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REVIEW

Unraveling market mysteries: a comprehensive review of financial anomalies and puzzles

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Abstract

This comprehensive literature review consolidates various market anomalies and puzzles, providing an aggregated perspective to understand these complex dynamics that challenge the traditional Efficient Market Hypothesis. We examined numerous academic works to reveal insights into long-term return irregularities, earnings management influence on equity offerings, and information uncertainty's impact on stock returns.

The review delves into unique phenomena like persistent mutual fund performance, the day-of-the-week returns, the January effect, weather-induced mood shifts on the market, and the dynamics of multiple anomalies. International asset pricing and weekend anomalies were also discussed, with a particular focus on cryptocurrency efficiency.

Incorporating behavioral finance perspectives, we explored social transmission bias, emotional finance, biased beliefs, investor optimism, sentiment, and global market inefficiencies. The influence of unique events and seasonal factors, such as the Super Bowl, daylight saving time, and the Halloween effect, were also analyzed.

The review concludes by highlighting the evolving landscape of market anomalies, discussing ma- chine learning approaches to anomaly research, investor behavior challenges, and the disappearing anomalies in country and industry returns. It sets the groundwork for holistic comprehension of market anomalies, suggesting future research directions such as exploring new data sources, comprehensive theoretical modeling, and the role of technology, market regulations, and environmental changes on market anomalies.

Keywords

Market Anomalies, Efficient Market Hypothesis, Long-term Returns, Earnings Management, Information Uncertainty, Post-Merger Performance, Mutual Funds, Day-of-the-Week Returns

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1 Introduction

The financial markets landscape is a complex tapestry woven from the intricate interplay of countless factors. Central to this complexity is the phenomenon of asset pricing anomalies, which consistently attract the attention of investors, traders, and academic researchers. These anomalies refer to patterns that contradict the Efficient Market Hypothesis (EMH), a theory positing that security prices fully reflect all available information (Fama, 1998). They present profit opportunities resulting from market inefficiencies (Bartram & Grinblatt, 2021), offering a captivating challenge to traditional financial models and theories.

One of the most prominent categories of these anomalies is the calendar or time-series anomalies, revealing systematic variations in stock returns over specific periods. Day-of-the-week effects, documented as early as 1984, have unveiled patterns where stock returns differ significantly based on the day of the week (Rogalski, 1984). This directly contradicts the EMH, which asserts that returns should follow a random walk, unaffected by the day of the week.

Following these, other temporal anomalies such as the January effect, which posits that stock returns in January are consistently higher than other months, have further strained traditional market theories (Bhardwaj & Brooks, 1992). Investigations into these anomalies have taken varied and fascinating paths, exploring even the influence of weather patterns on stock market dynamics. For example, research into the Halloween effect suggests higher returns in November compared to the rest of the year, with suggestions that this anomaly may be linked to seasonal affective disorder (Jacobsen & Visaltanachoti, 2009). Other researchers have extended this hypothesis, exploring whether weather patterns and the resulting human mood swings can significantly impact stock returns (Andrikopoulos *et al.,* 2019; Symeonidis *et al.*, 2010).

In the same vein, studies have examined quirky and unexpected market behaviors tied to specific events, leading to the identification of anomalies such as the Super Bowl effect (Krueger & Kennedy, 1990). This effect suggests a correlation between the outcomes of the Super Bowl and the subsequent year's stock market performance, challenging rational explanations.

However, it's important to underscore that calendar anomalies represent only one facet of the broad landscape of asset pricing anomalies. Research has also extensively probed into other anomalies related to firm-specific factors, market conditions, investor sentiment, and more.

For instance, anomalies like post-earnings announcement drift (PEAD) have been identified, where stock prices continue to drift in the direction of earnings surprise for several weeks post-announcement (Teoh *et al.*, 1998). This finding contradicts the EMH's prediction that prices should adjust immediately and fully to new information. Similarly, the post-merger performance of acquiring firms presents another anomaly, where the stocks of acquiring firms tend to underperform after mergers, challenging traditional asset pricing models (Agrawal *et al.*, 1992).

Furthermore, certain market conditions and firm-specific characteristics have been associated with anomalous returns. For example, low share prices and high transaction costs have been linked to the January effect (Bhardwaj & Brooks, 1992). Firm characteristics such as size and book-to-market ratios have been shown to have systematic effects on returns, thus giving rise to the size and value anomalies (Agarwal & Poshakwale, 2010; Fama & French, 2008).

Cross-sectional anomalies represent another critical subset of asset pricing anomalies that have attracted significant academic scrutiny. These anomalies emphasize the role of firm-specific attributes in influencing stock returns. An example of this is the size effect, where smaller firms are observed to generate higher average returns than larger firms (Agarwal & Poshakwale, 2010). A related anomaly is the book-to-market effect, where firms with high book-to-market ratios are found to yield superior returns (Chou *et al.*, 2010; Fama & French, 2008).

However, some scholars have criticized these anomalies as manifestations of omitted variable bias. For instance, Chou *et al.* (2010) suggest that the size and book-to-market anomalies are artifacts of neglected leverage risk. The authors propose that once leverage risk is appropriately accounted for, the purported anomalies dissolve. This perspective underscores the complexity of financial markets, where overlapping factors and interactions can create illusionary patterns, fostering misinterpretations and misguided investment strategies.

