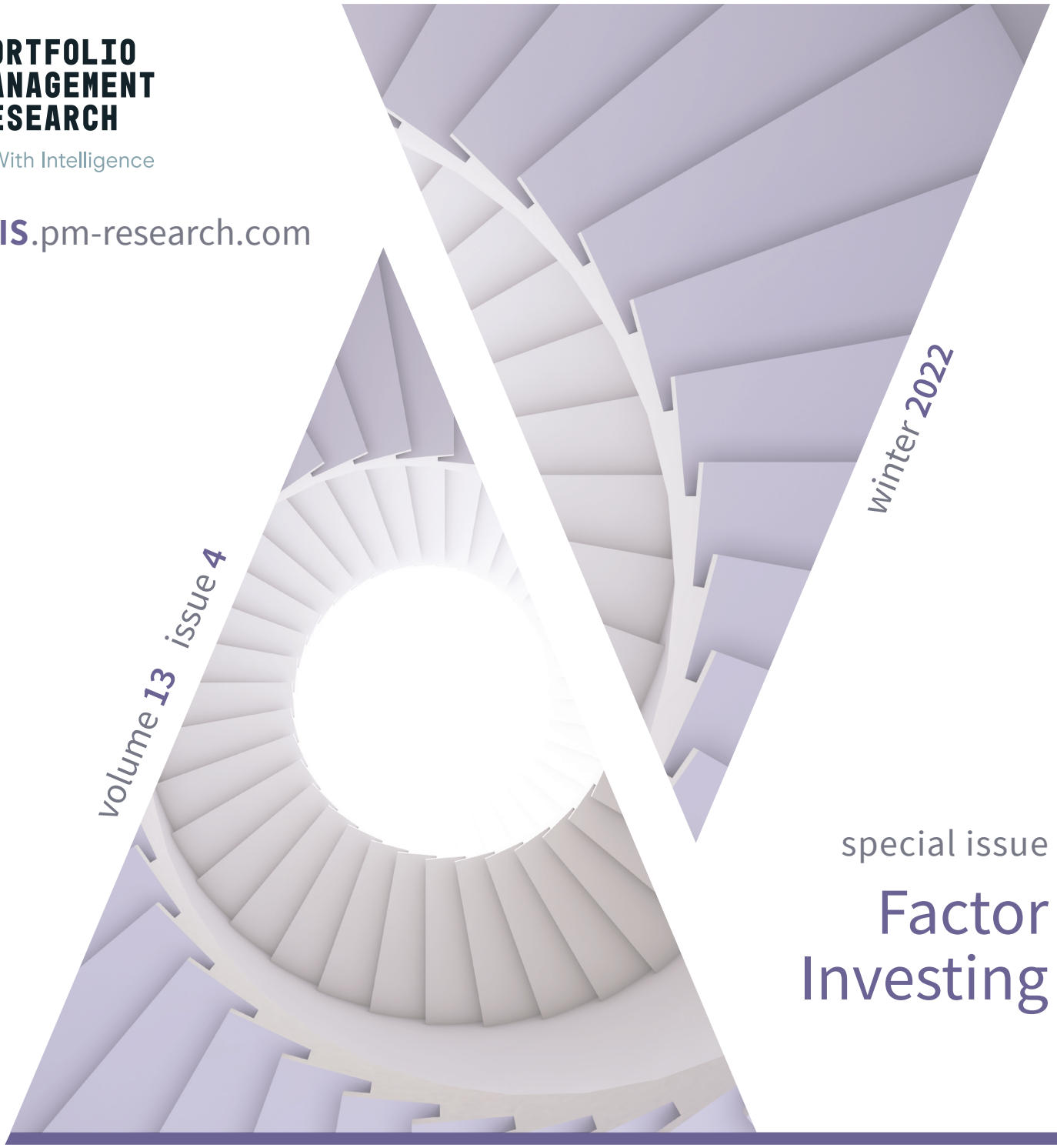

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Factor Investing

Factor Investing:
From Theory to Practice

Tarun Gupta, Jay Raol, and Viorel Roscovan

Invesco

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Practical Applications of

Factor Investing: From Theory to Practice

Practical Applications
Portfolio Management Research

Overview

In ***Factor Investing: From Theory to Practice***, from the Winter 2022 issue of ***The Journal of Beta Investment Strategies***, **Tarun Gupta, Jay Raol,** and **Viorel Roscovan** (all of **Invesco**) present a simple but rigorous evidence-based framework for testing and accepting factors as valid drivers of risks and returns. They find that value, momentum, quality, and low volatility are valid factors but that the size factor is questionable. Their methodology for validating factors comprises four elements: 1) economic theory, 2) robust risk and return evidence, 3) cross-asset and cross-region validation, and 4) implementability. The authors stress that investors should consider only factors that are implementable in practice. Incorporating real-world constraints into implementability tests allows investors to identify the factors that deliver attractive risk–return trade-offs after accounting for transaction costs and investment constraints.

Practical Applications

- **Investors should protect against framing strategies around spurious factors by applying a four-part test for factor validity: 1) economic theory, 2) robust risk and return evidence, 3) cross-asset and cross-region validation, and 4) implementability.** A valid factor is supported by a clear underlying economic rationale, has a track record of effectiveness across asset classes and regions, and is practical to implement in terms of transaction costs and investment constraints.
- **Based on the four-part test, value, momentum, quality, and low-volatility factors are valid.** Each is supported by an underlying rationale and shows robust performance in both equities and bonds, in both developed and emerging markets.
- **By contrast, the size factor shows mixed performance, and support for its validity is much weaker.** Investors should favor value, momentum, quality, and low volatility over size when framing strategies.

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Key Definitions

Factor

Factors are characteristics that help explain the risk and return behavior of a security. The most common factors are value, small size, low volatility, high yield, quality, and momentum.

Factor investing

Factor investing is an investment strategy that chooses securities based on factors associated with higher returns, lower risk, or both. There are many types of factors, including style (growth, value), size (large cap, small cap), risk (volatility, momentum), and fundamental (profitability, dividends). The Fama–French (1993) three-factor model started with a stock's beta and added size (i.e., small cap) and value (i.e., high ratio of book value to market equity) as factors of superior returns. The Fama–French (2015) five-factor model added profitability and investment as additional factors.

Momentum investing

Momentum investing is an investment strategy that buys or overweights stocks with high recent returns and underweights or shorts stocks with low recent returns.

Discussion

Factor investing is a topic of ongoing debate and increasing complexity. Factors are the various characteristics of a firm that can drive risks and returns across asset classes. They are used to form portfolios, test asset pricing theories, and identify potentially profitable investment strategies. The number of proposed factors documented in today's literature has grown to over four hundred, leading some to refer to this proliferation as "the factor zoo." Gupta, Raol, and Roscovan note the heavy burden that practitioners face in determining which among these hundreds of factors are actually true factors that will generate ongoing investment returns in excess of benchmarks. Many of the proposed factors in this factor zoo are tested only on US equities and fixed income, and the positive performance they show might be due to mere luck. Those same factors often fail when tested in live performance or across global markets or other asset classes. The authors contend that this problem of factor proliferation is exacerbated by the push in academia to publish novel and positive findings as opposed to negative ones.

To address the need to better identify valid factors, several statistically based multiple-testing techniques have been presented in academic literature. These tests are, in part, designed to reduce the number of false positives in factor selection. However, in doing so, the number of false negatives naturally increases, which can mean missed opportunities for valid factor discoveries.

Responding to the numerous concerns and complexities surrounding factor investing, Gupta, Raol, and Roscovan present a simple, evidence-based framework for testing and accepting factors as valid. Their practical approach focuses on applying economic theory and empirical evidence without compromising the statistical rigor of multiple testing. For a factor to exist, the authors require that it meet four criteria. Those criteria encompass economic theory, robust risk and return evidence, validity across asset classes and geographies, and implementability.

ECONOMIC THEORY

The first of the criteria is economic theory. The authors assert that the economic theory criterion does not require investors to take a stand on any particular economic theory. Rather, it is important that a factor be the subject of vast debate among academics and practitioners. These discussions, most often published in peer-review journals, need to be built on economic rationales grounded in strong academic

Quality factor

"Quality" as a risk factor is not as well established in the academic literature as other factors, such as momentum and value. However, it is well known and used by practitioners of factor investing in equities. Quality is defined by features such as low debt, stable earnings, consistent asset growth, and strong corporate governance. Investors identify quality stocks by using common financial metrics like return on equity, leverage, and earnings variability.

and industry foundations with abundant prior research dedicated to testing and evaluating a factor in various time periods, geographies, and samples. This criterion reduces the number of eligible factors from hundreds of proposed factors to a very narrow list.

Applying their economic theory criterion, the authors select five broad factor categories to test across two asset classes: equities and bonds. The factors selected for their demonstration are value, momentum, quality, low volatility, and size. Discussions and resources documenting the debates on these factors are provided, as well as explanations of the differences between each factor's attributes in the equity versus bond markets.

The value premium, widely investigated and debated, pertains to the tendency of low-priced securities, relative to their fundamental value, to outperform expensive securities. Similarly, with fixed income, the bond value signals relate to the bond spread.

The second factor selected is the momentum effect. The momentum theory holds that assets that performed well in the past will continue to outperform in the future. The third factor used in their example is quality. The rationale is that high-quality firms with stable earnings, strong business models, and good management are shown to outperform over the long term. The low-volatility factor demonstrates the tendency of lower-risk assets to outperform high-risk assets, on a risk-adjusted basis. The size factor theory holds that small caps will outperform large caps in the long run.

