Financial Anomalies in Asset Allocation: Risk Mitigation with Cross-Sectional Equity Strategies

Redouane Elkamhi, Jacky S. H. Lee, and Marco Salerno

Redouane Elkamhi
is an associate professor of finance in the Rotman School of Management at the University of Toronto in Toronto, Ontario, Canada.
redouane.elkamhi@rotman.utoronto.ca

Jacky S. H. Lee
is the senior managing director of the Total Portfolio Group at Healthcare of Ontario Pension Plan Trust Fund in Toronto, Ontario, Canada.
jlee5@hoopp.com

Marco Salerno
is a principal of the Total Portfolio Group at Healthcare of Ontario Pension Plan Trust Fund in Toronto, Ontario, Canada.
msalerno@hoopp.com

KEY FINDINGS

- Financial anomalies categorized as profitability and as investment exhibit a consistent countercyclical behavior with respect to the performance of traditional portfolios such as the 60/40 and risk parity as well as National Bureau of Economic Research (NBER) recessions.
- With the exception of the momentum category, financial anomalies are not good strategies for inflation hedging. All financial anomalies exhibit a larger cross-sectional dispersion within each category during times of high inflation.
- Adding financial anomalies to traditional portfolios increases the portfolio Sharpe ratio, and, more importantly, financial anomalies can help reduce portfolio drawdown.

ABSTRACT

There is a myriad of financial anomalies in the cross-section of equity returns. They have been widely studied in the literature, which gives investors a large choice in terms of investment styles. In this article, the authors show a perhaps unappreciated quality of financial anomalies: They exhibit a strong countercyclical behavior. Specifically, some anomalies (e.g., profitability and investment) perform particularly well when traditional portfolios (e.g., 60/40 or risk parity portfolios) exhibit prolonged periods of negative drawdowns and during National Bureau of Economic Research (NBER) recessions. With the exception of momentum strategies, the authors do not find evidence that financial anomalies are inflation hedging. Last, the authors examine whether financial anomalies lead to better portfolio performance. The results show that combining anomalies based on their style and then adding them to a traditional portfolio leads to higher Sharpe ratios overall, while also limiting portfolio losses during recessions.

Today's investment environment is challenging for investors because of the low interest rate environment and the expectations that risky assets may not perform as well as they did in the past (Ren et al. 2021). Low interest rates have been shown to reduce the diversification benefits of bonds. It is debatable as to how much further bond yields can fall and bond prices can rise (Di Maggio and Kacperczyk 2017; Daniel, Garlappi, and Xiao 2018; Campbell and Sigalov 2020). Furthermore, the broad consensus-view among practitioners is that, in the next decade, traditional investment portfolios are likely to perform less well than they did in the past 20 years. Using BlackRock's capital markets' assumptions, Ren et al. (2021) showed that a standard 60/40 equity-bond portfolio has an expected return of just 5.2% per year over the next decade. This future expectation is considerably less than the approximately 10% that a 60/40 portfolio earned in the past decade.

It follows that, more than ever before, investors have been looking for new investment strategies to enhance risk-adjusted returns of their portfolios while also reducing drawdowns. For example, pension funds have considerably increased their allocation to alternative asset classes such as private investments and hedge funds. In particular, hedge funds' assets under management have increased from $3 trillion in 2020 to $3.8 trillion in 2021, an increase of 26.7%.[1] Among the alternative investment strategies offered by hedge funds, many are built on financial anomalies in the cross-section of equity returns, and they have been widely studied in the literature.[2]

In this article, we study how financial anomalies in the cross-section of equity returns (henceforth, financial anomalies) perform in different economic regimes, and then we analyze how they contribute to various traditional portfolios (e.g., 60/40, risk parity, etc.).[3] Financial anomalies are attractive for investors for multiple reasons. They have been widely studied by both academics and practitioners, which gives investors ample evidence and research material to analyze prior to implementing them. Also, financial anomalies span many different characteristics of firms. For example, investors can decide to invest in the small-minus-big anomaly, or momentum, or many other anomalies that have historically low correlations between each other. This property makes them appealing for the purpose of portfolio construction. For ease of exposition, we group the anomalies into five categories according to the classification provided by Hou, Xue, and Zhang (2020): cross-sectional momentum, intangibles, value versus growth, profitability, and investment. The goal of this article is to provide investors with an analysis of which types of financial anomalies perform well during various economic regimes, which we describe below.

Our main results can be summarized as follows. First, profitability anomalies exhibit a strong and consistent countercyclical behavior with respect to periods of large drawdowns for traditional portfolios. Second, the financial anomalies considered in this study have not historically provided a hedge against inflationary times, with the exception of the cross-sectional momentum category. We also find the cross-sectional dispersion of the anomalies within each category becomes larger during times of high inflation and periods of portfolio drawdown. Third, although profitability consistently provided positive returns during times of large drawdowns, the other anomalies performed well only in some periods, whereas they underperformed during others. For example, during the large drawdown in 1981 for a 60/40 portfolio, cross-sectional momentum and intangibles anomalies had negative returns, whereas profitability had a strong positive return over the same period.[4] Fourth, adding financial anomalies to traditional portfolios increases the Sharpe ratio of the overall portfolio.

---

[1] These alternative asset classes have been shown to provide diversification benefits (Amin and Kat 2003; Daskalaki, Skiadopoulos, and Topaloglou 2017). Interestingly, Hoevenaars et al. (2008) showed that the benefits of alternative asset classes are even larger for pension funds that are exposed to changes in their liabilities.

[2] See, for example, Fama and French (2015), Hou, Xue, and Zhang (2020), and Bartram and Grinblatt (2021). Recently, Markowitz et al. (2021) demonstrated that many variables used to build financial anomalies are still statistically significant in a sample from 1996 to 2020, even after accounting for transactions costs. See also Frazzini, Israel, and Moskowitz (2012) for the effect of transaction costs on anomalies.

[3] We start from the set of more than 400 financial anomalies reported in Hou, Xue, and Zhang (2020). As discussed in Hou, Xue, and Zhang (2020), many anomalies fail to replicate when we apply a rigorous methodology (e.g., value-weighted portfolios, breakpoints based on NYSE, etc.). We apply this rigorous methodology, and we keep only the anomalies that exhibit statistically significant returns for the period 1971–2019.

[4] We present our results using a sample of 76 anomalies from January 1971 to December 2019. Extrapolating future performance based on historical information is prone to errors because history may not represent well the future economic conditions. For example, some anomalies that are statistically significant in the sample from 1971–2019 are not statistically significant when analyzed in more recent times (e.g., from 2000 to 2019).

Before conducting our analysis, we need to answer the question: Which economic regimes should be used to evaluate the performance of financial anomalies? The answer varies depending on the preferences of investors. Different investors are potentially interested in different regimes. We investigate how financial anomalies perform when traditional portfolios exhibit poor performance (i.e., large drawdowns) as well as during traditional economic regimes such as the National Bureau of Economic Research (NBER) recessions and inflationary times. To do so, we first classify historical periods according to the performance of four traditional portfolios: 60/40 portfolio of equities and bonds, a risk parity portfolio, an all-equity portfolio, and a portfolio of equities, fixed income, and commodities.[5] Specifically, for each portfolio, we categorize times when the portfolios exhibit severe drawdowns as bad times.[6] We build our regimes based on the performance of traditional portfolios because many investors want to avoid drawdowns.[7] For example, pension funds are adverse to large drawdowns because their funding status can be negatively affected; mutual funds and hedge funds can have liquidity problems following large drawdowns (e.g., many investors are performance sensitive and withdraw their capital after periods of large negative returns, as shown in Christoffersen and Xu 2017), and so on. Because investors are constantly seeking protection from large drawdowns, some financial anomalies help in this regard, as we show further below in the article.[8]

Our empirical results can be summarized as follows. First, we investigate how the various categories of financial anomalies perform in common economic regimes such as NBER recessions and inflationary times. These regimes are interesting to study historically because financial assets exhibit very strong patterns during such times: The equity market exhibits on average large negative returns during NBER recessions, bonds perform poorly during inflationary times, and so on. Profitability and investment are the categories with the strongest countercyclical behavior with respect to NBER recessions (i.e., they perform best during bad times), whereas cross-sectional momentum performs the worst among all financial anomalies (consistent with the results found in Daniel and Moskowitz 2016 and Baltzer, Jank, and Smajlbegovic 2019).[9] For inflationary times, the results are different from those for NBER recessions: Cross-sectional momentum is the category that performs the best, whereas the other anomalies exhibit a large dispersion in their returns compared to noninflationary times. Therefore, we find that financial anomalies are not particularly attractive as an inflation-hedging strategy with the only exception being cross-sectional momentum. This is consistent with the findings in Neville et al. (2021).

Second, given the aforementioned results, we expect financial anomalies to be helpful in portfolio construction. We address this question by analyzing how such anomalies would have contributed to the performance of traditional portfolios using data January 1971 to December 2019. Specifically, we first build the traditional portfolios and analyze their standalone performance. The 60/40 and risk parity portfolios

---

[5] Details on the construction of these portfolios are provided in the section “Setup for Traditional Portfolios and Regimes.”

[6] See the section “Setup for Traditional Portfolios and Regimes” for details on the definition of periods when traditional portfolios exhibit poor performance.

[7] See also Harvey et al. (2019) for a discussion on which strategies help during periods of large drawdowns.

[8] Note that the academic literature often analyzes the alpha of financial anomalies. In this article, we focus on the absolute returns of these anomalies because this is what matters for investors. In other words, we do not seek to address the question of whether the anomalies are uncorrelated with other existing factors (e.g., the Fama and French 2015 five factors). Our goal in this article is to evaluate the performance of these anomalies and evaluate whether they can be used in portfolio construction.

[9] The intangibles category also exhibits a countercyclical behavior with respect to NBER recessions, but it also has a very large cross-sectional dispersion compared with profitability and investment, which makes it less attractive for investors.

had an average excess return—conditional on a 10% annualized volatility—of 5.4% and 6.0%, respectively. We then combine the traditional portfolios with a portfolio representative of each category of anomalies and analyze how the performance changes compared to the standalone portfolios.[10] Overall, adding portfolios of anomalies to traditional portfolios such as the 60/40 or the risk parity portfolio increases the Sharpe ratio. For example, allocating a small portion of the portfolio to profitability anomalies increases the average excess return of 60/40 and risk parity portfolios—conditional on a 10% annualized volatility—to 6.7% and 7.2%, respectively. These are notable increases and suggest that institutional investors that have diversified portfolios of equities and bonds can benefit from including portfolios of anomalies in their asset allocation.

Third, we analyze how each category of anomalies performed during each of the drawdown periods. Throughout our sample that spans from 1971–2019, only profitability consistently delivered positive returns in all drawdown periods across the four traditional portfolios considered in this study (60/40, risk parity, portfolio of equities, fixed income and commodities, and an all-equity portfolio). That is, for every historical drawdown period of each of the four portfolios, profitability has always delivered positive returns, whereas the other four categories of anomalies had at least one instance in which returns were negative. For example, the cross-sectional momentum and intangibles categories lost 2.4% and 0.1%—respectively—when the 60/40 portfolio suffered a drawdown between May and Sept 1981. During the same period, profitability had a positive return of 5.3%.

To conclude, our results show that financial anomalies can be a valuable tool in the arsenal of asset managers to build robust and well-diversified portfolios. We contribute to the literature by providing evidence that financial anomalies have historically provided large diversification benefits and could have increased risk-adjusted returns if added to traditional portfolios. Furthermore, we highlight an unappreciated property of financial anomalies: some of them are useful to protect the portfolio against certain types of risks. For example, the profitability and investment anomalies perform particularly well during recessions, and cross-sectional momentum exhibits particularly high returns during inflationary times. Financial anomalies allow investors to harvest risk premiums, making them even more attractive in today's environment of low interest rates. Given the benefits that financial anomalies can provide to a portfolio, asset management firms should consider allocating more resources—both in terms of human capital and technology—to understand and deploy these types of strategies in their portfolios.

ANALYSIS SETUP

Dataset for the Financial Anomalies

In this article, we use a large dataset consisting of 76 anomalies in the cross-section of equity returns. Following Elkamhi et al. (2020), we begin from a set of more than 100 anomalies. However, we narrow the set by keeping those that are tested to be statistically significant using the methodology described by Hou, Xue, and Zhang (2020) over the period 1971 to 2019.[11] In Exhibit A1, for each anomaly we provide the reference that we followed to obtain or replicate the dataset.

[10] For details on how we build the portfolios of anomalies, see the section "Performance of Traditional Portfolios with Financial Anomalies."

[11] If a specific anomaly is not available as far back as 1971, we test its statistical significance starting from the oldest available data.

EXHIBIT 1

Anomaly Categorization and Regimes' Frequencies

Panel A: Number of Anomalies

Category	Number of Anomalies
Momentum	22
Intangibles	13
Trading Frictions	1
Value vs. Growth	9
Profitability	11
Investment	20
Total	76

Panel B: Frequencies

	Frequencies (%)	
	Yes	No
NBER Recession?	13.3%	86.7%
Inflation Regime?	16.5%	83.5%
60/40 Drawdown?	12.6%	87.4%
Risk Parity Drawdown?	11.2%	88.8%
EQFICOM Drawdown?	13.1%	86.9%
Equity Drawdown?	14.1%	85.9%

NOTES: Panel A reports the number of financial anomalies that fall into each of the following categories: momentum, intangibles, trading frictions, value versus growth, profitability, investment. Panel B reports the historical monthly frequencies of the various regimes from 1971 to the end of 2019. For a detailed description of the regimes, see the section "Analysis Setup."