In the same vein, financial markets often exhibit anomalies linked to information asymmetry and investor sentiment. The PIN (Probability of Informed Trading) anomaly is one such illustration, where mergers and acquisitions announcements lead to higher informed trading, altering stock returns (Aktas *et al.*, 2007). The underlying theory is that in periods leading up to significant corporate events, insiders and informed investors might take positions based on private information, leading to detectable price movements.

Sentiment-based anomalies, driven by behavioral biases, have also been documented extensively. For instance, the SAD (Seasonal Affective Disorder) anomaly revisited by Kelly (Kelly & Meschke, 2010) suggests that changes in mood due to seasonal variations can impact financial markets, leading to higher returns in the autumn. Taffler (Taffler, 2018) further elaborates on this aspect of emotional finance, highlighting how unconscious biases can influence investment decisions and drive market anomalies.

Moreover, anomalies like the 'turn-of-the-year' effect, where stocks tend to exhibit strong returns at the beginning of the year, often coincide with tax-motivated trading (Griffiths & White, 1993). This points to the influence of macro-level institutional factors in shaping stock market dynamics. Interestingly,

a similar monthly pattern is observed in dividend payments, giving rise to the dividend month premium anomaly (Hartzmark & Solomon, 2013).

Alongside these, trading-related anomalies have been detected, linked to trading volumes, liquidity, and transaction costs. For instance, James (James & Edmister, 1983) reports a positive association between common stock returns, trading activity, and market value, while Daves *et al.,* (Daves & Ehrhardt, 1993) explore the impact of liquidity and reconstitution on the value of U.S. Treasury Strips. On the other hand, Bhardwaj and Brooks (1992) illustrate how low share prices and high transaction costs could be contributing to the January effect.

The pervasive nature of anomalies across different time horizons and markets suggests potential opportunities for generating superior returns. The evolution of trading strategies like momentum, contrarian, and calendar-based trading is fundamentally rooted in these anomalies. Despite this, researchers continue to examine the persistence and exploitable nature of these anomalies.

The insights derived from these explorations not only offer potential strategies for market participants but also have significant implications for regulatory authorities, who must remain vigilant of market inefficiencies that could destabilize the financial system. It is worth noting that a subset of anomalies like the Super Bowl effect (Krueger & Kennedy, 1990) and the weather effect (Gerlach, 2010; Jacobsen & Marquering, 2008; Symeonidis *et al.*, 2010) may appear irrational or even whimsical, they represent the far-reaching influence of human behavior on market dynamics.

In conclusion, asset pricing anomalies present a fascinating testament to the intricacies of financial markets. Their existence and persistence challenge traditional financial theories, prompting the exploration of alternative models and theories. While some anomalies may offer exploitable opportunities, market participants must exercise caution in interpreting these patterns, considering the complex interplay of multiple influencing factors. Continuous advancements in computational power and data analysis techniques promise to further deepen our understanding of these anomalies and their implications for financial markets.

In the following sections of this paper, we will delve deeper into the aforementioned topics and their relation to financial anomalies. In Section 2, we embark on an exhaustive literature review that encapsulates several dimensions of financial anomalies and the attendant puzzles.

We start by exploring the anomalies and the notion of market efficiency in Section 2.1. We then transition into the realm of behavioral finance, focusing on investor sentiment and its role in shaping market outcomes in Section 2.2.

Subsequently, in Section 2.3, we turn our attention to the calendar effects and seasonal anomalies, phenomena that have perennially intrigued researchers due to their recurrent patterns that seem to defy traditional market theories.

In Section 2.4, we delve into the relationship between risk factors and asset pricing, scrutinizing the impact of these factors on market anomalies.

We then move on to examine how information flow influences trading strategies and its potential role in the formation of anomalies in Section 2.5.

Finally, in Section 3, we consolidate our findings and offer concluding remarks, providing a recap of the significant observations made throughout the paper, outlining the research gaps, and charting potential directions for future investigations in this fascinating area of financial economics. Our overarching aim is to illuminate the complexities and subtleties of financial anomalies, thereby contributing to the ongoing discourse in this vibrant field of research.

2 Literature review

2.1 Anomalies and efficiency of financial markets

The notion of market efficiency stands as a cornerstone in the financial economics literature, offering an intellectual paradigm that has fueled much of the scholarly inquiry and theoretical developments in this field. According to the Efficient Market Hypothesis (EMH) proposed by Fama (1998), financial markets should inherently reflect all publicly available information, and therefore, it is impossible to consistently achieve returns higher than the market average. Yet, this core premise of financial economics has been challenged and complicated by the empirical identification of so-called ‘anomalies’.

Anomalies, as defined by Fama and French (2008), represent empirical results that appear to be inconsistent with maintained theories of asset pricing behavior. They indicate patterns in returns that seem to contradict the EMH, suggesting possibilities of earning excess returns by capitalizing on these detected inconsistencies. These anomalies take various forms, encompassing calendar effects, such as the day-of-the-week effect (Rogalski, 1984), the January effect (Bhardwaj & Brooks, 1992), the Halloween effect (Jacobsen & Visaltanachoti, 2009), and even more novel phenomena, like the weather effect (Andrikopoulos *et al.*, 2019; Gerlach, 2010; Jacobsen & Marquering, 2008; Symeonidis *et al.*, 2010).

The persistence and breadth of these anomalies have been substantial, with more than 100 documented in the literature (Jacobs, 2015). Yet, a key question arises: if these anomalies allow for consistent earning of excess returns, why aren’t they arbitraged away by rational investors, thereby restoring market efficiency? Several explanations have been posited, focusing on issues like transaction costs (Bhardwaj & Brooks, 1992; Fortin, 1990) and investor psychology (Loewenstein & Willard, 2006; Taffler, 2018).