TESTING THE FACTORS

Having identified five factors that meet their economic theory criterion, the authors test each of them under the remaining criteria. According to the second criterion, a valid factor should generate robust risk and

> "Empirical evidence of factor efficacy across different asset classes and geographies may provide out-of-sample evidence, which forms a solid foundation for establishing a factor's existence and provides further confidence in avoiding false discoveries."
>
> ***—Factor Investing: From Theory to Practice***

return evidence. Additionally, the factors need to survive validation and falsification attempts across different circumstances. The authors' third criterion requires that factors remain valid in tests across asset classes and geographies and, when exceptions occur, they need to be supported by an economic rationale.

To test the second and third criteria in their framework, the authors create model factor portfolios that allow them to scrutinize the performance of each factor to determine its efficacy. They test each factor style on two asset classes, equities and fixed income, for two regions, developed markets and emerging markets. The data for their equity market sample runs from January 1997 to June 2022. The data for their fixed-income sample runs from January 2000 to June 2022.

In the equity sample, their test shows generally positive results for both regions for all of the factors evaluated, except for the size premium. The size factor delivers the smallest returns for both regions and is negative for the developed region. In the fixed-income sample, the only negative returns delivered are for the size factor. However, the authors note that the factor portfolios must also be tested for implementation constraints.

> "Although our results generally show attractive factor performance across the globe and for both asset classes, they should be taken with a grain of salt. The factor portfolios constructed consider the entire universe of securities and, as such, might not survive the various implementation constraints that investors have."
>
> ***—Factor Investing: From Theory to Practice***

IMPLEMENTABILITY

The fourth and final criterion of the authors' framework is that of implementability. Factor investing is, in large part, a practical approach that practitioners can use to manage the risks and returns of a portfolio. The authors maintain that factor implementability is as important as factor existence for those seeking to harvest factor premiums and deliver outperformance.

> "... [I]nvestors should consider only those factors that are implementable in practice and survive the effects of trading costs and other market frictions. Incorporating real-world frictions allows investors not only to focus on the factors that deliver an attractive risk–return trade-off after accounting for transaction costs and investment constraints, but also helps to align the factor toolkit to their objectives."
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In their initial tests, the sample space included all securities, including some that might be too small to be directly investable. Therefore, for their first implementability test, the authors remove the bottom quintile of securities ranked on market capitalization and recalculate using a smaller, investable universe. The results are broadly consistent with the larger universe tested, with some caveats. First, the value factor shows a weaker performance, though it is still positive. Notably, the size factor shows a more dramatic underperformance in the implementability test, turning performance in both regions to negative numbers.

To further test potential investor constraints, the authors run a second implementability test using long-only portfolios. As with the prior tests, the size factor does not perform well. The authors recommend that investors apply value, momentum, quality, and low-volatility factors to their investment strategies but remain cautious about the size factor.

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KEY FINDINGS

- This article proposes a parsimonious paradigm to evaluate factor existence for practitioners. It focuses on economic theory, along with robust empirical evidence, and incorporates implementation considerations without compromising the statistical rigor of multiple testing.
- The authors exemplify how to apply their framework to evaluate the performance of value, momentum, quality, low-volatility, and size factors in equity and fixed-income markets across the globe and find compelling evidence for the value, momentum, quality, and low-volatility factors but not the size factor.
- This evidence-based framework can be easily extended to evaluate alternative factor signals, broad factor categories across different asset classes, or additional investment constraints.

ABSTRACT

Although factor investing has become an industry standard, the debate over which factors drive the risk and return of various asset classes across the globe is ongoing. The literature documents more than 400 of such factors claiming to deliver an attractive risk and return trade-off. Although promising, this research also imposes a heavy burden on practitioners who seek to identify the true factors that can help generate ongoing investment returns in excess of benchmarks. Modern multiple-testing techniques proposed by academics typically fall under traditional hypothesis testing and can generally be summarized as imposing more-stringent statistical thresholds for factor premiums to satisfy. In addition, such statistical techniques may ignore prior economic beliefs that investors might have that are important for the optimal design of investment strategies. This article proposes a parsimonious yet rigorous paradigm for practitioners to determine factor existence by focusing on economic theory alongside robust empirical evidence and incorporating real-world implementation considerations. The main goal of the framework is to guide practitioners in factor selection while designing investment strategies that can maximize the probability of generating ongoing investment performance. The authors apply this framework for value, momentum, quality, low-volatility, and size factors in equity and fixed-income markets across the globe. They find compelling evidence for value, momentum, quality, and low-volatility factors, but not the size factor. Their framework can be readily extended to evaluate broad factor categories across different asset classes, alternative factor signals, or additional investment constraints.

Although factor investing has gained significant attention in recent years, the concepts behind this investment approach have been up for long academic and industry debates. Subjects of these debates are which characteristics are relevant for the cross-section of asset risks and returns. These characteristics,

commonly referred to as factors, are used to form portfolios and test a wide range of asset pricing theories and anomalies, as well as identify potentially profitable investment strategies. To this date, the asset pricing literature documents hundreds of (characteristics-based) factors that *seemingly* price the cross section of asset returns, motivating some authors to label this rise as the "factor zoo" (Cochrane 2011). Because of the overwhelming evidence, navigating the factor zoo has become a challenging task for professional investors seeking robust factor allocations in their portfolios with the goal of maximizing out-of-sample performance. Many of the proposed factors might show attractive risk and return characteristics based on mere luck, especially historically and in the given sample (which is typically US equities and fixed income), but fall short out of sample in live performance or when extended to other geographies and asset classes. This problem is exacerbated by the incentives in academia to publish novel and positive, rather than negative, findings.

In response to the ever-increasing factor production, recent literature has proposed various techniques to scrutinize factor existence. Essentially, most of these techniques impose higher statistical bars in factor evaluation, making it empirically a greater hurdle for factors to satisfy. Lewellen, Nagel, and Shanken (2010), for example, criticize the practice of using cross-sectional R^2 and pricing errors to evaluate success and provide evidence that the explanatory power of many previously studied factors is spurious. In a related study, McLean and Pontiff (2016) test various statistical biases identified in Ross (1989), Lo and Mackinlay (1990), Fama (1991), and Schwert (2003) and argue that most established equity market anomalies show weaker performance after their publication. In response, Campbell, Liu, and Zhu (2016) propose a new multiple-testing framework and establish an historical cutoff point—a *t*-statistic of greater than 3.0—for factors to satisfy in order to justify their existence. The authors conclude that most of the factor findings in financial economics are likely false.

This stream of literature has important implications for the investment management industry. On one hand, the multiple-testing methods proposed in financial economics aim to reduce the false positives in factor selection. On the other hand, increasing the *t*-statistic also increases the false negatives, or missed opportunities for factor discoveries. For retrospective studies, for example, it is difficult to judge with certainty whether the analyses performed were actually thought of when the research idea was conceived or whether the performed analyses were mere data dredging. Last but not least, multiple-testing approaches are statistically based and fall under the menu of traditional hypothesis testing. As such, they ignore prior economic beliefs that investors might have and that are crucial for the optimal design of investment strategies (Campbell, Liu, and Saretto 2016).

To address these concerns, our article proposes a practical evidence-based paradigm that can help practitioners evaluate factor existence while focusing on economic theory with robust empirical evidence and incorporating implementation considerations without compromising statistical rigor. Rather than going through the challenges that multiple-testing techniques impose, such as appropriate design of out-of-sample tests that require strong priors and are often not immediately straightforward, our goal is to design a simple testing framework that may help investors determine what factors may explain the ongoing performance and risks of securities.

For a factor to exist, we require the following criteria: (1) economic theory, (2) robust risk and return evidence, (3) cross-asset and cross-region validation, and last but not least (4) implementability. Our framework offers a practical way to leverage academic and practitioner research and use the factor zoo to one's advantage as a starting point to establish factor existence, not by relying on potentially arbitrary statistical techniques but rather focusing more on economic theory alongside empirical evidence. By design, our paradigm might typically be sensitive to factor discoveries

and is instead aiming to help investors avoid the false positives. In the following, we elaborate on each of the criteria of our framework designed to help identify the existence of factors that drive excess returns and risks in the cross section of securities.

Economic theory. Naturally, factors are appealing to investors, because they are built on a plausible economic rationale with strong academic and industry underpinnings. Hundreds of academic and practitioner articles have analyzed past factor behavior and have provided a theoretical foundation for why these factors are expected to generate excess returns in the future. Although this foundation can vary, be it rational, behavioral, market-structure related, or a combination thereof, the economic theory criterion does not necessarily require investors to take a stand on a particular view, but rather, as practitioners, ensure that plausible drivers exist and are not an outcome of a "black box." Under this criterion, we require a factor to be the subject of vast academic and practitioner debates, ideally materializing in publications in peer-reviewed journals. Despite the hundreds of factors that have been proposed in the literature, this criterion narrows down the list of candidate factors to a small pool of a few broad factor categories.

Robust risk and return evidence. Although rationalizing single factors is key for their existence, the selected factors should empirically generate excess returns over relevant benchmarks over the long term. This evidence should ideally be insensitive to parameter choices when defining factors and should show efficacy over various forecasting horizons. In that sense, investors should not only seek empirical evidence confirming favorable factor performance, but also allow for numerous replication and validation exercises. The selected factors should survive validation and falsification attempts over not only similar but also complementary samples and time periods. Such corroborating evidence helps restrict the available list of factors even further.

Cross-asset and cross-region validation. It is generally accepted by academics and practitioners that traditional asset classes share exposures to the same underlying risk and return factors. Thus, investors that scrutinize the candidate factors could benefit from documenting additional out-of-sample evidence that spans different asset classes and regions. If the underlying economic dynamics of the factors that generate excess returns are true, then they should generally be valid across asset classes and geographies. Empirical evidence of factor efficacy across different asset classes and geographies may provide out-of-sample evidence, which forms a solid foundation for establishing a factor's existence and provides further confidence in avoiding false discoveries. Importantly, one should not expect factors to work everywhere and at all times; however, when such exceptions occur, they should certainly be supported by an economic rationale.