We compiled the set of 76 anomalies as follows. Following Hou, Xue, and Zhang (2020), we only consider anomalies that have been constructed using a robust methodology. Specifically, all our anomalies (a) are built using value-weighted returns, (b) use the NYSE breakpoints to sort firms, and (c) generate excess returns that are statistically different from zero.[12] If the authors of the original study published the data, we obtained the anomalies dataset provided from their website. Otherwise, we constructed them ourselves.[13]

To facilitate our exposition, we categorize the anomalies into six categories following Hou, Xue, and Zhang (2020): momentum, intangibles, trading frictions, value versus growth, profitability, and investment. Panel A of Exhibit 1 shows the number of anomalies that fall into each of these categories. In the momentum category, we have standard cross-sectional momentum (Jegadeesh and Titman 1993) as well as postearnings announcement drift (Foster, Olsen, and Shevlin 1984). In the intangibles category, we find anomalies such as R&D-to-market (RDM), which sorts firms on their research and development (R&D) expenses (Chan, Lakonishok, and Sougiannis 2001), revisions in analysts' earnings estimates (Chan et al. 2001), and revisions in analysts' earnings' forecasts (Markowitz et al. 2021). In the value versus growth category, we find anomalies such as the quality-minus-junk factor (Asness, Frazzini, and Pedersen 2019) or the operating cash flow to price anomaly (Desai, Rajgopal, and Venkatachalam 2004). Profitability includes anomalies such as the cash-based operating profitability (Ball et al. 2016) or the return on equity factor (Hou, Xue, and Zhang, 2015). Last, in the investment category, we find anomalies such as the conservative minus aggressive factor of Fama and French (2015).

In our empirical results, we omit the trading frictions category because it has only one anomaly, betting against beta, that is statistically different from zero during the sample period considered in this study. This is not surprising because, as pointed out by Hou, Xue, and Zhang (2020), the vast majority of trading frictions anomalies fail to replicate once researchers account for value-weighted returns and NYSE breakpoints.

Setup for Traditional Portfolios and Regimes

In this section, we discuss the details of the traditional portfolios and economic regimes used for our analysis. First, we discuss the two types of economic regimes used in our analysis: economic recession and inflation. These two types of regimes

[12] We also calculated our results using the entire dataset of anomalies (i.e., both statistically and non-statistically significant). Results are qualitatively identical to the ones presented in the following and available upon request.

[13] Following the literature (e.g., Hou, Xue, and Zhang 2020), we do not include transaction costs. We refer to Frazzini, Israel, and Moskowitz (2012) for a discussion of transaction costs when using financial anomalies.

are of interest to many investors because these economic environments can greatly affect asset returns. Therefore, investors are interested in how different assets perform in these economic environments.

For recessionary periods, we use the business cycles dating as published by the NBER.[14] These recessionary periods are interesting for investors because they often coincide with periods when equity markets suffer large losses. Panel B of Exhibit 1 shows that recessionary periods make up approximately 13.3% of the observations from 1971 to 2019. Panel A of Exhibit 2 illustrates these recessionary periods as shaded areas. In our analysis, we compare the returns of anomalies during periods marked as NBER recessions against the returns during periods marked as NBER expansions.

For inflationary periods, we use the definition of inflationary regimes provided by Neville et al. (2021), which categorizes inflationary regimes as periods when the year-over-year realized inflation rate is rising and reaches a level of at least 5%. As shown in Panel B of Exhibit 1, 16.5% of the observations from 1971–2019 constitute inflationary periods. Panel B of Exhibit 2 illustrates these inflationary periods as shaded areas. In our analysis, we compare the returns of anomalies during periods marked as inflationary against returns during periods marked as noninflationary.

In addition to analyzing financial anomalies in the aforementioned economic regimes, we also analyze periods that are of direct interest to institutional investors: periods when traditional asset portfolios suffer losses. In order for financial anomalies to have a role in traditional portfolios that already contain multiassets (e.g., equities, bonds, etc.), they must offer risk diversification. However, they have countercyclical characteristics that may provide positive returns to offset losses elsewhere in a portfolio.

Specifically, we analyze drawdown periods for four different portfolios: a stock-bond portfolio, a risk parity stock-bond portfolio, a stock-bond-commodity portfolio, and an all-equity portfolio. First, we describe the construction for these portfolios. For the stock-bond portfolio, we use a portfolio with weights of 60% in equities and 40% in 10-year Treasuries (henceforth the 60/40 portfolio). For a risk parity stock-bond portfolio, the asset weights are determined such that the portfolio risk contributions between the equities and 10-year Treasuries are equal (henceforth the risk parity portfolio). The covariances used to compute the risk contributions are estimated using 36-months trailing windows. For the portfolio of stock-bond-commodity (henceforth the EQFICOM portfolio), we use a portfolio with weights of 55% in equities, 35% in 10-year Treasuries, and 10% in the Bloomberg commodity index. Finally, the all-equity portfolio is invested 100% in equities (henceforth the all-equity portfolio). For equity returns, we use the value-weighted returns across all firms listed on the NYSE, AMEX, or NASDAQ.[15] Our data frequency is monthly, and all portfolios are rebalanced monthly. Finally, for comparison purposes, excess returns of these portfolios are scaled to have a 10% annualized volatility in-sample using the full history for ex-post analysis.

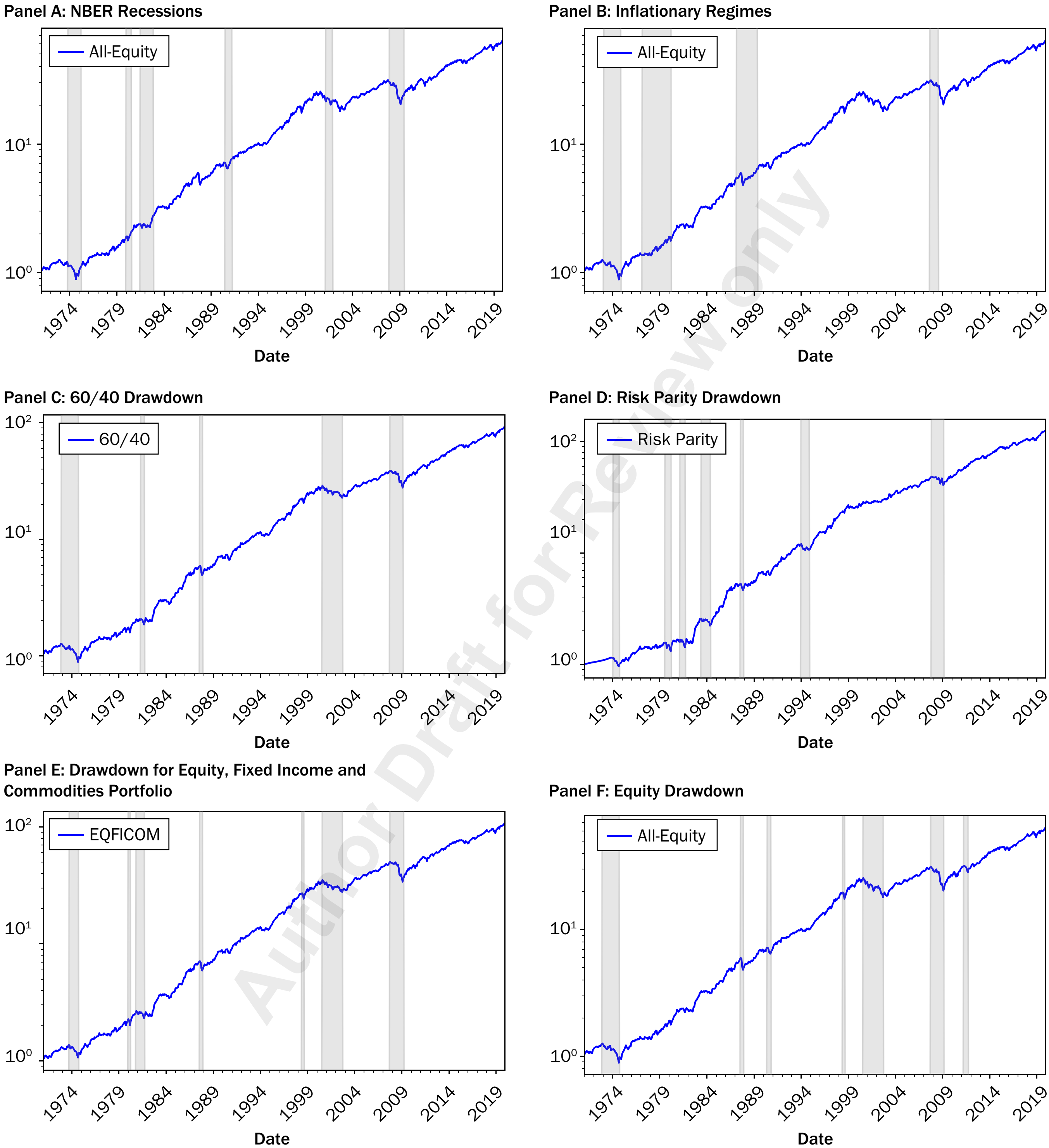
Using these portfolios, which all have a 10% annualized volatility on excess returns, we add monthly risk-free returns to the excess returns and compound the total returns monthly to construct a total return index. Drawdowns for each portfolio are determined using these total return indexes. For this article, we only consider drawdowns that are in excess of 10% in total returns. Panels C–F in Exhibit 2 illustrate these portfolio drawdown periods as shaded areas. In our analysis, we compare the returns of anomalies during those drawdown periods against returns during other periods. Exhibit 3 provides the start and end dates for all the drawdowns considered in this article, along with brief labels that describe those market events.

[14] See https://www.nber.org/research/business-cycle-dating.

[15] Data are obtained from Ken French's website: https://mba.tuck.dartmouth.edu/pages/faculty/ken.french.

EXHIBIT 2

Illustrations of Various Economic and Drawdown Regimes



NOTES: Panels A and B illustrate the NBER recessions and inflation regimes (gray shaded areas), respectively. The total return series of the all-equity portfolio is plotted for reference purposes only. Panels C–F illustrate the drawdown regimes (gray shaded areas) for the 60/40 portfolio, the risk parity portfolio, a portfolio of equity, fixed income and commodities (EQFICOM), and a portfolio of only equities (All-equity). For a detailed description of the regimes, see the section "Analysis Setup."

EXHIBIT 3

Definitions of Various Drawdown Regimes

Panel A: 60/40 Portfolio

Start	End	Description
December 1972	September 1974	1970s Stagflation
May 1981	September 1981	Energy Crisis
August 1987	November 1987	Black Monday
August 2000	September 2002	Dotcom Bubble Bursts
October 2007	February 2009	Global Financial Crisis

Panel B: Risk Parity Portfolio

Start	End	Description
February 1974	September 1974	1970s Stagflation
August 1979	March 1980	Energy Crisis (1)
March 1981	September 1981	Energy Crisis (2)
June 1983	May 1984	Energy Crisis (3)
August 1987	November 1987	Black Monday
January 1994	November 1994	Great Bond Massacre
November 2007	February 2009	Global Financial Crisis

Panel C: Equity Fixed Income and Commodities

Start	End	Description
October 1973	September 1974	1970s Stagflation
January 1980	March 1980	Energy Crisis (1)
November 1980	September 1981	Energy Crisis (2)
August 1987	November 1987	Black Monday
June 1998	August 1998	Asian Crisis
August 2000	September 2002	Dotcom Bubble Bursts
October 2007	March 2009	Global Financial Crisis

Panel D: Equities Only Portfolio

Start	End	Description
December 1972	September 1974	1970s Stagflation
August 1987	November 1987	Black Monday
June 1990	October 1990	Gulf War
June 1998	August 1998	Asian Crisis
August 2000	September 2002	Dotcom Bubble Bursts
October 2007	February 2009	Global Financial Crisis
April 2011	September 2011	Euro Crisis

NOTES: For each of the panels, the exhibit shows the start and end dates of drawdown periods defined on the total return series of the portfolio (e.g., 60/40 portfolio, etc.). To be counted as a drawdown regime, the drawdown must exceed –10%. Each drawdown is labeled by a description of the economic event. For a detailed description of the regimes, see the section "Analysis Setup."

In Appendix A (see Exhibit A2), we provide the average monthly returns for each of the 76 financial anomalies studied under each of the economic and drawdown regimes described earlier. In Appendix A (see Exhibit A3), we provide a heatmap corresponding to *t*-statistics for those returns. This heatmap shows that there are large variations in statistical significance across individual anomalies.[16]

RESULTS AND DISCUSSION

Cross-Sectional Performance of Financial Anomalies

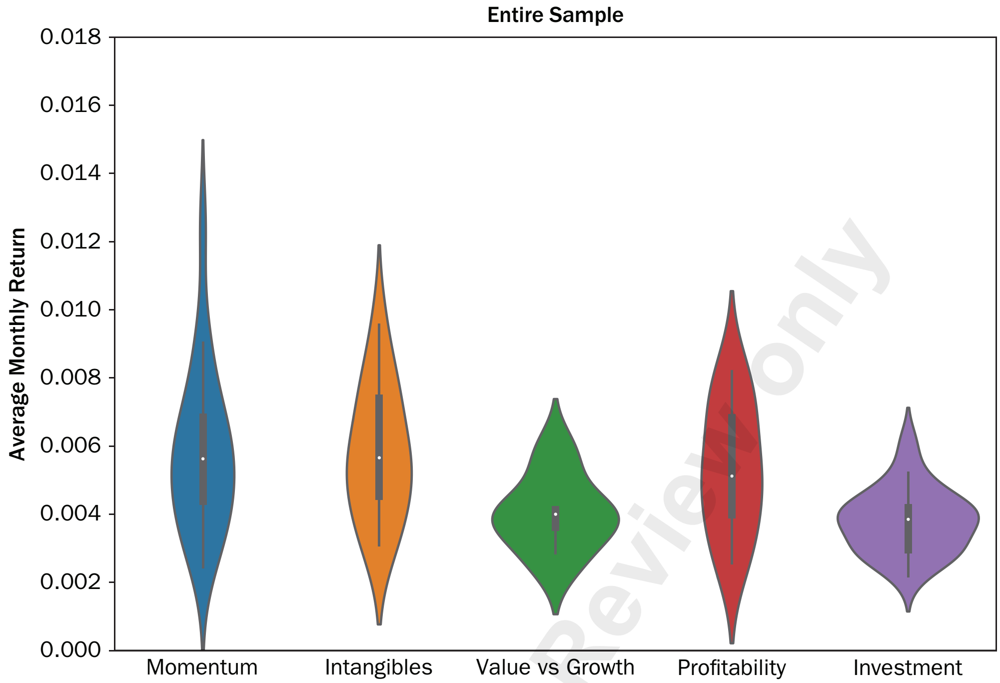
In this section, we analyze the performances of the 76 financial anomalies in regimes that we defined in the previous section. We bucket these 76 anomalies into five categories: intangibles, investment, momentum, profitability, and value versus growth. In Exhibit 4, for each category, we present the cross-sectional distribution of the average historical returns for anomalies that fall in that category using a violin plot.[17] Exhibit 4 shows that all anomalies have positive monthly average returns. This is not surprising because we chose financial anomalies that are statistically

[16] For example, the expected growth (R_EG) anomaly (Hou, Mo, Xue, and Zhang 2019) is strongly significant across all regimes, whereas the enterprise multiple (EM) anomaly (Loughran and Wellman 2011) is significant only in bad times while it is insignificant during times when traditional portfolios perform well.