A closer look at the anomalies can be divided into broad categories: firm-specific anomalies, event-based anomalies, calendar and time-based anomalies, and investor sentiment anomalies.

Firm-specific anomalies like the size and book-to-market ratio anomalies suggest that smaller firms and those with high book-to-market ratios tend to earn higher returns than predicted by the Capital Asset Pricing Model (CAPM) (Agrawal *et al.*, 1992; Fama, 1998). Yet, these anomalies might be linked to omitted risk factors like leverage risk, rather than being true departures from market efficiency (Agarwal & Poshakwale, 2010; Chou *et al.,* 2010).

Event-based anomalies highlight patterns surrounding corporate events, such as mergers and acquisitions (Agrawal *et al.*, 1992; Aktas *et al.*, 2007), seasoned equity offerings (Teoh *et al.*, 1998), and earnings announcements (Battalio & Mendenhall, 2011). Some of these patterns could be attributed to information asymmetries and investor sentiment (Gençay *et al.*, 2010; Lam *et al.*, 2012; Shu & Chang, 2015).

Calendar and time-based anomalies cover patterns linked to specific periods, such as the day of the week (Rogalski, 1984), month of the year (Bhardwaj & Brooks, 1992; Hartzmark & Solomon, 2013), holiday effects (Jacobsen & Visaltanachoti, 2009), and even the daylight-saving anomaly (Gerlach, 2010; Gregory-allen *et al.*, 2010). These effects could be driven by changes in investor risk preferences, institutional practices, or information dissemination over time (Kolb & Gay, 1985; Ma *et al.*, 1988; Ülkü & Andonov, 2016).

Investor sentiment anomalies are associated with changes in investor moods and behaviors. Studies have demonstrated the impact of sentiment on stock returns and volatility (Bird & Casavecchia, 2007; Ciccone, 2011; Hirshleifer, 2020; Kelly & Meschke, 2010). Furthermore, emerging research has pointed out that these anomalies are not confined to traditional markets, extending to the realm of digital assets like cryptocurrencies (Qadan *et al.*, 2022).

Recent studies highlight that these anomalies might not persist when considering trading costs, market frictions, and data snooping biases (Hsu *et al.*, 2016; Tobek & Hronec, 2021; Zaremba *et al.*, 2020). A few anomalies have also been explained by time-varying risk premiums, indicating that they may not necessarily contradict the EMH (Alti & Tetlock, 2014; Zhang, 2006). Furthermore, it has been observed that some anomalies diminish as markets mature, indicating a potential self-correcting mechanism in financial markets (Jacobs, 2016).

In conclusion, the existence of financial market anomalies presents a complex interplay between theoretical conceptions of market efficiency and empirical observations of apparent inefficiencies. The anomalies and the continual debate about their persistence and exploitations underscore the dynamic nature of financial markets and the evolving understanding of market efficiency. Future research directions should continue to investigate these anomalies, with a keen focus on separating truly exploitable inefficiencies from phenomena resulting from omitted variables, data biases, or changing risk premiums.

2.2 Behavioral finance and investor sentiment

Behavioral finance seeks to explain why investors sometimes act in ways that are inconsistent with classical economic theory. It draws on insights from psychology to explore how cognitive biases can impact financial decisions and market outcomes. Fama's work on market efficiency, long-term returns, and behavioral finance provides a foundation for our understanding of the relationship between investor sentiment and market behavior (Fama, 1998).

One of the key ideas in behavioral finance is that investors may not always act rationally or in their best interests. This is evident in phenomena such as earnings management, where companies manipulate their earnings reports to meet investor expectations, resulting in the underperformance of seasoned equity offerings (Teoh *et al.*, 1998). The principle of market efficiency holds that markets should fully incorporate all available information into prices, but Fama has dissected various anomalies that challenge this notion (Fama & French, 2008). One of these is information uncertainty, where stock returns can be influenced by the level of uncertainty about a company's future prospects (Zhang, 2006).

Behavioral finance also extends to phenomena observed post-merger, where the performance of acquiring firms often falls below expectations, despite market efficiency dictating that any potential gains should already be priced in (Agrawal *et al.*, 1992). This phenomenon also appears in the realm of mutual funds, where Hendricks (1993) noted a persistence in the short-run performance of top-performing funds, suggesting that investors may be influenced by recent performance when choosing funds (Hendricks *et al.*, 1993).

Market anomalies provide further examples of departures from market efficiency that may be influenced by investor sentiment. For example, the day-of-the-week effect, where returns on certain days of the week are systematically higher or lower than on others, may reflect investor psychology rather than changes in underlying value (Rogalski, 1984). The January effect is another such anomaly, where low share price, transaction costs, and bid-ask bias may combine to generate abnormal returns in January (Bhardwaj & Brooks, 1992).

Jacobs (2015) attempted to explain the dynamics of 100 anomalies and found that they were influenced by various factors including time, market conditions, and investor sentiment (Jacobs, 2015). Jacobsen and Marquering (2008) found that weather influences investor sentiment and in turn, stock returns, illustrating how psychology can affect financial markets (Jacobsen & Marquering, 2008).

The influences of investor sentiment are not limited to traditional equity markets. For example, in the world of cryptocurrencies, Qadan (2022) identified several seasonal and calendar effects that affect the price efficiency of cryptocurrencies, suggesting the influence of investor sentiment and behavior in these markets as well (Qadan *et al.*, 2022).