Implementability. Although heavily embedded in economic theory and evidence, factor investing is, by and large, a practical approach to efficiently manage the risks and returns of a portfolio. Unlike academics driven by the desire to better understand and explain the drivers in the cross section of returns and risks, practitioners have a material stake in the game. For this reason, the implementability criterion becomes especially important for those that seek to harvest factor premiums and deliver outperformance. As such, from a practitioner's perspective, factor existence goes hand in hand with factor implementability. To that extent, investors should consider only those factors that are implementable in practice and survive the effects of trading costs and other market frictions. Incorporating real-world frictions allows investors not only to focus on the factors that deliver an attractive risk–return trade-off after accounting for transaction costs and investment constraints, but also helps to align the factor toolkit to their objectives.

In this article, we put this framework to the test and exemplify how investors could build a foundation for their factor beliefs and investment philosophy. We evaluate five

broad factor categories that have been the subject of a longstanding debate among practitioners and academics—value, momentum, quality, low volatility, and size. For each factor, we select one commonly acknowledged expression and after controlling for various investment and implementation constraints, we evaluate its academic evidence and robustness through time across different regions in both equity and fixed-income markets.

Our findings suggest that value, momentum, quality, and low-volatility factors show robust performance across the globe and in both asset classes. The size factor, however, shows erratic performance and does not pass the implementability criterion. Based on our results, we recommend that investors harvest the benefits of value, momentum, quality, and low volatility for both equity and fixed-income markets but remain cautious about allowing for size tilts in their portfolios.

The framework proposed in this article can (and should) be readily extendable to other factor signals and/or broad factor categories. Having established a broad factor category, practitioners can use our paradigm to evaluate alternative signals that could help capture a factor better via, for example, more granular or timely data. These alternative signals should correlate with the underlying factor but might also deliver some additive alpha due to their efficacy. Our framework can also be extended to study factor existence in alternative asset classes, beyond equities and fixed income.

The rest of this article is organized as follows. In the next section, we summarize the existing literature justifying the economic rationale and theory behind a selection of factors in both equity and fixed-income markets. We then describe our data and factor construction methodology; present our results; evaluate which of the selected factors survives the implementability criterion; and present our conclusions.

ECONOMIC THEORY

In this section, we briefly summarize the literature rationalizing the economic theory behind five broad factor categories: value, momentum, quality, low volatility, and size. Although this literature is extensive, our objective is by no means to be exhaustive, but rather to emphasize that these debates have been ongoing for multiple decades and continue to this date. Most of the literature is concentrated on the equity markets, but other asset classes have also received considerable attention. We substantiate the existing discussions in equity markets with those in fixed-income markets. A brief summary of our discussion is summarized in Exhibit 1.

The value premium has been widely investigated in both US and international equity markets (e.g., see Basu 1977; DeBondt and Thaler 1985 and 1987; Chan, Hamao, and Lakonishok 1991; Fama and French 1992, 1993, 1995, 1996, and 1998; Lakonishok, Shleifer, and Vishny 1994; and Haugen and Baker 1996). This overwhelming international evidence suggests that securities with low market valuations relative to their fundamental values tend to outperform expensive securities.

The evidence for a value premium in corporate bond markets is just as extensive. However, unlike equities, where value signals relate the stock price to a measure of fundamental value, thus providing an indication of the relative valuation of a company, bond value signals relate a corporate's bond spread to a model spread, thus assessing the relative valuation of the bond. In that sense, these measures of value in equities and bond markets are intimately related. For complexity reasons related to model spread estimation, the literature documenting the value premium in fixed-income markets is more disperse. Nevertheless, the findings in the literature support the existence of a value premium in fixed-income markets as well (e.g., see Bharath and Shumway 2008; Correia, Richardson, and Tuna 2012; Beaver, Correia, and McNichols 2012; and Houweling and Zundert 2017). While the measures of

EXHIBIT 1

Common Factor Styles in Equity and Fixed-Income Markets

Factor Style	Economic Rationale	Asset Class	Example Factor Signals	Evidence
Value	The tendency of cheap securities, relative to their fundamental values, to outperform expensive securities in the long run	Equities	Book-to-Price Dividend Yield Cash Flow-to-Price	Basu (1977), DeBondt and Thaler (1985, 1987), Chan et al. (1991), Fama and French (1992, 1995, 1996, 1998), Rosenthal and Young (1990), Lakonishok, Shleifer, and Vishny (1994), and Haugen and Baker (1996), Kothari (2000), Lee and Swaminathan (1999), Griffin and Lemon (2001), Hirshleifer (2002), Daniel, Hirshleifer, and Subrahmanyam (1998), Daniel, Hirshleifer, and Teoh (2001), Barberis, Shleifer, and Vishny (1998), and Hong and Stein (1999)
		Fixed Income	Spread vs. Merton Default OAS Relative Predicted OAS Long-Term Reversal	Bharath and Shumway (2008), Correia, Richardson, and Tuna (2012), Beaver, Correia, and McNichols (2012), and Houweling and Zundert (2017)
Momentum	Securities that have performed well in the past continue to outperform in the future	Equities	12–1M Equity Price Momentum 6–1M Equity Price Momentum Analyst Earnings Revisions	Jegadeesh and Titman (1993), Carhart (1993), Asness, Liew, and Stevens (1997), Daniel, Hirshleifer, and Subrahmanyam (1998), Rouwenhorst (1998), Barberis, Shleifer, and Vishny (1998), Hong and Stein (1999), Berk, Green, and Naik (1999), Zhang (2004), and Chabot, Ghysels, and Jagannathan (2009)
		Fixed Income	12–1M Equity Price Momentum 6–1M Equity Price Momentum	Jostova et al. (2013), Barth, Scholz, and Stegmeier (2017), Bittlingmayer and Moser (2014), Ben Dor and Xu (2015), and Gebhardt, Hvidkjaer, and Swaminathan (2005)
Quality	High-quality securities with stable earnings, strong business models, and good management outperform low-quality securities in the long run	Equities	Gross Profits to Assets Operating Profitability Accruals ROE	Sloan (1996), Haugen and Baker (1996), Chan et al. (2006), Cooper, Gulen, and Shill (2008), Novy-Marx (2013, 2018), Fama and French (2006, 2008, 2015, 2016), Hsu, Kalesnik, and Kose (2019), and Kyosev et al. 2020)
		Fixed Income	Rating Leverage Capital Structure	Israel, Palhares, Richardson (2018), Bender and Samanta (2017), Ilmanen et al. (2004), de Carvalho et al. (2014), Frazzini and Pedersen (2014), and Houweling and Zundert (2017)
Low Volatility	The tendency of lower-risk securities to generate higher risk-adjusted returns in the long run	Equities	36M Equity Price Volatility 36M Equity Beta	Brennan (1971), Black (1972), Haugen and Baker (1996), Blitz and van Vliet (2007), Ang et al. (2006), Blitz, Pang, and van Vliet (2012), Baker and Haugen (2012), de Carvalho, Xiao, and Moulin (2012), Clarke, Silva, and Thorley (2006), Baker, Bradley, and Wurgler (2011), and Ramos and Han (2013)
		Fixed Income	Maturity	Chung, Wang, and Wu (2019)
Size	Small caps outperform large caps in the long run	Equities	Market Capitalization	Fama and French (1993) and Asness et al. (2018)
		Fixed Income	Market Capitalization	Polbennikov (2018), Alquist, Israel, and Moskowitz (2018), Houweling and van Zundert (2017), Richardson and Palhares (2018)

NOTE: This exhibit outlines five broad factor categories in equity and fixed-income markets, summarizes their economic rationale, exemplifies a number of signals that have been found to best capture the corresponding broad factor category, and provides further academic and practitioner evidence documenting the selected factors.

corporate bond value might vary, their performance shows consistency across these various definitions, and the general agreement is that the value premium in corporate bond markets is among the strongest of bond factors.

Although the evidence in favor of a value premium is substantial, in both equity and corporate bond markets, a topical and controversial debate still exists on what the rationale is behind the existence of a value premium and why this premium should persist in the future. One explanation is that the value premium is rational in nature and that it represents a compensation for higher risk that investors require when holding higher distress securities (Fama and French 1995, 1996, and 1998; Lakonishok, Shleifer, and Vishny 1994). Another explanation for higher returns from a value strategy stems from investors' irrational overreaction to positive or negative news. This overreaction leads prices to adjust by more than justified by fundamentals but correct at a later stage when investors' sentiment about a firm's value changes (Rosenthal and Young 1990; Fama 1991; Fama and French 1998; Kothari 2000; Lee and Swaminathan 1999; Griffin and Lemon 2001; Hirshleifer 2002; Daniel, Hirshleifer, and Subrahmanyam 1998; Daniel, Hirshleifer, and Teoh 2001; Barberis, Shleifer, and Vishny 1998; Hong and Stein 1999). Although this debate is not settled yet, we do not imply that one should take a stand on the rationale behind whether or not the value premium exists. The truth is likely somewhere in between. What is important here, however, is that the likelihood of the value premium being eroded is fairly low, as it has been around for decades, and, if anything, it would require severe structural changes in financial markets that would alter investor behavior for the premium to dissipate.

The second factor we discuss is the momentum effect, which refers to an asset's past performance continuation and is one of the most documented and robust anomalies in financial markets. The momentum effect has been extensively studied in US equity markets (Jegadeesh and Titman 1993), in international markets (Rouwenhorst 1998), over different time periods (Chabot, Ghysels, and Jagannathan 2009), and for various asset classes (e.g, Asness, Liew, and Stevens 1997 study the momentum effect for aggregate equity market indexes; Bhojraj and Swaminathan (2006) and Gorton, Hayashi, and Rouwenhorst (2013) study the momentum effect in currency and commodity markets, respectively; and Jostova et al. 2013 and Barth, Scholz, and Stegmeier 2017 find strong momentum effects in high-yield corporate bonds). Interestingly, some studies have also looked into cross-asset momentum strategies and found that equity momentum drives bond returns and that bond momentum drives equity returns (Bittlingmayer and Moser 2014; Ben Dor and Xu 2015; and Gebhardt, Hvidkjaer, and Swaminathan 2005).