[17] A violin plot is similar to a box plot in that it shows the distribution of the data across categorical variables (categories of anomalies in our case). However, the violin plot differs from a box plot. Although the violin plot contains a kernel density estimation of the underlying distribution, the box plot simply plots the components correspond to actual data points.

EXHIBIT 4

Performance of Various Categories of Anomalies: January 1971–December 2019



NOTES: This exhibit shows the distribution of the average returns across anomalies within each of the following categories: intangibles, investment, momentum, profitability, value versus growth. For each category, we calculate the average return of the anomalies that belong to that category and we plot the cross-sectional distribution of such averages using a violin plot.

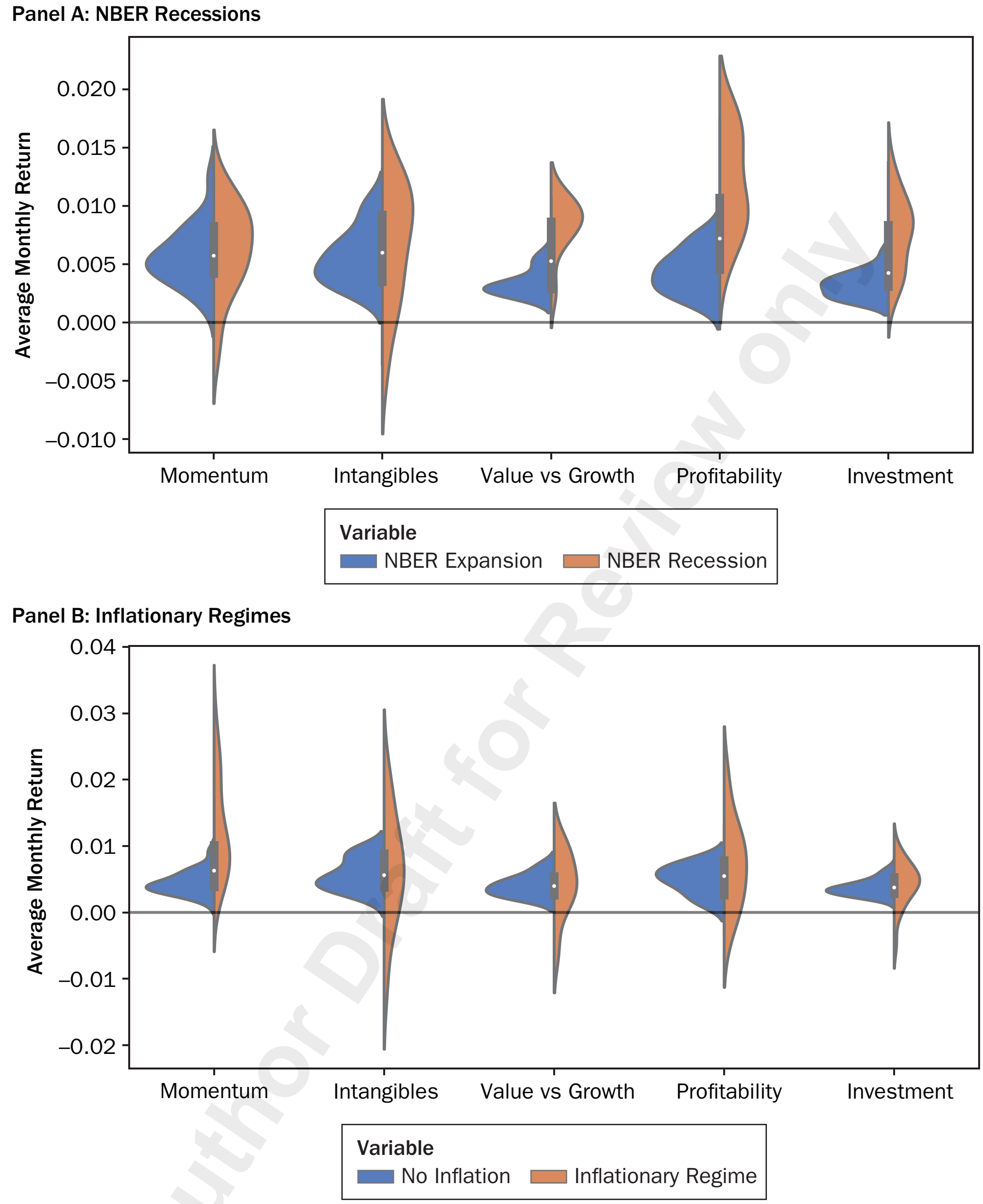
significant. However, it is worth noting that some anomalies exhibit much larger variation than others. For example, both the momentum and the investment category contain approximately the same number of anomalies (22 versus 20, as shown in Panel A of Exhibit 1) and yet the cross-sectional distribution of momentum is much wider than investment. A similar observation is made between profitability and value versus growth. Both categories contain approximately 10 anomalies each, but the profitability category has a much wider distribution.

Panels A and B of Exhibit 5 show the cross-sectional distributions of the average historical returns for the five anomaly categories conditional on the recessionary and inflationary regimes, respectively. Using the violin plots allows us to visually compare the distributions on periods of interests (e.g., recessions) with other periods. Examining Panel A of Exhibit 5 shows that the momentum, intangibles, and profitability anomaly categories have wider dispersions of returns across their individual anomalies during recessionary times. For the momentum category, the wider dispersion is also skewed toward more negative returns. This observation is consistent with Daniel and Moskowitz (2016) and Baltzer, Jank, and Smajlbegovic (2019) that showed momentum anomalies do not perform well during recessionary periods. Conversely, the intangibles and profitability anomaly categories have wide dispersions but skewed toward more positive returns. The value versus growth and investment anomalies also perform slightly better cross-sectionally during recessionary periods.[18]

[18] Although it is commonly known that value versus growth performed poorly post the 2008 financial crisis, the positive returns shown in Panel A of Exhibit 5 reflect a longer history dating back to 1971.

EXHIBIT 5

Performance during NBER Recessions and Inflationary Regimes

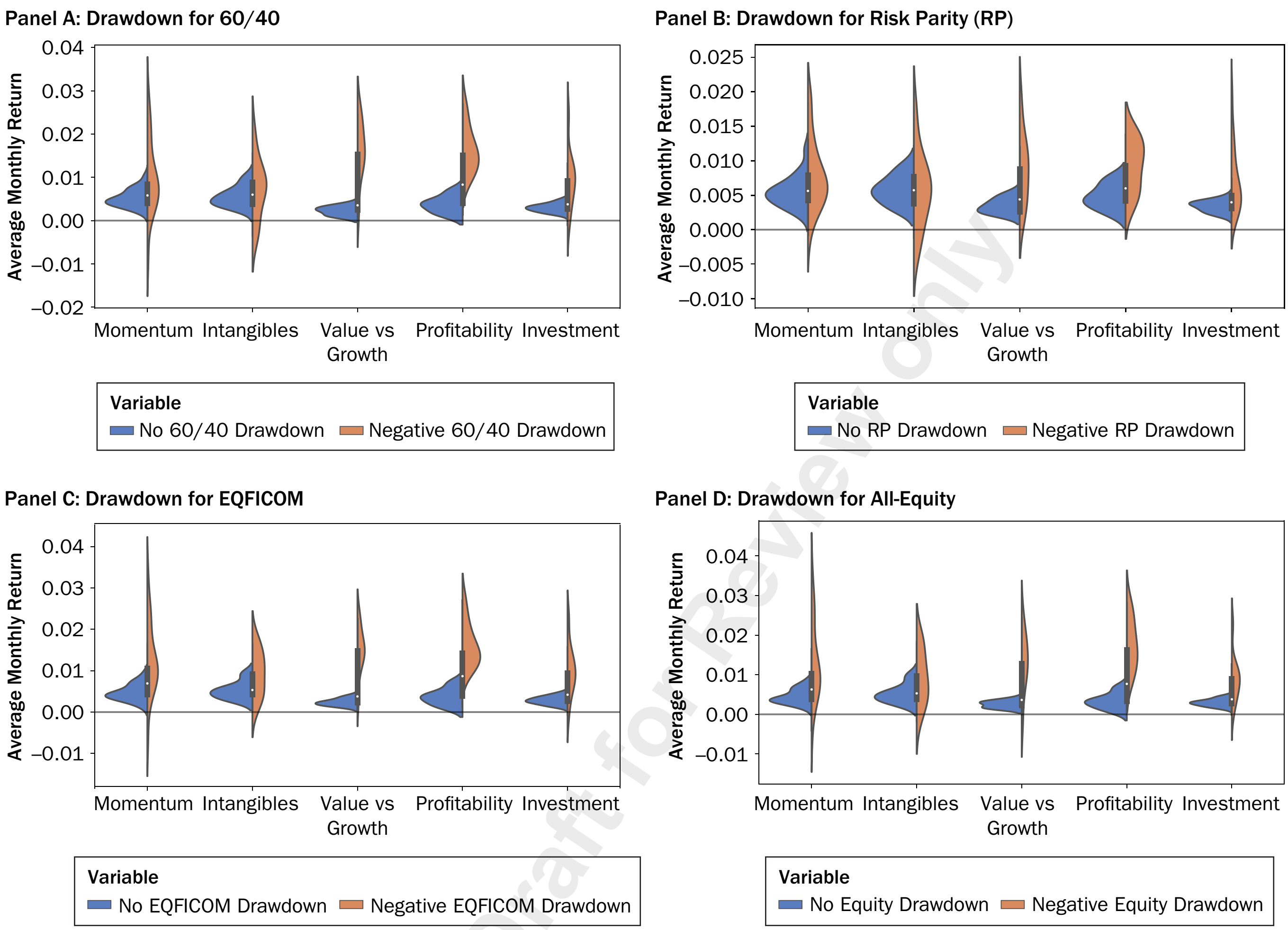


NOTES: This exhibit shows the distribution of the average returns across anomalies within each of the following categories: intangibles, investment, momentum, profitability, value versus growth. Panel A shows the conditional distributions of the average returns for two NBER regimes: expansion and recession. The blue (left) component of the violin plot shows the cross-sectional distribution of the average returns during NBER expansions. The orange (right) component shows the distribution during NBER recessions. Panel B performs the same analysis using inflationary regimes. For a detailed description of the regimes, see the section "Analysis Setup."

Examining Panel B of Exhibit 5 shows that all five anomaly categories have wider dispersions of returns across their individual anomalies during inflationary times, reflecting the higher performance uncertainties with different implementations on the same anomaly category. Out of all the categories, only the momentum category shows a clear skew toward more positive returns, suggesting that individual

EXHIBIT 6

Performance during Drawdown Regimes



NOTES: This exhibit shows the distribution of the average returns across anomalies within each of the following categories: intangibles, investment, momentum, profitability, value versus growth. Panel A shows the distribution of average cross-sectional returns during drawdown periods for a 60/40 portfolio. The blue (left) component of the violin plot shows the cross-sectional distribution of the average returns during times when the 60/40 portfolio performs well. The orange (right) component shows the distribution during times when the 60/40 portfolio exhibits prolonged periods of negative returns. Panels B, C, and D perform the same analysis using the drawdown periods for risk parity (RP), EQFICOM, and all-equity portfolios, respectively. For a detailed description of the drawdown regimes as well as the details for the construction of the portfolios, see the section "Analysis Setup."

momentum anomalies are more likely to perform better during inflationary times. This observation regarding the momentum anomalies is consistent with the findings in Neville et al. (2021), which showed that momentum anomalies may be helpful as an inflation-hedging strategy.

Next, we perform a similar analysis on the financial anomalies, but we use periods of portfolio drawdown instead of economic regimes. This analysis is motivated by the fact that many investors are interested in mitigating portfolio drawdowns and might be especially interested in how these financial anomalies perform when the rest of the portfolio is performing poorly. Panels A–D of Exhibit 6 show the cross-sectional distributions of the average historical returns for the five anomaly categories conditional on the drawdown periods of the 60/40 portfolio, the risk parity portfolio, the EQFICOM portfolio, and the all-equity portfolio, respectively. There are several observations. Firstly, all anomaly categories have a wide dispersion of returns during drawdown periods, reflecting that, when markets are underperforming, the performance of individual financial anomalies are more disperse and uncertain. The large dispersion of anomaly returns during bad times highlights the need to build a diversified anomaly portfolio for each category (i.e., combining multiple strategies within each anomaly category) for it to be considered useful in asset allocation. Secondly, the anomaly category that appears to provide the most reliable and positive performances during drawdowns across the for portfolios investigated is profitability: It consistently provides positive returns during bad times across all four traditional portfolios considered in Exhibit 6. Third, the value versus growth category also appears to provide good performance albeit with (1) a wider dispersion of outcomes when compared to the profitability category and (2) a weaker performance during good times. Finally, the performance of the intangibles category is mixed, while the investment category appears to offer some benefits to all the portfolios except for the risk parity portfolio.