Investor sentiment is also a crucial factor in explaining asset pricing (Colacito & Croce, 2013). Asset prices often deviate from their fundamental values due to biased beliefs and investor sentiment, as explored by Alti (2014) (Alti & Tetlock, 2014). A model proposed by Lam (2012) even highlighted the role of

pseudo-Bayesian behavior in understanding financial anomalies and investor behavior.

One common manifestation of investor sentiment is overreaction, where investors respond too strongly to new information, leading to price swings that are larger than warranted by the fundamentals (Davidson & Dutia, 1989). Contrarian investing, a strategy of buying assets that have recently performed poorly and selling those that have performed well, takes advantage of such overreactions (Chin *et al.*, 2002).

Furthermore, certain calendar and seasonal effects, like the 'Halloween effect' or the 'turn of the year effect', which have been observed in U.S sectors and intraday studies respectively, can be attributed to behavioral aspects of investors (Griffiths & White, 1993; Jacobsen & Visaltanachoti, 2009). Even macroeconomic news and events like the Super Bowl have been found to have impacts on stock market anomalies, further reinforcing the importance of sentiment in understanding market behavior (Gerlach, 2007; Krueger & Kennedy, 1990).

Emotional factors also play a significant role in investment decisions. Taffler (2018) argued that unconscious emotions often guide financial decisions, which leads to certain investment outcomes (Taffler, 2018). Emotional finance suggests that financial health indicators can significantly vary for value and growth stocks based on investor sentiment (Bird & Casavecchia, 2007).

The complexity of the relationship between investor sentiment and market outcomes is further highlighted by the role of external factors like weather (Symeonidis *et al.*, 2010). Weather effects can cause significant variations in stock market volatility, suggesting that investors' mood states influenced by weather conditions can lead to observable effects in financial markets (Gerlach, 2010).

Moreover, research has shown that the sentiment of retail investors can play a key role in inflating stock price bubbles, revealing the potential downside of sentiment-driven trading (Henker & Henker, 2010). Likewise, the way investors perceive risk and react to it can significantly influence the profitability of certain trading strategies. As an example, investors' biases may lead to poor timing in investing, causing underperformance even when following successful strategies (Hsu *et al.*, 2016).

In summary, the field of behavioral finance provides a rich perspective on how investor sentiment can drive financial market outcomes. Whether it is earnings management, post-merger performance, market anomalies, or asset pricing, investor sentiment appears to play a critical role. This sentiment, shaped by a range of factors from psychological biases to external events and even the weather, leads to a variety of behaviors that can cause markets to depart from the predictions of classical economic theory. Understanding these behaviors and their implications is key to navigating the complexity of financial markets.

2.3 Calendar effects and seasonal anomalies

The efficient market hypothesis (EMH), initially posited by (Fama, 1998), suggests that financial markets fully reflect all available information, thus implying that generating abnormal returns on a consistent basis would be an improbable task for investors. However, various observed market irregularities, or "anomalies", often related to calendar effects and seasonality, challenge this fundamental premise.

Perhaps one of the most extensively documented of these phenomena is the "January effect". This effect refers to the tendency of stocks, especially small-cap stocks, to outperform the broader market in January (Bhardwaj & Brooks, 1992). Explanations for the January effect have revolved around tax-loss selling, institutional investors' "window dressing", and liquidity effects (Griffiths & White, 1993). Tax-loss selling refers to the practice of selling securities at a loss to offset a capital gains tax liability, which typically occurs at the end of the year and may contribute to lower prices in December and a rebound in January. Window dressing is the strategy used by fund managers near the year-end to improve the appearance of the fund's performance before presenting it to clients or shareholders. Liquidity effects, meanwhile, refer to the impact of changes in market liquidity on asset prices and returns.

Another significant calendar effect is the 'weekend effect', or the tendency for returns to be lower on Mondays than on other days of the week (Rogalski, 1984). While a multitude of theories have been put forth to explain this phenomenon, the most prominent revolve around settlement procedures, the timing of corporate announcements, and the psychology of traders (Tong, 2000).

Contrasting with the more universal January and weekend effects, certain calendar anomalies are specific to particular geographic regions. For instance, the 'Halloween effect' or 'Sell in May and go away' strategy is observed primarily in Western countries. It refers to the observed tendency of stocks to perform better between November and April compared to the period from May to October (Jacobsen & Visaltanachoti, 2009). Despite the persistent existence of this anomaly across several markets, conventional risk-based theories have yet to provide a convincing explanation (Jacobsen & Marquering, 2008).

Beyond the traditional asset markets, there is evidence to suggest that calendar effects also pervade the world of cryptocurrencies. (Qadan *et al.*, 2022) found substantial seasonality in cryptocurrency prices, which they attributed to cycles in investor attention. However, the exact mechanisms behind such phenomena in this burgeoning domain remain a topic of ongoing research.

As the field of behavioral finance has grown, researchers have attempted to explain calendar effects through the lens of investor sentiment and behavioral biases. (Kelly & Meschke, 2010) provided evidence that seasonal affective disorder (SAD), a psychological condition that fluctuates with seasonal

changes, significantly influences stock returns. Similarly, research has found that weather conditions and changes in daylight saving time can affect stock market volatility and investor sentiment, thereby contributing to the presence of seasonal anomalies (Gerlach, 2010; Symeonidis *et al.*, 2010).