Since its discovery, many studies have attempted to identify the sources behind the momentum effect. Some rational explanations have associated the momentum premium with industry effects (Moskowitz and Grinblatt 1999), variation of expected returns (Grundy and Martin 2001), factor levels and stock specific momentum (Grundy and Martin 2001), macro risk factors (Chordia and Shivakumar 2002; Griffin, Ji, and Martin 2003; and Liu and Lu, 2008), and states of the business cycle (Cooper, Gutierrez, and Hameed 2004; Siganos and Chelley-Steeley 2006; and Stivers and Sun 2012). Most of these studies agree that industry and stock level momentum are distinct effects and that the state of the business cycle is a better risk proxy than macro factors. Interestingly, both Jegadeesh and Titman (1993) and Grundy and Martin (2001) find that the beta loading of the momentum portfolio is key for the momentum factor realization in the portfolio formation period. The latter study actually shows theoretically that the momentum portfolio comprises high-beta stocks during bull markets and low- or negative-beta stocks during recessions. In short, this literature attributes the momentum returns to its beta; thus, the business cycle risk is hypothesized to be the driver behind the momentum premium. Blitz, Huij, and Martens (2011) show

that the exposures of conventional momentum strategies to priced risk factors can be significantly reduced when ranking stocks on their so-called idiosyncratic returns rather than total returns, thus eliminating a stock's beta exposure. Interestingly, although the exposure of their residual momentum signal to priced risk factors is significantly diminished, its risk is halved, as opposed to conventional momentum, but its returns are just as high. As a consequence, the risk-adjusted returns to a residual momentum strategy are twice as high as those of a conventional momentum strategy. These results are inconsistent with the explanation that conventional momentum returns are driven by the exposure to priced risk factors and microstructure effects.

To this date, the literature on explaining momentum effects using risk-based explanations has not reached a clear-cut consensus. As a result, the academic literature has shifted to behavioral finance explanations, which suggest that momentum profits are primarily driven by irrational investor behavior. Barberis, Shleifer, and Vishny (1998), for example, build a theoretical model with two types of investors: a conservative type and representative heuristic type. Daniel, Hirshleifer, and Subrahmanyam (1998) consider psychological biases in their model—that is, overconfidence and self-attribution bias. These models, however, are unable to match all empirically documented frequencies for the momentum profits. Hong and Stein (1999) build a model that provides a generalized theory of investors' underreaction to news, however, without explicitly modeling a psychological bias of the said model participants. Instead, the authors interact two types of investors: momentum and news traders. While the interaction between these two types leads to significant momentum profits, under certain conditions, the realized equilibrium is still unable to match the frequencies of momentum profits that have been empirically documented. Jegadeesh and Titman (2001) provide further empirical results that show these models are not fully supportive of the observed empirical evidence.

More recently, a number of alternative behavioral explanations for the momentum effect have been put forward. For example, Chui, Titman, and Wei (2010) examine how cultural measures of individualism around the world affect momentum returns, and Fama and French (2012) show that, contrary to previous findings, momentum in Japan doesn't work purely because of chance and not because of the low-individualism culture. Gupta and Kelly (2018) suggest that factor momentum can serve as an explanation for the existence of the momentum premium. Although traditionally momentum signals have been constructed using price data, some authors have also proposed alternative measures of momentum derived from a firm's fundamentals, such as a firm's earnings surprises (Novy-Marx 2018) or credit card transactions (Gupta, Leung, and Roscovan 2022). Even though the momentum premium was introduced early in the 1990s, the premium has remained strong and persistent in other regions even after discovery (Asness, Moskowitz, and Pedersen 2008).

The next factor we survey is the quality factor. Good-quality firms with more conservative accounting practices, that are able to generate a healthy amount of cash from operations and that distribute this cash back to investors, have been shown to outperform over the long term. As such, the quality factor is constructed using various accounting-based signals of a firm's profitability, conservative management, and safety (e.g., see Haugen and Baker 1996; Sloan 1996; Richardson et al. 2005; Cooper, Gulen, and Shill 2008; Novy-Marx 2013; Ball et al. 2016; Pontiff and Woodgate 2008; and an extensive overview by Hsu, Kalesnik, and Kose 2019). Although there is no general agreement on what the best measure of a firm's quality is, this literature looks into a number of alternatives, such as the return on a firm's equity (Haugen and Baker 1996), accruals (Sloan 1996), investments (Cooper, Gulen, and Shill 2008), leverage (Georgy and Hwang 2010), and gross profitability (Novy-Marx 2013). These signals generally relate to investor perception of a firm's accounting quality and are strong predictors of a firm's earnings growth (Kyosev et al. 2020).

Similar signals of quality have also been considered for corporate bonds. For example, Israel, Palhares, and Richardson (2018) use leverage, gross profitability, and low duration as measures of a firm's quality and safety. Other studies have looked further into bond-specific quality measures, such as credit ratings (Ilmanen et al. 2004; de Carvalho et al. 2014) and duration (Frazzini and Pedersen 2014; Houweling and Zundert 2017). Bender and Samanta (2017) show that a quality factor can reduce overall risk and enhance risk-adjusted returns in a balanced equity/bond portfolio. These corporate bond signals of safety are also proxies for low risk, which we discuss in greater detail later.

The low-volatility premium is the tendency of low-risk securities to outperform, on a risk-adjusted basis, the high-risk securities in the longrun. Black (1972), Black, Jensen, and Scholes (1972), and Miller and Scholes (1972) were the first to note that the securities market line may be flatter than suggested by CAPM, with low-beta stocks outperforming the CAPM and high-beta stocks underperforming it. Subsequently, the low-volatility effect has been studied extensively in US equity markets (Haugen and Baker 1991; Black 1993) but also internationally (Ang et al. 2006; Blitz and van Vliet 2007; Blitz, Pang, and van Vliet 2013; Baker and Haugen 2012; de Carvalho, Xiao, and Moulin 2012; and Clarke, Silva, and Thorley 2006, among others). This observation is often referred to as the low-volatility anomaly, as it contradicts the very foundation of the CAPM, which states that investors are willing to hold risky assets only if they receive adequate returns for the nondiversifiable risk of the asset. Critically, this is not the same as saying that the return on low volatility is higher than that of the market. In fact, to earn the low-volatility premium, one needs to risk-adjust the performance of the market portfolio. Brennan (1971) suggests that the effect is persistent due to market structure effects related to the leverage and shorting constraints that long-only managers might have, while Ramos and Hans (2013) bring forward investors' behavior in an attempt to explain this phenomenon and argue that risk-seeking investors that are willing to accept a moderate loss in pursuit of high returns tend to overpay for riskier assets. Fraikin, Gerard, and Roberts (2020) and Gupta et al. (2021) provide further details on how to efficiently construct low-volatility portfolios for long-only investors.

Similar studies have also been conducted in the cross-section of bond returns, both in the US and internationally. Chung, Wang, and Wu (2019) study the pricing of volatility risk and idiosyncratic volatility in the cross section of corporate bond returns and find that high-beta bonds have lower expected returns. The authors argue that the channel is similar to the one observed in equity markets.

Finally, we turn to the size effect, which has also been well documented in the academic literature (e.g., Fama and French 1993; Asness et al. 2018), but within corporate credit, it is not clear-cut as to whether size offers a significant abnormal return premium on a risk-adjusted basis. On the one hand, Polbennikov's (2018) analysis does not support the existence of a size factor in the US investment-grade and high-yield markets, something that is also supported by Alquist, Israel, and Moskowitz (2018). Houweling and van Zundert (2017), on the other hand, find evidence for a size factor that could be systematically exploited in the same way that equity investors do. Although Houweling and van Zundert (2017) find that there is a risk premium associated with small-cap bonds, Alquist, Israel, and Moskowitz (2018) find that there is no size effect among investment-grade bonds. On the other hand, Richardson and Palhares (2018) do not find risk-adjusted outperformance of less-liquid bonds in the corporate bond market.

Overall, based on this brief survey, we conclude that the economic theory for value, momentum, quality, low volatility, and size is overwhelming in both equity and

bond markets. This serves as a good starting point to establish factor existence. In the next sections, we scrutinize the performance of these factor premiums in equity and corporate bond markets across the globe.

DATA AND METHODOLOGY

In the previous section, we summarize the extensive literature documenting a value, momentum, quality, low-volatility, and size premium in equity and corporate bond markets. This section discusses our data and factor construction methodology. Our equity return data come from Datastream and comprise both developed and emerging markets, with our regional definitions following closely the Morgan Stanley Capital International (MSCI) classification. For each company in our sample, we download quarterly balance sheet data from Compustat US (for the US equity sample) and Worldscope (for the rest of world). We require stocks to have market-capitalization data for December of year t to be included in months ranging from December of year t to December of the next year ($t + 1$). Our final sample is a comprehensive dataset of 55,778 unique stocks and more than 5 million stock-month observations from December 1993–June 2022. Exhibit 2 (Panel A) summarizes our final equity sample.

For each factor, we create double-sorted quintile value-weighted portfolio returns constructed as the intersection of five portfolios based on size (market value of equity) and five portfolios formed on a generic factor characteristic corresponding to each factor style we analyze. More specifically, for value, we use book equity-to-market equity ratios (B/P); for momentum, prior 2–12M return; for quality, operating profitability; for low risk, market beta; and for size, the inverse of the market value of a firm's equity.