Performance of Traditional Portfolios with Financial Anomalies

In this section, we analyze the impact that these financial anomalies have historically on the four traditional portfolios that we defined earlier in this article. Given that there are multiple anomalies that fall within each of the five anomaly categories, we build five anomaly portfolios by equal weighting each anomaly within each category. Panel A of Exhibit 7 reports the historical average excess returns, volatilities, and Sharpe ratios for the four traditional portfolios and the five anomaly portfolios. It is useful to reiterate that the anomaly portfolios have moderate to high positive returns because the 76 anomalies used in this study have statistically significant historical returns (see the “Analysis Setup” section for more details). Furthermore, it is also worth noting that those anomaly portfolio returns are absent of transaction costs. Panel B of Exhibit 7 illustrates the total return of the five anomaly portfolios with an initial investment of $100 with no reinvestment. The shaded area on the figure denotes drawdown periods of the all-equity portfolio as we defined previously and is shown for reference purposes. It is worth noting that: (1) There was a large runup in all anomalies between 2000 and 2003, (2) the momentum strategy crashed between 2009 and 2010, and (3) the value versus growth strategy severely underperformed since 2010.

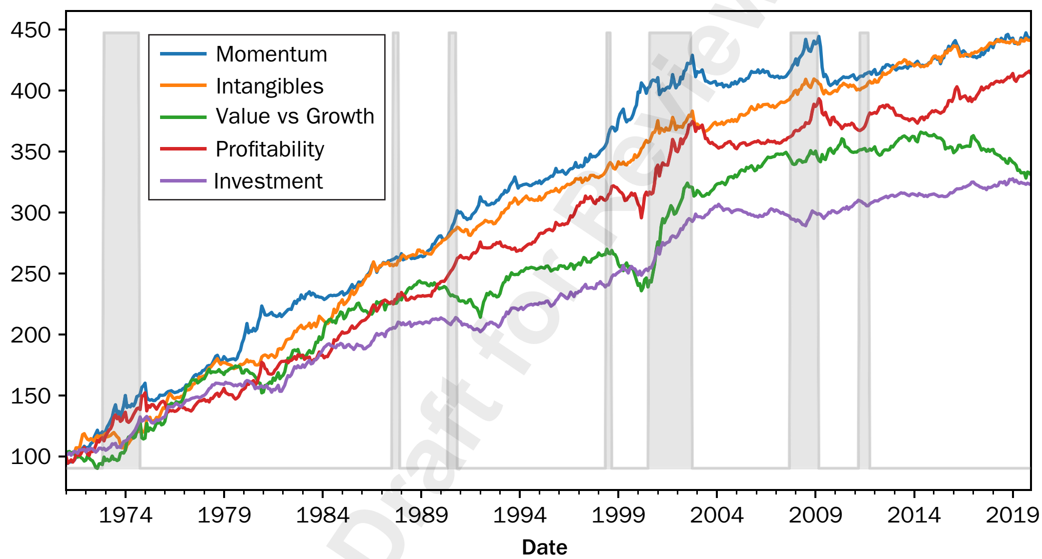
In Exhibit 8, we show the performance of the traditional portfolios and the portfolios of anomalies across different regimes: NBER recessions/expansions, inflationary regimes, and periods of large drawdowns for traditional portfolios. For each regime, we show the average excess return in the good state (i.e., when traditional portfolios exhibit positive returns) and bad state (i.e., when traditional portfolios exhibit negative returns). The row *t*-stat presents the *t*-statistics for the test of equality of the means between the good state and bad state. Consistent with the intuition provided in Exhibit 5 and Exhibit 6, Exhibit 8 shows that profitability, investment, and value versus growth are the three categories that perform well when traditional portfolios are experiencing large drawdowns. Excess returns of these anomalies are positive during these the bad state for traditional portfolios, and, in most cases, the difference in average excess returns between good and bad states is statistically significant. Furthermore, in inflationary regimes, a portfolio of momentum anomalies performs very well, and it is the only one exhibiting an average excess return in inflationary times that is higher (and statistically significant) than low inflation times.

EXHIBIT 7
Descriptive Statistics of Various Portfolios

Panel A: Descriptive Statistics

	Average Excess Return	Volatility	Sharpe Ratio
All-Equity	7.21%	15.48%	0.47
60/40	5.40%	10.01%	0.54
EQFICOM	5.35%	9.37%	0.57
Risk Parity	4.40%	7.36%	0.60
Momentum Portfolio	7.21%	9.71%	0.74
Intangibles Portfolio	7.20%	7.08%	1.02
Value vs. Growth Portfolio	4.82%	9.24%	0.52
Profitability Portfolio	6.60%	8.81%	0.75
Investment Portfolio	4.64%	5.44%	0.85

Panel B: Time series Performance of the Portfolios of Anomalies



NOTES: This exhibit shows the descriptive statistics of the traditional portfolios and the portfolios of anomalies. Panel A shows the annualized average returns, volatilities and Sharpe ratios. Panel B shows the cumulative performance of the portfolios of anomalies under the assumption of no reinvestment (i.e., sum of arithmetic returns). The shaded areas at the drawdown periods for an all-equity portfolio. The dates of these drawdown periods are provided in Exhibit 3.

The setup for the subsequent analysis is as follow. For comparison purposes, we scale the excess returns for the four traditional portfolios such that the full-sample portfolio annualized volatilities are 10% for each of them. We take the five anomaly portfolios and also scale their excess returns to create 10% volatility versions of them. We do this because many hedge funds and pension funds target a similar level of risk (i.e., volatility when running their portfolios) in practice.[19] Using the 10% volatility versions of the four traditional and five anomaly portfolios, we build composite (traditional + anomaly) portfolios by having an 85% weighting on a chosen traditional portfolio and a 15% weighting on a chosen anomaly portfolio. The weights are expressed in terms of risk contributions. Having constructed these composite portfolios, we scale their annualized volatilities to be 10%.

[19] Scaling those portfolios' excess returns to the same 10% volatility has an additional benefit of allowing comparisons on a risk-adjusted basis.

EXHIBIT 8

Performance of Various Portfolios in Different Regimes

	All-Equity	60/40	EQFICOM	Risk Parity	Momentum	Intangibles	Value vs. Growth	Profitability	Investment
Entire Sample	7.21%	5.40%	5.35%	4.40%	7.21%	7.20%	4.82%	6.60%	4.64%
NBER Expansion/Recession									
Expansion	9.92%	6.90%	6.84%	5.11%	7.07%	6.82%	4.00%	5.37%	3.91%
Recession	–9.09%	–3.97%	–3.93%	–0.09%	8.13%	9.73%	10.35%	15.03%	9.55%
t-stat	–2.06**	–1.76*	–1.87*	–1.13	0.16	0.74	1.09	1.78*	1.84*
Inflation Regime									
Low Inflation	10.23%	7.78%	7.00%	6.19%	5.47%	7.32%	4.75%	6.10%	4.53%
High Inflation	–6.99%	–5.95%	–2.67%	–4.20%	16.47%	6.63%	5.16%	9.17%	5.20%
t-stat	–2.46**	–3.13***	–2.35**	–3.64***	2.62***	–0.25	0.11	0.94	0.32
60/40 Drawdowns									
Expansion	14.51%	9.66%	9.10%	6.30%	6.44%	7.16%	2.64%	4.64%	3.60%
Drawdown	–32.85%	–20.27%	–17.61%	–7.96%	12.73%	7.49%	21.16%	21.18%	12.14%
t-stat	–6.50***	–6.66***	–6.04***	–4.75***	1.01	0.07	3.24***	2.91***	2.68***
Risk Parity Drawdowns									
Expansion	12.83%	9.37%	8.98%	7.29%	6.87%	7.10%	4.07%	5.99%	4.14%
Drawdown	–28.99%	–21.64%	–19.71%	–16.02%	9.99%	7.98%	10.96%	11.55%	8.73%
t-stat	–5.54***	–6.37***	–5.98***	–6.17***	0.64	0.26	1.69*	1.43	1.79*
EQFICOM Drawdowns									
Expansion	14.59%	9.84%	9.60%	6.67%	5.89%	6.77%	2.76%	4.61%	3.45%
Drawdown	–31.77%	–20.16%	–19.24%	–9.55%	16.40%	10.13%	19.45%	20.76%	12.90%
t-stat	–5.90***	–6.24***	–6.17***	–4.88***	1.69*	0.78	2.91***	2.85***	3.08***
All-Equity Drawdowns									
Expansion	15.72%	10.08%	9.50%	6.16%	5.66%	6.84%	2.94%	4.14%	3.58%
Drawdown	–33.37%	–19.40%	–16.95%	–5.73%	17.11%	9.45%	16.96%	22.78%	11.34%
t-stat	–7.08***	–6.89***	–6.32***	–4.26***	1.98**	0.66	2.68***	3.61***	2.65***

NOTES: This exhibit shows the performance of the traditional portfolios and the portfolios of anomalies across different regimes. For each regime, we show the average return in the good state (i.e., when traditional portfolios exhibit positive returns) and bad state (i.e., when traditional portfolios exhibit negative returns). The row *t*-stat presents the *t*-statistics for the test of equality of the means between good state and bad state. We use * to signal when two means are statistically different (* 10%, ** 5%, and *** 1% significance levels).

For each of the four traditional portfolios, Panels A–D of Exhibit 9 compare the standalone portfolio (i.e., the traditional portfolio without the addition of financial anomalies) with the associated five composite portfolios (the traditional portfolio plus a portfolio of financial anomalies for a given category) under the NBER recessionary regimes and the inflationary regimes. The first observation is that composite portfolios have higher average excess returns than traditional portfolios. Because their volatilities are scaled to the same 10% annualized, this means all composite portfolios have higher Sharpe ratios than their traditional portfolio counterparts. This is expected because all anomalies have positive returns, and they diversify risks of the traditional portfolios. For the NBER recessionary regimes, profitability, investment, and intangibles are the most effective in improving performance during NBER recessions. For example, with the original all-equity portfolio, shifting 15% in risk weighting to profitability increases the average return of the resulting portfolio by 1.3% (from 4.6% to 5.9%), whereas the average loss reduction during NBER recessions periods is 2.7% (from –6.0% to –3.3%). The investment and intangibles categories

EXHIBIT 9

Macroeconomic Regimes and Portfolios Using Risk Weights

	Entire Sample	NBER Recession?		Inflationary Regime?	
		No	Yes	No	Yes
Panel A: Average Excess Returns of 60/40 Portfolio for an Annualized Volatility of 10%					
60/40 Portfolio	5.4%	6.9%	–4.0%	7.8%	–5.9%
60/40 + Momentum	6.7%	8.2%	–2.6%	8.8%	–3.3%
60/40 + Intangibles	7.1%	8.5%	–1.7%	9.5%	–4.3%
60/40 + Value vs. Growth	6.3%	7.7%	–2.1%	8.7%	–5.0%
60/40 + Profitability	6.7%	8.0%	–1.2%	9.0%	–4.2%
60/40 + Investment	6.9%	8.2%	–1.1%	9.3%	–4.4%
Panel B: Average Excess Returns of Risk Parity Portfolio for an Annualized Volatility of 10%					
RP Portfolio	6.0%	7.0%	–0.1%	8.5%	–5.7%
RP + Momentum	7.3%	8.2%	1.3%	9.4%	–3.0%
RP + Intangibles	7.7%	8.5%	2.2%	10.1%	–4.0%
RP + Value vs. Growth	7.0%	7.8%	1.8%	9.4%	–4.7%
RP + Profitability	7.2%	8.0%	2.7%	9.6%	–3.9%
RP + Investment	7.5%	8.2%	2.9%	9.9%	–4.1%
Panel C: Average Excess Returns of Portfolio of Equities, Fixed Income and Commodities for an Annualized Volatility of 10%					
EQFICOM Portfolio	5.7%	7.3%	–4.2%	7.5%	–2.8%
EQFICOM + Momentum	7.0%	8.6%	–2.8%	8.5%	–0.1%
EQFICOM + Intangibles	7.4%	8.9%	–1.9%	9.2%	–1.2%
EQFICOM + Value vs. Growth	6.6%	8.1%	–2.4%	8.4%	–1.9%
EQFICOM + Profitability	7.0%	8.4%	–1.4%	8.7%	–1.1%
EQFICOM + Investment	7.2%	8.6%	–1.3%	9.0%	–1.2%
Panel D: Average Excess Returns of Portfolio of All-Equities for an Annualized Volatility of 10%					
Equity Portfolio	4.6%	6.3%	–6.0%	6.5%	–4.6%
Equity + Momentum	5.9%	7.6%	–4.6%	7.5%	–1.9%
Equity + Intangibles	6.3%	7.9%	–3.7%	8.3%	–3.0%
Equity + Value vs. Growth	5.5%	7.1%	–4.2%	7.4%	–3.6%
Equity + Profitability	5.9%	7.4%	–3.3%	7.8%	–2.9%
Equity + Investment	6.1%	7.6%	–3.1%	8.0%	–3.0%

NOTES: Using macroeconomic regimes, this exhibit presents the performance of the anomalies together with four traditional portfolios: 60/40, risk parity, a portfolio of equities, fixed income and commodities, and an all-equity portfolio. The portfolios are built using risk weights. For example, the 60/40 + Momentum portfolio has 85% of its risk (i.e., volatility) coming from the 60/40 portfolio and 15% from the portfolio of momentum anomalies.

exhibit similar improvements. However, we also note that intangibles exhibit a high cross-sectional dispersion during recessionary periods (as shown in Panel A of Exhibit 5), which makes it less appealing for investors. Overall, our results demonstrate that profitability and investment (1) improve the overall portfolio Sharpe ratio, (2) improve performance during recessionary periods such NBER recessions, and (3) have considerably lower standard deviation during NBER recessions compared with intangibles.