However, it is worth noting that the existence of calendar effects is not equivalent to the existence of profitable trading strategies. Practical barriers such as transaction costs can significantly reduce, if not entirely eliminate, the profitability of trading strategies built on these anomalies (Duran & Bommarito, 2011; Teoh *et al.*, 1998). Moreover, anomalies often weaken or even disappear after they have been publicly identified, potentially due to market participants' adaptive behavior (Fama & French, 2008; Jacobs, 2016).

While the existence of calendar effects appears to contradict the EMH, these phenomena might be better understood as symptoms of the larger complexities and potential inefficiencies present in financial markets. (Zhang, 2006) suggests that information uncertainty is a key factor in explaining stock market anomalies. This perspective postulates that anomalies are a result of investors' responses to uncertainty and their preferences for stocks with less ambiguous information.

It is also important to note that despite the wealth of literature supporting the existence of calendar effects, there is also a body of work questioning their validity. Some researchers argue that these effects are statistical artifacts that emerge as a result of data snooping bias or methodological flaws in the employed statistical tests. These criticisms call for a more rigorous analysis of calendar effects using robust statistical techniques.

In summary, the study of calendar effects and seasonal anomalies uncovers intriguing patterns in financial markets and provides important insights into market dynamics, investor behavior, and the limits of market efficiency. Although these anomalies seem to contradict the EMH, they might better be viewed as evidence of the intricacies and potential inefficiencies of financial markets. Understanding the mechanisms behind these anomalies, whether they are rooted in investor psychology, institutional practices, or information dynamics, can potentially offer valuable insights into the functioning of financial markets and the development of effective investment strategies. Nevertheless, the practical implications of these anomalies for investment strategies should be carefully considered in light of transaction costs, adaptive market behavior, and the risk of data snooping bias.

2.4 Risk factors and asset pricing

Understanding risk factors and their impact on asset pricing is fundamental in financial economics. Asset pricing models have evolved over time from the single-factor model, like the Capital Asset Pricing Model (CAPM), to multifactor models that incorporate various dimensions of risk. The implication of these factors for market anomalies is an area of considerable research.

Fama and French (2008) made significant contributions in this regard, dissecting numerous anomalies in terms of risk factors. Fama challenges the notion that anomalies provide exploitable returns, suggesting instead that they can be understood and explained through risk factors. By extension, this implies that a thorough understanding of risk factors can potentially mitigate some of the uncertainty around asset pricing and inform better investment decisions.

Research by Agrawal *et al.* (1992) further illustrates the importance of risk factors in explaining anomalies. In a re-examination of the post-merger performance of acquiring firms, Agrawal found that traditional risk factors alone could not fully account for the observed underperformance. This insight underscores the complexity of asset pricing and the importance of considering a broad range of risk factors.

Building upon this research, Gultekin and Gultekin (1987) scrutinized the relationship between stock return anomalies and the arbitrage pricing theory (APT). His work emphasized the possible existence of unobserved risk factors that may explain such anomalies. These findings lend support to the notion that asset pricing is influenced by a wide array of factors, some of which may not be captured in conventional models.

Investigating risk factors further, Zhang (2006) proposed information uncertainty as a significant determinant of stock returns. He argued that an increase in uncertainty could lead to higher required returns and subsequently lower prices, manifesting as an anomaly.

In the context of globalized financial markets, research by Colacito and Croce (2013) highlighted the importance of incorporating global risk factors in asset pricing models. They introduced a recursive preference model for international asset pricing, thereby expanding our understanding of risk factors beyond domestic or regional contexts. Similarly, Bartram and Grinblatt (2021) provided a comprehensive examination of global market inefficiencies, emphasizing the relevance of global risk factors in understanding asset pricing and anomalies.

Aktas *et al.* (2007) examined the 'PIN' anomaly around merger and acquisition announcements, revealing a different perspective on risk factors. The "PIN" anomaly, which pertains to private information-based trading, illustrates how information asymmetry can influence asset pricing. This highlights the importance of considering market microstructure and information dynamics when examining risk factors.

Moreover, Alti and Tetlock (2014) presented a structural approach that incorporated biased beliefs as a potential risk factor. Alti argued that such beliefs could lead to asset mispricing, ultimately manifesting as market anomalies. His work indicates that understanding investor psychology and behavioural biases is crucial in assessing risk factors and their role in asset pricing.

While Daves and Ehrhardt (1993) focused on liquidity as a critical risk factor, particularly for U.S. Treasury strips, Ammann and Verhofen (2012) proposed an alternative three-factor model for international markets. These studies demonstrate the variety and evolution of risk factors considered in asset pricing research.

Adding another dimension to risk factors, Chou *et al.* (2010) and Agarwal and Poshakwale (2010) argued that traditional risk factors might not fully explain the size and book-to-market anomalies. They proposed that relative leverage and relative distress are also significant factors.

Research by Henker and Henker (2010) and Hirshleifer (2020) emphasizes the role of investor behavior and social transmission bias, respectively, in understanding stock market anomalies. These contributions highlight the need to consider non-traditional risk factors, such as investor sentiment and social influences, when analyzing asset pricing.

Consequently, the literature provides a rich array of perspectives on risk factors and asset pricing. Traditional measures like size and value, as well as less observable factors such as information uncertainty, biased beliefs, and global market risks, are all relevant. Incorporating these diverse risk factors can improve our understanding of financial markets, asset pricing, and the anomalies observed therein.