To construct each factor's return series, we average the return on the top- and bottom-quintile portfolios. We take long positions in the top quintile, short the bottom-quintile portfolios, and rebalance these portfolios at the end of each year, in December. Consequently, our value factor is the average return on the two value portfolios (small and big value) minus the two growth portfolios (small and big growth). The momentum factor is the average return on the two winners' portfolios (small and big winners) minus the average return on the two losers' portfolios (small and big losers).

EXHIBIT 2

Descriptive Statistics

Panel A: Equity Sample

Region	Start	End	Total Number of Stocks	Average Size (US$ billion)
Developed	12/1993	06/2022	36,547	3.484
Emerging	12/1993	06/2022	19,231	2.312

Panel B: Fixed-Income Sample

Region	Start	End	Total Number of Bonds	Average Amount Outstanding (US$ billion)
Developed	01/2000	06/2022	33,052	0.643
Emerging	01/2000	06/2022	3,156	0.125

NOTES: This exhibit presents summary statistics for our equity (Panel A) and fixed-income (Panel B) samples. Country/region classifications are following MSCI. Columns 2 and 3 report the start and end date of our sample. Column 4 reports the total number of unique securities for each country/region throughout the entire sample period. Column 5 reports average market capitalization for equities and average amount of bonds outstanding in each country/region.

For quality, our long–short portfolio comprises the average return on the two robust operating profitability portfolios (small and big robust) minus the two weak operating profitability portfolios (small and big weak). The size factor ignores the second sort and is just the difference between the large- and small-cap quintile portfolios.

The low-volatility factor requires special treatment, because low-volatility stocks are expected to outperform high-volatility stocks only on a risk-adjusted bases. Since we sort our stocks based on market betas, the corresponding market exposures of the lower-quintile portfolios are significantly smaller than those of the higher-quintile portfolios. The low-beta quintile portfolios have lower market betas than the average of the securities in the corresponding region ($\beta_H < 1$). The high-beta quintile portfolios have higher betas than the corresponding market segment ($\beta_H > 1$). Thus, to adjust for this difference requires modest leverage proportional to the ratio of market betas of the low- and high-quintile portfolios (β_L/β_H). We also rescale by the corresponding amount the short position in the high-beta portfolio to be < 1, introducing a small dollar imbalance funding by the risk-free rate. Consequently, the low-volatility factor (R_{LV}) is constructed as follows:

$$R_{LV} = R_L - \frac{\beta_L}{\beta_H} \times R_H - \left(1 - \frac{\beta_L}{\beta_H}\right) \times r_f,$$

where R_L is the return on the low-market-beta quintile portfolio, R_H is the return on the high-market-beta quintile portfolio, and β_L and β_H are the market betas corresponding to the low- and high-quintile portfolio estimates over a prior period of 36 months against the corresponding regional market returns; r_f is the risk-free rate.

Finally, for comparison reasons, we restrict the length of our sample period to the shortest available return series for each of the corresponding factors. Since the construction of the low-volatility factor requires three-year rolling beta estimates, our final sample comprises 306 months of factor return data from January 1997–June 2022 for two regions: developed and emerging markets. For brevity and to avoid being repetitive with the previous literature, we do not report per-country results, although these are also available upon request. Exhibit 3 (Panel A) summarizes the correlation matrix between the corresponding factors for both regions.

Although we do not impose strong priors on the correlation matrix presented in Exhibit 3, some interesting patterns emerge. First and foremost, factors diversify well across each other in both regions, with no extreme outliers. In line with previous research, the value and momentum factors correlate negatively; quality and low volatility show positive correlations in developed markets, but in emerging markets these seem to be rather uncorrelated.

For corporate bond data, we rely on monthly quoted bond prices and analytics from the Bloomberg Barclays Global Corporate Index, Bloomberg Barclays US High Yield Index, and Bloomberg Barclays Emerging Market Hard Currency Index, from January 2000–June 2022. For each bond, the data include the monthly total return as well as the excess return, or duration-hedged return, using quoted prices. The excess return is calculated by taking the total return of the bond and subtracting the total return of a maturity-matched treasury bond in the local currency. This return isolates the impact of the spread return from the interest rate return. In addition to return information, the data contain offering amount, offering date, maturity date, coupon rate, coupon type, average bond rating, issuer, and sector information. Our final sample is a comprehensive dataset of more than 36,200 developed and emerging market bonds and more than 3 million bond-month observations. The summary statistics for our bond sample are depicted in Exhibit 2 (Panel B).

EXHIBIT 3
Factor Correlations

	Value	Momentum	Quality	Low Volatility	Size
Panel A: Equity Sample					
Developed Markets					
Value	1.00				
Momentum	–0.27	1.00			
Quality	0.03	0.25	1.00		
Low Volatility	0.20	0.05	0.36	1.00	
Size	–0.04	0.03	–0.17	–0.29	1.00
Emerging Markets					
Value	1.00				
Momentum	–0.24	1.00			
Quality	–0.46	0.33	1.00		
Low Volatility	0.10	0.25	–0.02	1.00	
Size	0.07	–0.12	–0.19	0.08	1.00
Panel B: Fixed-Income Sample					
Developed Markets					
Value	1.00				
Momentum	–0.34	1.00			
Quality	0.10	–0.03	1.00		
Low Volatility	–0.58	0.26	0.05	1.00	
Size	0.63	–0.31	0.20	–0.35	1.00
Emerging Markets					
Value	1.00				
Momentum	0.15	1.00			
Quality	0.30	0.12	1.00		
Low Volatility	0.58	–0.01	0.23	1.00	
Size	–0.24	0.00	–0.20	–0.33	1.00

NOTES: This exhibit presents the time-series correlation matrix between the selected factors in both equity (Panel A) and fixed-income (Panel B) samples. Factor construction is discussed in the Data and Methodology section. Our equity sample runs from January 1997–June 2022, and our fixed-income sample runs from January 2000–June 2022.

In order to study the significance of different factors to the cross section of corporate bond returns, we form bivariate quintile portfolios each month from January 2000–June 2022 by sorting on each factor while controlling for duration times spread (DTS; see Ben Dor et al. 2007) for value, low volatility, and size. For momentum, we control portfolios on size, finding that DTS controlling the portfolios negatively impacts premiums. Moreover, in line with previous findings that show that momentum in bonds has the strongest effect at the lowest-rated securities, we confine our momentum factor to the BBB rated bonds in the universe. More specifically, for value, we use option-adjusted spread normalized by industry, rating, and maturity; for momentum, prior 2–6M return; for low risk, the duration of a bond; and for size, the inverse of the market value of a bond. Quintile portfolios are formed every month by first sorting the corporate bonds based on DTS; then, within each quintile portfolio, bonds are sorted further into five subquintiles based on their factor rank. The bonds are value weighted by amount outstanding in each subquintile. Finally, five portfolios are formed by combining subquintiles across all of the quintiles. This methodology, under each DTS-sorted quintile, produces portfolios with similar DTS but with dispersion in factor exposures. We report the average monthly excess, or duration-hedged, returns of the portfolios.

For the quality factor, we are looking at the return of higher-rated securities over lower-rated securities. These portfolios require special treatment, because rating is not a characteristic that lends itself easily to the quintile methodology. Instead, we form portfolios by rating where all bonds are value weighted by amount outstanding within each rating—AAA, AA, and so on. When more than one credit rating agency assigns a rating to a bond, we use the middle of three rating agencies or the worst of two. Since the credit betas of the higher-rated portfolio are lower than the lower-rated portfolios, we follow a similar methodology of adjustment in equity low volatility by using the DTS ratio. Specifically, we rescale the return of BBB bonds to calculate the return of quality

$$R_{quality} = R_A - \frac{DTS_A}{DTS_{BBB}} \times R_{BBB} - \left(1 - \frac{DTA_A}{DTS_{BBB}}\right) \times r_f,$$

where R_A is the return on the higher-rated portfolio; R_{BBB}, the return on the lower-rated portfolio; and DTS_A and DTA_{BBB} are the market betas corresponding to the A and BBB portfolios; r_f is the risk-free rate. Finally, we align the regional breakdown in fixed income with equities.

The fixed-income correlations in Exhibit 3 (Panel B) show strong diversification and relatively low correlation among the factors across regions. Unlike the equity correlations, we do not see any consistent correlation patterns between value and momentum or quality and low volatility.

ROBUST RISK AND RETURN EVIDENCE

Following our practical framework to establish factor existence, we now discuss the risk and return evidence across the globe for both equity and fixed-income factors. Our first objective is to assess the efficacy of the broad factor categories discussed in Exhibit 1 in forecasting the cross section of stock and bond returns in each regional universe. We present average annualized returns, annualized standard deviations, as well as the corresponding information ratios and *t*-statistics for each factor style in both equity and bond markets and across both regions. Exhibit 4 summarizes our results in the main sample.

Our first set of results shows consistently positive factor performance across the two regional equity samples (see Exhibit 4: equity sample). Most equity factors deliver positive returns and information ratios in both regions of our sample. Note, however, that our results also show that the size premium is consistently the smallest in both regions. Moreover, while most equity factors deliver statistically significant positive returns, this is not the case for the size factor, which does not show significant *t*-statistics in any of the regions. Our findings are in line with previous research that documents mixed results on the performance of size across the globe.

Looking at the fixed-income performance (Exhibit 4: fixed-income sample), we observe similar results, albeit with some key qualitative differences. Value, low volatility, and quality deliver consistently strong performance across both regions. The momentum factor shows economically positive but statistically weak results. We find that is mostly due to a lower beta bias in the long portfolios, which leaves the long–short portfolio short credit beta. However, the size factor shows mixed results, with a very low premium in the developed sample and a negative premium in emerging markets. This finding is consistent with Richardson and Palhares (2018), who show a close to zero premium associated with size in investment-grade markets globally.