For the inflationary regimes, we find that momentum provides the most effectiveness in lowering losses. This is consistent with the findings in Panel B of Exhibit 5 that momentum anomalies can be a good inflation-hedging strategy. Overall, our results for inflationary times are consistent with Neville et al. (2021).

EXHIBIT 10
Performance of Anomalies during Drawdowns of the 60/40 Portfolio

Panel A: Annualized Average Excess Returns for 10% Volatility

	All	Bad Time	Good Time
60/40	5.4%	–20.3%	9.6%
Momentum Port	7.4%	13.1%	6.6%
Intangibles Port	10.3%	10.7%	10.2%
Value vs. Growth Port	5.2%	23.1%	2.9%
Profitability Port	7.5%	24.3%	5.3%
Investment Port	8.7%	23.3%	6.7%
60/40 + Momentum	6.7%	–18.3%	10.8%
60/40 + Intangibles	7.1%	–18.4%	11.3%
60/40 + Value vs. Growth	6.3%	–17.2%	10.2%
60/40 + Profitability	6.7%	–16.9%	10.6%
60/40 + Investment	6.9%	–17.1%	10.9%

Panel B: Total Excess Returns for 10% Volatility

	1970s Stagflation	Energy Crisis	Black Monday	Dotcom Bubble Bursts	Global Financial Crisis
60/40	–38.7%	–14.9%	–18.6%	–26.7%	–30.2%
Momentum Port	38.4%	–2.4%	1.2%	18.8%	23.9%
Intangibles Port	2.6%	–0.1%	5.9%	28.8%	18.6%
Value vs. Growth Port	28.3%	4.5%	1.2%	120.4%	2.8%
Profitability Port	33.9%	5.3%	9.3%	78.7%	33.7%
Investment Port	45.3%	1.3%	8.2%	98.4%	6.1%
60/40 + Momentum	–34.6%	–15.2%	–18.3%	–24.1%	–27.2%
60/40 + Intangibles	–37.6%	–14.6%	–17.4%	–22.5%	–27.5%
60/40 + Value vs. Growth	–35.7%	–14.2%	–18.4%	–15.0%	–29.7%
60/40 + Profitability	–35.1%	–14.0%	–17.2%	–18.1%	–26.3%
60/40 + Investment	–34.1%	–14.6%	–17.3%	–16.7%	–29.2%

NOTES: This exhibit shows the performance of the portfolio and the financial anomalies for various periods. Each of these portfolios is normalized to have a full-sample volatility of 10% for the ease of comparability. Panel A shows the historical annualized excess returns for the full historical period as well as the drawdown periods (labeled as bad time) and the remaining periods (labeled as good time). The bad time periods are the drawdown periods defined in Exhibit 3. Panel B shows the historical excess returns for each drawdown period defined in bad time.

The results show that anomalies can help with different kinds of portfolio ranging from an all-equity portfolio (100% equity risk profile) to an equity and bond balanced risk parity portfolio (balanced equity and bond risk profile). This suggests that anomalies should provide benefits to most long-only investors' portfolios because their portfolios' risk profile likely falls in between an all-equity portfolio and a risk parity portfolio.

Exhibits 10–13 analyze the performance of the traditional portfolios and their associated composite portfolios under regimes defined by drawdowns of traditional portfolios. Panel A for Exhibits 10–13 reports the annualized excess returns of the traditional portfolios, the five anomaly portfolios and the five composite portfolios (all scaled to 10% volatility as described earlier) for the full sample period, periods of drawdowns (denoted as bad time) and other periods (denoted as good time). Panel B for Exhibits 10–13 provides further details into the bad times and report the losses of portfolios in excess returns for each individual drawdown episode.

EXHIBIT 11

Performance of Anomalies during Drawdowns of the Risk Parity Portfolio

Panel A: Annualized Average Excess Returns for 10% Volatility

	All	Bad Time	Good Time
Risk Parity	6.0%	–21.2%	10.0%
Momentum Port	7.4%	10.3%	7.1%
Intangibles Port	10.3%	11.4%	10.2%
Value vs. Growth Port	5.2%	11.9%	4.4%
Profitability Port	7.5%	13.2%	6.8%
Investment Port	8.7%	16.6%	7.7%
RP + Momentum	7.3%	–19.5%	11.2%
RP + Intangibles	7.7%	–19.2%	11.6%
RP + Value vs. Growth	7.0%	–19.5%	10.8%
RP + Profitability	7.2%	–19.0%	11.1%
RP + Investment	7.5%	–18.8%	11.3%

Panel B: Total Excess Returns for 10% Volatility

	1970s Stagflation	Energy Crisis (1)	Energy Crisis (2)	Energy Crisis (3)	Black Monday	Great Bond Massacre	Global Financial Crisis
Risk Parity	–20.2%	–22.2%	–20.9%	–20.4%	–13.5%	–14.3%	–17.8%
Momentum Port	9.9%	35.0%	–1.1%	–0.6%	1.2%	3.1%	19.7%
Intangibles Port	16.6%	10.0%	–0.1%	6.0%	5.9%	2.6%	16.6%
Value vs. Growth Port	11.3%	–3.5%	7.4%	33.1%	1.2%	2.8%	6.1%
Profitability Port	12.8%	16.0%	0.8%	9.3%	9.3%	10.4%	32.1%
Investment Port	29.2%	6.6%	–4.0%	34.8%	8.2%	6.9%	6.8%
RP + Momentum	–18.5%	–17.5%	–20.8%	–20.2%	–13.1%	–13.6%	–14.8%
RP + Intangibles	–17.5%	–20.3%	–20.5%	–19.0%	–12.2%	–13.5%	–15.1%
RP + Value vs. Growth	–18.5%	–22.6%	–19.8%	–16.1%	–13.2%	–13.8%	–16.7%
RP + Profitability	–18.1%	–19.7%	–20.4%	–18.7%	–11.8%	–12.5%	–13.3%
RP + Investment	–16.1%	–21.0%	–21.3%	–15.8%	–12.0%	–13.1%	–16.5%

NOTES: This exhibit shows the performance of the portfolio and the financial anomalies for various periods. Each of these portfolios is normalized to have a full-sample volatility of 10% for the ease of comparability. Panel A shows the historical annualized excess returns for the full historical period as well as the drawdown periods (labeled as bad time) and the remaining periods (labeled as good time). The bad time periods are the drawdown periods defined in Exhibit 3. Panel B shows the historical excess returns for each drawdown period defined in bad time.

Panel A from these exhibits provides a very clear picture on the benefits of these anomaly portfolios: (1) Historically, the returns of the anomaly portfolios are positive and (2) on average, the returns during bad times are higher than those during good times, which shows a strong countercyclical behavior that should make such anomalies appealing for investors who are willing to minimize drawdowns. Examining Panel B from these exhibits shows that the anomaly portfolios performed extremely well during the Dotcom bubble crash. And they also performed well during other drawdown events with positive returns in the majority of cases. Examining the performance of the composite portfolios shows that the profitability and investment anomalies provide the most portfolio loss reduction to the four traditional portfolios while also improving the portfolio Sharpe ratios.

EXHIBIT 12

Performance of Anomalies during Drawdowns of the EQFICOM Portfolio

Panel A: Annualized Average Excess Returns for 10% Volatility

	All	Bad Time	Good Time
EQFICOM	5.7%	–20.4%	10.3%
Momentum Port	7.4%	16.9%	6.1%
Intangibles Port	10.3%	14.6%	9.7%
Value vs. Growth Port	5.2%	21.2%	3.0%
Profitability Port	7.5%	23.8%	5.2%
Investment Port	8.7%	24.9%	6.4%
EQFICOM + Momentum	7.0%	–18.0%	11.3%
EQFICOM + Intangibles	7.4%	–18.1%	11.8%
EQFICOM + Value vs. Growth	6.6%	–17.5%	10.8%
EQFICOM + Profitability	7.0%	–17.2%	11.2%
EQFICOM + Investment	7.2%	–17.0%	11.4%

Panel B: Total Excess Returns for 10% Volatility

	1970s Stagflation	Energy Crisis (1)	Energy Crisis (2)	Black Monday	Asian Crisis	Dotcom Bubble Bursts	Global Financial Crisis
EQFICOM	–27.2%	–13.0%	–23.0%	–18.0%	–10.9%	–26.5%	–29.2%
Momentum Port	14.8%	13.6%	–0.4%	1.2%	11.3%	18.8%	30.4%
Intangibles Port	14.9%	4.8%	8.1%	5.9%	7.4%	28.8%	15.1%
Value vs. Growth Port	24.6%	2.9%	5.0%	1.2%	4.1%	120.4%	–0.6%
Profitability Port	12.4%	5.9%	3.1%	9.3%	5.2%	78.7%	40.7%
Investment Port	44.2%	7.4%	–2.6%	8.2%	5.4%	98.4%	7.1%
EQFICOM + Momentum	–24.6%	–10.8%	–22.9%	–17.7%	–9.0%	–23.8%	–25.5%
EQFICOM + Intangibles	–24.8%	–12.0%	–21.5%	–16.8%	–9.6%	–22.4%	–26.9%
EQFICOM + Value vs. Growth	–24.0%	–12.5%	–22.2%	–17.7%	–11.6%	–14.7%	–29.0%
EQFICOM + Profitability	–25.4%	–12.0%	–22.3%	–16.5%	–10.0%	–17.9%	–24.5%
EQFICOM + Investment	–21.9%	–11.8%	–23.2%	–16.6%	–9.9%	–16.5%	–27.9%

NOTES: This exhibit shows the performance of the portfolio and the financial anomalies for various periods. Each of these portfolios is normalized to have a full-sample volatility of 10% for the ease of comparability. Panel A shows the historical annualized excess returns for the full historical period as well as the drawdown periods (labeled as bad time) and the remaining periods (labeled as good time). The bad time periods are the drawdown periods defined in Exhibit 3. Panel B shows the historical excess returns for each drawdown period defined in bad time.

CONCLUSION

In this article, we investigate the usefulness of 76 financial anomalies in portfolio construction and asset allocation. For simplicity, we group the anomalies into five different categories (momentum, intangibles, value versus growth, profitability, investment) and analyze their performance in the NBER recessionary regimes and inflationary regimes. We also analyze their performance during periods of traditional portfolios drawdown.

We find that, during NBER recessions, inflationary periods as well as periods of portfolio drawdowns, the cross-sectional returns of individual anomalies are much more disperse than other times. We report that the anomalies that fall within the profitability category have strong overall countercyclical performances cross-sectionally with respect to drawdown periods for traditional portfolios. The large dispersion of anomaly returns during bad times highlights the need to build a diversified anomaly portfolio that relies on multiple strategies within each anomaly category for it to be

EXHIBIT 13

Performance of Anomalies during Drawdowns of the All-Equity Portfolio

Panel A: Average Annualized Excess Returns for 10% Volatility

	All	Bad Time	Good Time
All-Equity	4.6%	–22.9%	9.9%
Momentum Port	7.4%	17.7%	5.8%
Intangibles Port	10.3%	13.6%	9.8%
Value vs. Growth Port	5.2%	18.5%	3.2%
Profitability Port	7.5%	26.2%	4.7%
Investment Port	8.7%	21.7%	6.7%
All-Equity + Momentum	5.9%	–20.7%	11.0%
All-Equity + Intangibles	6.3%	–20.9%	11.5%
All-Equity + Value vs. Growth	5.5%	–20.5%	10.5%
All-Equity + Profitability	5.9%	–19.6%	10.8%
All-Equity + Investment	6.1%	–20.1%	11.1%

Panel B: Total Excess Returns for 10% Volatility

	1970s Stagflation	Black Monday	Gulf War	Asian Crisis	Dotcom Bubble Bursts	Global Financial Crisis	Euro Crisis
All-Equity	–38.1%	–20.6%	–12.5%	–11.8%	–34.5%	–36.7%	–11.7%
Momentum Port	38.4%	1.2%	14.1%	11.3%	18.8%	23.9%	3.3%
Intangibles Port	2.6%	5.9%	7.6%	7.4%	28.8%	18.6%	8.6%
Value vs. Growth Port	28.3%	1.2%	–2.6%	–4.1%	120.4%	2.8%	–0.8%
Profitability Port	33.9%	9.3%	10.7%	5.2%	78.7%	33.7%	13.6%
Investment Port	45.3%	8.2%	9.4%	5.4%	98.4%	6.1%	–7.0%
All-Equity + Momentum	–34.0%	–20.4%	–10.2%	–9.9%	–32.2%	–34.0%	–11.1%
All-Equity + Intangibles	–37.2%	–19.5%	–11.1%	–10.5%	–30.7%	–34.2%	–10.2%
All-Equity + Value vs. Growth	–35.1%	–20.4%	–12.8%	–12.4%	–24.0%	–36.3%	–11.8%
All-Equity + Profitability	–34.6%	–19.3%	–10.8%	–11.0%	–26.9%	–33.2%	–9.6%
All-Equity + Investment	–33.5%	–19.3%	–10.9%	–10.8%	–25.6%	–35.8%	–12.8%

NOTES: This exhibit shows the performance of the portfolio and the financial anomalies for various periods. Each of these portfolios is normalized to have a full-sample volatility of 10% for the ease of comparability. Panel A shows the historical annualized excess returns for the full historical period as well as the drawdown periods (labeled as bad time) and the remaining periods (labeled as good time). The bad time periods are the drawdown periods defined in Exhibit 3. Panel B shows the historical excess returns for each drawdown period defined in bad time.

considered useful in asset allocation. During inflationary periods, momentum anomalies perform well and can have a role to play as an inflation-hedging strategy.

We also study how adding a modest allocation in financial anomalies affects overall portfolio performances. We find that shifting a small allocation to a portfolio of financial anomalies in traditional portfolios improves portfolio Sharpe ratio, but more interestingly, they also provide additional loss reduction benefits during periods of recessions, market underperformance, and inflationary periods. Specifically, we found that, although all five anomalies studied in this article help various kinds of traditional portfolios, profitability and investment help traditional portfolios the most in terms of protecting from drawdowns.