2.5 Information flow and trading strategy

The efficient market hypothesis argues that market prices should reflect all available information at any given moment, making it impossible to consistently outperform the market (Fama, 1998). In spite of this, numerous studies have documented patterns in stock returns that seem to violate market efficiency, known as anomalies.

The existence of such anomalies implies that information flow is not perfect and trading strategies may exploit these patterns. For instance, a well-documented anomaly is the underperformance of firms following seasoned equity offerings, which might suggest that insiders have access to private information about their firms (Teoh *et al.*, 1998). Other anomalies include patterns in stock returns that are related to firm characteristics such as size and book-to-market ratio (Fama & French, 2008). Moreover, evidence suggests that stocks with higher information uncertainty earn higher returns (Zhang, 2006).

There are many other types of anomalies which have been observed and analyzed over the years. Mergers and acquisitions often lead to underperformance for acquiring firms, pointing towards possible issues in deal pricing (Agrawal *et al.*, 1992). Additionally, there is a persistence of short-run relative performance in mutual funds (Hendricks *et al.*, 1993).

Market returns also exhibit certain calendar effects. For instance, the day-of-the-week effect shows consistent differences in returns depending on the trading day, with Monday returns being lower than returns for the other days (Rogalski, 1984). Similarly, the January effect indicates higher returns in January, especially for low-priced stocks (Bhardwaj & Brooks, 1992).

In terms of explaining these anomalies, research has proposed various factors. Jacobs (2015) argues that market frictions, sentiment-driven mispricing, and varying risk premiums could be behind the dynamics of many anomalies. Other researchers have pointed to the influence of factors such as weather (Jacobsen & Marquering, 2008; Symeonidis *et al.*, 2010), international asset pricing (Colacito & Croce, 2013), the timing of mergers and acquisitions (Aktas *et al.*, 2007), and asymmetry of information flow between volatilities (Gençay *et al.*, 2010).

The market's maturity may also influence mispricing, as suggested by Jacobs (2016) who observed that young firms are more prone to mispricing. Certain seasonal effects, such as the Halloween effect, have been shown to influence returns in various sectors of the U.S. economy (Jacobsen & Visaltanachoti, 2009).

The role of investor sentiment and behavioral factors in the creation of anomalies has also been explored. For instance, Hirshleifer (2020) demonstrates the existence of social transmission bias in economics and finance, where people's judgements and behaviors influence each other and impact the market. Kelly and Meschke (2010) re-examines the Seasonal Affective Disorder (SAD) anomaly, noting that sentiment does indeed influence stock returns.

Other anomalies related to calendar effects include the tax-induced trading and the turn-of-the-year anomaly (Griffiths & White, 1993), the dividend month premium (Hartzmark & Solomon, 2013), and the relation between common stock returns, trading activity, and market value (James & Edmister, 1983).

Beliefs and biases of investors have been shown to impact asset prices and investment decisions (Alti & Tetlock, 2014), and the liquidity and reconstitution of U.S. Treasury Strips can significantly affect their value (and Ehrhardt, 1993). Moreover, investor behavior can be modeled to help explain financial anomalies, as shown by Lam (2012).

These anomalies persist on a global scale as well. There is international evidence of weekend anomalies (Tong, 2000), and the computation of returns in tests of the stock market overreaction hypothesis has been examined (Dissanaike, 1994).

Sentiment and financial health indicators are also important for value and growth stocks, as demonstrated in the European experience (Bird & Casavecchia, 2007). Furthermore, emotional finance explores the role of unconscious factors in investment decision-making (Taffler, 2018).

One peculiar anomaly is the so-called 'Super Bowl Predictor', which suggests that the stock market's performance can be predicted by the outcome of the Super Bowl (Krueger & Kennedy, 1990).

There are also findings related to the effects of macroeconomic news and stock market calendar and weather anomalies (Gerlach, 2007), the impact of investor sentiment on financial market volatility (Shu & Chang, 2015), the relationship between investor optimism, false hopes, and the January effect (Ciccone, 2011), and the limits of investor behavior (Loewenstein & Willard, 2006).

Finally, despite the vast number of identified anomalies, recent research argues for global market inefficiencies and discusses their persistence and potential explanations (Bartram & Grinblatt, 2021).

In summary, the flow of information in the market is complex and does not always lead to perfect efficiency. Trading strategies that take into account various anomalies could potentially achieve above-average returns. However, it is important to note that these strategies often involve additional risks and complexities. Moreover, as our understanding of these anomalies improves, market participants may adjust their behavior, which can lead to the disappearance of these anomalies over time (Zaremba *et al.*, 2020). Therefore, careful research and analysis are essential when attempting to exploit these patterns.

3 Limitations and implications for future research

Despite the wide-ranging discussion and examination of various market anomalies in the present review, certain limitations should be acknowledged. These limitations, in turn, open up avenues for future research, further contributing to our understanding of these complex phenomena.

3.1 Limitations

The following are some of the key limitations of the current review:

- **Scope of Literature:** Although we have attempted to provide a comprehensive overview of market anomalies, due to the vastness of the subject, not all anomalies have been included in the review. Therefore, our discussion does not represent the entire spectrum of financial anomalies.
- **Cultural and Geographic Differences:** Most of the studies reviewed in this paper are predominantly based on western markets. Anomalies in emerging and non-western markets have not been extensively discussed. The cultural and institutional differences in these markets can give rise to unique anomalies that are not seen in western markets.
- **Dynamics of Cryptocurrency Markets:** While we touched on the efficiency of cryptocurrency markets, a detailed examination of anomalies in these relatively new and rapidly evolving markets was beyond the scope of this review.
- **Methodological Limitations:** The majority of the studies discussed in this review utilized traditional statistical methods. The use of machine learning and advanced data analytics techniques is limited in the current literature on financial anomalies.
- **Exogenous Shocks and Anomalies:** The impact of exogenous shocks (like global pandemics, political events, and natural disasters) on market anomalies was not explored extensively in this review. These events can significantly influence market dynamics, giving rise to unique anomalies.