EXHIBIT 4

Long–Short Factor Performance Characteristics for Generic Universes

	Equity Sample		Fixed-Income Sample	
	Developed	Emerging	Developed	Emerging
Value				
Return (ann.)	4.2%	8.8%	2.1%	3.9%
Standard deviation (ann.)	10.9%	7.8%	1.4%	3.6%
Information Ratio	0.39	1.13	1.56	1.08
t-statistic	1.96	5.73	7.39	5.02
Momentum				
Return (ann.)	10.5%	9.3%	0.9%	1.6%
Standard deviation (ann.)	16.2%	10.0%	4.1%	5.2%
Information Ratio	0.65	0.93	0.23	0.30
t-statistic	3.27	4.69	1.07	1.38
Quality				
Return (ann.)	6.4%	2.5%	1.0%	2.6%
Standard deviation (ann.)	7.0%	5.0%	1.7%	4.5%
Information Ratio	0.92	0.50	0.59	0.57
t-statistic	4.66	2.51	2.71	2.67
Low Volatility				
Return (ann.)	5.2%	6.6%	1.5%	2.5%
Standard deviation (ann.)	7.3%	7.5%	2.1%	4.5%
Information Ratio	0.71	0.88	0.70	0.55
t-statistic	3.57	4.45	3.30	2.59
Size				
Return (ann.)	–2.3%	2.5%	–0.1%	–0.2%
Standard deviation (ann.)	10.0%	13.3%	2.4%	5.5%
Information Ratio	–0.23	0.19	–0.01	–0.04
t-statistic	–1.16	0.94	–0.04	–0.16

NOTES: This exhibit presents performance characteristics for selected long–short factors in both equity and fixed-income samples. Factor construction is discussed in the Data and Methodology section. This exhibit reports annualized returns, annualized standard deviations, annualized Information ratios, and corresponding *t*-statistics. Our equity sample runs from January 1997–June 2022, and our fixed-income sample runs from January 2000–June 2022.

To generalize, our first set of results shows consistently positive performance for most premiums except for size. Even though the momentum factor in the fixed-income sample shows insignificant *t*-statistics, it shows strongly significant *t*-statistics in all regions in our equity samples. For both equities and bonds, the performance of momentum stays consistently positive. Contrary to momentum, the size factor shows a more erratic pattern as we navigate from region to region and across the two asset classes. Its performance figures fluctuate around zero and are never significant in either regional equity or fixed-income cross sections.

Although our results generally show attractive factor performance across the globe and for both asset classes, they should be taken with a grain of salt. The factor portfolios constructed consider the entire universe of securities and, as such, might not survive various implementation constraints that investors have. We address this implementability issue in the next section.

EXHIBIT 5

Long–Short Factor Performance Characteristics for Investable Universes

	Equity Sample		Fixed-Income Sample	
	Developed	Emerging	Developed	Emerging
Value				
Return (ann.)	1.9%	3.0%	2.0%	3.0%
Standard deviation (ann.)	11.9%	10.1%	1.4%	3.4%
Information Ratio	0.16	0.29	1.43	0.88
t-statistic	0.82	1.49	6.74	4.15
Momentum				
Return (ann.)	7.8%	8.7%	1.0%	1.9%
Standard deviation (ann.)	17.7%	12.1%	4.3%	5.2%
Information Ratio	0.44	0.71	0.23	0.37
t-statistic	2.24	3.61	1.08	1.71
Quality				
Return (ann.)	6.8%	3.8%	1.0%	2.6%
Standard deviation (ann.)	7.3%	7.2%	1.7%	3.2%
Information Ratio	0.94	0.52	0.59	0.81
t-statistic	4.74	2.63	2.76	3.82
Low Volatility				
Return (ann.)	5.1%	6.5%	1.4%	2.5%
Standard deviation (ann.)	7.3%	7.5%	2.2%	4.9%
Information Ratio	0.71	0.88	0.64	0.51
t-statistic	3.57	4.43	2.99	2.39
Size				
Return (ann.)	–1.9%	1.6%	0.0%	–1.0%
Standard deviation (ann.)	8.1%	13.2%	2.7%	3.5%
Information Ratio	–0.24	0.12	0.00	–0.29
t-statistic	–1.21	0.61	–0.02	–1.37

NOTES: This exhibit presents performance characteristics for selected long–short factors in both equity and fixed-income samples. Factor construction is discussed in the Data and Methodology section. The investable universe is constructed by removing the smallest quintile of names (measured by market capitalization for equities and issue amount outstanding for fixed income) sorted in December each year. This exhibit reports annualized returns, annualized standard deviations, annualized information ratios, and corresponding *t*-statistics. Our equity sample runs from January 1997–June 2022, and our fixed-income sample runs from January 2000–June 2022.

IMPLEMENTABILITY

In this section, we evaluate whether the broad factor styles considered in our study survive the implementability criterion. We take two simple approaches here. First, because our equity and fixed-income universe considers all securities, some of the smaller names in our sample might not be directly investable, especially in the short leg of the factor portfolios. To address this issue, we exclude from the universe the bottom quintile of securities ranked on market capitalization and recalculate all factors for each region and in each asset class. Our results are presented in Exhibit 5.

In equities, the performance of factor premiums across the globe in the restricted universe is broadly consistent with our previous findings. However, note that the value factor shows weaker performance and has lost its significance in both regions in our equity sample. Its returns are insignificant but remain consistently positive in both developed and emerging market equity samples. The size factor, on the other hand, shows an even more dramatic underperformance. Excluding the smallest names in the equity universe turns the performance of size negative in both regions consistently.

This casts further doubts on the existence of a size premium in equity markets. Other than that, the performance of momentum, quality, and low volatility remains economically positive and statistically significant even after excluding the smaller names from the universe. In fixed income, the results are broadly unchanged. However, note that momentum *t*-statistics improve slightly in the larger and more liquid universe; although insignificant, they remain consistently positive. All in all, these results are again largely consistent and point toward a questionable size premium across equities and fixed income around the globe.

To summarize, our cross-asset findings in the investable universe are broadly consistent with our previous results. First and foremost, the fact that equity value shows weaker significance is rather expected due to the long drawdown it has experienced in the recent growth cycle. Despite these results for equities, the value premium remains positive and significant in fixed income. Second, the momentum performance in fixed income shows a similar pattern; it shows positive but insignificant performance in fixed income but very strong and significant performance in equities. We find that the weaker *t*-statistics for the fixed-income momentum premium are mostly due to a lower beta bias in the long portfolios, which leaves the long–short portfolio short credit beta. Third, our results for quality and low volatility show consistency across all samples. Finally, the size premium performance remains questionable in both equities and fixed income.

Although we exclude the smallest names in the universe, some investors might still face short-sale constraints. Thus, the above factor strategies might remain unimplementable for investors interested in long-only portfolios. To address this issue, we take a second implementability test and reconstruct each factor for all regions and both asset classes by imposing long-only constraints. Essentially, we ignore the short sides of the portfolios and present our results against the corresponding regional benchmarks. One caveat here is for low-volatility long-only portfolios in equity and quality portfolios in fixed income where we present risk-adjusted outperformance figures against the corresponding regional benchmarks. Our results are presented in Exhibit 6.

Imposing long-only constraints brings forward some interesting results, which are again very much consistent with our previous findings. In our equity sample, all of our factor premiums except for size deliver positive performance across all regions. This includes the long-only value factors in both emerging and developed equities. The equity value premium is still insignificant in the developed region but becomes strongly significant in the emerging equities sample. Also, the low-volatility factor in equities consistently outperforms its corresponding benchmark in both regions (after risk adjustment). In line with our previous findings, the size premium shows an erratic and statistically insignificant pattern.

Similar to equities, the long-only constrained portfolios in fixed income are broadly consistent with our previous long–short results. We see statistically strong positive outperformance for value, quality, and low volatility. The momentum premium is consistently positive and has gained some significance, although it remains rather weak. The results for size remain consistently insignificant, showing both weakly positive and negative returns in both samples.

Overall, our findings suggest that value, momentum, quality, and low-volatility factors show robust performance across the globe and both asset classes. The size factor, however, shows some erratic performance. Turning back to our framework to justify factor existence, we recommend that investors harvest the benefits of value, momentum, quality, and low volatility for both equity and fixed-income markets but remain cautious about allowing for size tilts in their portfolios.

EXHIBIT 6

Long-Only Factor Performance Characteristics for Investable Universes

	Equity Sample		Fixed-Income Sample	
	Developed	Emerging	Developed	Emerging
Value				
Outperformance (ann.)	1.1%	2.7%	1.2%	1.8%
Standard deviation (ann.)	6.9%	6.2%	0.9%	2.3%
Information Ratio	0.16	0.43	1.3	0.77
t-statistic	0.79	2.19	6.15	3.64
Momentum				
Outperformance (ann.)	4.1%	4.7%	0.8%	0.6%
Standard deviation (ann.)	9.4%	6.2%	3.2%	2.1%
Information Ratio	0.44	0.77	0.26	0.26
t-statistic	2.23	3.89	1.22	1.21
Quality				
Outperformance (ann.)	2.9%	2.3%	0.2%	2.3%
Standard deviation (ann.)	3.5%	3.9%	0.6%	4.2%
Information Ratio	0.82	0.59	0.39	0.56
t-statistic	4.14	2.97	1.64	2.60
Low Volatility				
Outperformance (ann.)	4.4%	4.9%	0.7%	1.4%
Standard deviation (ann.)	5.7%	5.6%	1.4%	2.8%
Information Ratio	0.78	0.87	0.45	0.51
t-statistic	3.95	4.40	2.13	2.40
Size				
Outperformance (ann.)	–1.6%	2.4%	0.1%	–0.4%
Standard deviation (ann.)	8.7%	11.8%	1.0%	1.5%
Information Ratio	–0.19	0.20	0.04	–0.25
t-statistic	–0.95	1.03	0.04	–1.20

NOTES: This exhibit presents performance characteristics for selected long-only factors in both equity and fixed-income samples. Factor construction is discussed in the Data and Methodology section. The investable universe is constructed by removing the smallest quintile of names (measured by market capitalization for equities and issue amount outstanding for fixed income) sorted in December each year. This exhibit reports annualized outperformance relative to the corresponding benchmark, annualized standard deviations, annualized information ratios, and corresponding *t*-statistics. The outperformance for the low-volatility factor in equities and the quality factor in fixed income is beta-adjusted. Our equity sample runs from January 1997–June 2022, and our fixed-income sample runs from January 2000–June 2022.