Overall, our research is important for academics and practitioners that are interested in using financial anomalies for portfolio construction. It highlights the properties of many of these anomalies, and it shows how they would perform when added to traditional portfolios.

APPENDIX

EXHIBIT A1

Sources of the Financial Anomalies

No.	Anomaly	Description	Category
1	ABR1	Cumulative abnormal returns around earnings announcement dates. Holding period 1 month. Chan et al. (1996)	Momentum
2	ABR6	Cumulative abnormal returns around earnings announcement dates. Holding period 6 months. Chan et al. (1996)	Momentum
3	ADM	Advertising expense-to-market. Chan et al. (2001)	Intangibles
4	BAB	Betting-against-beta. Frazzini and Pedersen (2014)	Trading Frictions
5	BM	Sort by book-to-market equity. Fama and French (1993)	Value vs Growth
6	CEI	Composite Equity Issuance. Hou et al. (2020)	Investment
7	CLAQ1	Cash-based operating profits-to-lagged assets using quarterly Compustat data and holding period of 1 month. Ball et al. (2016)	Profitability
8	CMA	Conservative minus Aggressive. Fama and French (2015)	Investment
9	COP	Changes in in short-term investments. Hou et al. (2020)	Profitability
10	DA	Cash-based operating profitability Ball et al. (2016)	Investment
11	DFIN	Changes in net Financial assets Hou et al. (2020)	Investment
12	DLTI	Changes in in short-term investments. Hou et al. (2020)	Investment
13	DNCA	Changes in non-current operating assets. Hou et al. (2020)	Investment
14	DNCO	Changes in net non-current operating assets Hou et al. (2020)	Investment
15	DNOA	Changes in net operating assets. Hou et al. (2020)	Investment
16	DPIA	Changes in gross property, plant, and equipment (PPE) and inventory-to-assets. Hou et al. (2020)	Investment
17	DROE1	4-quarter change in return on equity. Holding period of 1 month. Hou et al. (2020)	Profitability
18	DROE12	4-quarter change in return on equity. Holding period of 6 month. Hou et al. (2020)	Profitability
19	DROE6	4-quarter change in return on equity. Holding period of 6 months. Hou et al. (2020)	Profitability
20	DWC	Changes in net noncash working capital. Hou et al. (2020)	Investment
21	EM	Enterprise Multiple Loughran and Wellman (2011)	Value vs Growth
22	HML	High minus Low. Fama and French (1993)	Value vs Growth
23	IA	Investment-to-assets. Hou et al. (2020)	Investment
24	IG	Investment Growth, 1 year. Hou et al. (2020)	Investment
25	IG2y	Investment Growth, 2 years. Hou et al. (2020)	Investment
26	IVC	Inventory Changes. Hou et al. (2020)	Investment
27	IVG	Inventory Growth. Hou et al. (2020)	Investment
28	NEI1	The number of quarters with consecutive earnings increase. Holding Period 1 month. Barth et al. (1999)	Momentum
29	NEI6	The number of quarters with consecutive earnings increase. Holding Period 6 months. Barth et al. (1999)	Momentum
30	NOA	Net operating assets. Hirshleifer et al. (2004)	Investment
31	NOP	Net payout yield. Boudoukh et al. (2007)	Value vs Growth
32	NSI	Net stock issues. Pontiff and Woodgate (2008)	Investment
33	OCA	Industry-adjusted organizational capital-to- assets. Eisfeldt and Papanikolaou (2013)	Intangibles
34	OCP	Operating cash-flow to price. Desai et al. (2004)	Value vs Growth

(continued)

EXHIBIT A1 *(continued)*

Sources of the Financial Anomalies

No.	Anomaly	Description	Category
35	OP	Payout Yield Hou et al. (2020)	Value vs Growth
36	OPA	Operating profits to assets. Ball et al. (2016)	Profitability
37	POA	Percent operating accruals. Sloan (1996)	Investment
38	PTA	Percent total accruals. Sloan (1996)	Investment
39	QMJ	Quality minus Junk. Asness et al. (2019)	Value vs Growth
40	R_EG	Expected Growth Factor. Hou et al. (2019)	Profitability
41	R_IA	Investment Factor. Hou et al. (2015)	Investment
42	R_ME	Equity Market Size Factors. Hou et al. (2015)	Value vs Growth
43	R_ROE	Return on Equity (ROE) Factor. Hou et al. (2015)	Profitability
44	R111	Price momentum, prior 11-month returns, holding period 1 month Jegadeesh and Titman (1993)	Momentum
45	R1112	Price momentum, prior 11-month returns, holding period 12 months Jegadeesh and Titman (1993)	Momentum
46	R1115A	Years 11–15 lagged returns, annual Heston and Sadka (2008)	Momentum
47	R1115n	Years 11–15 lagged returns, nonannual Heston and Sadka (2008)	Intangibles
48	R116	Price momentum, prior 11-month returns, holding period 6 months Jegadeesh and Titman (1993)	Momentum
49	R15A	Years 1–5 lagged returns, annual Heston and Sadka (2008)	Momentum
50	R1620A	Years 16–20 lagged returns, annual Heston and Sadka (2008)	Momentum
51	R1A	Year 1-lagged return, annual Heston and Sadka (2008)	Momentum
52	R1N	Year 1-lagged return, nonannual Heston and Sadka (2008)	Momentum
53	R25A	Years 2–5 lagged returns, annual Heston and Sadka (2008)	Intangibles
54	R61	Price momentum, prior 6-month returns, holding period 1 months Jegadeesh and Titman (1993)	Momentum
55	R610A	Years 6–10 lagged returns, annual Heston and Sadka (2008)	Intangibles
56	R610n	Years 6–10 lagged returns, nonannual Heston and Sadka (2008)	Intangibles
57	R612	Price momentum, prior 6-month returns, holding period 12 months Jegadeesh and Titman (1993)	Momentum
58	R66	Price momentum, prior 6-month returns, holding period 6 months Jegadeesh and Titman (1993)	Momentum
59	RAF1	Revision in analysts' earnings forecasts and holding period of 1 month. Markowitz, Guerard, Xu, and Beheshti (2021)	Intangibles
60	RAF12	Revision in analysts' earnings forecasts and holding period of 12 months. Markowitz, Guerard, Xu, and Beheshti (2021)	Intangibles
61	RAF6	Revision in analysts' earnings forecasts and holding period of 6 months. Markowitz, Guerard, Xu, and Beheshti (2021)	Intangibles
62	RDM	R&D expense-to-market using Compustat yearly. Chan et al. (2001)	Intangibles
63	RE 1	Revisions in analysts' earnings forecasts – 1 month holding period Chan et al. (2001)	Intangibles
64	RE 6	Revisions in analysts' earnings forecasts – 6 months holding period Chan et al. (2001)	Intangibles
65	RER	Industry-adjusted real estate ratio Tuzel (2010)	Intangibles
66	RESID11 1	11-month residual momentum, 1-month holding period Blitz et al. (2011)	Momentum

(continued)

EXHIBIT A1 *(continued)*
Sources of the Financial Anomalies

No.	Anomaly	Description	Category
67	RESID11 12	11-month residual momentum, 12-month holding period Blitz et al. (2011)	Momentum
68	RESID11 6	11-month residual momentum, 6-month holding period Blitz et al. (2011)	Momentum
69	RESID6 12	6-month residual momentum, 12-month holding period Blitz et al. (2011)	Momentum
70	RESID6 6	6-month residual momentum, 6-month holding period Blitz et al. (2011)	Momentum
71	RMW	Robust minus weak factor Fama and French (2015)	Profitability
72	ROE1	Return on Equity with holding period of 1 month. Hou et al. (2015)	Profitability
73	ROE6	Return on Equity with holding period of 6 months. Hou et al. (2015)	Profitability
74	SP	Sales-to-price ratio Barbee Jr et al. (1996)	Value vs Growth
75	SUE1	Standardized unexpected earnings. Holding period of 6 months. Foster et al. (1984)	Momentum
76	SUE6	Standardized unexpected earnings. Holding period of 6 months. Foster et al. (1984)	Momentum

NOTES: This exhibit lists the 76 anomalies used in this study. The "Description" column briefly describes the anomaly and refers to the article that first discovered it. When authors make the data available until the end of 2019, we use their data. If not, we build the anomalies ourselves.

EXHIBIT A2
Average Return of Individual Anomalies under Various Regimes

		NBER Recession?		Inflationary Regime?		60/40 Drawdown?		Risk Parity Drawdown?		EQFICOM Drawdown?		All-Equity Drawdown?	
Anomaly	Entire Sample	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
ABR1	0.7%	0.7%	0.6%	0.7%	1.0%	0.8%	0.4%	0.7%	0.5%	0.8%	0.5%	0.7%	0.6%
ABR6	0.4%	0.4%	0.0%	0.3%	0.5%	0.4%	0.3%	0.4%	0.3%	0.3%	0.4%	0.3%	0.5%
ADM	0.5%	0.4%	1.0%	0.4%	0.6%	0.4%	0.8%	0.5%	0.1%	0.5%	0.4%	0.5%	0.4%
BAB	0.9%	1.0%	0.2%	1.0%	0.1%	0.9%	0.9%	1.0%	–0.2%	0.9%	0.9%	0.9%	0.7%
BM	0.4%	0.3%	1.1%	0.3%	1.0%	0.2%	1.5%	0.3%	1.2%	0.2%	1.5%	0.3%	1.0%
CLAQ1	0.5%	0.3%	1.8%	0.6%	0.2%	0.4%	1.5%	0.4%	1.3%	0.3%	1.7%	0.3%	1.9%
CMA	0.3%	0.2%	0.8%	0.2%	0.5%	0.1%	1.2%	0.2%	0.7%	0.1%	1.2%	0.1%	1.1%
COP	0.7%	0.5%	1.7%	0.8%	0.2%	0.5%	2.0%	0.6%	1.4%	0.5%	2.0%	0.4%	2.5%
DFIN	0.2%	0.2%	0.4%	0.3%	0.0%	0.3%	–0.1%	0.2%	0.2%	0.3%	–0.1%	0.3%	0.0%
DROE1	0.8%	0.7%	1.1%	0.5%	2.0%	0.7%	1.4%	0.8%	0.9%	0.7%	1.2%	0.6%	1.5%
DROE12	0.3%	0.2%	0.8%	0.1%	0.9%	0.1%	1.0%	0.2%	0.3%	0.1%	1.1%	0.1%	0.9%
DROE6	0.4%	0.3%	0.9%	0.2%	1.3%	0.3%	1.0%	0.4%	0.5%	0.3%	1.0%	0.3%	0.9%
HML	0.3%	0.2%	0.7%	0.3%	0.4%	0.1%	1.5%	0.2%	0.6%	0.2%	1.2%	0.2%	1.0%
CEI	0.5%	0.5%	0.9%	0.5%	0.5%	0.2%	2.5%	0.4%	1.3%	0.3%	2.3%	0.2%	2.3%
DA	0.4%	0.4%	0.4%	0.5%	0.0%	0.5%	0.0%	0.4%	0.5%	0.4%	0.1%	0.4%	0.2%
DLTI	0.3%	0.3%	0.2%	0.2%	0.6%	0.2%	1.2%	0.3%	0.3%	0.2%	0.7%	0.2%	1.0%
DNCA	0.4%	0.4%	0.3%	0.4%	0.4%	0.3%	0.6%	0.4%	0.3%	0.3%	0.6%	0.4%	0.5%
DNCO	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.8%	0.4%	0.5%	0.4%	0.8%	0.4%	0.7%
DNOA	0.4%	0.4%	0.7%	0.4%	0.6%	0.3%	1.1%	0.4%	0.4%	0.3%	1.0%	0.3%	1.0%

(continued)