3.2 Future research

Building on the limitations mentioned above, the following are some promising directions for future research:

- **Expanding the Scope of Literature:** Future studies could expand the scope of market anomalies by including less explored anomalies. This will enrich the current body of literature and provide new perspectives on financial anomalies.
- **Non-western and Emerging Markets:** Given the potential for unique anomalies in non-western and emerging markets, future research could explore these markets in depth. This will allow for a more comprehensive understanding of market anomalies that includes cultural and institutional diversity.
- **Cryptocurrency Market Anomalies:** As cryptocurrency markets continue to grow and evolve, future studies could focus on identifying and understanding the anomalies unique to these markets. This could pave the way for new trading strategies and regulatory interventions in these markets.
- **Advanced Data Analytics Techniques:** The use of machine learning and advanced data analytics techniques can provide deeper insights into financial anomalies. Future research could focus on developing and applying these advanced techniques in the study of market anomalies.
- **Exogenous Shocks and Anomalies:** Further research is needed to understand the impact of exogenous shocks on market anomalies. This could help in predicting the emergence of new anomalies and improving our ability to manage risks associated with these shocks.

4 Conclusion

In conclusion, the extensive body of research on market anomalies and puzzles provides a multifaceted perspective on market efficiency and the influences affecting stock market returns. Notably, the studies examined in this literature review cover a broad spectrum of market anomalies and provide evidence of their persistence across various domains of the financial market.

These anomalies range from long-term return anomalies (Fama, 1998), earnings management effects on seasoned equity offerings (Teoh *et al.*, 1998), anomalies associated with net stock issues and accruals (Fama & French, 2008), information uncertainty and price continuation anomalies (Zhang, 2006), to post-merger performance (Agrawal *et al.*, 1992), performance persistence in mutual funds (Hendricks *et al.*, 1993), day-of-the-week returns (Rogalski, 1984), the January effect

(Bhardwaj & Brooks, 1992), and even weather-induced mood shifts on stock returns (Jacobsen & Marquering, 2008).

Despite the Efficient Market Hypothesis' argument that these anomalies may be chance results, several studies provide evidence of their persistence and potential influences on market dynamics. The variation in findings across these studies suggests that these anomalies may be a regular feature of financial markets rather than aberrations. Furthermore, it indicates the potential impact of factors like information uncertainty, behavioral biases, and corporate strategies on these anomalies.

Looking forward, it's evident that more research is needed to understand the true nature and causes of these anomalies. Future work may involve developing new methodologies and theoretical models to better comprehend these phenomena, as well as exploring other potential influencing factors.

More specifically, while existing research has identified and analyzed many anomalies, new data sources and computational methods could enable the identification of previously undetected anomalies. At the same time, the development of more robust and comprehensive theoretical models could help improve our understanding of these anomalies' origins and the mechanisms driving them.

Finally, the influence of other factors, such as technological innovations, market regulations, and macroeconomic variables, should be examined in greater depth. The complex and interconnected nature of financial markets suggests that a broad range of factors could potentially contribute to these anomalies and understanding these influences could provide valuable insights into market dynamics and efficiency.

Data availability

No data are associated with this article.

Acknowledgements

A preprint version of this paper is also made available on SSRN (Osterrieder & Seigne, 2023).

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?

Muhammad Waqas
The University of Lahore, Lahore, Punjab, Pakistan

The conclusion section should be concise and it should not contain references. better to include latest references and follow proper in-text text citation. There should be proper review methodology. It would be better to clarify he research gap and demonstrate that this review is needed. The clear objectives should be mentioned.

Is the topic of the review discussed comprehensively in the context of the current literature?
Yes

Are all factual statements correct and adequately supported by citations?
Partly

Is the review written in accessible language?
Yes

Are the conclusions drawn appropriate in the context of the current research literature?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Finance and HRM

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 24 February 2024

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?

Kai Yin Woo
Hong Kong Shue Yan University, Hong Kong, Hong Kong

This manuscript reviews the concepts of market anomalies that challenge EMH with the large amount of relevant literature provided. The readers can follow the literature in the manuscript to further investigate the concepts of EMH, anomalies and behavioral finance.

There are some minor concerns:

1. it is found that Fama (1998) is quoted for several times in order to show the ideas of EMH. Actually, the ideas of EMH was proposed in Ref [1],[2].

2. In section 2.2, Fama (1998) is quoted again. However, Fama (1998) is a paper written in defence of EMH, not to support behavioral finance, and investor sentiment.

3. Also, Section 2.2 Behavioral finance and investor sentiment, mainly discusses investor sentiment, rather than behavioral finance, even when the theory of behavioral finance such as prospect theory, is not discussed there. Hence, would it be better if the name of topic in section 2.2 is "Investor sentiment" only?