CONCLUSION

A large amount of literature has documented the existence of factor premiums across the globe and different asset classes. Given that hundreds of factors have been put forward as contenders of *true* risk and return drivers, however, there is an ongoing concern that many of the findings reported in the literature might show attractive risk and return characteristics by mere luck. As a consequence, another stream of literature has emerged that proposes various multiple-testing techniques to scrutinize factor existence. Although the objective of these techniques is to reduce false positives, it naturally increases the probability of false negatives or missed opportunities for important factor discoveries. Importantly, multiple-testing approaches are statistically based and fall under the menu of traditional hypothesis testing, thus ignoring prior economic beliefs that investors might have and that are crucial for optimal design of investment strategies.

To our knowledge, this is the first study to put forward an evidence-based, intuitive, and simple framework of evaluating factor existence across asset classes. Our approach is simple in design but does not compromise on rigor, leaving investors with a menu of rules they could use to evaluate which factors to allow in their portfolios and define their investment philosophies. For a factor to exist, it should satisfy the following criteria: (1) economic theory, (2) robust risk and return evidence, (3) cross-asset and cross-region validation, and last but not least (4) implementability. Such a framework offers a practical way to leverage academic and practitioner research and use the factor zoo to one's advantage, as a starting point to establish factor existence—not relying on potentially arbitrary statistical techniques, but rather focusing more on economic theory alongside empirical evidence.

We test this framework for a set of generic factors and evaluate their performance across the globe in developed and emerging markets and for two asset classes: equities and fixed income. Our equity sample runs from January 1997–June 2022, while our fixed-income sample runs from January 2000–June 2022.

Our findings suggest that value, momentum, quality, and low-volatility factors show robust performance across the globe and in both asset classes. The size factor, however, shows some erratic performance. Based on our results, we recommend that investors harvest the benefits of value, momentum, quality, and low-volatility factors for both equity and fixed-income markets but remain cautious about allowing for size tilts in their portfolios.

The framework proposed in this article can (and should) be readily extendable to other factor signals and/or broad factor categories. Having established a broad factor category, practitioners can use our paradigm to evaluate alternative signals that could help capture a factor better via, for example, more granular or timely data. These alternative signals should correlate with the underlying factor but might also deliver some additive alpha due to their efficacy. Our framework can also be extended to study factor existence in alternative asset classes, beyond equities and fixed income, and can accommodate alternative investability constraints that investors might have.

REFERENCES

Alquist, R., R. Israel, and T. Moskowitz. 2018. "Fact, Fiction and the Size Effect." *The Journal of Portfolio Management* 45: 34–61.

Ang, A., R. J. Hodrick, Y. Xing, and X. Zhang. 2006. "The Cross-Section of Volatility and Expected Returns." *The Journal of Finance* 61: 259–299.

Asness, C., A. Frazzinia, R. Israela, T. Moskowitz, and L. H. Pedersen. 2018. "Size Matters If You Control Your Junk." *Journal of Financial Economics* 129: 479–509.

Asness, C. S., J. M. Liew, and R. L. Stevens. 1997. "Parallels between the Cross-Sectional Predictability of Stock and Country Returns." *The Journal of Portfolio Management* 23: 79–87.

Asness, C. S., T. J. Moskowitz, and L. H. Pedersen. 2008. "Value and Momentum Everywhere." *The Journal of Finance* 68: 929–985.

Baker, M. P., B. Bradley, and J. Wurgler. 2011. "Benchmarks as Limits to Arbitrage: Understanding the Low Volatility Anomaly." *Financial Analysts Journal* 67: 1–15.

Baker, N. L., and R. A. Haugen. 2012. "Low Risk Stocks Outperform within All Observable Markets of the World." Social Science Research Network Working Paper.

Ball, R., J. Gerakos, J. T. Linnainmaa, and V. Nikolaev. 2016. "Accruals, Cash Flows, and Operating Profitability in the Cross Section of Stock Returns." *Journal of Financial Economics* 121: 28–45.

Barberis, N., A. Shleifer, and R. Vishny. 1998. "A Model of Investor Sentiment." *Journal of Financial Economics* 49: 307–343.

Barth, F., H. Scholz, and M. Stegmeier. 2017. "Momentum in the European Corporate Bond Market: The Role of Bond Specific Returns." *The Journal of Fixed Income* 27: 54–70.

Basu, S. 1977. "Investment Performance of Common Stocks in Relation to Their Price-Earnings Ratios: A Test of the Efficient Markets Hypothesis." *The Journal of Finance* 32: 663–682.

Beaver, W., M. Correia, and M. McNichols. 2012. "Do Differences in Financial Reporting Attributes Impair the Predictive Ability of Financial Ratios for Bankruptcy?" *Review of Accounting Studies* 17: 969–1010.

Ben Dor, A., L. Dynkin, J. Hyman, P. Houweling, and E. van Leeuwen. 2007. "DTS (Duration Times Spread)." *The Journal of Portfolio Management* 33: 77–100.

Ben Dor, A., and Z. Xu. 2015. "Should Equity Investors Care about Corporate Bond Prices? Using Bond Prices to Construct Equity Momentum Strategies." *The Journal of Portfolio Management* 43: 35–49.

Bender, J., and R. Samanta. 2017. "Quality Assurance: Demystifying the Quality Factor in Equities and Bonds." *The Journal of Portfolio Management* 43: 88–98.

Berk, J., R. C. Green, and V. Naik. 1999. "Optimal Investment, Growth Options, and Security Returns." *The Journal of Finance* 54: 1553–1607.

Bharath, S., and T. Shumway. 2008. "Forecasting Default with the Merton Distance to Default Model." *The Review of Financial Studies* 21: 1339–1369.

Bhojraj, S., and B. Swaminathan. 2006. "Macromomentum: Returns Predictability in International Equity Indices." *The Journal of Business* 79: 429–451.

Bittlingmayer, G., and S. M. Moser. 2014. "What Does the Corporate Bond Market Know?" *The Financial Review* 49: 1–19.

Black, F. 1972. "Beta and Return." *The Journal of Portfolio Management* 20: 8–18.

——. 1993. "Capital Market Equilibrium with Restricted Borrowing." *The Journal of Business* 45: 444–455.

Black, F., M. C. Jensen, and M. Scholes. 1972. "The Capital Asset Pricing Model: Some Empirical Tests." In *Studies in the Theory of Capital Markets*. Praeger Publishers Inc.

Blitz, D., J. Huij, and M. Martens. 2011. "Residual Momentum." *Journal of Empirical Finance* 18: 506–521.

Blitz, D., J. Pang, and P. van Vliet. 2013. "The Volatility Effect in Emerging Markets." *Emerging Market Review* 16: 31–45.

Blitz, D., and P. van Vliet. 2007. "The Volatility Effect." *The Journal of Portfolio Management* 34: 102–113.

Brennan, M. J. 1971. "Capital Market Equilibrium with Divergent Borrowing and Lending Rates." *Journal of Financial and Quantitative Analysis* 6: 1197–1205.

Campbell, H., Y. Liu, and A. Saretto. 2016. "An Evaluation of Alternative Multiple Testing Methods for Finance Applications." *The Review of Asset Pricing Studies* 10: 199–248.

Campbell, H., Y. Liu, and H. Zhu. 2016. "… and the Cross-Section of Expected Returns." *The Review of Financial Studies* 29: 5–68.

Chabot, B., E. Ghysels, and R. Jagannathan. 2009. "Momentum Cycles and Limits to Arbitrage Evidence from Victorian England and Post-Depression US Stock Markets." National Bureau of Economics Research, NBER working Paper No. 15591.

Chan, K., L. K. C. Chan, N. Jagadeesh, and J. Lakonishok. 2006. "Earnings Quality and Stock Returns." *The Journal of Business* 79: 1041–1082.

Chan, L. K. C., Y. Hamao, and J. Lakonishok. 1991. "Fundamentals and Stock Returns in Japan." *The Journal of Finance* 46: 1739–1789.

Chordia, T., and L. Shivakumar. 2002. "Momentum, Business Cycle, and Time-varying Expected Returns." *The Journal of Finance* 57: 985–1019.

Chui, A. C. W., S. Titman, and K. C. J. Wei. 2010. "Individualism and Momentum around the World." *The Journal of Finance* 65: 361–392.

Chung, K., J. Wang, and C. Wu. 2019. "Volatility and the Cross-Section of Corporate Bond Returns." *Journal of Financial Economics* 133: 397–417.

Clarke, R., H. D. Silva, and S. Thorley. 2006. "Minimum-Variance Portfolios in the U.S. Equity Market." *The Journal of Investing* 33: 108–118.

Cochrane, J. 2011. "Presidential Address: Discount Rates." *The Journal of Finance* 66: 1047–1108.

Cooper, M. J., H. Gulen, and M. J. Shill. 2008. "Asset Growth and the Cross-Section of Stock Returns." *The Journal of Finance* 63: 1609–1651.

Cooper, M. J., R. C. Gutierrez, and A. Hameed. 2004. "Market States and Momentum." *The Journal of Finance* 59: 1345–1365.

Correia, M., S. Richardson, and I. Tuna. 2012. "Value Investing in the Corporate Bond Market." *The Review of Accounting Studies* 17: 572–609.

Daniel, K., D. Hirshleifer, and A. Subrahmanyam. 1998. "Investor Psychology and Security Market Under-and-Overreactions." *The Journal of Finance* 53: 2143–2184.