EXHIBIT A2 *(continued)*

Average Return of Individual Anomalies under Various Regimes

Anomaly	Entire Sample	NBER Recession?		Inflationary Regime?		60/40 Drawdown?		Risk Parity Drawdown?		EQFICOM Drawdown?		All-Equity Drawdown?	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
DPIA	0.4%	0.3%	0.9%	0.5%	0.2%	0.3%	0.9%	0.4%	0.8%	0.3%	1.2%	0.3%	0.9%
DWC	0.4%	0.3%	0.9%	0.3%	0.7%	0.4%	0.7%	0.4%	0.4%	0.4%	0.7%	0.3%	1.0%
EM	0.4%	0.3%	1.0%	0.3%	0.8%	0.1%	2.5%	0.2%	1.8%	0.1%	2.2%	0.2%	1.9%
IA	0.3%	0.2%	0.9%	0.3%	0.3%	0.2%	1.2%	0.3%	0.4%	0.1%	1.4%	0.2%	1.0%
IG	0.4%	0.3%	1.1%	0.4%	0.5%	0.3%	1.0%	0.4%	0.5%	0.3%	1.1%	0.3%	0.9%
IG2y	0.3%	0.2%	0.7%	0.3%	0.3%	0.2%	0.5%	0.3%	0.4%	0.2%	0.9%	0.2%	0.4%
IVC	0.5%	0.3%	1.4%	0.4%	0.8%	0.4%	0.8%	0.3%	1.5%	0.4%	0.9%	0.5%	0.6%
IVG	0.3%	0.2%	1.2%	0.3%	0.3%	0.2%	1.3%	0.3%	0.7%	0.1%	1.6%	0.2%	1.1%
NOA	0.5%	0.5%	0.4%	0.7%	–0.5%	0.5%	0.3%	0.5%	0.3%	0.5%	0.5%	0.4%	0.6%
NSI	0.6%	0.6%	0.7%	0.6%	0.8%	0.3%	2.4%	0.4%	2.0%	0.4%	2.3%	0.3%	2.3%
POA	0.4%	0.3%	1.1%	0.3%	1.0%	0.3%	1.3%	0.3%	1.2%	0.3%	1.5%	0.3%	1.3%
PTA	0.3%	0.2%	0.9%	0.2%	0.7%	0.3%	0.4%	0.2%	1.0%	0.2%	0.6%	0.3%	0.4%
R1115n	0.3%	0.3%	0.6%	0.4%	–0.1%	0.3%	0.8%	0.3%	0.4%	0.3%	0.4%	0.2%	0.8%
R610n	0.6%	0.5%	1.1%	0.6%	0.6%	0.4%	2.0%	0.6%	0.8%	0.4%	1.6%	0.4%	1.8%
NEI1	0.3%	0.3%	0.7%	0.3%	0.4%	0.2%	0.8%	0.3%	0.4%	0.2%	1.0%	0.2%	1.0%
NOP	0.6%	0.6%	0.8%	0.7%	0.1%	0.3%	2.4%	0.5%	1.2%	0.3%	2.3%	0.3%	2.4%
OCA	0.6%	0.5%	1.3%	0.9%	–1.1%	0.5%	0.9%	0.7%	–0.1%	0.5%	0.9%	0.5%	1.1%
OCP	0.5%	0.5%	0.9%	0.5%	0.9%	0.4%	1.6%	0.5%	1.0%	0.4%	1.5%	0.4%	1.4%
OP	0.4%	0.3%	0.9%	0.6%	–0.6%	0.1%	2.2%	0.4%	0.3%	0.2%	1.6%	0.1%	1.7%
OPA	0.5%	0.4%	1.0%	0.7%	–0.3%	0.3%	1.7%	0.4%	1.0%	0.4%	1.3%	0.3%	2.0%
QMJ	0.4%	0.3%	0.9%	0.4%	0.3%	0.2%	1.5%	0.3%	1.0%	0.2%	1.5%	0.2%	1.7%
R_EG	0.8%	0.7%	1.5%	0.8%	1.0%	0.7%	1.7%	0.8%	1.4%	0.7%	1.6%	0.7%	1.7%
R_IA	0.3%	0.3%	0.9%	0.3%	0.5%	0.2%	1.1%	0.3%	0.6%	0.2%	1.1%	0.2%	1.0%
R_ME	0.2%	0.2%	0.3%	0.2%	0.4%	0.2%	0.3%	0.2%	0.3%	0.2%	0.4%	0.3%	–0.1%
R_ROE	0.5%	0.5%	0.8%	0.5%	0.7%	0.4%	1.2%	0.5%	0.9%	0.4%	1.5%	0.4%	1.3%
R111	1.2%	1.2%	1.2%	0.9%	2.9%	1.0%	2.9%	1.2%	1.9%	0.9%	3.3%	0.9%	3.5%
R1112	0.5%	0.5%	0.4%	0.3%	1.5%	0.5%	0.8%	0.5%	0.6%	0.4%	1.0%	0.4%	1.4%
R1115A	0.6%	0.6%	0.6%	0.5%	0.8%	0.6%	0.6%	0.5%	0.8%	0.5%	0.9%	0.6%	0.6%
R116	0.9%	0.9%	1.0%	0.6%	2.4%	0.8%	1.8%	0.8%	1.3%	0.7%	2.2%	0.6%	2.5%
R15A	0.6%	0.6%	0.9%	0.6%	0.6%	0.6%	0.6%	0.6%	0.8%	0.6%	1.1%	0.6%	0.6%
R1620A	0.5%	0.6%	–0.3%	0.5%	0.2%	0.4%	0.9%	0.5%	–0.1%	0.4%	1.1%	0.4%	1.0%
R1A	0.6%	0.5%	0.9%	0.4%	1.2%	0.8%	–0.8%	0.6%	0.3%	0.7%	–0.6%	0.7%	–0.4%
R1N	0.7%	0.8%	0.5%	0.4%	2.1%	0.5%	2.1%	0.7%	1.2%	0.4%	2.5%	0.4%	2.7%
R25A	0.6%	0.7%	0.2%	0.5%	0.9%	0.6%	0.8%	0.6%	0.7%	0.5%	1.1%	0.5%	1.3%
R61	0.7%	0.8%	0.2%	0.4%	2.2%	0.4%	2.4%	0.5%	1.9%	0.4%	2.4%	0.3%	2.8%
R610A	0.8%	0.7%	1.1%	0.9%	–0.2%	0.7%	1.0%	0.8%	0.6%	0.6%	1.5%	0.7%	1.2%
R612	0.6%	0.6%	0.8%	0.4%	1.7%	0.5%	1.1%	0.6%	0.8%	0.5%	1.4%	0.4%	1.7%
R66	0.9%	0.9%	1.1%	0.6%	2.2%	0.7%	2.0%	0.9%	1.3%	0.7%	2.3%	0.6%	2.5%
RAF1	1.0%	1.0%	0.6%	0.8%	2.1%	1.0%	0.4%	0.9%	1.7%	0.9%	1.2%	1.0%	0.7%
RAF6	0.5%	0.6%	0.2%	0.4%	1.4%	0.6%	–0.4%	0.5%	0.8%	0.5%	0.5%	0.6%	0.2%
RAF12	0.3%	0.3%	0.1%	0.2%	0.8%	0.4%	–0.2%	0.3%	0.4%	0.3%	0.3%	0.3%	0.3%
RDM	0.8%	1.0%	–0.4%	0.9%	0.1%	0.9%	–0.2%	0.9%	–0.3%	0.9%	0.0%	0.9%	–0.2%
RE_1	0.7%	0.7%	1.1%	0.6%	1.7%	0.7%	1.5%	0.7%	1.2%	0.6%	1.8%	0.6%	2.0%
RE_6	0.5%	0.4%	0.8%	0.4%	1.0%	0.4%	1.1%	0.5%	0.4%	0.3%	1.4%	0.3%	1.8%
RER	0.4%	0.3%	0.8%	0.4%	0.5%	0.4%	0.5%	0.3%	0.8%	0.3%	0.9%	0.4%	0.5%
RESID11_1	0.6%	0.5%	1.1%	0.5%	1.2%	0.5%	1.3%	0.6%	0.9%	0.4%	1.6%	0.4%	1.5%

(continued)

EXHIBIT A2 *(continued)*

Average Return of Individual Anomalies under Various Regimes

Anomaly	Entire Sample	NBER Recession?		Inflationary Regime?		60/40 Drawdown?		Risk Parity Drawdown?		EQFICOM Drawdown?		All-Equity Drawdown?	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
RESID11_12	0.3%	0.3%	0.4%	0.2%	0.7%	0.3%	0.2%	0.3%	0.4%	0.3%	0.6%	0.3%	0.6%
RESID11_6	0.5%	0.5%	0.6%	0.4%	1.1%	0.5%	0.7%	0.4%	0.8%	0.4%	1.1%	0.4%	1.0%
RESID6_12	0.4%	0.4%	0.3%	0.3%	0.7%	0.4%	0.4%	0.3%	0.6%	0.3%	0.8%	0.3%	0.7%
RESID6_6	0.5%	0.5%	0.5%	0.4%	0.8%	0.4%	0.8%	0.4%	0.8%	0.4%	1.1%	0.4%	1.1%
RMW	0.3%	0.3%	0.5%	0.3%	0.1%	0.1%	1.3%	0.2%	0.6%	0.1%	1.3%	0.1%	1.3%
ROE1	0.7%	0.5%	1.7%	0.6%	1.1%	0.4%	2.7%	0.6%	1.2%	0.4%	2.7%	0.4%	2.8%
ROE6	0.4%	0.3%	1.3%	0.4%	0.5%	0.2%	2.3%	0.4%	0.6%	0.1%	2.2%	0.1%	2.5%
SP	0.4%	0.3%	1.0%	0.4%	0.5%	0.3%	1.2%	0.4%	0.5%	0.3%	1.4%	0.3%	0.9%
SUE1	0.4%	0.4%	0.8%	0.4%	0.9%	0.4%	0.9%	0.4%	0.5%	0.4%	1.0%	0.3%	1.1%
SUE6	0.2%	0.1%	0.9%	0.2%	0.7%	0.2%	0.5%	0.2%	0.5%	0.1%	1.0%	0.2%	0.7%

NOTES: This exhibit presents the average returns of individual anomalies over the entire sample (January 1971–December 2019) as well as during regimes identified by NBER recessions, inflation, and the drawdowns of four portfolios: a 60/40 stock/bond portfolio, a portfolio of equities, fixed income and commodities (denoted as EQFICOM), a risk parity portfolio, and a portfolio of only equities. For a detailed description of the drawdown regimes, see the section "Analysis Setup."

EXHIBIT A3

Statistical Significance of Individual Anomalies under Various Regimes

Anomaly	Entire Sample	NBER Recession?		Inflationary Regime?		60/40 Drawdown?		Risk Parity Drawdown?		EQFICOM Drawdown?		All-Equity Drawdown?	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
ABR1	5.37	5.62	1.12	4.46	3.20	5.58	0.83	5.22	1.35	5.55	1.07	5.36	1.35
ABR6	3.86	4.35	–0.08	3.21	2.48	3.77	1.03	3.63	1.33	3.60	1.44	3.39	1.85
ADM	2.19	1.77	1.31	1.91	1.16	1.94	1.04	2.29	0.09	2.14	0.61	2.13	0.61
BAB	6.25	6.97	0.39	6.56	0.33	6.86	1.29	7.00	–0.53	6.81	1.41	7.00	1.09
BM	1.97	1.42	1.50	1.20	2.25	1.11	2.29	1.33	2.35	1.06	2.32	1.40	1.62
CLAQ1	3.50	2.30	3.65	3.43	0.76	2.82	2.14	2.68	2.87	2.53	2.56	2.32	3.01
CMA	3.49	2.45	2.79	2.66	2.79	1.93	3.57	2.57	3.63	1.92	3.49	1.91	3.50
COP	4.02	3.05	2.84	4.19	0.49	2.92	2.99	3.34	2.45	2.87	3.07	2.28	4.04
DFIN	2.18	1.77	1.35	2.41	–0.04	2.79	–0.21	2.03	0.79	2.80	–0.16	2.72	–0.03
DROE1	5.46	5.63	1.67	3.60	4.97	4.79	2.63	5.01	2.21	4.90	2.40	4.56	3.06
DROE12	2.64	1.83	2.02	1.33	3.19	1.47	3.00	2.43	1.03	1.40	2.66	1.48	2.97
DROE6	3.21	2.80	1.64	1.55	3.82	2.44	2.28	2.95	1.26	2.43	2.18	2.46	2.23
HML	2.39	1.91	1.48	1.98	1.54	1.01	3.11	1.95	1.58	1.34	2.41	1.41	2.34
CEI	3.26	2.75	1.78	2.91	1.47	1.50	4.37	2.50	2.67	1.59	4.28	1.42	4.49
DA	3.11	2.95	1.04	3.39	–0.02	3.58	–0.03	2.78	1.68	3.44	0.21	3.40	0.37
DLTI	2.18	2.07	0.68	1.53	2.23	1.19	2.59	1.95	1.28	1.59	1.78	1.24	2.43
DNCA	3.17	3.08	0.85	2.84	1.40	2.74	1.64	3.08	0.78	2.74	1.60	2.79	1.52
DNCO	3.72	3.47	1.32	3.41	1.46	3.12	2.09	3.44	1.40	3.14	2.03	3.19	1.94
DNOA	3.14	2.62	1.87	2.57	2.09	2.34	2.30	2.89	1.31	2.46	2.04	2.41	2.13
DPIA	3.22	2.66	1.85	3.23	0.59	2.59	2.05	2.68	2.01	2.22	2.88	2.49	2.24
DWC	3.15	2.45	2.29	2.46	2.37	2.76	1.53	2.96	1.09	2.73	1.57	2.33	2.39
EM	2.28	1.71	1.62	1.61	2.04	0.58	4.12	1.18	3.44	0.75	3.53	0.83	3.40
IA	2.04	1.32	1.98	1.75	1.15	1.15	2.25	1.80	1.17	0.94	2.60	1.24	2.00
IG	3.10	2.00	3.28	2.58	2.01	2.34	2.16	2.81	1.37	2.18	2.42	2.45	1.94

(continued)