4. In section 2.5, Ehrhardt (1993) cannot be found in Reference. But Daves and Ehrhardt (1993) can be found.

5. In section 1, Introduction, "Dave et al., (Daves and Ehrhardt, 1993)" is found, and should be replaced by .Daves and Ehrhardt (1993). Also, "James (James & Edmister, 1983)" is found, but should be replaced by James and Edmister (1983) . "Kelly (Kelly & Meschke, 2010)" is found, but should be replaced by Kelly and Meschke (2010). "Taffler (Taffler, 2018)" is found but should be replaced by Taffler (2018).

6. In section 2.2, "Alti (2014) (Alti & Tetlock, 2014)" should be replaced by Alti and Tetlock (2014).

7. In sections 2.2 and 2.5, Lam (2012) cannot be found. In Reference, Lam, Liu & Wong (2012) can be found. Hence, Lam (2012) should be replaced by Lam et al. (2012).

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Is the topic of the review discussed comprehensively in the context of the current literature?

Yes

Are all factual statements correct and adequately supported by citations?
Yes

Is the review written in accessible language?
Yes

Are the conclusions drawn appropriate in the context of the current research literature?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Applied Econometrics

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 01 November 2023

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Maria Iannario
Universita degli Studi di Napoli Federico II, Naples, Campania, Italy
Claudia Tarantola
Department of Economics and Management, University of Pavia, Pavia, Lombardia, Italy

The paper offers a comprehensive literature review on financial and market anomalies, providing a consolidated perspective on these intricate dynamics that challenge the conventional efficient market hypothesis. The authors have diligently considered a substantial body of academic works, especially recent ones, shedding light on irregularities in long-term returns, the influence of earnings management on equity bids, and the impact of information uncertainty on equity returns.

The methodological premises are sufficient and the authors exhibit meticulousness in presenting their context.

However, there are areas where further clarification is needed. It would be beneficial to incorporate summary diagrams or tables to visually illustrate the main points. Additionally, there is some repetition of concepts across different sections that could be streamlined. Furthermore, key elements like 'uncertainty,' pseudo-Bayesian behavior, and leverage could benefit from clearer

explanations to avoid unconventional interpretations.

The inclusion of real examples and quantifications would enhance the description of the impact on efficiency. It would also be valuable to understand the criteria used for selecting the literature. In the limitations section, there is mention of a portion of the literature not covered by the proposal. Delving deeper into the rationale for this selection would be beneficial.

The exploration of emerging markets as an open issue is of significant interest. A more detailed exposition of methodological limitations would further enrich and round out the work. Additionally, it would be helpful to clarify what is meant by "traditional statistical models" for the reader's comprehension.

Overall, this paper holds promise but would benefit from the suggested refinements to strengthen its impact and clarity.

Minor points:

Abstract: A discussion of the use of machine learning approaches for anomaly analysis appears in the abstract. However, this point is not clearly presented in the discussion despite being of great interest. I propose a more thorough examination.

Pag. 3 – first column line -22 eliminate ‘weather’.

Pag. 3 – first column line – 20 -13. I suggest to specify in this part the geo-regional area referred to in order to make the analysis of the text and understanding of the contents referring (as indicated below) to the western market immediate.

Pag. 3 – first column line – 20 -12. Replace It’s with It is.

Pag. 3 – second column line – 30. Please clarify the concept of leverage risk in this area.

Pag. 3 – second column line – 21. Postpone the acronym after the definition.

Pag. 3 – second column line – 12. Attention to bibliographical references. Kelly & Meschke instead of Kelly.

Pag. 4 – first column line 6. Attention to bibliographical references. James & Edmister instead of James.

Pag. 4 – first column line 8. Attention to bibliographical references. Daves & Edrhardt instead of Daves et al.

Pag. 4 – section 2. I suggest to summarize the main content of this section with a Table or a diagram to simplify the reading and the main contents.

Pag. 5 first column line -4. Please clarify the sentence and elaborate on how omitted variables, distorted data or changing risk premium may compromise results. I believe that this can overcome the limitation of the discourse on the modelling approaches selected in the literature

review and also provide an opportunity to address a brief discussion on the selected statistical techniques.

Pag. 5 second column line 3. Anticipate the reference (Fama, 1998).

Pag. 5 first column line -17-15. This content of this paragraph has been reported in other part of the paper. Please avoid repetitions if not necessary to lighten the reading.

Pag. 5 first column line -2. Add comma after Alti (2014).

Pag. 6 first column line 1. Please clarify the 'pseudo-Bayesian behaviour'.

Pag. 5 second column line 2. The EMH has been previously introduced.

Pag. 6 section 2.3 I suggest that the calendar effects be included in this section only, avoiding repetition of quotations and contents in other parts of the work, again to make the text easier to read. Again, a summary outline might help in the steps (e.g. what are the main calendar effects that impact and how).

Pag. 7 first column line 18. Change with Zhang (2006).

Pag. 7 first column line 19. Please clarify the meaning of 'uncertainty' in this contest.

Pag. 7 first column line 23-29. Add references to this paragraph.

Pag. 8 first column line 10. Please clarify the concept of relative leverage and relative distress.

Pag. 8 section 2.5. Some of the sentence reported in this section have already been introduced and some key concepts already presented in the previous paragraphs with the relevant bibliographical references. I suggest a greater synthesis to allow a quicker understanding of the main contents.

Pag. 9 Cultural and geographic differences; Methodological limitation: see the main comments.

Is the topic of the review discussed comprehensively in the context of the current literature?

Yes

Are all factual statements correct and adequately supported by citations?

Yes

Is the review written in accessible language?

Yes

Are the conclusions drawn appropriate in the context of the current research literature?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Statistics

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.