Daniel, K., D. Hirshleifer, and S. H. Teoh. 2001. "Investor Psychology in Capital Markets: Evidence and Policy Implications." *Journal of Monetary Economics* 49: 139–209.

DeBondt, W. F. M., and R. Thaler. 1985. "Does the Stock Market Overreact?" *The Journal of Finance* 60: 793–803.

——. 1987. "Further Evidence on Investor Overreaction and Stock Market Seasonality." *The Journal of Finance* 62: 557–581.

de Carvalho, R. L., P. Dugnolle, X. Lu, and P. Moulin. 2014. "Low-Risk Anomalies in Global Fixed Income: Evidence from Major Broad Markets." *The Journal of Fixed Income* 23: 51–70.

de Carvalho, R. L., L. Xiao, and P. Moulin. 2012. "Demystifying Equity Risk-Based Strategies: A Simple Alpha Plus Beta Description." *The Journal of Portfolio Management* 38: 56–70.

Fama, E. F. 1991. "Efficient Capital Markets: II." *The Journal of Finance* 46: 1575–1617.

Fama, E., and K. French. 1992. "The Cross-Section of Expected Stock Returns." *The Journal of Finance* 47: 427–465.

——. 1993. "Common Risk Factors in the Returns of Stocks and Bonds." *Journal of Financial Economics* 33: 3–56.

——. 1995. "Size and Book-to-Market Factors in Earnings and Returns." *The Journal of Finance* 50: 131–155.

——. 1996. "Multifactor Explanations of Asset-Pricing Anomalies." *The Journal of Finance* 51: 55–84.

——. 1998. "Value versus Growth: The International Evidence." *The Journal of Finance* 53: 1975–1999.

——. 2012. "Size, Value, and Momentum in International Stock Returns." *Journal of Financial Economics* 105: 457–472.

——. 2015. "A Five-Factor Asset Pricing Model." *Journal of Financial Economics* 116: 1–22.

——. 2016. "Dissecting Anomalies with a Five-Factor Model." *The Review of Financial Studies* 29: 69–103.

Fraikin, M., X. Gerard, and A. Roberts. 2020. "Integrating Low Volatility Style Exposure into Core Equity Factor Investments." *Risk and Reward* 1: 33–40.

Frazzini, A., and L. H. Pedersen. 2014. "Betting Against Beta." *The Journal of Financial Economics* 111: 1–25.

Gebhardt, W. R., S. Hvidkjaer, and B. Swaminathan. 2005. "Stock and Bond Market Interaction: Does Momentum Spill Over?" *The Journal of Financial Economics* 75: 651–690.

Georgy, T. M., and C. Y. Hwang. 2010. "A Resolution of the Distress Risk and Leverage Puzzles in the Cross Section of Stock Returns." *The Journal of Financial Economics* 96: 56–79.

Gorton, G. B., F. Hayashi, and G. K. Rouwenhorst. 2013. "The Fundamentals of Commodity Futures Returns." *The Review of Finance* 17: 35–105.

Griffin, D. M., and M. L. Lemon. 2001. "Does Book-to-Market Equity Proxy for Distress or Overreaction?" Working paper, University of Arizona.

Griffin, J. M., X. Ji, and J. S. Martin. 2003. "Momentum Investing and Business Cycle Risk: Evidence from Pole to Pole." *The Journal of Finance* 58: 2515–2547.

Grundy, B. D., and J. S. Martin. 2001. "Understanding the Nature of the Risks and the Source of the Rewards to Momentum Investing." *The Review of Financial Studies* 14: 29–78.

Gupta, T., T. Herzig, V. Roscovan, and C. Rother. 2021. "On the Importance of Performance Attribution of Low Volatility-Tilted Factor Portfolios." *Risk and Reward* 4: 28–33.

Gupta, T., and B. Kelly. 2018. "Factor Momentum Everywhere." *The Journal of Portfolio Management* 45: 13–36.

Gupta, T., E. Leung, and V. Roscovan. 2022. "Consumer Spending and the Cross-Section of Stock Returns." *The Journal of Portfolio Management* 48: 117–137.

Haugen, R., and N. L. Baker. 1991. "The Efficient Market Inefficiency of Capitalization-Weighted Stock Portfolios." *The Journal of Portfolio Management* 17: 35–40.

——. 1996. "Commonality in the Determinants of Expected Stock Returns." *The Journal of Financial Economics* 41: 401–439.

Hirshleifer, D. 2002. "Investor Psychology and Asset Pricing." *The Journal of Finance* 56: 1533–1597.

Hong, H., and J. C. Stein. 1999. "A Unified Theory of Underreaction Momentum Trading and Overreaction in Asset Markets." *The Journal of Finance* 54: 1839–1885.

Houweling, P., and J. van Zundert. 2017. "Factor Investing in the Corporate Bond Market." *Financial Analysts Journal* 73: 100–117.

Hsu, J., V. Kalesnik, and E. Kose. 2019. "What Is Quality?" *Financial Analysts Journal* 75: 44–61.

Ilmanen, A., R. Byrne, H. Gunasekera, and R. Minikin. 2004. "Which Risks Have Been Best Rewarded?" *The Journal of Portfolio Management* 30: 53–57.

Israel, R., D. Palhares, and S. Richardson. 2018. "Common Factors in Corporate Bond Returns." *The Journal of Investment Management* 16: 17–46.

Jegadeesh, N., and S. Titman. 1993. "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency." *The Journal of Finance* 48: 65–91.

——. 2001. "Profitability of Momentum Strategies: An Evaluation of Alternative Explanations." *The Journal of Finance* 56: 699–720.

Jostova, G., S. Nikolova, A. Philipov, and C. W. Stahel. 2013. "Momentum in Corporate Bond Returns." *The Review of Financial Studies* 26: 1649–1693.

Kothari, S. P. 2000. "Capital Markets Research in Accounting." *Journal of Accounting and Economics* 31: 105–231.

Kyosev, G., J. Huij, M. Hanauer, and S. Lansdorp. 2020. "Does Earnings Growth Drive the Quality Premium?" *Journal of Banking and Finance* 114: 1057–1085.

Lakonishok, J., A. Shleifer, and R. Vishny. 1994. "Contrarian Investment, Extrapolation, and Risk." *The Journal of Finance* 49: 1541–1578.

Lee, C. M., and B. Swaminathan. 1999. "Do Stock Prices Overreact to Earnings News?" *The Journal of Finance* 55: 2017–2069.

Lewellen, J., S. Nagel, and J. Shanken. 2010. "A Skeptical Appraisal of Asset Pricing Tests." *Journal of Financial Economics* 96: 175–194.

Liu, L. X., and Z. Lu. 2008. "Momentum Profits, Factor Pricing, and Macroeconomics Risk." *The Review of Financial Studies* 21: 2417–2448.

Lo, A. W., and A. C. Mackinlay. 1990. "Data-Snooping Biases in Tests of Financial Asset Pricing Models." *The Review of Financial Studies* 3: 431–467.

McLean, R. D., and J. Pontiff. 2016. "Does Academic Research Destroy Stock Return Predictability?" *The Journal of Finance* 71: 5–32.

Miller, M., and M. Scholes. 1972. "Rates of Return in Relation to Risk: A Re-examination of Some Recent Findings, Studies." In *The Theory of Capital Markets*, Praeger Publishers Inc.

Moskowitz, T. J., and M. Grinblatt. 1999. "Do Industries Explain Momentum?" *The Journal of Finance* 54: 1249–1290.

Novy-Marx, R. 2013. "The Other Side of Value: The Gross Profitability Premium." *Journal of Financial Economics* 108: 1–28.

——. 2018. "Fundamentally, Momentum Is Fundamental Momentum." NBER Working Paper.

Polbennikov, S. 2018. "Issuer Size Premium in Credit Markets." Barclays Research.

Pontiff, J., and A. Woodgate. 2008. "Share Issuance and Cross-Sectional Returns." *The Journal of Finance* 63: 921–945.

Ramos, E., and J. Hans. 2013. "Finding Opportunities through the Low Volatility Anomaly." BMO Global Asset Management.

Richardson, S. A., and D. Palhares. 2018. "(Il)iquidity Premium in Credit Markets: A Myth?" *The Journal of Fixed Income* 28: 5–23.

Richardson, S. A., R. G. Sloan, M. T. Soliman, and I. Tuna. 2005. "Accrual Reliability, Earnings Persistence and Stock Prices." *The Journal of Accounting and Economics* 39: 437–485.

Rosenthal, L., and C. Young. 1990. "The Seemingly Anomalous Price Behavior of Dutch Shell and Unilever NV/PLC." *The Journal of Financial Economics* 26: 123–141.

Ross, S. A. 1989. "Regression to the Max." Working paper, Yale University.

Rouwenhorst, G. K. 1998. "International Momentum Strategies." *The Journal of Finance* 53: 267–284.

Schwert, G. W. 2003. "Anomalies and Market Efficiency." In *Handbook of the Economics of Finance*, edited by G. M. Constantinides, M. Harris, and R. Stulz. Amsterdam: Elsevier Science.

Siganos, A., and P. Chelley-Steeley. 2006. "Momentum Profits Following Bull and Bear Markets." *Journal of Asset Management* 6: 381–388.

Sloan, R. G. 1996. "Do Stock Prices Fully Reflect Information in Accruals and Cash Flows about Future Earnings?" *Accounting Review* 71: 289–315.

Stivers, T. S., and L. Sun. 2012. "Cross-Sectional Return Dispersion and Time-Variation in Value and Momentum Premiums." *Journal of Financial and Quantitative Analysis* 45: 987–1014.

Zhang, H. 2004. "Dynamic Beta, Time-Varying Risk Premium, and Momentum." Available at SSRN: https://ssrn.com/abstract=571006.

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