EXHIBIT A3 *(continued)*

Statistical Significance of Individual Anomalies under Various Regimes

Anomaly	Entire Sample	NBER Recession?		Inflationary Regime?		60/40 Drawdown?		Risk Parity Drawdown?		EQFICOM Drawdown?		All-Equity Drawdown?	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
IG2y	2.26	1.61	2.12	2.02	1.08	1.88	1.32	1.97	1.31	1.48	2.14	2.03	1.00
IVC	3.87	2.81	2.87	2.97	2.95	3.47	1.72	2.81	3.17	3.45	1.80	3.70	1.33
IVG	2.84	1.68	3.08	2.54	1.29	1.70	2.71	2.32	1.82	1.25	3.47	1.70	2.66
NOA	3.71	3.56	1.11	4.69	–1.75	3.74	0.67	3.68	0.70	3.56	1.13	3.37	1.53
NSI	4.78	4.61	1.48	4.00	3.09	2.81	5.04	3.26	5.42	2.86	4.87	2.69	5.13
POA	3.44	2.46	2.93	2.33	3.38	2.32	3.24	2.53	3.39	2.02	3.97	2.23	3.33
PTA	2.67	1.81	2.21	1.73	2.85	2.39	1.21	1.65	4.24	2.14	1.79	2.40	1.18
R1115n	2.02	1.66	1.29	2.23	–0.17	1.67	1.17	1.85	0.80	1.89	0.74	1.57	1.35
R610n	3.27	2.75	1.80	2.96	1.40	2.15	2.76	2.86	1.84	2.47	2.21	2.19	2.64
NEI1	3.06	2.39	2.06	2.63	1.62	2.28	2.30	2.79	1.31	1.97	2.92	1.89	3.02
NOP	3.58	3.25	1.48	3.75	0.22	1.99	3.93	2.91	2.65	2.03	3.79	1.69	4.49
OCA	2.99	2.44	1.73	4.26	–2.58	2.88	1.07	3.37	–0.17	3.01	1.01	2.60	1.49
OCP	2.65	2.38	1.17	2.01	2.15	1.80	2.37	2.20	1.82	1.85	2.25	1.86	2.23
OP	1.97	1.54	1.25	2.79	–1.23	0.51	3.32	1.95	0.42	0.91	2.31	0.75	2.78
OPA	3.02	2.51	1.78	3.60	–0.85	2.01	2.77	2.48	2.03	2.27	2.19	1.58	3.58
QMJ	4.27	3.40	2.74	4.05	1.36	2.65	4.04	3.29	3.58	2.68	3.95	2.10	4.96
R_EG	10.60	9.12	5.65	9.00	6.24	9.41	5.24	9.10	6.46	9.36	5.27	9.15	5.67
R_IA	4.57	3.50	3.20	3.82	2.80	3.22	3.58	3.77	3.51	3.10	3.81	3.21	3.52
R_ME	1.97	1.87	0.66	1.64	1.14	1.89	0.61	1.84	0.71	1.75	0.92	2.36	–0.32
R_ROE	5.14	4.70	2.12	4.23	3.45	4.20	3.05	4.29	3.85	3.87	3.62	3.95	3.50
R111	4.28	4.55	0.97	2.85	4.40	3.53	2.46	3.75	2.26	3.27	2.92	3.01	3.37
R1112	2.48	2.59	0.54	1.32	3.35	2.33	0.93	2.31	0.91	2.17	1.22	1.77	1.88
R1115A	4.10	3.94	1.24	3.46	2.47	4.13	0.92	3.74	1.68	3.90	1.46	4.07	1.03
R116	3.65	3.72	0.98	2.20	4.19	3.17	1.81	3.24	1.76	2.92	2.24	2.60	2.81
R15A	4.36	3.93	1.88	3.97	1.81	4.45	1.01	4.04	1.62	3.95	1.90	4.32	1.23
R1620A	2.56	2.95	–0.50	2.52	0.45	2.64	0.88	2.74	–0.14	2.43	1.13	2.45	1.10
R1A	3.01	2.80	1.20	2.07	2.96	4.30	–1.04	2.99	0.59	4.29	–0.74	4.02	–0.55
R1N	2.36	2.75	0.33	1.33	2.79	1.74	1.67	2.04	1.25	1.52	2.02	1.31	2.36
R25A	3.93	4.40	0.34	3.23	2.43	3.70	1.42	3.68	1.36	3.41	1.95	3.08	2.57
R61	2.42	2.90	0.15	1.20	3.57	1.58	2.11	1.77	2.38	1.53	2.17	1.18	2.79
R610A	4.96	4.49	2.12	5.55	–0.46	4.75	1.69	4.83	1.25	4.29	2.51	4.47	2.17
R612	3.51	3.44	1.12	2.07	3.94	3.13	1.60	3.21	1.41	2.93	1.94	2.52	2.63
R66	4.14	4.13	1.22	2.74	4.01	3.42	2.38	3.69	1.98	3.21	2.78	2.93	3.24
RDM	4.72	5.06	0.64	3.47	4.44	5.30	0.39	4.25	2.05	4.84	1.26	5.13	0.73
RE_1	3.48	3.82	0.33	2.31	3.94	4.28	–0.47	3.19	1.37	3.87	0.65	3.89	0.28
RE_6	2.47	2.72	0.26	1.63	2.81	3.00	–0.27	2.35	0.80	2.70	0.53	2.52	0.60
RAF1	3.35	3.89	–0.42	3.45	0.13	3.66	–0.22	3.66	–0.49	3.64	0.06	3.68	–0.25
RAF6	3.23	2.99	1.26	2.29	3.39	2.98	1.30	2.83	1.64	2.80	1.65	2.62	1.92
RAF12	2.28	2.02	1.05	1.66	2.20	1.95	1.18	2.21	0.63	1.77	1.45	1.42	2.13
RER	2.69	2.14	1.87	2.35	1.35	2.65	0.81	2.20	1.84	2.26	1.46	2.64	0.85
RESID11_1	3.69	3.30	1.68	2.71	2.93	3.11	2.01	3.38	1.48	2.73	2.67	2.77	2.60
RESID11_12	2.75	2.68	0.84	1.88	2.70	2.81	0.56	2.55	1.03	2.53	1.16	2.37	1.40
RESID11_6	3.62	3.44	1.27	2.54	3.14	3.41	1.33	3.22	1.68	3.08	1.92	3.04	1.98
RESID6_12	3.80	3.96	0.86	2.91	2.67	3.69	1.16	3.47	1.54	3.27	1.94	3.19	2.07
RESID6_6	3.87	3.98	0.95	3.09	2.45	3.52	1.67	3.53	1.60	3.11	2.34	3.09	2.38
RMW	3.12	2.59	1.87	3.09	0.58	1.66	3.31	2.45	2.93	1.62	3.35	1.36	3.79

(continued)

EXHIBIT A3 *(continued)*

Statistical Significance of Individual Anomalies under Various Regimes

Anomaly	Entire Sample	NBER Recession? No	NBER Recession? Yes	Inflationary Regime? No	Inflationary Regime? Yes	60/40 Drawdown? No	60/40 Drawdown? Yes	Risk Parity Drawdown? No	Risk Parity Drawdown? Yes	EQFICOM Drawdown? No	EQFICOM Drawdown? Yes	All-Equity Drawdown? No	All-Equity Drawdown? Yes
ROE1	3.34	2.54	2.35	2.61	2.58	2.03	3.18	2.80	2.39	1.97	3.23	1.71	3.71
ROE6	2.10	1.40	1.81	1.75	1.37	0.76	2.95	1.83	1.24	0.76	2.86	0.42	3.52
SP	2.20	1.78	1.32	1.95	1.04	1.60	1.68	1.99	1.01	1.41	2.02	1.75	1.39
SUE1	3.12	2.76	1.47	2.33	2.37	2.69	1.59	2.80	1.50	2.54	1.85	2.37	2.15
SUE6	2.11	1.33	1.75	1.28	2.26	1.70	1.30	1.76	1.25	1.21	2.02	1.46	1.74

NOTES: This exhibit presents the *t*-statistics of individual anomalies over the entire sample (January 1971–December 2019) as well as during regimes identified by NBER recessions, inflation, and the drawdowns of four portfolios: a 60/40 stock/bond portfolio, a portfolio of equities, fixed income and commodities (denoted as EQFICOM), a risk parity portfolio, and a portfolio of only equities. For a detailed description of the drawdown regimes, see the section "Analysis Setup."

ACKNOWLEDGMENT

The authors like to thank Michael Wissell and Robert Goobie for their support on innovation and research and Jaylie Lee for her helpful comments. The authors also thank the Global Peer Financing Association (GPFA) for its support and the Referee for the constructive comments and recommendations.

REFERENCES

Amin, G. S., and H. M. Kat. 2003. "Hedge Fund Performance 1990–2000: Do the 'Money Machines' Really Add Value?" *Journal of Financial and Quantitative Analysis* 38 (2): 251–274.

Asness, C. S., A. Frazzini, and L. H. Pedersen. 2019. "Quality Minus Junk." *Review of Accounting Studies* 24 (1): 34–112.

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 (1): 28–45.

Baltzer, M., S. Jank, and E. Smajlbegovic. 2019. "Who Trades on Momentum?" *Journal of Financial Markets* 42: 56–74.

Barbee Jr., W. C., S. Mukherji, and G. A. Raines. 1996. "Do Sales–Price and Debt–Equity Explain Stock Returns Better than Book–Market and Firm Size?" *Financial Analysts Journal* 52 (2): 56–60.

Barth, M. E., J. A. Elliott, and M. W. Finn. 1999. "Market Rewards Associated with Patterns of Increasing Earnings." *Journal of Accounting Research* 37 (2): 387–413.

Bartram, S. M., and M. Grinblatt. 2021. "Global Market Inefficiencies." *Journal of Financial Economics* 139 (1): 234–259.

Blitz, D., J. Huij, and M. Martens. 2011. "Residual Momentum." *Journal of Empirical Finance* 18 (3): 506–521.

Boudoukh, J., R. Michaely, M. Richardson, and M. R. Roberts. 2007. "On the Importance of Measuring Payout Yield: Implications for Empirical Asset Pricing." *The Journal of Finance* 62 (2): 877–915.

Campbell, J. Y., and R. Sigalov. "Portfolio Choice with Sustainable Spending: A Model of Reaching for Yield." Technical report, National Bureau of Economic Research, 2020.

Chan, K., L. K. Chan, N. Jegadeesh, and J. Lakonishok. "Earnings Quality and Stock Returns." Technical report, National Bureau of Economic Research, 2001.

Chan, L. K., N. Jegadeesh, and J. Lakonishok. 1996. "Momentum Strategies." *The Journal of Finance* 51 (5): 1681–1713.

Chan, L. K., J. Lakonishok, and T. Sougiannis. 2001. "The Stock Market Valuation of Research and Development Expenditures." *The Journal of Finance* 56 (6): 2431–2456.

Christoffersen, S. E., and H. Xu. 2017. "Investor Attrition and Fund Flows in Mutual Funds." *Journal of Financial and Quantitative Analysis* 52 (3): 867–893.

Daniel, K., L. Garlappi, and K. Xiao. "Monetary Policy and Reaching for Income." Technical report, National Bureau of Economic Research, 2018.

Daniel, K., and T. J. Moskowitz. 2016. "Momentum Crashes." *Journal of Financial Economics* 122 (2): 221–247.

Daskalaki, C., G. Skiadopoulos, and N. Topaloglou. 2017. "Diversification Benefits of Commodities: A Stochastic Dominance Efficiency Approach." *Journal of Empirical Finance* 44: 250–269.

Desai, H., S. Rajgopal, and M. Venkatachalam. 2004. "Value-Glamour and Accruals Mispricing: One Anomaly or Two?" *The Accounting Review* 79 (2): 355–385.

Di Maggio, M., and M. Kacperczyk. 2017. "The Unintended Consequences of the Zero Lower Bound Policy." *Journal of Financial Economics* 123 (1): 59–80.

Eisfeldt, A. L., and D. Papanikolaou. 2013. "Organization Capital and the Cross-Section of Expected Returns." *The Journal of Finance* 68 (4): 1365–1406.

Elkamhi, R., C. Jo, J. S. Lee, and M. Salerno. "The Jury Is Still Out on the Performance of Naive Diversification (1/n Rule)." Working paper 3638713, Rotman School of Management, 2020.

Fama, E. F., and K. R. French. 1993. "Common Risk Factors in the Returns on Stocks and Bonds." *Journal of Financial Economics* 33 (1): 3–56.

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

Foster, G., C. Olsen, and T. Shevlin. 1984. "Earnings Releases, Anomalies, and the Behavior of Security Returns." *Accounting Review* 59 (4): 574–603.

Frazzini, A., R. Israel, and T. J. Moskowitz. "Trading Costs of Asset Pricing Anomalies." Fama–Miller working paper, Chicago Booth research paper 14-05, 2012.

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

Harvey, C. R., E. Hoyle, S. Rattray, M. Sargaison, D. Taylor, and O. Van Hemert. 2019. "The Best of Strategies for the Worst of Times: Can Portfolios Be Crisis Proofed?" *The Journal of Portfolio Management* 45 (5): 7–28.

Heston, S. L., and R. Sadka. 2008. "Seasonality in the Cross-Section of Stock Returns." *Journal of Financial Economics* 87 (2): 418–445.

Hirshleifer, D., K. Hou, S. H. Teoh, and Y. Zhang. 2004. "Do Investors Overvalue Firms with Bloated Balance Sheets?" *Journal of Accounting and Economics* 38: 297–331.

Hoevenaars, R. P., R. D. Molenaar, P. C. Schotman, and T. B. Steenkamp. 2008. "Strategic Asset Allocation with Liabilities: Beyond Stocks and Bonds." *Journal of Economic Dynamics and Control* 32 (9): 2939–2970.

Hou, K., H. Mo, C. Xue, and L. Zhang. 2019. "Which Factors?" *Review of Finance* 23 (1): 1–35.

Hou, K., C. Xue, and L. Zhang. 2015. "Digesting Anomalies: An Investment Approach." *The Review of Financial Studies* 28 (3): 650–705.

——. 2020. “Replicating Anomalies.” *The Review of Financial Studies* 33 (5): 2019–2133.

Jegadeesh, N., and S. Titman. 1993. “Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency.” *The Journal of Finance* 48 (1): 65–91.

Loughran, T., and J. W. Wellman. 2011. “New Evidence on the Relation between the Enterprise Multiple and Average Stock Returns.” *Journal of Financial and Quantitative Analysis* 46 (6): 1629–1650.

Markowitz, H., J. Guerard, G. Xu, and B. Beheshti. 2021. “Financial Anomalies in Portfolio Construction and Management.” *The Journal of Portfolio Management* 47 (6): 51–64.

Neville, H., T. Draaisma, B. Funnell, C. R. Harvey, and O. Van Hemert. 2021. “The Best Strategies for Inflationary Times.” *The Journal of Portfolio Management* 47 (8): 8–37.

Pontiff, J., and A. Woodgate. 2008. “Share Issuance and Cross-Sectional Returns.” *The Journal of Finance* 63 (2): 921–945.

Ren, H., S. Siwinski, C. Yu, and A. Ang. 2021. “Public Pension Portfolios in a World of Low Rates and Low Risk Premiums.” *SSRN* 3869703.

Sloan, R. G. 1996. “Do Stock Prices Fully Reflect Information in Accruals and Cash Flows about Future Earnings?” *Accounting Review* 71 (3): 289–315.

Tuzel, S. 2010. “Corporate Real Estate Holdings and the Cross-Section of Stock Returns.” *The Review of Financial Studies* 23 (6): 2268–2302.